15th International Forum on Knowledge Asset Dynamics

PROCEEDINGS

Knowledge in Digital Age

9-11 September 2020
Matera, Italy

IFKAD 2020

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FOREWORD

Knowledge in Digital Age

Welcome to the 15th edition of IFKAD. This 2020's edition is signed by a disruptive event which has affected not only our annual academic event by it is profoundly touching and influencing the life of organisations and communities worldwide. Indeed, the coronavirus pandemic is introducing a new level of uncertainty and posing difficult and even unprecedented challenges for the sustainability of organisations and communities comparable only to the once generated by war.

Because of the coronavirus pandemic, we have decided to run IFKAD as a blended event with some sessions to be managed onsite and other online. For organisational reasons and taking into account the Matera is so far a coronavirus free city, we have opted to move the onsite event in Matera from the 9th to the 11th September 2020.

This year's IFKAD is supported by the University of Basilicata, the University of Rome Tre and the Chinese Culture University. The purpose of IFKAD 2020 is to understand the role of knowledge in the digital age to support organisational value creation dynamics and shape a sustainable future. Today's Digital Age is providing immediate access to data and information at a broader and more comprehensive quantity, and the acceleration of digital transformation is offering new paradigms for creating and managing knowledge.

The 15th edition of IFKAD wishes to extend our theories, findings and business discourses about the role and the dynamics of knowledge in the time of digital transformation and to what extent new technologies in combination with new strategic knowledge management approaches are innovating business models and supporting growth. The understanding of the role and methods of managing knowledge in the digital age takes even more relevance in today's scenario of facing the coronavirus pandemic. Technologies are proving to be the way to support knowledge sharing and the knowledge-based platform to guarantee the quasi-normal operation of organisations.

The coronavirus outbreak is first and foremost a human tragedy which is impacting on the people's lives across the world. But it is also having significant implications on the global economy and the enterprises' survival. The working mechanisms of socio-cultural and economic-production ecosystems are under threatening of disruption, and organisational systems are challenged to understand how they can face the consequences of the epidemic's spreading and impact. Organisations at the macro and micro level must learn how to meet and contain the adverse outcomes of the coronavirus outbreak. The business models and traditional working mechanisms are at stake.

Around the world meanwhile, the governments are putting in place actions both to contain the spreading of pandemic across territories and to manage the economic crisis, organisations must develop strategies and implement management initiatives to respond to the waves of disruption that the epidemic is generating. The understanding of the

strategy, projects and tools to manage the knowledge to get through the coronavirus crises is essential for survival and sustainability of any private, public and social organisation. The capacity of creating, employing and deploying knowledge is critical to protect the business and to guarantee that organisations can continuously contribute to the value creation dynamics of stakeholders' wealth creation. Knowledge management is essential to drive organisations through the crisis. It can help to implement change management, to optimise operations, and most importantly, to support organisational learning mechanisms that can turn into innovations strengthening organisational systems of responding to a complex socio-economic landscape. Knowledge management can contribute in different ways to face the coronavirus crisis. The management and assessment of knowledge assets can drive the workplace protection ensuring employees safety and engagement to find new solutions. A knowledge-based view of the employment and deployment of new technologies can support smart working, the security of employees' expertise from dispersion, the creation of knowledge communities for innovation, the strengthening of social capital to face the psychological and sociological human tragedies. Knowledge management strategies play a central role in developing supply chains resilience and reorganise operations. The assessment and protection of intellectual capital are critical to reducing the risks of a financial downturn. Finally, knowledge-based strategies can help to maintain relationships with customers and key stakeholders.

The mission of IFKAD is the development of research and scientific conversations aimed at contributing to theory-building as well as to the managerial practice about the role of knowledge as an organisational value-driven source. Our view is that organisations are primarily in the business of knowledge and from their capacity of managing knowledge depends on their future business sustainability and value creation capacity.

I want to extend my thank to all those colleagues and friends that every year work to make IFKAD a successful scientific event as well as a great social gathering where to meet old friends and make new once. Despite the particular moment we are living, I am sure that IFKAD2020 will continue to inspire a fruitful conversation capable of nurturing our curiosity and scientific expertise. And to provide insights that can help organisations to navigate during the difficult time and complex socio-economic landscape generated by the coronavirus crisis.

Prof. Giovanni Schiuma
University of Basilicata, Italy

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Innovation Management and Barriers – Creating Space for Innovation and Organisation Change in Germany (former GDR) and Slovakia

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Abstract

The major purpose of this paper is to determine the opportunities and challenges relating to successful innovation management in SMEs in German and Slovakia. The research includes SME case studies so that recommendations can be made to SMEs for enhancing innovation management in the firm. In this research secondary data is gathered predominantly from empirical studies on SMEs; since these data sources are permanent the research can be repeated easily and therefore the reliability of the findings is enhanced. In order to answer the research problem, numerical and textual data is gathered but it is analysed in different ways. There are not participants in this study, since secondary data is the only source, hence the major ethical consideration is to ensure that the original author´s intentions are expressed when interpreting the data. This research identified key innovation management success factors for SMES as: innovation management models needed to be adapted to different organisational contexts; culture had a high impact on innovation management focus; social acceptance was a major factor for original new product market success so that customer needs and competitor activities were important information sources; cross cultural and cross functional teamworking. The failure factors identified were skills shortage in the labour market; lack of skills in the company; market uncertainty, imitation by competitors; lack of R&D planning and management. The study made three new findings, which add to the current knowledge: innovation circles were an effective innovation management approach to generating and developing ideas and getting innovation to market quickly; government agencies that encourage firms to collaborate effectively enhance the level and success of innovation; SMEs and large companies have distinctly different rankings of barriers to innovation and small and micro firms are more effective in original product innovation and speed to market than medium sized companies.
The limitations of this study are the lack of primary research that was possible. Therefore, recommendations for further include repeating this research but using primary sources of information, a small group of SMEs. The findings would be compared with these secondary outcomes. The surprising finding that micro and small companies were more successful than medium sized companies at new product/service innovation and generating high proportions of

their turnover from it, justifies further research into this concept. The validity of the study findings is strong as demonstrated by the convergence of findings with those of the established concepts comprising the Literature Review.

Keywords – Innovation, Organizational Change, SME, Barriers.

Paper type – Practical Paper

1 Introduction

Businesses thrive in a dynamic environment and in the contemporary global marketplace, organisations aim to survive by gaining competitive edge to increase their market share. As competition becomes increasingly difficult, companies need to find new ways of differentiating themselves, the traditional ways of doing business are becoming less attractive, because technology is constantly changing, and companies cannot rely on their current positions. Whilst large companies become more rigid, smaller organisations gain market share because of their ability to innovate and adapt to new technologies, new market situations and customer needs (Reichwald and Piller, 2009, p.1). The introduction of new technologies with appropriate strategies may also generate sustainable competitive advantage, this is not merely a consequence of adapting to change but also the ability to innovate. Large companies tend to react more slowly to changes in the market owing to their size and relatively bureaucratic structure, but they possess the resources to increase innovation. In terms of innovation, companies of all sizes experience advantages and disadvantages and traditionally innovation has been driven by a company's Research and Development (R&D) department but many companies have recognised its limitations and implemented interventions that would expand their knowledge sources. Therefore, closed innovation represented by internal R&D is becoming obsolete and organisational preference is for an open innovation framework.

The prerequisites for future success include the creation of the optimum environment for innovation so that competitiveness is continuously strengthened but often the challenges are the coordination of innovation specialists and removing organisational obstacles, such as silos, traditional sector mind-sets, and bureaucratic processes. In contrast to large organisations, Small and Medium sized Enterprises (SMEs) rarely have an innovation strategy or an innovation management system for systematically planning and implementing innovative practices, partly because management is usually focused on operational activities that are necessary for survival, so that strategic considerations are relatively neglected. Innovation research to date has focused primarily on large enterprises, rather than SMEs and therefore the purpose of this paper is to gain insight into the characteristics of innovation management including the challenges encountered.

2 Methodology Used

The essential of this paper is to determine the opportunities and challenges relating to successful innovation management in SMEs in German and Slovakia. The research includes SME case studies so that recommendations can be made to SMEs for enhancing innovation management in the firm.

The resolution of this research problem requires a philosophy that enables integration of objective facts and subjective opinions, because cause and effect links between innovation management methodology and new innovation product or service success is usually measured by economic means. This economic measurement is based on numerical factors, for instance number of successful innovations and associated revenue streams. However, the selection of the appropriate innovation methodology is subjective, and relies on the company owner's preferences and cultural norms, as identified in the Literature Review bellow. Therefore, the research philosophy selected is a pluralist or pragmatic approach (Onwuegbuzie and Leech, 2005, p. 382-385). The objective and the subjective stances to research comprise three interlinking philosophies: epistemology, ontology and axiology.

Therefore, the perspective of the pluralist philosophy is choice, the researcher adopts the stance most suitable for the specific research (Onwuegbuzie and Leech, 2005, p. 382-385). Since objective and subjective stances must be combined, the research design must reflect this, so for this study the major design elements are the explanatory and the exploratory approaches.

The purpose of explanatory design is to identify cause and effect links between key variables, in this case innovation management and commercial success, whereas the exploratory approach seeks to gain deeper insight into new phenomena or those that are not fully understood, as is the case with innovation management in SMEs.

In this paper a case study is the selected research strategy because it focuses on a small number of SME companies, in which real life issues are experienced and its purpose is to use multiple sources to gain deep understanding of innovation management within them. The case study is ideal for this research because it answers questions of what, when, how and why so that different perspectives on the issues can be expressed. Hence the case study forms the unit of analysis for the research (Saunders et al., 2008, p. 145-147).

The data gathering, and analysis is conducted using mixed methods, because the method is well established with the pluralist philosophy and allows the objective or positivist approach to be employed concurrently with the subjective stance (Onwuegbuzie and Leech, 2005, p. 385); it also provides a more holistic understanding of the issues so that the answer to the research problem demonstrates more than one perspective (Creswell and Creswell, 2017, p.1).

In this research secondary data is gathered predominantly from empirical studies on SMEs and published data on the case company; since these data sources are permanent the research can be repeated easily and therefore the reliability of the findings is enhanced (Ritchie and Lewis, 2010, p.270). In order to answer the research problem, numerical and

textual data is gathered but it is analysed in different ways. The numerical data is subjected to statistical analysis, which means that statistical constants indicate the significance of the findings, in other words is there a proven relationship between the two variable or not. The textual data is scrutinised to find recurring themes, expressed in the publications in certain words and phrases. Each of the themes is interpreted by the research with the purpose of expressing the meaning that the author associated with the words in the text.

The appropriate methodology is employed to enhance the reliability and validity of the findings. In terms of reliability the researcher provides full details of all research sources so that another researcher can access all of the data sources, whereas the validity of the findings is demonstrated by the degree of convergence they have with previous studies, for instance (Ritchie and Lewis, 2010, p.273-277). There are not participants in this study, since secondary data is the only source, hence the major ethical consideration is to ensure that the original author´s intentions are expressed when interpreting the data (Ritchie and Lewis, 2010, p.278).

3 Literature Review

Innovation is required for sustainable business but is a complex process that is often accompanied by organisational change, but change management usually fails (Beer and Nohria, 2000, p. 1-8), because the challenges of implementing change are as problematic as accomplishing successful innovation (GIZ©2012). Therefore, identifying a robust strategic change management system is vital.

Organisational change management is difficult to define (Stewart and Kringas, 2003, p. 1), since the term managing change has two distinct inferences: making changes in response to impacts over which the organisation has little control; invoking change in a planned and systematic manner (Stewart and Kringas, 2003, p.2). Contemporary organisations are confronted with diverse challenges resulting from globalisation and technological advances, which have necessitated new forms of operation and control (Kotter, 1996, p. 18).

A broader definition of organisational change suggests that globalisation is "an increasing consciousness of the organisation of finance, investment, production, distribution and marketing in ways that pertain to or embrace the world; a phenomenon that has both reinforced and been reinforced by the wider, more longstanding but continuing noting that history of technological developments that have reduced the significance of geographic space" (Sheil, 2001, p. 11). Globalisation has invoked diverse business risks for enterprise organisations (Kotter, 1996, p. 18), so that they must implement improvements to maintain competitive stance and to survive; in other words, change processes are vital to the retention of competitive advantage. These processes vary according to the organisation's characteristics, and may include elements of structure, vision and culture, financial aspects, organisational locations and control, transformational relationships, and technological developments. Therefore, organisational

change management can be primarily described as the implementation of efficient, effective methods to foster modifications throughout the organisation, whilst simultaneously encouraging all employees to accept the change, which is the most challenging aspect. Sustaining change is very challenging, as most companies comprise multiple work cultures which make change management increasingly difficult (Porras and Robertson, 1992, p. 719-822); sustainable change requires changes in organisational behaviours, values and rituals.

The importance of change management and the high failure factor, are reflected in the academic interest in the phenomenon, for instance Mintzberg and Westley (1992, p.41), subdivided it into four cycles, which describe the content and levels of change, means and processes, episodes and phases, and sequences and patterns of change. In comparison, Alvesson and Sveningsson (2016, p. 17) assume that the most important factors are its dimensions, sources, content and the political aspect. Therefore, it is apparent that both economic and social factors change an organisation, so that management planning is vital and that change cannot be effected by spontaneous experiments conducted by subordinate managers and employees (Alvesson and Sveningsson, 2016, p. 18).

Change may be instigated in various ways, from the need to resolve internal issues to engaging technological advances and strategic change must be shaped in terms of its scope, resource use, synergy and competitive advantage (Naghibi and Baban, 2011, p. 542). This means that strategic change is the change of the goals and vision of an organisation by focusing on achieving greater success; changes implemented do not always succeed (Naghibi and Baban, 2011, p. 542). The reasons for failure include poor implementation that is often characterised by poor communicate of change to the employees, and most importantly resistance to change because the organisational culture is so deeply embedded, according to Naghibi and Baban (2011, p. 542).

Change is associated with new policies, behaviours, patterns, methodologies, products or new market ideas and the management of change involves the design and construction of new patterns, or the re-conceptualisation of old ones, so as to enable more productive activities (Kanter, 1992, p.279). Change may also include the transformation of structures, procedures, regulations and rules, technology, education, and development (Lycke, 2003, p.206), affecting all parts of an organisation (Kanter, 1992, p. 11). However, organisations are mostly affected by environmental changes, which require an adjustment of inner processes to influence employees reshape their values and behaviours so that they coincide with selected strategic direction (Lawrence et al., 2006, p. 66). Zimmerman (1995, p. 15) argues that the workforce is the main facilitator of change, because they are involved into the processes of change and Swedberg and Douglas (2005, p.51) propose that gradual implementation limits resistance to change. Therefore, change can be understood as an ongoing process that occurs in public and private organisations and enables organisations to compete and develop innovative products or skills more effectively and generate higher profits and/or other desired goals (Doppler and Lauterburg, 2014, p.67). However, if change is not effectively managed there will be not

change, and the organisation is unlikely to survive in the longer term goals (Doppler and Lauterburg, 2014, p.122).

The main external barriers to changing to and innovation culture are regulation, bureaucracy, social acceptance, accessing employees with the requisite skills and knowledge, the external environment including sourcing the funding. The inhibitory effect of regulatory frameworks and bureaucratic procedures are exemplified by strict occupational safety, environmental and consumer protection regulations, which consume resources that could be applied to innovation (IW CONSULT©2015, p.443-451). The bureaucracy and regulation relating to new technologies deters SMEs from innovating to produced them (IW CONSULT©2015, p.56).

The barrier that relates to social acceptance often poorly understood (Currall et al., 2006, p. 153-155), it is very often linked to regulatory requirements, but the early adopter stage of the product life cycle is characterised by small numbers of consumer purchasers, who know about the product and are willing to take the risk that it will accomplish the claims made for it. This success of this stage is vital to more general acceptance as more information emerges.

Skills shortages are major barrier to innovation, especially professional skills especially in science and technology but also the soft skills required for collaborative working and information exchange and intercultural competence (Hunter, 2010, p. 88). The location of SMEs may also present a barrier to accessing graduate and postgraduate students, who tend to prefer major cities in which larger established firms are located. Large companies also have more resources to recruit staff on a global basis, although they may be somewhat hindered by immigration restrictions (IW CONSULT©2015, p.74).

A major barrier to innovation for SMEs is attracting adequate funding for new projects, owing to lack of collateral to act as security for a loan or absence of company credit rating (IW CONSULT©2015, p.80). The projects that tend to be favoured by funding organisations such a venture capitalist are high tech innovations rather than application related research. Access to suitable funding sources with terms and conditions that are manageable by SMEs is one of the major enablers or restrictors of developing an innovation culture and instigating the associated change management initiatives.

4 Findings and Discussion

Four analysed and researched studies on innovation management revealed a range of diverse but significant findings, which show distinct convergence with the major concepts and theories relating to innovation and organisational change. In studies, the impact of culture on the management of innovation, specifically, which aspects are considered to be important and the national reputation for innovation converge with idea the capacity of leaders to create an innovative culture in the organisation is of paramount importance (Furr and Dyer, 2014, p. 82-88). They also highlight the difficulty that firms appear to have in altering their innovative attempts from that associated with national culture, generating the necessary organisational change, to appeal to a more global market for

instance, traditionally the Irish SMEs have little innovative culture and fail to significantly contribute to the nation's high cultural standing in EU ratings (Kotter, 2015, p. 132), and less than 30% German SMEs participate. The French appear to concentrate on internal R&D and neglect external information available from customers, whereas the UK and Portuguese firms are more open to external contributions, with Portuguese being particularly externally focused. Hence, new patterns, behaviours and methodologies appear to change very slowly and learning is likely to be inhibited (Kanter, 1992, p. 279). The Korean study demonstrated that in terms of open innovation 50% or less of large firms and SMEs considered interaction with the external environment important. Therefore, the relatively low commitment to the social learning process that drives change may inhibit SMEs from optimising the initiation of innovation and of competitive advantage it represents (Kotter, 2015, p. 132), (Lawrence, 2006, p. 66).

Innovation management was considered to comprise scanning the external environment to identify change (Moore, 2004, p. 88), changes in organisational behaviour to optimise innovation (Vahs and Brem, 2013, p. 27), but customer demands, customer relationships and detailed analysis of competitor products were cited as more important in the first cross cultural study. In the German SME study nine factors were identified, which added teamwork, HRM tools and collaboration with external contacts. An interesting innovation management activity that was only mentioned in this study was specific innovation development practices, for instance the creation of innovation circles, changing the specialist composition of project teams regularly and interventions to enable employees to share information to develop the innovation strategy. These activities reflect at the very least a type of innovation process is concerned (Vahs and Brem, 2013, p. 225) and in some cases a managed approach to change that mirrors the first four stages of Kotter's (2013, p.23) eight stage change model, however, in terms of actual innovation management the concept of innovation circles did not appear in any of the established innovation management literature in the Literature Review for this study and can be considered a new finding. It may also be particularly suitable for SMEs owing to the flexibility of their organisational structure. In the Irish study formal management procedures were not found to generate superior outcomes that when no formal innovation management took place, the higher outcomes shown by the data for innovation management could not be statistically linked to innovation management.

In the Korean case, eight categories of specific innovation management were identified: training, marketing, employment of external knowledge, introducing external R&D, organisational change, product and process innovation support and internal R&D focus. This conception of innovation management implies focus on strategic and operational issues as were mentioned in the German study in which appropriate strategy was considered to be a substitute for it, converging with Franken and Franken (2011, p. 225).

In the Irish SME case a different type of innovation evaluation process was employed and concentrated on managing three distinct innovation stages, rather than focus on finer

detail such as resources; attention to internal and external idea generation, development of the concept and then distribution of products into the relevant market (Davenport, 1992, p. 1). Hence this approach was also highly concerned with marketing innovation (Levitt, 1962, p. 102) and organisational innovation (Moore, 2004, p. 88). The focus of this model is very similar to that of Hartschen et al. (2009, p. 11).

However open innovation was considered in all four studies, and perceived be relatively unimportant in the early study which spanned three countries, especially in France, where the implication was that closed innovation was preferred (Dyer and Singh, 1998, p. 676). The date of this study may have some relevance to the overall conclusion made by the researchers, since globalisation has generated more focus and diverse approaches as external environmental changes have increasingly impacted on firms (Kotter, 1996, p. 18). The findings of the study of German SMEs the German study suggested that whilst combination of internal and external sources for innovation often provided a superior outcome, that this could be equally well achieved by a closed approach if the firm developed a suitable strategy, which has some alignment with the RBV concept of the firm (Dyer & Singh, 1998, p. 576). The study also suggested the major open innovation choices was outside-in (Gassman and Enkel, 2004, p. 15), as did the Irish SME study, which mentioned no knowledge sourcing activities except use of external knowledge.

As with the Irish SME prime activity and competence, the Korean firms tended to focus most, and most effectively on original new innovations, using the invention, develop and commercialise process. They also concentrated on both outside-in and inside-out, coupled open innovation (Gassman and Enkel, 2004, p. 13), and with a wider range of contacts, since universities and research centres were also a preferred source, especially for long term projects and the lower risk of exploitation of their ideas by an external partner. This represents a different context for innovation that found in the other three studies, much broader external knowledge sourcing and possibly a consequence of governmental agency supports to extend networking in these firms; a factor not mentioned in the established literature and therefore a second new finding from this study.

Hence, the findings from these studies align with the established theory, that identical innovation processes and approaches are to be expected owing to each firm's specific set of circumstances (Damanapour et al., 2009, p. 650).

Innovation success factors varied from a need to use open innovation on a continuous basis if the firm opted for open innovation, otherwise success was less certain, to highly detailed innovation management as in the Korean case but also developing detailed strategy as a substitute for formal management, an idea that has similarities to the German eight element innovation management model. Social acceptance factors were emphasised by the Korean case, specifically the marketing activity and training required to ensure that the original invention met market needs; the Korean SME focus on customers, competitors in the same market and affiliates aligns with this strategy and with the

established literature's emphasis on social acceptance as a success factor (IW CONSULT©2012, p. 443-451). The Irish case also suggested that managed innovation resulted in more original product and service innovations and faster market introduction and penetration; these findings tend to align with the Korean research. The importance of working closely with key customers was also mentioned in the cross cultural study, this align with altering behaviours and organisational change to leverage productivity (Kotter, 2012, p. 24-25). Cross cultural teamworking was found to a success factor in all four studies (Kotter, 2015, p. 132), but the Irish study also mentioned appointing a team manager, defining key metrics to measure progress, and specifying an R&D budget (Vahs & Brem, 2013, p. 27).

The barriers to SME innovation had substantial emphasis in the Korean study, which rated them by impact finding that shortage of skills in the labour market and internally were the two highest barriers, followed by market uncertainty, new product or service imitation by competitors and limited R&D planning and management. In the other studies the main barriers highlighted were lack of access to financing networks; many of these align with established studies (IW CONSULT©2015, s. 28-34). A third new finding emerged from the Korean study, which established a list of ratings of barrier to innovation for SMEs and large companies, and whilst the Irish study noted that formal innovation management appeared to be more important in the large company context than for SMEs. Whilst the highest barriers to innovation for SMEs related to skills shortages, market structure was rated first for large companies; large companies ranked labour market skills shortages 3 and internal skills shortages 11.

A surprising finding from the Irish context was that large firms tended to be more innovative than SMEs, which is partly contradicted by the findings of that study, which show that the micro and small SMES have more capacity for getting original products to market and speedily, as well as generating higher proportions of their total revenue from them than medium sized companies. In the Literature large firms are considered to have lower innovation capacity than small firms, so that the findings of this study do not align with accepted theory that large firms are less innovation ready owing to lack of organisational flexibility (IW CONSULT©2015, s. 23). However, the Korean study also suggested large firms had advantages for innovation, specifically their access to advanced technologies that SMEs did not.

The outcomes of the case study conducted in Slovakia are different from the above. The company culture is highly traditional, it is hierarchical, risk averse as demonstrated by tight budgeting and the lack of change in the behaviours of the Slovak based employees in recent years; a short term orientation that represents a barrier to change, exemplified by retention of old technology that represents its cultural norms (IW CONSULT©2015, p. 34); it has many attributes of large company culture that impedes organisational learning (Leavy, 2005, p. 4). Whilst the company information implies that change to an innovative culture has already taken place, in fact some of the systems and processes have changed, whilst the culture has not, as Kotter (2012, p. 37-142),

emphasises, the first stages represent a shift in some behaviours but that does not indicate that cultural values have altered. The organisation is between steps 5 and 6 of the eight-stage plan, as suggested by celebrating successes and system alterations, but Slovak employees retain a public sector attitude. In addition, the Managing Directors are not leading the culture change as they retain inappropriate structures in Slovakia and high risk attitude that is not appropriate to an innovation culture (Kotter, 2012, p. 37-124).

The current arrangement that resemble an innovation management attempt to change to an innovation culture include creating the environment for substantial exchange of information and perspectives.

The company is striving to accomplish two types of innovation, incremental which is more typical of large companies and original innovation that is more often successful in SMEs (Govindarajan et al., 2010, p.76). It is also employing considerable external knowledge from its clients when on their premises, which it merges with its current knowledge in order to improve its offering to them, so that both inside out and outside-in open innovation, coupling is a key innovation management approach (Gassman and Enkel, 2004, p.13).

Amongst the barriers to change not already specified, is the shortage of skills in Slovak which is implied by high staff turnover.

The total company is not strictly an SME as it has more than 250 employees, but the Bratislava location comes within the definition of a micro or a small enterprise. It currently has the latest technology, a small flexible team and has been provided with training support all of which are innovation management techniques to create an innovation culture. However, serious barriers to innovation are the restricted budgets.

UVI can be described as a paradox at this stage, whilst its business model offered to clients promotes open innovation, its internal organisation generally represents a culture that is hindering innovation.

5 Conclusions

The aim of this paper was to develop a broad understanding of innovation management linked to related management literature. In the theoretical framework the related concepts were appraised as relevant to answering the research problem, specifically innovation, innovation management, open innovation and organisational change in the context of developing an organisational innovation culture.

The research problem was to identify the opportunities and challenges for successful innovation management in SMEs. This objective was accomplished in two ways, firstly be selecting a small sample of empirical studies, which evaluated innovation management, innovation culture and organisational change from diverse cultural perspectives and using different innovation management evaluation models, these were presented, analysed and discussed and the key success and failure factors identified as well as specific innovation management techniques and the differences between large, medium and small organisations. A new case study was then introduced, a German

organisation, which had recently internationalised by creating a new company in Bratislava, Slovakia. Its organisational structure, main activities innovation approaches were identified and its strengths and weaknesses as an innovative company were evaluated. The findings showed that this company, retained a traditional hierarchical culture despite espousing that it practices open innovation and helped its clients to do so. The findings from the four cases were then applied to the German company as potential opportunities and threats.

This research identified key innovation management success factors for SMES as: innovation management models needed to be adapted to different organisational contexts; culture had a high impact on innovation management focus; social acceptance was a major factor for original new product market success so that customer needs and competitor activities were important information sources; cross cultural and cross functional teamworking. The failure factors identified were: skills shortage in the labour market; lack of skills in the company; market uncertainty, imitation by competitors; lack of R&D planning and management.

The study made three new findings, which add to the current knowledge: innovation circles were an effective innovation management approach to generating and developing ideas and getting innovation to market quickly; government agencies that encourage firms to collaborate effectively enhance the level and success of innovation; SMEs and large companies have distinctly different rankings of barriers to innovation and small and micro firms are more effective in original product innovation and speed to market than medium sized companies.

The limitations of this study are the lack of primary research that was possible. Therefore, recommendations for further include repeating this research but using primary sources of information, a small group of SMEs. The findings would be compared with these secondary outcomes. The surprising finding that micro and small companies were more successful than medium sized companies at new product/service innovation and generating high proportions of their turnover from it, justifies further research into this concept.

The validity of the study findings is strong as demonstrated by the convergence of findings with those of the established concepts comprising the Literature Review.

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Digital Skills in Tourism: a Study from the Next Tourism Generation (NTG) Alliance

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Abstract

The digital age has been witnessing important changes derived from ICTs development in every economic sector (Soava, 2015). Consequently, if they want to survive and develop in the digital age, the different economic sectors will need to integrate ICTs into their everyday activities. The tourism sector currently arises as a key driver of economic growth and job creation. The influence of ICTs on the tourism sector has been twofold. On the one hand, changing how organisations operate in the tourist market; and, on the other hand, developing a new way for customers to interact with these tourism enterprises. The future of the tourism sector is going to require 'digital skills'.

In view of the above, this work has as its aim to identify the gap existing between the current and future needs regarding digital skills, as well as the training needs for the 2030 horizon in Spanish tourism organisations belonging to five subsectors (Accommodation; Food & Beverage; Destination Management; Visitor Attractions; and Travel Agents & Tour Operators).

The development of this work is framed within the European project called *Next Tourism Generation* (NTG). It can be described as a multidisciplinary association that involves 14 partners from 8 countries. The NTG Alliance seeks to develop a Blueprint Strategy for digital and sustainability (green and social) skills within the tourism and hospitality sector.

A mixed research methodology, which combined qualitative and quantitative approaches, served as the basis for this research work. Qualitative research took place between April 2018 and March 2019 and went through three stages: *desk research*, *focus groups* and *interviews*. Quantitative research developed from January to June 2019 by means of an online administered survey (*Qualtrics*). 139 Spanish tourism organisations participated.

Both research methodologies provided interesting results not only about the current and future status of digital skills in the Spanish subsectors analysed but also about the training needs associated with them. Those findings constitute the starting point to develop a Europe-wide blueprint strategy able to provide employees, employers, entrepreneurs, teachers, trainers and students with a set of core digital skills represented in a skills matrix.

Keywords – NTG Alliance, Digital skills, Tourism, Training

Paper type – Practical Paper

1 Introduction

The appearance of the Internet, together with the development of Information and Communication Technologies (ICTs), have revolutionised today's economic context, giving rise to the emergence of the digital economy. The digital age has been witnessing important changes derived from ICTs development in every economic sector (Soava, 2015). Consequently, if they want to survive and develop in the digital age, the different economic sectors will need to integrate ICTs into their everyday activities.

The tourism sector has currently become a key driver of economic growth and job creation. The influence of ICTs on this sector has been twofold. On the one hand, by changing how organisations operate in the tourist market; on the other hand, by developing a new way for customers to interact with these tourism firms. Expressed differently, the future of the tourism sector is going to require a set of skills other than those used at present, namely the so-called 'digital skills.'

Amongst the key challenges to be faced by the tourism sector, the most outstanding ones are both the lack of training and the difficulty to attract and retain highly-qualified professionals. This, along with the increased use of ICTs, directly impacts on the need for skills that can ensure a competent performance at workplaces, which in turn generates training needs (Cerezo and Guevara, 2018).

In view of the above, this work aims to identify the gap existing between the current and future needs regarding digital skills, as well as the training needs for the 2030 horizon in Spanish tourism organisations belonging to five subsectors (Accommodation, Food & Beverage, Destination Management, Visitor Attractions, and Travel Agents & Tour Operators). More specifically, this paper will try to answer five research questions.

The development of this work is framed within the European project called *Next Tourism Generation* (NTG). A mixed-research methodology, which combined qualitative and quantitative approaches, served as the basis for its development. Both methodologies provided interesting results not only about the current and future status of digital skills in the Spanish subsectors analysed but also about the training needs associated with them.

The paper is structured as follows: after an introduction, a review of the literature is performed, analysing the impact of ICTs on the tourism business and the need for new skills by tourism professionals. Then, the methodology section describes the mixed-research strategy applied, the study population and the tools used to collect information. Following this, the results obtained are shown, and the paper finishes with the main conclusions and potential lines of research.

2 Literature review: digital era, digital skills and tourism

ICTs have changed the manner in which we live and do our work, altering the way we buy products, communicate with each other and train students (Stone et al., 2015). In the business context, the use of ICTs has become a strategic asset for corporations, changing the way they communicate and relate to their stakeholders. ICTs and the Internet have

altered the foundations of competition in all economic sectors, leading to the appearance of new products, services, and processes. Therefore, there is no doubt that technology has also affected the tourism sector (Prentice, Dominique and Wang, 2019; Soava, 2015; Hojeghan and Esfangareh, 2011; Minghetti and Buhalis, 2010).

The Internet has changed the value chain of tourism creation, commercialization, distribution and consumption (Capriello and Riboldazzi, 2019; Gretzel, Yuan and Fesenmaier 2000), allowing tourists access to reliable, accurate information, and to make real-time reservations, thus improving service quality and increasing customer satisfaction. In the digital era, tourists are more independent and sophisticated, and can use a wide range of tools to plan their travel (Soava, 2015).

The impact of ICTs on tourism and their potential evolution in the future also seem to be creating a new context for tourist destination management (Ivars-Baidal et al., 2019; Trunfio and Della Lucia, 2019). In turn, Big Data offer challenges and opportunities both for existing firms and for new players in the tourism sector. Big Data make it possible to predict tourist demand, manage knowledge flows and interact with customers. This may lead to higher productivity, increased customer satisfaction, personalized marketing campaigns and more efficient operations (Ardito et al., 2019).

Virtual reality and Artificial Intelligence (AI) systems offer major opportunities for the tourism sector. Simon (1980) defines AI as the science dealing with the design and the development of computer solutions in order to carry out human tasks. Within the sphere of tourism, AI systems will provide users with a choice of virtual reality examples allowing them to see places of interest, hear and even feel the landscape (Soava, 2015). Besides, chatbots applying analytical artificial intelligence in the hotel industry may generate automatic replies to customers' queries (Chung et al., 2018).

ICTs are increasingly becoming a part of jobs in the tourism sector and, together with the evolution of the technology itself and the changes in the productive framework of tourism, are increasing job complexity (some jobs change, many disappear, and new jobs emerge) and demand new types of skills (Cerezo and Guevara, 2018). Tourism is labour-intensive and the customer-employee interface is a key determinant of quality, employees being key assets for tourism organisations. The real challenge is finding and retaining employees with the right skills, knowledge and attitudes (Haven-Tang and Jones, 2008).

In this context, one may wonder if the human capital, a key component of the tourism sector, possesses the necessary skills to use these technological tools, both at present and over the next years. In this line, the European Commission has emphasized the lack of qualifications of tourism employees in the face of the increasing usage of ICTs in this industry (European Commission, 2010).

In this context, training and developing digital skills among tourism professionals becomes a necessary condition for the success of tourism organizations. Therefore, this paper tries to provide a reply to the following research questions: (1) What is the current level of digital skills in tourism organisations? (2) What level should tourism organisations achieve regarding digital skills by 2030? (3) Do tourism organisations

provide training in digital skills? (4) What types of training in digital skills are offered by tourism organisations? (5) What are the reasons why training in digital skills is not provided in tourism organisations?

The following section describes the research strategy implemented in order to reply to the five research questions formulated.

3 Methodology

As mentioned in the Introduction section, the development of this work is framed within the European project called *Next Tourism Generation* (NTG). NTG is the first European alliance meant to improve the collaborative and productive relationship between the educational system and the tourism sector. It is financed with a total of 4 million euros by the European Union and has a four-year duration (January 2018-December 2021). It can be described as a multidisciplinary association that involves 14 partners from 8 countries: 7 industrial partners and tourism sector representatives (Federturismo Confindustria-Italy, UnionCamere-Italy, Eurogites-France, Deutsches Seminar Für Tourismus (DSFT)-Germany, People 1st International-UK, Vimosz-Hungary, CEHAT-Spain), 6 universities (University of Alicante-Spain, Varna University of Management-Bulgaria, Breda University of Applied Science-The Netherlands, Cardiff Metropolitan University-UK, University of Sopron-Hungary, Technological University Dublin-Ireland) and the Association for Tourism and Leisure Education and Research (ATLAS). The NTG Alliance seeks to develop a Blueprint Strategy for digital and sustainability (green and social) skills within the tourism and hospitality sector.

In line with the purpose stated, this work focuses on the development of a part of the NTG project, analysing only the digital skills and the training needs for the 2030 horizon in Spanish tourism organisations belonging to five subsectors mentioned. Spain is the second largest tourist destination in Spain, after France. The Spanish tourism sector grew by 2.4% in 2018 —making a 14.6% contribution to Spain's GDP— and employed 2.8 million people, which accounts for 14.7% of total employment (WTTC, 2019). Due to the economic weight of tourism and the employment it creates, Spain is the ideal context for the study of the topics analysed.

A mixed-research methodology, which combined qualitative and quantitative (QUAL/QUAN) approaches, served as the basis for this research work. We shall now describe each of the methodologies used.

3.1 Qualitative research

The qualitative research took place between April 2018 and March 2019, and was performed in three phases: (1) desk research; (2) focus groups; (3) interviews.

In the first phase (*desk research*), each partner performed, in its country, an in-depth analysis of the situation of digital and sustainability skills in the five subsectors mentioned. For such purpose, secondary data were thoroughly examined, obtained from

corporate reports, academic journals, specialized industry journals, government strategies, handbooks and websites. The purpose was to know the problems and challenges related to gaps in such skills, and also the training needs in tourism organizations (NTG Skills Alliance, 2019).

The second phase was carried out through focus groups, formed by the most representative public and private organizations within each of the subsectors analysed. The focus groups are a key tool to show current practices. Five focus groups were created for each subsector, whose main purpose was to discuss the key challenges, problems and opportunities for the development of staff skills and job descriptions within the corporations. The meetings had an approximate duration of one and a half hours, and dealt with 11 main issues, regarding the need for skills and training in the areas studied (digital, green and social).

For the third stage of the research (interviews), it was decided to use the case study as a research method, since its characteristics allow a closer approach to the subject matter. The multiple case study was used, instead of the single case, in order to find behaviour patterns making it possible to extrapolate the results obtained in various economic, organizational and sector contexts ("replication logic", Yin, 2012). A single case would have a low degree of representativeness and would limit the scope of the conclusions to a specific type of organization and business sector.

The cases were selected using non-random sampling, choosing those that offered the best opportunities for learning. 264 organizations were selected from various tourism subsectors at a European level, 30 of them from Spain (14 Accommodation, 5 Food & Beverage, 6 Destination Management, 2 Visitor Attractions, 3 Travel Agents & Tour Operators).

In order to collect information, a standard semi-structured interview was used, divided into 4 sections, containing 23 questions. The first two sections included 5 questions related to the main characteristics of the organization studied. The third section consisted of 13 questions enquiring into the importance the respondents attached at present to the set of skills analysed, to their future weight and the training currently offered on such skills. The fourth section, consisting of 5 questions, focused on obtaining information on the respondents' view on the future of tourism (skills and training) for the year 2030. The interviews, which had an average duration of approximately 1 hour, were recorded and then transcribed. All organizations studied signed a participant consent form.

3.2 Quantitative research

The quantitative research took place between January and June 2019, and was carried out through an online survey at a European level. The total number of organizations taking place in the survey was 1404, out of which 139 were Spanish organizations (68 Accommodation, 15 Food & Beverage, 22 Destination Management, 27 Visitor Attractions and 7 Travel Agents & Tour Operators).

The questionnaire was developed by a group of experts including both academics and professionals. It was sent to the senior person responsible for each organization using the Qualtrics online platform, together with an introductory letter stating the project goals and the confidentiality terms. The questionnaire consisted of 25 questions of different types (closed, open, dichotomic, ordinal, multiple-choice and Likert scales) divided into 4 sections. The first section, of an introductory nature, included 6 questions; the second section, consisting of 5 questions, focused on obtaining information on environmental management skills; the third section, with 9 questions, dealt with social skills; and the fourth section, consisting of 5 questions, focused on digital skills. As this paper deals with the analysis of digital skills, a description will now be offered of sections one and four, which have been the basis for the empirical work.

Section I: Introduction

- Country where the firm or organization is located.
- Region, within the country, where the firm or organization is located.
- Subsector in which the firm operates.
- Specific activity developed by the firm or organization.
- Respondent's role.
- Size of the organization.

Section IV: Digital skills

- With the first question, each respondent had to assess, within a scale of 1 (no digital skills are possessed) to 5 (expert) the present level of competence of their organization regarding digital skills (13 items).
- With the second question, each respondent had to assess, within a scale of 1 (no skills are possessed) to 5 (expert) the future level of competence that their organization will need by the year 2030 regarding digital skills (13 items).
- With the third question, the respondent had to state if their organization provides any type of training to its employees (internally or externally) in digital skills.
- If the answer was "yes", in the fourth question the respondent had to state the type of training in digital skills provided to their employees (10 items).
- If the answer was "no", in the fifth question the respondent was asked to explain the reasons why they were not providing training in digital skills to their employees.

4 Empirical evidence

This section attempts to provide answers to the research questions proposed. Table 1 shows the results obtained in the qualitative research with respect to the present and future need for digital skills in each of the subsectors analysed. Tables 2 and 3 show the results obtained in the quantitative research.

Research question 1. What is the current level of digital skills in tourism organisations? Research question 2. What level should tourism organisations achieve regarding digital skills by 2030?

In general terms, it may be observed that, almost in all subsectors, basic digital skills (use of operating systems, Microsoft Office, Wi-Fi, sound systems, video projectors and social media) are the most important ones, both at present and for the year 2030. In spite of the fast technological advances, it is worth noting that, in all of them, the least important skills at present are also the least important ones for the future. These include skills related to computer programming, robotics and artificial intelligence and use of virtual and augmented reality. Such skills, which are quite necessary for the near future, will require high degrees of training, in order to reach an optimum level in tourism organizations.

Table 1. Current and future digital skills needs in tourism in Spain (qualitative research)

	ACCOMMODATION		**FOOD & BEVERAGE**		**DESTINATION MANAGEMENT**		**VISITOR ATTRACTIONS**		**TRAVEL AGENTS & TOUR OPERATORS**	
DIGITAL SKILLS	**Current digital skills needs**	**Most important digital skills in 2030**	**Current digital skills needs**	**Most important digital skills in 2030**	**Current digital skills needs**	**Most important digital skills in 2030**	**Current digital skills needs**	**Most important digital skills in 2030**	**Current digital skills needs**	**Most important digital skills in 2030**
Big data analysis	X	X	X		X	X				X
Internet of Things (IoT)	X	X		X						
Augmented reality	X					X				
Business Intelligence	X	X			X					
Loyalty programs	X									
Revenue and cost management	X			X						
Automated logistics systems	X									
Improvement in the development of customer demands	X									
Domotics	X	X								
Customer Relationship Management			X	X						

(CRM software)										
Management of different devices (computers, tablets, mobile, etc)			X							
Mobile Apps			X							
Knowledge for basic computer tools (Microsoft Office)			X							X
Social networks management (Facebook, Twitter, YouTube, Instagram, etc.)			X							X
Enterprise Resource Planning (ERP)			X							
Payment systems			X							
Cybersecurity		X	X			X				X
Digital design					X					
AdWords software					X					
Skills to work in a paperless environment					X					
Creation of new content that reaches the public easily, quickly and cheaply							X			
Adaptability and flexibility									X	
Skills to manage different technologies									X	
No fear of changes									X	
Biometrics		X								

Artificial Intelligence (AI)				X		X		X		
Working with robots or cobots				X						
Industrialise the activity				X						
Digital storytelling				X				X		
Virtual reality						X				
Digital marketing								X		
Digital communication								X		
Content development and online applications										X
Teleworking										X

Source: adapted from Espeso-Molinero and Camps (2019).

Table 2. Level of proficiency in digital skills for tourism in Spain (quantitative research)

	ACCOMMODATION		**FOOD & BEVERAGE**		**DESTINATION MANAGEMENT**		**VISITOR ATTRACTIONS**		**TRAVEL AGENTS & TOUR OPERATORS**	
DIGITAL SKILLS	**Current level of proficiency in digital skills**	**Future level of proficiency in digital skills for 2030**	**Current level of proficiency in digital skills**	**Future level of proficiency in digital skills for 2030**	**Current level of proficiency in digital skills**	**Future level of proficiency in digital skills for 2030**	**Current level of proficiency in digital skills**	**Future level of proficiency in digital skills for 2030**	**Current level of proficiency in digital skills**	**Future level of proficiency in digital skills for 2030**
MOST PROFICIENCY										
Operating System use skills (e.g., Windows)	X	X	X	X	X	X	X	X	X	X
Microsoft Office skills (e.g., Word, Excel, PowerPoint)	X	X	X	X	X	X	X	X	X	X
Skills to adjust digital equipment such as Wi-Fi connectivity, sound systems and video projectors	X						X		X	

Skills to monitor online reviews		X								
Social media skills			X		X	X		X		
Skills to monitor online reviews			X	X						
Online marketing and communication skills					X	X		X	X	X
Skills for implementing online safety procedures									X	X
Desk top publishing skills (for designing brochures, catalogues, etc.)									X	
Website development skills									X	X
LEAST PROFICIENCY										
Artificial Intelligence and robotics skills	X	X	X	X	X	X	X	X	X	X
Skills related to applying digital hardware technologies, such as augmented and virtual reality	X	X	X	X	X	X	X	X	X	X
Computer programming skills	X	X	X	X	X	X	X		X	X
Data analytics, business intelligence, big data skills			X					X	X	
Website development skills				X					X	
Social media skills									X	X
Skills to monitor online reviews										

Desk top publishing skills (for designing brochures, catalogues, etc.)										X

Source: adapted from CEHAT, Alicante University and Eurogites (2019)

Table 3. Training provision in digital skills for tourism in Spain (quantitative research)

	ACCOMMODATION	FOOD & BEVERAGE	DESTINATION MANAGEMENT	VISITOR ATTRACTIONS	TRAVEL AGENTS & TOUR OPERATORS
TRAINING PROVISION IN DIGITAL SKILLS (%)	YES (54.4%) NO (45.6%)	YES (53.3%) NO (46.7%)	YES (72.7%) NO (27.3%)	YES (61.9%) NO (38.1%)	YES (100%)
TYPES OF TRAINING					
On the job	X	X	X	X	X
Online courses	X	X	X	X	X
Several days on-site training by external provider	X		X	X	X
One day on-site training by external provider		X		X	X
Higher education		X			
One day off-site training by external provider			X		X

Source: adapted from CEHAT, Alicante University and Eurogites (2019)

More specifically, in the accommodation subsector, the use of mobile devices and tablet computers for apps related to check-in and check-out activities, and control of air conditioning, heating, TV and lighting, are examples of how the digital sphere is currently playing a major role in its activities. By the year 2030, cybersecurity, domotics and biometrics skills will be a must. Domotics will make it possible to enhance guest experience by creating environments suited to their mood and improving comfort in the facilities. Biometrics will be increasingly used to enable guest identification and access to the various services in each establishment (Espeso-Molinero and Camps, 2019).

In the food & beverage subsector, there is evidence that dietary habits are changing, and both for the present and future generations, it will be usual to eat at restaurants, buy prepared meals or order food online and have it delivered at home (NTG, 2019). Therefore, currently there is a need for marketing and customer interaction skills, mobile apps management, specialization in social media, knowledge of payment systems, and

online security. Due to the large amounts of prepared meals that will predictably be demanded by the market by 2030, one of the most immediate needs will be to industrialize the activity. Also important for the future will be digital storytelling around food and restaurants.

It is expected that Destination Management Organization (DMO) will change from merely providing information to providing inspiration and experiences for visitors (NTG, 2019). In order to manage the large amount of information they possess, they will need to acquire destination monitoring skills through big data analysis and the use of business intelligence tools. This will provide them with a database allowing decision-making and destination monitoring. For the future, it is expected that virtual and augmented reality will improve visitor experience (Espeso-Molinero and Camps, 2019).

In the visitor attraction subsector, visitor experience plays a central role; this is why there is a wide range of virtual and augmented reality apps and software enhancing visitor experience. However, since there is still a certain digital divide among visitors, it is necessary for institutions to maintain device and software usability for all audiences; such devices and software must be easy to use.

In the travel agents & tour operators subsector, it may be observed that many future customers will be digital natives, which will make it pointless to distinguish between online and offline offer, as is done today. Although the average digital skills level appears to be sufficient at present, it will be necessary to face the fear of change, the need to be flexible and quickly learn to manage different technologies. In this subsector, basic digital skills will be complemented by online marketing and communication skills, and also those skills necessary for web development.

Research question 3. Do tourism organisations provide training in digital skills?

Research question 4. What types of training in digital skills are offered by tourism organisations?

Research question 5. What are the reasons why training in digital skills is not provided in tourism organisations?

Because digitalisation has increased very quickly and the trend nowadays is to be more and more digital, a high percentage of respondent organizations provide some training for their employees in digital skills. It is worth emphasizing that 100% of the organizations participating in the study belonging to the travel agents & tour operators subsector, provide training to their employees. At the other end of the spectrum, mention must be made of the fact that almost 50% of the organizations in the food & beverage and accommodation sectors do not provide any type of training in digital skills.

The most common types of training in digital skills are on-the-job courses, followed by online courses, several days on-site training by an external provider and one day on and off-site training by external provider. On-line training provides greater flexibility, efficiency and reduced costs, as compared to more traditional training methods (Stone et al., 2015). The subsector *food & beverage* is the only one that considers that one of the main types of training is higher education, mainly because the digital skills required by

their organisations (higher knowledge of information technology tools and specialization in social networks, marketing tools, CRM and ERP software, payment systems, online security, etc.) need a higher level of education that cannot be achieved through another type of training.

The main reasons why tourism organizations do not provide training in digital skills are mainly due to lack of budget, lack of time, to the fact that managers are not sensitive to digital issues, and to the fact that many of those capabilities are outsourced.

5 Conclusions

The development of ICTs and their integration in the activities of all economic sectors has shown the need to possess digital skills in order to optimize the use of these technologies. Because the tourism sector is at present a key driver of economic growth and job creation, the purpose of this paper has been to identify the gap existing between the current and future needs regarding digital skills, as well as the training needs for the 2030 horizon in Spanish tourism organisations belonging to five subsectors (Accommodation; Food & Beverage; Destination Management; Visitor Attractions; and Travel Agents & Tour Operators).

Within the framework of the NTG European project, and applying a mixed-research method (QUAL/QUAN), answers were provided to the five research questions formulated. The results obtained for Spain are similar to those obtained at a European level. Those findings show that the future tourism sector will require skills sets which in some respects will be radically different from today's, especially in the field of digital skills. These skills should be supplemented by others, mainly those related to social skills.

In spite of the constant technological advances, the tourism organizations analysed consider that digital skills are still an unresolved issue. Employees are more prone to work with a greater number of devices, and are willing to operate in environments where technology has an increasingly leading role. However, organizations believe that there remains a lot to be done until employees have, both at present and by the year 2030, a suitable level of digital skills enabling them to operate in the tourism subsectors analysed. In all these sectors, the need has been observed for staff to be more adaptable, due to the existence of a higher degree of automatization and the use of specific computer software.

The main contributions of this paper are as follows: from a theoretical point of view, a review of the literature has been made, showing the existence of a gap in digital skills (both at present and for the future, in 2030) in the tourism sector, and also the training needs in this area. From an empirical point of view, firstly, a thorough survey was carried out at a European level, combining qualitative and quantitative methodologies, using four research tools (desk research, focus groups, interviews and surveys) in order to identify the abovementioned gaps in digital skills. To date, we have been unable to find a similar study in the scientific literature. Secondly, with the results obtained, a Blueprint strategy will be developed (within the NTG Alliance European project) which will provide employees, employers, entrepreneurs, teachers, trainers and students with a set of core

digital skills represented in a skills matrix with associated content in units/modules. Those modules can be applied using a range of delivery methods, guidelines and tools across different levels of industry jobs and different levels of qualification and training by education and learning providers (NTG Skills Alliance, 2019). Thirdly, the skills matrix and the Blueprint strategy become proactive tools making it possible to anticipate future needs in digital skills in the tourism sector. This results from the need for a consensus among tourism operators of the need to upgrade skills, improve professionalism among employers and employees, and to nurture a training culture as an integral part of overall business performance. At a local level, learning providers and tourism businesses need to work together to understand each other's operating environments and needs, so that tourism and hospitality students develop realistic expectations of the sector and have the skills to ensure competitiveness (Adeyinka-Ojo, 2018; Haven-Tang and Jones, 2008).

In spite of the exhaustive research carried out, the main limitation of this work is that it has focused on the analysis of digital skills in the Spanish tourism sector. Future research should extend the analysis both to green and to social skills in the five tourism subsectors analysed, not only in Spain, but also at a European level.

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Marketing-Specific Structural Capital, Marketing Innovation and Market Performance

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Abstract

Organization's capability to innovate is closely tied to its intellectual capital; yet, studies addressing this issue have neglected marketing innovation and have mostly focused on technological innovation. However, marketing innovation (i.e., innovation in pricing, product/service design and packaging, placement and promotion) can help attract customers and increase the demand of a firm's products with a relatively smaller investment than technological innovation. In this paper, we test how knowledge generated by means of marketing-specific IT solutions (i.e., marketing-specific IT capital) and other forms of organizational memory in the marketing domain (i.e., marketing-specific organizational memory) can contribute to marketing innovation and subsequent market performance. Using marketing directors-reported data, we empirically test research hypotheses by means of structural equation modelling based on partial least squares. Results reveal that while marketing innovation fully mediates the relationship between organizational memory and market performance, it partially mediates the relationship between IT capital and market performance. Moreover, the study identifies which are the most relevant knowledge resources within marketing-specific IT capital and organizational memory to boost both marketing innovation and market performance. This encourages marketing managers to carefully assess marketing-specific knowledge resources residing in the firm to benefit their businesses.

Keywords – Intellectual capital, Structural capital, Marketing innovation, Market performance.

Paper type – Academic Research Paper

1 Introduction

Despite the relevant role that marketing innovation could play in firm competitiveness (e.g., Ren et al., 2010), there is dearth of empirical studies addressing both the antecedents (Geldes and Felzenstein, 2013; Ramírez et al., 2018) and outcomes (Medrano-Sáez and Olarte-Pascual, 2016) of such innovation.

According to Ramírez et al. (2018), attention has only been substantially drawn on marketing innovation since its inclusion in the third edition of the Oslo Manual (OECD, 2005), i.e., the international reference guide for collecting and using innovation data. According to this guide, "Marketing innovations involve the implementation of new marketing methods. These can include changes in product design and packaging, in product promotion and placement, and in methods for pricing goods and services" (p. 17). In other words, marketing innovation consists of "improvements in the marketing mix" (Naidoo, 2010; p. 1311) and has been positioned in the literature as a type of incremental innovation (e.g., Grewal and Tansuhaj, 2001; Contò et al., 2015).

As Naidoo (2010) points out, marketing innovation provides quick fix solutions emphasizing low-risk product modifications, extension, and design changes. It allows differentiation by enabling companies to address the psychological needs of consumers and the rational needs of business-to-business customers by improving their ability to sell (Gupta and Malhotra, 2013). In short, marketing innovation attracts clients (Medrano-Sáez and Olarte-Pascual, 2016) and increases the demand for a firm's products (Ramírez et al., 2018) with a relatively smaller investment than technological innovation (Medrano-Sáez and Olarte-Pascual, 2016).

Among the array of potential enablers of marketing innovation, intellectual capital (IC) deserves special attention. According to Subramaniam and Youndt (2005), "It is widely accepted that an organization's capability to innovate is closely tied to its intellectual capital or its ability to utilize its knowledge resources" (p. 450). However, a recent structured literature review on the IC-innovation linkage by Buenechea-Elberdin (2017) revealed that no previous study had analyzed the influence of IC on marketing innovation.

Given the proliferation of marketing-oriented IT solutions and the significant possibilities now offered by data analytics to extract marketing-related knowledge from companies' data records, as well as the importance of marketing-specific organizational memory (i.e., stored information from an organization's past; Walsh and Ungson, 1991), the question arises about the real impact of each type of knowledge resources in the generation of new marketing methods (and subsequent market performance). These two elements (IT capital and organizational memory) constitute what is known as structural capital (SC) (Bueno et al., 2011) and, in this case, marketing-specific SC (i.e., all marketing-related knowledge residing in a firm's information systems, databases, documents, manuals, routines, and procedures, as well as in any other physical and/or digital artefacts; Peñalba-Aguirrezabalaga et al., 2020). The aim of this paper is to analyze the influence of both constituents of marketing-specific SC on marketing innovation and market performance.

This paper represents a relevant contribution to the IC, marketing, and innovation literatures because it clarifies how organizational knowledge in the marketing domain can contribute to innovation in marketing methods, and thus to attract and retain customers. Moreover, this study is among the first ones that adopts a contextual approach to IC and that shows how knowledge resources regarding a particular function in the company could contribute to firm performance, hence providing a more fine-grained picture about the specific knowledge resources and IT technology in which managers need to invest.

2 Theoretical background

This study assumes the knowledge perspective of IC (Peñalaba-Arrizabalaga et al., 2020), and thus conceives the former as the sum of all knowledge that firms leverage to gain competitive advantage. Usually, a tricomponent classification is suggested that groups resources according to where they reside: people (i.e., human capital), the organization (i.e., structural capital), or relationships (i.e., relational capital).

Following Bueno et al. (2011), a distinction could be made within SC between IT (or technological) capital and organizational capital. In the context of this paper, IT capital refers to knowledge resources generated by means of IT solutions (e.g., knowledge on behavioral patterns obtained through data analytics), while organizational knowledge (or "organizational memory") refers to knowledge that has not been generated by means of computer-based data processing, although it may be stored in a digital repository (e.g., knowledge on best practices and lessons learned, or information records regarding past projects, deals, and/or campaigns).

As we are interested in marketing innovation and its influence on customer acquisition and retention (i.e., market performance), this paper adopts a contextual approach to IC (Kianto et al., 2018) and focuses on marketing-specific SC (Peñalaba-Arrizabalaga et al., 2020). As Morgan et al. (2009) point out, although many organizational capabilities may cross different functional areas of the firm, capabilities regarding the marketing-mix processes (and, thus, innovation related to them) are usually associated with the marketing function (e.g., Dutta et al., 2003). Therefore, knowledge resources residing in the marketing department should play a prominent role.

Along these lines, Morgan et al. (2009) contend that having a greater understanding of customers' expressed wants and latent needs, competitor capabilities and strategies, channel requirements and developments, and the broader market environment constitutes an advantage that enables the firm to be both more effective and efficient by allowing managers to select the most productive available resource combinations to match market conditions. More specifically, it is the interaction between such knowledge resources and marketing capabilities (e.g., marketing innovation) that allows the firm to outperform its rivals (Morgan et al., 2009).

In the following section, we hypothesize how marketing-specific SC can lead to marketing innovation and market performance.

3 Hypothesis development

As already highlighted in the introduction section, marketing innovation has been positioned in the literature as a type of incremental innovation (e.g., Grewal and Tansuhaj, 2001; Contò et al., 2015). According to Abernathy and Clark (1985), incremental innovations build on and reinforce the applicability of existing knowledge. Hence, an organization's preserved knowledge or SC is a fundamental input for such innovation to occur. As Subramaniam and Youndt (2005) point out, reliance on manuals, databases, and other types of codified knowledge, along with the establishment of structures, processes, and routines that encourage repeated use of knowledge will boost and organization's incremental innovative capabilities.

Regarding marketing-specific IT capital, a plethora of IT-based solutions (e.g., CRM, customer experience management software, customer journey tracking software, social media management software, marketing intelligence software) have emerged (Soltani and Navimipour, 2016; Benítez et al., 2018), which enable companies to extract new knowledge from their data records and guide decision-making. These marketing-oriented technological tools offer the ability to identify potential new customers, customer groups and/or segments, patterns of customer behavior, market trends, and even top industry insiders and influencers, as well as to analyze customer's profitability and product/service performance, all of which could be very valuable to guide marketing innovation decisions.

Moving on to organizational memory (i.e., stored information from an organization's history that can be brought to bear on present decisions; Walsh and Ungson, 1991), previous studies provide empirical confirmation that what has already been stored in organizational memory drives innovation (e.g., Hanvanich et al., 2006; Camisón and Villar-López, 2011). According to Camisón and Villar-López (2011), prior knowledge that a firm possesses about clients and markets can lead to early identification of changes in consumer preferences and facilitate the introduction of novel marketing tools to distinguish the firm's products from those of its competitors. In other words, the storage of marketing-specific knowledge and its easy access by the members of the marketing department facilitates and encourages the generation and implementation of new ideas for marketing practices.

Based on the above, we hypothesize that:

H1a. Marketing-specific IT capital is positively related to marketing innovation.

H1b. Marketing-specific organizational memory is positively related to marketing innovation.

As early as 1960, Theodore Levitt drew attention to the profit possibilities of creating new value satisfactions through changes in the marketing schemes (Levitt, 1960). As Ren et al. (2010) point out, "some marketing managers pay exaggerate attention to product innovation as a source of competitive advantage while neglecting other sources of innovation like marketing" (p. 82). However, the particular style of products, the nuances

of advertisements, the level and availability of after-sales service, and even the cultural implication of a brand symbol may be important means to increase a firm's market share, as the analysis of some leading Chinese companies demonstrated (Ren et al., 2010). In other words, marketing innovation provides a way of differentiating firms from their competitors and adapt to markets in order to gain competitive advantage (Medrano and Olarte-Pascual, 2016; Ramírez et al., 2018). As highlighted by the Oslo Manual, "marketing innovations are aimed at better addressing customer needs, opening up new markets, or newly positioning a firm's product on the market, with the aim of increasing the firm's sales" (OECD, 2005; p. 49). To that end, "the logic of marketing innovation emphasizes shifting consumer demand from elastic to more inelastic market segments through the delivery of better value (actual or perceived) to the consumer" (Naidoo, 2010; p. 1311).

Consequently, we hypothesize that:

H2. Marketing innovation is positively related to market performance.

Marketing-specific SC (both IT capital and organizational capital) are expected to have additional benefits beyond those related to the promotion of marketing innovation that could also improve market performance (i.e., customer acquisition and retention). For instance, knowledge generated by means of marketing-specific IT solutions (e.g., knowledge regarding customer behavior, market trends, or product/service performance) could also be essential to guide product/service innovation efforts by highlighting the type of product/service characteristics and functionalities that need to be reinforced to increase customer acceptance. Likewise, knowledge generated regarding potential customers and existing customer segments may help improve targeting capabilities and thus the effectiveness of commercial actions (e.g., selling the right products to the right customers; Soltani and Navimipour, 2016).

In the case of other types of stored knowledge that do not necessarily involve computer-based data processing, the marketing department controls and retains information flows which are critical to understand the industry complexity where the firm operates (Guilding and Pike, 1990). The importance of these marketing-specific assets and their exploitation and coordination enables firms to develop strategies that match their market environments more effectively (Eisenhardt and Martin, 2000; Makadok, 2001; Morgan et al. 2009). Moreover, well established marketing routines and procedures, easily accessible best practices and lessons learned, and information records about past projects, deals, and campaigns may provide marketers with solid guidance to carry out their work and build durable relationships with customers.

As these additional benefits derived from marketing-specific SC that could also lead to improved market performance (i.e., better focused product/service innovation efforts, superior targeting capabilities, more effective marketing strategies, and improved work guidance) have been excluded from our research, we hypothesize that:

H3. Marketing-specific structural capital – (a) IT capital; (b) organizational memory – is positively related to market performance.

In other words, we suggest that marketing innovation partially mediates the relationship between marketing-specific SC and market performance.

4 Research methods

4.1 Sample and data collection

This research examines Spanish companies with at least 100 employees. We established this threshold to guarantee that companies had a well-established marketing 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. The search resulted in 2,346 firms. Setting out from the above population, we calculated the sample size needed to carry out a representative study (342 firms) and then contacted the target population by phone, guaranteeing total confidentiality. A stratified sampling procedure was applied to ensure that different proportions of company types according to industry (manufacturing vs. service), size, and technology intensity were preserved as in the population. The final sample included 346 companies that answered the provided email or phone survey.

This sample size was large enough to carry out a statistical study based on the partial least squares (PLS) structural equation modelling (SEM) approach. As a first approximation, and according to the level of complexity of the model to be tested, we calculated the minimum required sample size as ten times the number of variables in the most complex regression, which contained seven variables (Barclay et al., 1995). The calculated sample size was 70 firms. Thus, our final sample (346 companies) was well above the minimum threshold.

As data regarding all dependent and independent variables were reported by a single key informant in each company, this presented the possibility of the occurrence of what is known as common-method bias (Podsakoff et al., 2003). To determine the extent of method variance in the dataset, a full collinearity test specially conceived for PLS-SEM (Kock, 2015) was carried out. The above test includes both vertical (predictor-predictor) and lateral (predictor-criterion) collinearity analyses. According to Kock (2015), if all the variance inflation factors (VIFs) resulting from a full collinearity test are equal to or lower than 3.3, the model can be considered free of common-method bias. The highest VIF in our model was 2.023, well below the 3.3 threshold. Therefore, common-method variance was ruled out of our research.

4.2 Measures

Our research model included two independent variables (marketing-specific SC subcomponents), one mediating variable (marketing innovation), one dependent variable (market performance) and five control variables (size, age–year of foundation–, industry–manufacturing vs. service–, technology intensity–high-techs vs. low-techs–, and customer type–B2B vs. B2C). We relied on a newly developed and validated scale for marketing-

specific SC categories (Peñalba-Aguirrezabalaga et al., 2020), while the scale used for marketing innovation was based on traditional marketing mix components, and the market performance scale was adapted from Liozu (2015). All the items were measured by means of 7-point Likert scales.

SC, marketing innovation, and market performance constitute designed conceptual variables. In other words, they are abstractions or human-made conceptual "artefacts" that do not have an autonomous existence in the real world. In this case, the indicators or observable variables define or build up the conceptual variable. They do not cause it, but they make it up (i.e., it is a "definitorial" relationship). Thus, a composite measurement model applies (Henseler, 2017). In such kind of measurement model, constructs are obtained as a linear combination of their indicators without error term, and each indicator enters the linear combination with a specific weight.

4.3 Statistical analyses

The proposed research model was analyzed with SEM based on PLS using SmartPLS 3.2.8 software (Ringle et al., 2015). Unlike covariance-based SEM, which adopts a common factor approach, PLS-based SEM relies only on composites (Rigdon, 2016). There are two stages in 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 attempting to draw conclusions about the relationships among constructs (Barclay et al., 1995).

5 Results

5.1 Measurement model evaluation

In composite measurement, traditional common factor approaches to measurement model evaluation do not apply. Researchers need to analyze convergent validity to determine the extent to which the indicators making up a construct capture the essence of the conceptual variable they are intended to represent. According to Hair et al. (2017), this requires redundancy analysis. To perform this analysis, the survey included one indicator that summarized each conceptual variable under study in order to calculate the correlation between the composite and this summary indicator. Appropriate convergent validity requires a correlation of 0.707 or higher, which translates into 50% of the variance explained for the summary indicator (Hair et al., 2017). Good correlations were found for all the constructs in the research but one: market performance. As the correlation obtained in this case was very close to the established limit (0.692), no changes were made in the model.

Potential problems in the estimation of indicators' weights due to collinearity issues are another aspect that must be considered. Ideally, VIF values should be lower than 3 (Hair et al., 2019), which is the case for all indicators used in the model. Thus, a mode "B" composite has been applied in all constructs, which means that correlations weights are

calculated by means of multiple regression (Hair et al., 2017). This allows assessing the specific relevance of each indicator when it comes to maximizing the amount of variance explained of the dependent variables.

Finally, as far as correlations between latent variables are concerned, none are excessively high. The largest correlation (0.660) was found between marketing-specific IT capital and organizational memory.

5.2 Structural model evaluation

Once the quality of the measurement model was guaranteed, we used bootstrapping to test the strength of the established relationships between constructs. More specifically, we employed a one-tailed 5,000 sub-sample bias-corrected and accelerated (BCA) bootstrap (Hair et al., 2017). Table 1 shows the results obtained.

Table 1: Structural model evaluation

	Effects	*t statistics*	*p-values*	*5%*	*95%*
Direct effects on marketing innovation (R^2 = 38.9%)					
Size	0.042	1.060	0.145	-0.025	0.104
Year of foundation	0.028	0.663	0.254	-0.039	0.100
Industry (manufacturing vs. service)	-0.017	0.371	0.355	-0.092	0.058
Technology intensity (high-techs vs. low-techs)	-0.020	0.442	0.329	-0.096	0.051
Customer type (B2B vs. B2C)	-0.032	0.714	0.238	-0.109	0.041
Marketing-specific IT capital	**0.320**	**4.941**	**0.000**	**0.194**	**0.411**
Marketing-specific organizational memory	**0.349**	**5.181**	**0.000**	**0.237**	**0.460**
Direct effects on market performance (R^2 = 34.6%)					
Size	-0.025	0.592	0.277	-0.092	0.045
Year of foundation	0.045	0.957	0.169	-0.026	0.129
Marketing-specific IT capital	**0.194**	**2.661**	**0.004**	**0.065**	**0.306**
Marketing-specific organizational memory	0.057	0.776	0.219	-0.073	0.165
Marketing innovation	**0.414**	**6.575**	**0.000**	**0.311**	**0.517**
Indirect and total effects of marketing-specific IT capital on market performance					
Indirect effect via marketing innovation	**0.132**	**3.879**	**0.000**	**0.075**	**0.187**
Total effect (Direct + Indirect)	**0.326**	**4.498**	**0.000**	**0.193**	**0.433**
Indirect and total effects of marketing-specific organizational memory on market performance					
Indirect effect via marketing innovation	**0.145**	**3.914**	**0.000**	**0.092**	**0.215**
Total effect (Direct + Indirect)	**0.202**	**2.891**	**0.002**	**0.074**	**0.306**

As can be observed in Table 1, both marketing-specific IT capital (β=0.320) and organizational memory (β=0.349) are positively and significantly related to marketing innovation, while marketing innovation (β=0.414) also shows a positive and significant relationship with market performance. Thus, hypotheses H1a, H1b, and H2 are accepted.

Moving on now to the direct effects of marketing-specific SC on market performance, in the case of IT capital (β=0.194) this is positive and significant, while in the case of organizational memory (β=0.057) is positive but insignificant. Therefore, hypothesis H3a is accepted, while hypothesis H3b is rejected. As the indirect effects of both marketing-specific IT capital and organizational memory on market performance are statistically relevant, the above means that, in the case of marketing-specific IT capital, partial mediation applies (i.e., such component of marketing-specific SC has additional benefits on market performance beyond the promotion of marketing innovation), while in the case of marketing-specific organizational memory, full mediation applies (i.e., marketing-specific organizational memory positively affects market performance inasmuch it contributes to marketing innovation).

Regarding the specific relevance of each of the elements making up marketing-specific IT capital and organizational memory in terms of enhancing both marketing innovation and market performance (detailed tables have been omitted for space reasons), identifying patterns of costumer behavior constitutes the most important functionality provided by marketing-specific IT solutions (γ=0.294), followed by knowledge generated in terms product/service performance (γ=0.274), potential new customers (γ=0.216), existing customer groups or segments (γ=0.208), and top industry insiders and influencers (γ=0.203). On the contrary, knowledge generated on customer profitability and market trends seems to be completely irrelevant (i.e., their specific weights are very close to 0).

In the case of marketing-specific organizational memory, having updated, relevant, and easily information records about competitors shows the highest weight (γ=0.355), followed by having well established routines and procedures (γ=0.257), updated and easily accessible information about relevant trends in the market (γ=0.217), and also about key projects, deals, and/or campaigns so employees can reuse them when needed (γ=0.205). Conversely, having updated and easily accessible records regarding best practices and lessons learned; a "who knows what" directory; and updated, relevant, and easily information records about customers are not significant.

Finally, although all dimensions within marketing innovation are statistically relevant to improve market performance, innovation in pricing shows the highest weight (γ=0.420), followed by innovation in communication (γ=0.317), and in product/service distribution (γ=0.302). Thus, innovation in product/service design, image, and/or packaging is the least relevant, although still significant (0.153).

6 Conclusions

The research carried out shows the relevance of marketing-specific SC (both IT capital and organizational memory) on marketing innovation and market performance and

highlights the specific elements within each independent and mediating variable that are the most influential to maximize the amount of variance explained.

Results confirm that an organization's preserved knowledge is a key input for incremental innovation (and, thus, marketing innovation) to occur (Abernathy and Clark, 1985; Subramaniam and Youndt, 2005). Moreover, our findings highlight existing complementarities between IT-generated marketing-specific knowledge and other forms of organizational memory that do not necessarily involve computer-based data processing.

In the case of customers, results show that IT-generated knowledge constitutes a must to guide marketing innovation efforts and to attract and retain customers. As indicators' weights clearly point out, merely having historical information records about customers is not enough: marketing-specific IT solutions are needed that help extract new knowledge from these records for marketing innovation to succeed. Conversely, in the case of market knowledge, it seems that marketing-specific IT solutions in this regard are not as effective as more traditional forms of organizational memory based on data recording from direct observation.

Following with other forms of organizational memory, the results obtained also suggest that best practices and lessons learned are not effective unless they become embedded in organizational routines and procedures, and that facilitating the recording and retrieval of information regarding past projects, deals, and/or campaigns constitutes a very solid foundation to build new marketing solutions. However, providing marketing employees with a complete and updated "who knows what directory" so they can find the right expert to take advice from when needed proves to be irrelevant. In other words, investing in a project repository seems to be much more effective than having access to expert advice, which seems to highlight that marketing innovation relies more on codified knowledge than on tacit knowledge.

Going back to IT-generated knowledge, the results obtained show that product-performance-related knowledge and knowledge on top industry insiders and influencers complete the recipe to increase the chances of successful marketing innovation and market performance.

This study has a number of limitations that may be addressed in future research. First, survey responses were collected only from Spanish firms, and therefore the study is based on data from a single country. Future research could extend the analysis to other national contexts. Second, a key informant in each company reported the data collected through a structured cross-sectional survey. This allowed us to access firm-level perceptional data and test our hypotheses, but there may be limitations regarding the scope of informants' knowledge and the ability to draw causal inferences. Future studies could thus adopt different types of measurement approaches and combine them with various ways to measure innovation and other types of performance over time.

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Performing Openness: How Innovation Performance, Organization, Crowd and Platform interact in Open Innovation

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Abstract

The contribution of this paper is to propose that OI theory and practice need to consider how platforms perform relations of accountability and in doing so develop a further understanding of the sociomateriality of accountability. The paper develops a performative theory of openness. It shows how an influential and widespread theory of radically distributed organizational forms performs a global technology company.

While recent streams of research (e.g. Lakhani, et al., 2013; Kornberger, 2016) suggest that the context of distributed innovation shifts the unit of analysis of organization design from the individual firm to networks of actors organized on platforms, we find that the focal firm still remains a key conceptual parameter, which in turn makes it difficult to capture the suggested radicality of 'Open Innovation' (OI). The article uses empirical materials from a spiral case study of the design of, and implementation of OI. Drawing on performativity theory the paper studies how the achievements and values created in OI are measured in practice. Both digital platform designers/providers and an organization implementing OI are included in the context in order to analyze the case holistically.

The ostensive definitions by OI scholarship explains causal models where OI elements predict value creation for the firm. Innovation intermediaries recognize both "OI" and "open collaborative innovation" since their digital designs are an ecology of devices that can enact and afford for both. The question of openness, is from a performative perspective, a matter of how peers, in different situations, mobilize OI elements on platforms, how these OI elements are bent, connected and allowed to do certain things but not other things. We show, that in practice, the firm has to take into account the performance of the external crowd, and at times put resources into its training and education. In heterarchy distributed authority is assumed to be facilitated through lateral accountability, whereby the traditional principles of vertical authority no longer hold, but rather, managers and their team members can be accountable to multiple units, or teams, across the organization. Our case material shows that the ecology of devices and their performative struggles, afford for such distributed authority and lateral accountability. As the paper consolidates theory by Scott & Orlikowski (2012) the contribution adds to a growing body of studies that shows that apparatuses such as platforms are performative. It also investigates platform organization critically by discussing the limits of accountability in heterarchies

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Keywords - Open Innovation, Digital Platforms, Infrastructure, Performativity, Sociomateriality, Accountability

1 Introduction

> *Open Innovation starts here.*
> *The Campaign connects Nokia QD and all friend coroperations investing innovations together.*
> *Submit any ideas*
> *(NOKIA Open Innovation Challenge, 2017.)*

Innovators rarely innovate alone. They tend to band together in teams and alliances based on 'swift trust,' nested in communities of practice and embedded in a dense network of interactions (Brown & Duguid, 2000; Laursen & Salter, 2006; Scott & Brown, 1999). Different forms of large-scale collaborative creativity, such as open innovation, crowd sourcing, co-innovation, and commons-based peer production, are new ways of organizing these communities. While earlier research on innovation saw competitive success as dependent upon an organization's successful management of the innovation process, open innovation (OI) happening on digital platforms cannot solely be understood as an internal organizational response of a firm to strategic choices.

While recent streams of research (e.g. Lakhani, et al., 2013; Kornberger, 2016) suggest that the context of distributed innovation shifts the unit of analysis of organization design from the individual firm to networks of actors organized on platforms, in this study we find that the focal firm still remains a key conceptual parameter, which in turn makes it difficult to capture the suggested radicality of the phenomenon. Constructs such as the above "Open Innovation starts here…", point to, and include performance. However, where is the "here" where performance is happening?

While innovation performance in the context of the firm is measured by evaluating for instance innovation strategy, portfolio management, project management and/or organizational culture (for a more comprehensive framework Adams, et al., 2006) the *loci* of OI is organized in "the open" (Kornberger, 2016), "O2O platforms" (McAfee & Brynjolfsson, 2017), in complex organizational boundaries (Lakhani, et al., 2013), and in order to harness the "wisdom of the crowd" (Surowiecki, 2005). In this study, we use the conceptualization 'Open Innovation' (Chesbrough, 2003; Hayek, 1945; Lakhani, et al., 2013; Piller, et al., 2019; Vanhaverbeke & Cloodt, 2006) in order to describe these emerging organizational forms.

This study addresses the emergence of platform organized OI with two motivations. The first specific motivation has to do with understanding the performance of OI better. With a performative orientation, we ask how the achievements of OI are measured in situated practices. The case description draws on different sources from a spiral case study (Gherardi, 2012), as openness is performed by firm, platform, crowd and innovation intermediaries. The methodological disadvantages of not pre-given case selection are partially counterbalanced by the second motivation of the paper, that is to extend on theory (Eisenhardt, 1989) and to examine the question of the how platforms reconfigure relations of accountability (Scott & Orlikowski, 2012). Thusly, this article seeks to

explore the following question: What happens to the distribution of accountability in platform organized OI?

The contribution of this paper is to propose that OI theory and practice needs to consider how platforms perform relations of accountability and in doing so develop a further understanding of the sociomateriality of accountability.

The paper is organized in the following way: section 2 offers a literature review. Section 3 provides the presentation of the research methodology, the details of the fieldwork, the data collection and analysis. In section 4, we dig deep into the case study. The section analyzes the case holistically, and approaches OI as a boundary object (Star, 2010; Star, 1999). Finally, in the fifth section, we discuss the field material in relation to the theoretical insights, based upon which we draw brief conclusions and suggestions for future research.

2 Literature Review

In this study, innovation is defined as the generation of novel ideas or combinations of existing ideas and routines that are perceived as new and valuable by individuals and organization (Nelson & Winter, 1982; Roberts, 1998; Van de Ven, 1986). Open innovation 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 & Bogers, 2014).

Performance is a concept determined in the context in which it is practiced (Corvellec, 1996). Since Schumpeter (1947), Barnard (1938 [1968]), Chandler (1962) and Myers and Marquis (1969), the context of innovation has been the firm, and scholars have emphasized innovation as a source of a firm's competitive advantage. The measurement of innovation in this context has been the subject of a number of studies (e.g. Adams, et al., 2006; Dziallas & Blind, 2018). However, very few studies address the issue of what happens when innovation is 'open' (Frishammar, et al., 2019).

According to Chen & Vanhaverbeke (2019) external innovation resources do not simply flow into companies as, "open innovation highlights the entire innovation system"(p.192). One of the major contributions of a OI approach is, according to Gassmann & Enkel (2004), the perception "that the locus of knowledge and the locus of innovation need not necessarily be the same" (p. 15). Recent literature has sought to find mapping of concepts of OI to more general theories about the hierarchical firm and its boundaries (Lakhani & Panetta, 2007; Vanhaverbeke & Roijakkers, 2013). The empirical context of OI is to large extent platforms that organize economic activity in a situation when boundaries are complex (Lakhani, et al., 2013), where "performative dynamics" (Barrett, et al., 2016) need unpacking. You need to 'look across' (Hopwood, 1996) organization where one encounters "heterogeneous, ongoing, overlapping *performative* struggles" (Kornberger, et al., 2017) between a multiplicity of devices and people.

2.1 Open Innovation Performance Measurement

A number of studies focus on innovation performance management (De Felice & Petrillo, 2013; Gana, 1992; Huergo, 2006; Tipping, et al., 1995; Van de Ven, 1986) and management control systems have been shown to improve performance in contexts characterized by high levels of uncertainty (Lounsbury, 2008; Rautiainen, 2010; Siti-Nabiha“ & Scapens, 2005; Contrafatto & Burns, 2013) as well as act as boundary objects for engaging the multiple parties that participate in the process of innovation ((Busco, et al., 2017; Johanson & Vakkuri, 2018). In their extensive literature review Dziallas & Blind (2018) outline an indicator landscape consisting of 82 unique indicators to evaluate innovation performance. Building on Becheikh, et al. (2006) they categorize the identified indicators into company specific and contextual dimensions. The problem with many of these indicators is that they are mainly ‘firm centric’. This hierarchical consciousness also dominates OI scholarship (Chiaroni, et al., 2011; Mortara & Minshall, 2011; Piller, et al., 2019; Wang & Hu, 2017; Najafi-Tavani, et al., 2018). Absorptive capacity, collaborative innovation capability, sharing i.e. inter- and intraorganizational transfer of knowledge are identified as indicators of OI performance. Nonetheless, while this literature expands on the indicator landscape, OI requires a ‘eco-system oriented view’ (Frishammar, et al., 2019). OI platforms organize third parties without directly controlling or monitoring them, since the openness of the “open” in OI is often self-organized, or organized by ‘innovation intermediaries’ (henceforth intermediary) on platforms, beyond traditional meetings, hierarchy and central coordination (Benkler, 2002; Benkler, 2017; Bollier, 2016; Chen & Vanhaverbeke, 2019; Kornberger, 2016; Kornberger, et al., 2017; Lakhani, et al., 2013; Laursen & Salter, 2006). In consequence, we scrutinized and adapted the frameworks suggested by Adams, et al. (2006) and Dziallas & Blind respectively and found that the majority of the OI indicators identified in the literature fall under the categories “innovation culture” and “knowledge management”.

2.2 Performativity: Conceptual Background

Demonstrating achievements yields different forms and systems (Johanson & Vakkuri, 2018). The literature on OI performance suggests that performance is linked to ‘openness’ (Frishammar, et al., 2019; Laursen & Salter, 2006). This openness is related to the organizations ability to exploit external knowledge (Laursen & Salter, 2006), an indicator that is identified in innovation performance (Adams, et al., 2006) as part of an organizations innovation culture (Dziallas & Blind, 2018). New OI activities are an insufficient indicator of OI performance and organizational capability has been suggested as a contributing factor in successful OI performance (Podmetina, et al., 2018). Hence a move from firm-centric innovation to OI requires a change in culture (Chen & Vanhaverbeke, 2019). Building on Volkoff, et al. (2007) we adopt the view that this change as embedded in technology. This approach to organizational change sees it as a

three-stage cycle in which the ostensive, performative, and material aspects of organizational elements and routines that interact differently in each stage.

Performativity has emerged as a highly generative concept that has inspired social scientists and stimulated theory building in various disciplines including organizational and management theory (Gond, et al., 2016). In management theory, there coexists several foundational perspectives on performativity (Gond, et al.). In this study, we pull on Silvana Revellino and Jan Mouritsen, who draw on Judith Butlers interpretation of performativity. Performativity is, according to them, a "pervasive movement that proceeds from one stage to another when new information ex-cites the development of even further technologies for provoking and making things real (2017, p. 454)." Inspired by D'Adderio & Pollock (2014) this study threats OI theory as such ex-citing information.

3 Research Methodology

In this study a case is explored in order to provide a body of empirical evidence in relation to the concept of OI. The spiral case study differs from the 'linear school' (Piekkari & Welch, 2018) of Yin (2009) and Eisenhardt (1989). This case study methodology allows, according to Gherardi (2012) technologies to be more vocal, adopting an "ethnography of objects" (Bruni, 2005), which, she argues, enables us to study the performativity of technology as it emerges in situated practices. Iteratively, we did in-depth inquiry (Table 1) in different 'not pre-given' (Gherardi, 2012) units of analysis and then expended the focus to other locations by following emerging relations.

Table 1:Core Case study data

	Individual Interviews/# interviews(2017-2019):		Positions	Observations (2017-2018)	Corporate white papers, Case studies, events, videos and webinars (2010-2019)	Reports	Websites/ Press	Email
OI Innovation Intermediaries (#5)	8/10		Executive Vice President, Co-Founders, Executive Manager, CEO, Community Facilitator (2)		68	7		15
Global technology Company	3/6	2 group-interviews	Project Manager, Community Managers	1	4	3		23
Methodology	Analytical Interview	Kreiner& Mouritsen (2005)		Nethnography Kozinets, et al., (2014)	Qualitative Content Analysis (QCA) (Hsieh & Shannon, 2005)	QCA	Q	
TOTAL	18			1	72	10		28

Nicolini (2009), describes this strategy as 'zooming in' and 'zooming out of' practice. Cecez-Kecmanovic et al. (2014,) state that the objective of this practice is to: "develop an appreciation and articulate the dynamics of practice by observing and experiencing from

different angles and perspectives how entities, people and technologies, their boundaries, properties and identities, are continuously performed, what the consequences are and for whom" (p. 821). In the analysis our approach was based on systematic combining (Dubois & Gadde, 2002) grounded in an abductive logic (Timmermans & Tavory, 2012). The literature review guided us in the initial coding (Timmermans & Tavory) along the dimension of performance in terms of ideation rate, innovation process management, knowledge management and innovation culture. The empirical framework was also modified as the boundary of the set of relevant cases shifted (Ragin, 1997). An adjusted focus in coding followed where the empirical material was categorized into ostensive, performative, and material aspects of organizational performance. These focused codes were scrutinized again and again in order to evaluate which ones best explain the empirical phenomenon.

4 Findings: OI interveawing a multiplicity of performances and accountabilities

Although ambiguous, innovation is in a sense a strategic orientation describing how purposive institutional action is instigated and created (March, 1987; March, 1988). In this section we approach OI, and its evolving system of boundary objects which multiple communities of practice interact with. A report called "A maturity model for High Involvement Innovation" published by *Hype,* a provider of digital infrastructure for OI, starts with a contemplation on the 'Innovation imperative' (Hype Inc, 2003):

It's a simple message – innovation matters. In today's environment, organizations need to change (and keep on changing) what they offer the world and the ways they create and deliver that.

Such statements are common in the context of OI, and they are hardly surprising considering that this learning material also functions as marketing communication for the providers of platforms and other software. However, what is striking is that the academic literature also adopts the same rhetoric (e.g. Lerch & Spieth, 2012; Najafi-Tavani, et al., 2018; Wang & Hu, 2017) over 70 years after Schumpeters seminal text. This could be read as a succesful linking between the theoretical realm and the empirical realm, we however choose to approach it through a performative lens, building on work that suggests that theories and models are not simple descriptions of a setting but powerful 'engines' which can profoundly transform the contexts they describe (MacKenzie, 2006; Revellino & Mouritsen, 2015). The chapter is structured as follows, first we introduce agency producing the ostensive and material aspects of OI, then the spiral zooms into the interaction between specific agents and their performative dynamics and struggles (Cabantous & Gond, 2011).

4.1 Innovation intermediaries produce the ostensive aspects of OI

Digital infrastructures are central to Open Innovation. *Hype, 100%Open, Spigit (Planview) and Imaginatik* are companies that offer digital infrastructures and other OI services to organizations who are moving into distributed models of innovation. Clients include organizations like LEGO, Exelon, PWC, Crisis, Unilever, Citi, Pfizer, Siemens, UNHCR, and Nokia.

Based on our analysis of the empirical material, we find that the intermediaries create rules, routines and other artifacts that create *accounts for the ostensive aspect of OI*. The ostensive aspect "guides, accounts, and refers" (Feldman & Pentland, 2006), but how clients actually perform will as one account stated, be all "about different subject matter". Further, as the intermediaries embedd organizational elements in digital infrastructures a *material aspect* is also acquired. As a matter of illustration one account by a CEO describes:

> *The beauty of a platform is that it can be distributed through or accessed through different channels. And the beauty of a well-designed challenge is that it is transparent. The design principle around effective challenges is: "How do you make visible what is invisible?"*

Platform organization solves two of the four central problems of innovation, as identified by Van de Ven (1986). 'Transparency', solves the human problem of managing attention, as well as the structural problem of managing part-whole relationships. Our findings show that a lot of innovation programs and even challenges fail because they are not transparent, and they do not have a closed loop between identifying a challenge and taking up the challenge, assessing and prioritizing the results. A CEO described a well-designed loop as a "trust cycle" that "guarantees credibility and accountability". You have to close the loop with the crowd: "Thank you for your ideas. This is incredibly interesting. This is what we're going to do with this thing now ".

Transparency, is also a factor that Laursen & Salter (2006) identify as an explanation to succesful OI. It addresses how easily and understandably participants can follow and understand what is happening in the collaboration. There are different crowds and they require different OI management. In terms of crowds there are a couple of common practical concerns. The first is IP protection, the second is connected to accountability. External crowds are according to several accounts reluctant to "give up" their IP rights. And, then there's the expectation that comes along:

> *If you're going to invite somebody in to be part of a crowd, and they're an external entity, especially your customers, you have to do something with the ideas that they submit. So that sets an expectation that companies don't always want to be held accountable to.*

The intermediaries legitimate some performances as appropriate to OI routines, and statements of achievements related to factors such as absorptive capacity and innovation culture function as guides to clients. In principal an open culture seems to imply trust, nevertheless, during the research we also found contradictory statements, where external

crowds for instance create "noise" and "nonsense." As illustrated by one account, where it was said:

> *We connect individuals with large organizations. We can get big people to sign non-disclosure agreements or small people to sign up for, or whatever it takes to make sure small people don't feel exploited, and big people get what they need in the end.*

The division between 'big' and 'small' people signals dilemmas in the actual practice of heterarchy. It and other similar accounts also point to where OI is performed: with the support of intermediaries on digital infrastructures, peers produce what clients need. A dilemma occurs since OI communities can also hold "big" people accountable, feel exploited and produce nonsense.

4.2 Technologies configure the ostensive and the material aspect of OI

One way to manage "nonsense" and "make visible what is invisible" is rankings and ratings. All the intermediaries offer different digital evaluation infrastructures, where contributors (Figure 1), as well as contributions are rated since its "useful to get a sense of what people like." Value is connected to some standard criteria—including votes, star ratings, comments, replies, approval ratings, and expert reviews. As a matter of illustration, *Spigit* offers a crowd-based prediction tool in order to "truly make better business decisions based around the combination of human intelligence and data". The 'wisdom' of the crowd is also a dilemma as crowd biases and herd behavior were generally identified as problems in the actual practice of OI. One respondent suggested the possibility that more "interesting ideas" might be "less obvious", and therefore attract fewer votes: "so you need to apply additional level of evaluation of that idea." An example of additional levels of evaluation is offered by Hype. The evaluation is based on an intuitive and direct comparison of two ideas at a time (Figure 2).The metrics in this tool focus on efficiency and not so much innovation as something "new". The "less obvious" in the quote above often represented new and potentially disruptive innovations. The platform collects data, but the challenge is how to analyze this data?

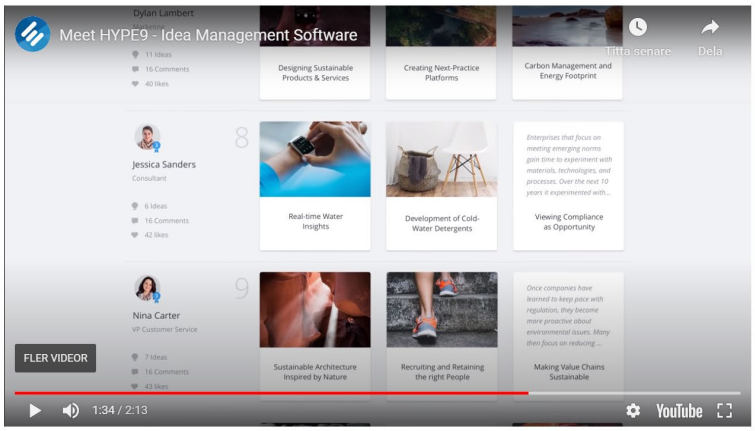

Figure 1: Rewviews of contributors to challenges

As identified in previous quote a quantified evaluation does not necessarily lead to innovation performance especially when one is looking for something 'outside the box'.

There is a lot of data, but as one of our interviewees observed, "it is dark, fragmented and incomplete." And how does one make sense of that? Control of the outcome of OI is difficult, as the "pervasive movement" of innovation extends, in line with Revellino & Mouritsen (2017), innovation into spaces other than those originally forecasted. Which in turn suggests that the value of innovation is not a stable object, but relational and social.

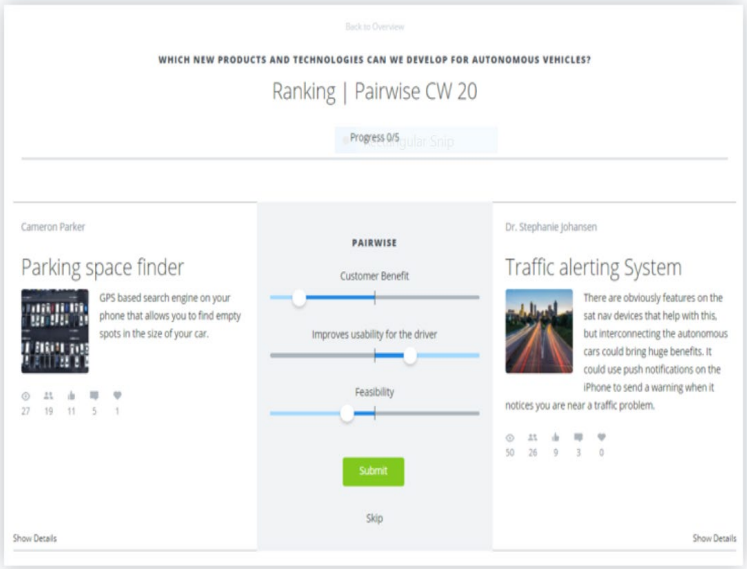

Figure 2: Example of OI evaluative infrastructure

A key performance indicator for the intermediaries is innovation culture, i.e. how you measure in terms of openness. The achievements of OI are described in terms of how you as an organization and peer perform in terms of transparency, iteration, and dialogue with the crowd, be it internal or external (Figure 3). In this way the intermediaries create templates for behavior and normative goals, what Feldman & Pentland refer to as 'guiding'(2006). The platforms bring a material aspect to the ostensive aspects produced by the intermediaries, they help monitor performances, but they do not, as the routines described by Feldman & Pentland "enforce compliance." Rather we find that crowds are being "nudged" as community managers participate in the iteration of innovations by either forming communities around certain ideas or helping refine ideas that were just "the bare bones of an idea." The facilitators "probe, test and question", they can also bring ideas to the project team during a challenge, they can let the crowd work on the surprising, the less obvious:" we're actively exploring with the crowd." This utterance shows that both the loci of the knowledge and the management of it might be outside of the firm which supports Gassmann & Enkels, (2004) claim that the organization that emulates an OI approach has to be prepared to transform its "solid boundaries into a semi-permeable membrane that enables innovation to move more easily between the external environment and the company's internal innovation process." We propose that the platform is this membrane, that we conceptualize as infrastructure. It is the material aspect: the ecology where organizational change that is open to a wider ecosystem of peers can happen.

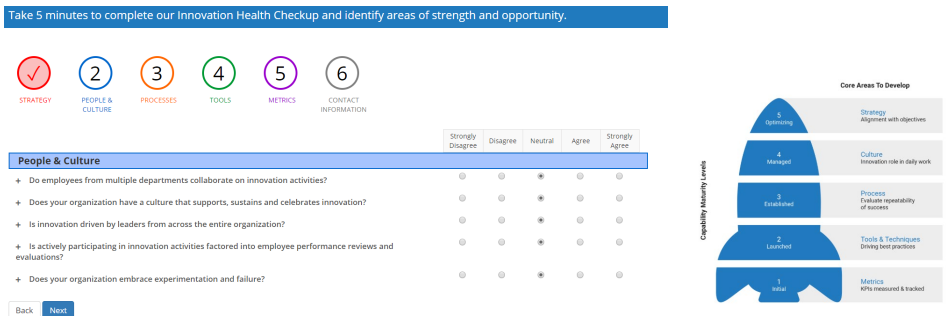

Figure 3OI culture: Example of indicators measuring

4.3 Performativity: the firm interacting with the ostensive and the material aspect of OI

Nokia Open Innovation Challenge (NOIC) is an annual global competition whereby Nokia seeks innovative technologies, products and solutions "that can change the world" (NOIC, 2017-2018).

> *All over the world, there are good initiatives and start-ups coming up with great ideas. But it's very difficult to find them. And of course, these events are one way to*

find out what is happening around the world/…/ There is always this generic, 'looking around thing', that shows that we are not a closed community.

Such accounts indicating accountability and the need to perform 'openness', were reoccurring in the data and point to positive attitude to searching external ideas and tech, as well as open boundaries, all organizational capabilities reflecting on OI culture. One of the many intermediaries *Nokia* uses, *Hype*, describes the relationship between firm and the platform like this:

In my experience, organizations will typically start by building programs and potentially using digital platforms to support them. Software platforms are especially useful because they provide scale, transparency, the ability to store and research knowledge and ensure governance and accountability. When deployed using the right guidance and incentives, platforms amplify meaningfulness.

During the research a number of seminal texts and OI authorities where mentioned in conversations and emails. For example, regarding innovation process and business modelling one account presented the following list (Figure 4).

Taustalla tosiaan on paljon tutkimustietoa ja metodeja paitsi innovointiin, myös prosessikehitykseen ja business mallinnukseen liittyen.
Tässä jotain innovaatio puolen lähteitä:

- Henry Chesbrough (Open Innovation)
- Curt Carlson (SRI)
- Clayton Christensen (Disruption)
- Geoffrey Moore (Crossing the Chasm)
- John Bessant (Discontinuous Innovation and applied Innovation Management)
- Anna Trifilova (the future of Innovation)
- Katrin Möslein (Open Innovation / Fab Labs)
- Tim Jones (Future Agenda / Growth Champions)
- Joe Tidd (Managing Innovation)
- Frank Piller (Open Innovation)
- Larry Keeley (10 types of Innovation)

• applied Research and Innovation institutes

- ideo / Hasso Plattner Standford (Design Thinking)
- Stanford Research Institute (SRI) (5 disciplines of Innovation / NABC value creation forum)
- MIT Media Lab
- unternehmerTUM (FabLab)

Figure 4: Illustration of OI theory performing a firm

Such findings point, to how OI theory performs an OI organization and consolidates theory of performativity (Callon, 2007; MacKenzie, 2006). In this case, a change in culture was needed since Nokia lacked a "common language" for its innovation activities. The research efforts focusing on the changing landscape of innovation helped, according to the interviewee's, the organization find such a language. Passages and small notes in the case study of *Nokia* and *Hype* (Hype, 2018a) refer to "Chesbrough" and "Lakhani" as inspirational sources in the journey towards a "new innovation culture."

Tools to manage the innovation were also identified, and in order to measure the changes in culture an "internal innovation culture index" was introduced. Such findings

can be read in line with theory depicting how organizational elements such as routines, roles, and data become embedded in technology (Volkoff, et al., 2007). Their material aspect interacts with and affects their ostensive and performative aspects. In Figure 5, a document produced by Hype, illustrates the interaction between performative and material aspects. We learn that Nokia and Hype intend to "create an innovation culture at Nokia, review innovation platform" in 2015, indicating 'cultural change' as depicted by Feldman & Pentland (2006).

Figure 5: Illustration of interaction between the performative (Nokia) and the material (Hype) aspects

After this the platform, however, in line with Volkoff, et al (2007) needs to be redesigned since "that interaction is constrained/enabled and moderated by the material aspects" (p.843).

As to Nokia, innovation culture was not measured specifically at the time of our research, since: "those KPI's do not surface, anymore." There did not seem to be a need

for such an indicator and instead the company measures "cultural coherence", where innovation is part of a bundle of performances supporting the culture of the organization.

In terms of OI and accountability relationships, a difference identified to internal innovation is the managing of diversity: "difficult, impossible…easy" ideas. NOIC uses rating and ranking mechanisms, but only for internal evaluation. There is little transparency as to the evaluation and NOIC does not communicate the assessment criteria to the submitters. An expert jury does the rating, and the intermediaries offer the infrastructure for evaluation and assessment. For example, in Figure 6 the uniqueness of an idea is evaluated on the basis of how the idea compares to what already exists in "the field", where the relative quality "improvement" ranks lower than the quality "fresh", while "unique" gets the highest score of 3. The platform then organizes the ideas according to an average and a detailed score, as can be seen in Figure 7.

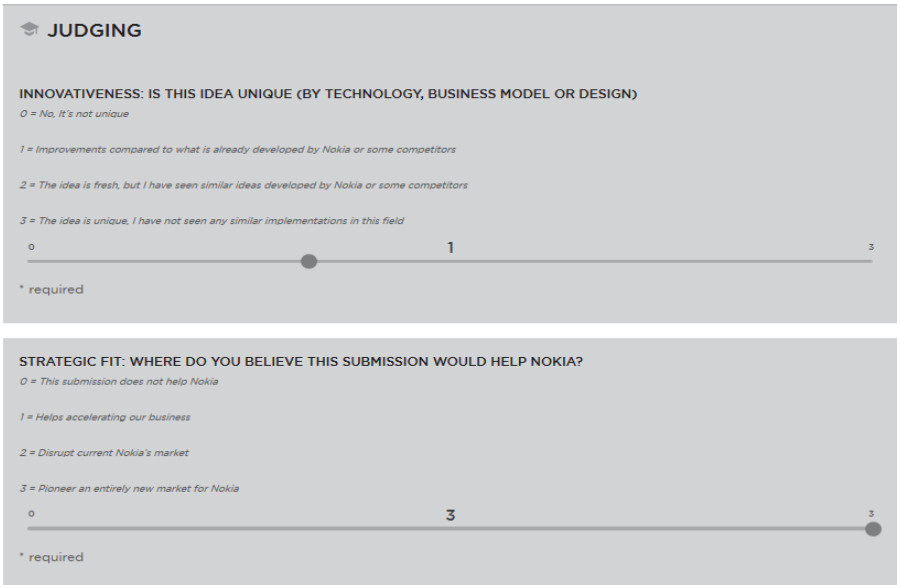

Figure 6: Judging view of assesment of 'innovativeness' and 'strategic fit'

The accounting operating here can be read in conjunction with the evaluative infrastructures described by Kornberger, et al. as it creates relations between actions, behaviors and preferences, "so as to engineer possibilities of a match. (2017, p. 9)" In this case, the match is not mutual, it is the firms "strategic fit". Disruptive innovations are largely disbanded, as it is hard to find commitment within the organization for something that is "really outside of the box". Nonetheless, NOIC invests some effort in trying to find internal contacts, with similar interests that could work on the disruptive innovation with the start-up. These accounts from the practice of OI show that absorptive capacity indicators create 'paradoxical tensions' (Jarvenpaa & Wernick, 2011). As disruptive

innovations are “difficult” or even impossible, ‘good performance’ in terms of absorptive capacity might mean going for less radical ideas that have a strategic fit.

Rank	Entry	Judge progress	Weighted average score	Innovativeness: Is this idea unique (by technology, business model or design)	Strategic fit: Where do you believe this submission would help Nokia?	Business potential: Is the value proposition convincing?
3		43 of 75	1,78	2,23	1,62	1,48
11		39 of 75	1,45	1,3	1,46	1,58
15		39 of 75	1,32	1,66	1,17	1,12
17		39 of 75	1,16	1,23	1,05	1,2
9		41 of 75	1,56	1,9	1,26	1,51
5		40 of 75	1,7	1,8	1,47	1,85
8		40 of 75	1,59	1,55	1,55	1,67
6		40 of 75	1,64	1,65	1,45	1,82
1		41 of 75	2,02	2,31	1,82	1,92
10		41 of 75	1,49	1,95	1,14	1,39
21		38 of 75	1,06	1,23	0,84	1,1

Figure 7: Example of weighted score (judge view)

During the research it became evident that the capability of the start-ups to bring the ideas submitted to realization is emerging as a key factor for NOIC. Questions that related to the management of a crowd or a community where in large part dismissed as irrelevant. This was striking since these same questions resonated well, and produced long elaborations when addressed to the intermediaries. Thus, extending on theory on the differences between ostensive and performative aspects of routines, as suggested by Feldman (2000).

5 Discussion

Studying performativity, aims to “illustrate leakage” from or resistance that is met to the generalizations made in ostensive research (Hansen, 2011). A performative perspective is useful in understanding how actors act in this world characterized by risk and uncertainty, since they do not need to be ‘correct’ or ‘accurate’ in their projections on complex emergent phenomena. How the organizations presented in the paper focus their efforts, can in conjunction with Kumaraswamy’s et al. (2018), be analyzed as an enactment of a constituted world. Or as one account from Nokia phrased the reason for OI:

> *It’s because it’s kind of hype thing at the moment. So, everybody is organizing open innovation and it’s of course, it’s something that just must be there even though the reasoning is maybe a little bit vague but still (laughter).*

An entity like *Nokia* and *Hype*, which engages in the new practice of OI, knows that its efforts are part of a larger ecology of relationships and interactions among heterogenous actants. In terms of accountability our findings consolidate theory, as presented by Scott & Orlikowski, (2012). OI platforms perform a redistribution of accountability in order to meet increased demands for transparency. We extend on theory by Gassmann & Enkel (2004) and Kornberger, et al. (2017), as we propose that the platform is a membrane, that we conceptualize as infrastructure. It is “here” in this infrastructure with its ecology of devices, where organizational change that is open to a wider ecosystem of peers happens.

The findings in the paper demonstrate accountability relations on platforms as a sociomaterial configuring of strategy (challenges formulated by firm plus innovation intermediaries), platform (designed by innovation intermediaries) and external crowd where the entities doing OI are accountable to the crowd. Technology embeds a multiplicity of accountabilities into the organization. Relations of accountability are understood by innovation intermediaries and OI theory as issues of 'knowledge management' and transparency, which the digital infrastructure affords. In this ideal of transparency, the platform guarantees that anyone can observe from different perspectives how organization, people as well as "technologies, their boundaries, properties and identities" (Cecez-Kecmanovic, et al., 2014), are continuously performed. However, what are the consequences of 'sociomateriality' (Orlikowski & Scott, 2014) in terms of the distribution of accountability? Drawing on Messner (2009) notion of the limits of accountability, we examine what and "who is doing what to whom here" (Suchman, 2002) and whether more accountability is always and unambiguously desirable.

The question of openness is from a performative perspective, a matter of how peers, in different situations, mobilise OI elements on platforms, how these OI elements are bent, connected and allowed to do certain things but not other things. The field study illustrates, how the material aspect frames accountability as it configures the intelligible identity as an accountable in certain 'regimes of truth' (Butler, 2001). In Nokias case, internal 'sponsors' also trained and educated finalists to give better accounts to the jury. In terms of accountability, multiplicity is not a problem if the evaluative infrastructures afford for diverse accounts. Which they often do. A dilemma occurs when OI peers face 'multiple demands of accountability' (Messner, 2009), where the accountable self does not have alternatives of how to give an account. In the heterarchies we studied managers and their team members are, as has been observed in similar settings, "accountable to multiple units, or teams, across the organization" (Taylor, et al., 2019, p. 1639) but also, *to* and not *for* (difference discussed by Messner) the crowd. We argue that the reluctance to be held accountable that makes the firms 'afford' (Bygstad, et al., 2016) different levels of openness on platforms be understood as a problem of 'conflicting accountabilities'. Thus, the devices concentrate observations in certain ways, their representations make certain properties become *determinate* (Barad, 2007), while others are specifically excluded (Orlikowski & Scott, 2014). The firm can argue away different types of accountabilities by embedding a hierarchical organizational logic is in the platform, and accountability is not evenly distributed as there is an absence of mutual accountability. The 'transparency' found in the ostensive definitions of OI, we interpret in line with Flyverbom, et al. (2015), as a productive force, which is both "*conditioned upon* and *conditions* a host of relations, actions, and norms for conduct is informative". Being 'open' is, from the perspective of the firm considered vital for employee and customer satisfaction, accountability and legitimacy. The narrative of achievements (Corvellec, 1996) produced by ostensive definitions of OI 'condition upon' those doing OI, thus they can be understood as 'exposed' in Messner's (2009) sense of the term. The peers are also 'mediated' they have

to speak "several languages at the same time" (Messner, p. 931) which can result in conflicting accountabilities.

The field study also depicts how the desire to make visible inter- and intradependence leads to the development of a culture of innovation. Nevertheless, it is good to consider that control increasingly works through culture, and the transparency ideal afforded by the digital infrastructure, also regulates identities by producing particular cultural and normative conditions for human conduct (Flyverbom, et al., 2015). Crowd accountability and IP are often intertwined in the accounts, as well as indication that the crowd could also be held accountable for the evolution and result of a contribution posted on a OI platform. For example, in one account, an external crowd member is likened to an 'author', who owns the idea and can be confronted about it, since the " author is accountable to the rest of the community". Such findings are interesting since they point to a practice where OI builds on the expectation that the author be open and share contributions, and is, also, responsible for the idea in a process that involves both serendipity and 'relational drift' (Revellino & Mouritsen, 2015). Such observations raise questions as to both the limits of traceability and accountability as we are expecting that author to measure up to multiple *and* conflicting accountabilities, which is in itself ethically questionable. A dimension of temporality is introduced to disruption and innovation, IP is a way, to 'end' an author being held accountable, but transparency could also imply that an author is held accountable for as long as her or his digital reputation trail exists, i.e. for a very very long time.

6 Conclusion

In this study we answer calls made by Kornberger, et al. (2017) and Stark (2006) for scholarship to extend analytical focus from hierarchical settings to heterarchical. Stark (2009) describes two features of heterarchies that enable innovation – distributed intelligence, co-ordinated through lateral accountability, and an organizing dissonance that enables "productive friction" by recognizing and managing the interplay between multiple, competing evaluative principles. Our study consolidates theory by Scott & Orlikowski (2012) that a presumed shift to digitally enabled openness, brings its own issues as the platform performs a redistribution of accountability.

By considering both innovation intermediaries and a firm, the paper examines practices of openness as transparency, as well as practices of relative openness characterized by opacity. Nokias 'openness" performance, is a careful balancing act where transparency and opacity are combined to create excitement and curiosity about its new products as well as its innovation culture. Nonetheless, this transparency is performative and different framings of OI creates overflows (Callon, et al., 2009) and works back upon those subject to it (Roberts, 2009), which in turn creates new questions in terms of accountability relations. According to Hultin (2019) responsibility, viewed from a sociomaterial perspective, is the ability to be responsive to the possibilities of becoming in each moment, where one has to ask 'Is this what I am doing?', or 'Did I do that?'. However, as

Schumpeter (1947) observed already 70 years ago, disruption can take considerable time in revealing the true features and ultimate effects of an innovation's performance, one might ask, as we do in this study: what are the limits of accountability in heterarchies?

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A Conceptual Framework for a Dynamic Model of the Regional Labeling Systems

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Abstract

Since the beginning of the century an increasing demand for regional products have been observed in the EU, that eventually lead to the intense development of the regional labelling schemes. These systems were primarily built as a form of the support for the local small and medium producers and agriculturists. Based on available literature and authors' longitudinal research focused on evolution of Czech regional labels and their impact on regional development, the aim of this article is to model a set of relations and dynamic mechanisms associated with variables relevant to the regional labelling. Such approach allows the formulating and justifying of viable dynamic hypotheses, which can later serve as strategic development scenarios. On a sustainability model we demonstrate a need for systematic institutionalization of regional labels management system. During the development of labeling system, we suggest to concentrate of sophisticated joint marketing, combing regional and product-related features and addressing different needs of wide group of prospective customers. A predictive scalar label productivity index, which can be incorporated into regional controlling processes, is proposed.

Keywords – Conceptual Modelling, Regional Labeling Scheme, System Dynamics, Regional Development

Paper Type - Academic Research Paper

1 Introduction

The increasing global interest in the regional food market runs parallel to rising supply and promotion of such production, also reflecting consumers' concerns about food quality, authenticity and health safety issues (Bowen, Mutersbaugh, 2013; Doherty, Campbell, 2014; Bryla 2015; Fornay, Häberli, 2016). To capture this increasing trend and market potential a large variety of regional labelling schemes has been introduced in the EU food market in the last thirty years (Albuquerque, Oliveira, Costa, 2018; Kos Skubic, Erjavec and Klopčič, 2019; Gracia, De Magistris, 2016). In general, the purpose of the food labelling schemes is to provide information to consumers about certain aspects of the food or its production method, often in the form of a logo and / or a statement on the product. It should clearly inform the consumer that the food meets the standards of that scheme e.g. the food is produced in a certain geographic region or has been produced in accordance to additional requirements (Gracia, De Magistris, 2016). It is common that food labels strive to signal more than one major characteristic. Regional labelling schemes, that primarily aim to label and signal the origin of the products, may also ask the producers to meet requirements for sustainability (Hashem, Migliore, Schifani, Schimmenti and Padel, 2018; Nicolosi, Laganà, Laven, Marcianò, Skoglund, 2019).

The functioning regional labelling system requires cooperation among local businesses - small and medium producers and agriculturists (Stoklasa, Starzyczna, 2016). Local and regional authorities, development agencies, nature conservancy administration and non-governmental organisations often contribute to introduction and maintenance of the system in various forms – information circulation, financial and material support, active involvement in the system's coordination or implementation of the projects (Čadilová, 2011). However, as Bingen (2012) or Ratinger and Bošková (2018) have pointed out, there is more often an adversarial, not a collaborative, relationship between especially SMEs and most governmental agencies. Dempsey (2011) have identified the critical elements in the planning, developing and resourcing of the regional labelling scheme (based on the case study of the West Cork Fuchsia brand): engagement and communication within the network to build strategic alliances, the ability of the label to build and maintain competitive advantage and network's emphasis on longer term strategic planning and coherent strategy. With the wide variety of stakeholders and policy targets, regional labelling schemes may face various issues at the strategic management level, f.e. Ikuta, Yukawa and Hamasaki (2007) have observed how difficult it may become for local governments' measures to control the regional schemes, which may result in lowered effectiveness.

The authors who have studied regional labeling schemes have focused on variety of themes connecting them with various aspects of regional development – economical (f.e. Hashem et al, 2018; Van Ittersum et al., 2007, Spilková, Fialová, 2012), social (Fornay and Häberli, 2015; Long, Murray, 2013) and environmental (Marsden, Smith, 2005; Onozaka and McFadden, 2011). However, the research on relations and mechanisms within these networks remains underdeveloped. Presented article aims to model a set of

relations and dynamic mechanisms associated with variables relevant to the regional labeling that would allow to formulate a viable dynamic hypotheses as a basis for a strategic development scenarios. Its effective and broadly understood structural simplification represents a prerequisite for correct establishment of practically applicable, reliable and scalable managerial platform (Davies and Davies, 2016). Generic planning cycle of non-profit organisations has following stages (Chalupová et. al., 2014):

- Organizational planning, defining mission, establishing shared vision and outlining particular goals, objectives and strategies.
- Alignment of planned activities with available or assumed finances
- Allocation of capacities (incl. human resources and operational infrastructure)
- Definition of key enablers for success (processes, projects, initiatives and frameworks)
- Implementation and execution
- Continuous performance tracking, feedback review and necessary improvement

Created model model may represent a useful device in understanding how the regional-based system functions, as well as a tool that the decision-makers in regional development planning may benefit from.

2 Regional Labeling in the Czech Republic

A study, funded by the European Comission, identified 901 voluntary food labelling schemes operating on European market; the highest number (20%; 180) of them were found in Spain, 12.5% (113) in Germany, 7.8% (70) in Italy, the next largest number of schemes were identified in Portugal (61; 6.8) and the Czech Republic, France (5.9%; 53). This study, with focus on the functioning of voluntary food labelling schemes for consumers in the EU, classified the schemes by the attribute claimed in the label. The most claimed characteristic was the origin of production, which was covered by 60% (540) of all schemes (901) (Ipsos - London Economics Consortium EAHC, 2013). In the Czech Republic there are three major umbrella regional labeling schemes. At the EU level there are schemes of geographical indications: Protected Designation of Origin (PDO) and Protected Geographical Indication (PGI). These labels still suffer from relatively small awareness among the Czech consumers (Velčovská, Del Chiapa, 2015; Margarisová et al., 2018). Also Grunnert and Aachman (2016) or Skubic, Erjavec and Klopčič (2018) have suggested that the role of these labels is still relatively low in the consumer decision-making within the EU.

The national level is represented by the project Regional Food of the Ministry of Agriculture of the Czech Republic (and its State Agricultural Intervention Fund) established in 2010, it runs as a top-down scheme. As an important outcome of this project is the label ‘Regional Food’ present in all the Czech regions at the NUTS 3 level (14). It has a form of competition for local small and medium producers and agriculturists. The project aims to improve the consumers’ awareness of the regional food, communicate its benefits, emphasizing the advantages of consuming local food in

relation to the development of a region - support of employment, tourism, etc. (Czech Ministry of Agriculture, 2019).

Association of Regional Brands (ARB) represents 27 regional and microregional labels, it is a nonprofit organization that associates the coordinators of the member regional labels, it runs as a bottom-up scheme. The first regional labels were established in 2005 (Krkonoše, Beskydy Mts. and Šumava Mts.), the ARB has been created three years later. All of the labels associated in ARB have unified graphic design and common granting principles, such as guaranteed origin, respect for the environment in all phases of both production and sale proportion of manual or mental work and local raw materials, the certificates can be obtained by SMEs, producing food and handicraft, as well as service providers within tourism (Čadilová, 2011). Each regional label within ARB represents the subsystem of regional or microregional network (referring to smaller than administrative regions, usually the landscape protection areas or touristic regions). There is a regional coordinator in each region that manages the label, communicates with local producers or service providers and the ARB. The label is awarded to products or services by an independent certification committee (separate in each region). The ARB is open to any region with defined borders - , an initiator must be a local organization or institution that, by consensus of potential label holders and other stakeholders, takes on the role of regional coordinator (www.regionalni-znacky.cz, 2019). According to Čadilová (2011) the labels associated in ARB differ in the numbers of certificates as well as conditions in which the individual coordinators work. Along with the type of organisation that performs this function (usually in the form of local action groups (LAGs of LEADER) or a destination management associations), financial sources that the coordinator can use are quite substantial, usually using the sources from EU, national or regional subsidy programmes. Additional funds are collected directly from the labels' users (SMEs), which are paid for the duration of the certificate validity – for three years, it can be renewed multiple times. The sub-schemes, operating under their own regional label, are quite autonomous. The ARB helps the coordinators by sharing experience and through the common marketing communication (funded mostly by its own budget with occasional supplement from development and structural funds). The role of the National Office of ARB is also to supervise the certification processes and their outcomes in the member regions, to promote regional labels on the national level and to make and maintain connections with other national authorities and stakeholders, such as Ministry of Regional Development and of Agriculture or the Association of Small and Medium-Sized Enterprises and Crafts CZ.

3 Methodology

The model represents a regional-level strategy-planning task, it is based on available literature and authors' longitudinal research focused on evolution of the various Czech and international regional labels and their impact on regional development (e.g. Chalupová, Prokop, Rojík, 2016; Chalupová et al., 2017; Rojík et al., 2018). Structural

analysis of regional labels, as well as their proper management, is a complex dynamic task with significant involvement of subjectivity in the form of personal or group preferences, perceptions, relations, or attitudes. These limitations can be minimized with the utilization of knowledge-based techniques, which are holistic, i.e., work with bounded, internally structured and interconnected elements, internally understandable and architecturally scalable. Related implementation techniques, stimulating teamwork and creativity, results in straightforward, user-friendly solutions. In this phase, we followed the traditional spiral development lifecycle, consisting of the following generic stages:

- Formulation of the real-world problem, serving as a set of functional and qualitative requirements for subsequent analysis and design phases, as well as the primary validation platform before the routine utilization of generated output.
- Knowledge elicitation, including the collection of adequate amount of information, data, domain, and expert knowledge, characterizing the original problem.
- Knowledge specification, i.e., structuring and formalization of outcomes from the previous stage into a conceptual model, suitable for qualitative analysis of the studied phenomenon.
- Experiments, namely sensitivity and scenarios analyses, outlining the internal operational range of invented solution, its limitations and robustness with respect to changes of external environment.

In the presented research, we transformed the results of the literature review directly to the Causal Loop Diagram (CLD), characterizing the dynamics of the underlying problem as a result mutual effects of interconnected causal loops of different complexity and duration. Single loops are either balancing, i.e., stabilizing or limiting, and reinforcing, i.e., guaranteeing growth of involved variables. In the real-world problems, the number of reinforcing loops is typically higher, but there must also be some balancing ones, introducing the natural limits and restrictions. Presented model within a system-thinking framework describes the problem as a system, shows boundaries and level of model aggregation, elements, and relationships between them. Through them, it is possible to communicate information about endogenous and exogenous variables (Sterman, 2016).

4 Results and Discussion

As Dempsey (2011) emphasized, a regional labeling scheme should represent a comprehensive integrated development strategy, creating a prime infrastructure and supporting system, that should be delivering exceptional benefits to the certified businesses. In order to analyze all aspects of development of regional labelling processes, they must be placed into the right context and delimited against the surrounding environment. Only under such circumstances it is possible to plan and control their impact, usefulness and importance. Because we studied primarily the regional labels, an

independent region was selected as the compact target platform. Consequently, the related research questions were formulated:

- How to include the system of regional labelling into the traditional regional development structures?
- How to quantify the impact of regional labels to the regional performance?
- What are the most productive ways of inclusion of regional labels among the traditional regional development policies and strategies?

We were also fully aware of the related risk of underestimation, because the impact of this task is relatively small in comparison with standard agenda, but believed, that although globally minor, this framework has a strong development potential and deserves to be conclusively institutionalized and standardized. To be able to answer our questions based on the knowledge, presented in the literature review, we started from the concept of regional sustainability. These processes, summarizing and confronting internal and external factors, are integral part of regional governance, striving to preserve and develop local resources with particular emphasis on the non-renewable ones. The specificity of this task insists in its slow dynamics, incomparable even with duration of several election periods. Moreover, continuous postponement of sustainability agenda can easily slip to irreversible losses (Mol, Lauber, Liefferink, 2000; Ramos, Squeff, 2020).

Sustainability is composed from the three fundamental pillars, economic, social and environmental, called the triple bottom line (Alhaddi, 2015), which are further refined and validated in numerous implementation frameworks. For example, ISO standard 37120 (International Organization for Standardization [ISO], 2018) proposes 17 sustainability themes and 100 indicators. In the past decade, the administrative ways of sustainability achievement were extended with data, information and technology driven so called smart solutions, which increase the overall efficiency of realization processes.

The way of our embedding of regional labels into a sustainable holistic framework is shown in Figure 1. It contains causal loop diagram, with six key sustainability sectors, *Management and governance*, Society, composed from *Population, Effectiveness policy* and *Quality of life* components, *Environment, Land, Economy, Transport* and *Energy*. Despite the representational simplicity, the diagram contains more than 100 loops with the length varying from 2 to 10 underlying elements. It is evident, that longer loops with more mutually shared variables require careful justification and produce more complex behavior. The sector of *Governance and management* forms the most important part of our study, because it is responsible for inclusion and management of regional labels. For detailed analysis, we partially unrolled two backward (causes) and forward (effects) levels of all loops, passing through this variable, as it is illustrated in Figure 2.

There are two inputs, determining the suggested decision-making policies - *Budget*, represented with incomes from regional *Economy* and governmental subsidy per capita (*Population*). *Population,* or rather society, consists of *Quality of life, Effectiveness policy*, expressing quantitative features of *Population* and *Economy*, serving as a salaries

paying regional employer in this context. This particular input *Population* can be also considered as an instantiation of participative democracy.

Resulting recurrent policies, strategies and decisions on the right side follow the two main directions – *effective*, establishing the basic functionality and *efficient*, introducing qualitative features up to the rest of available budget.

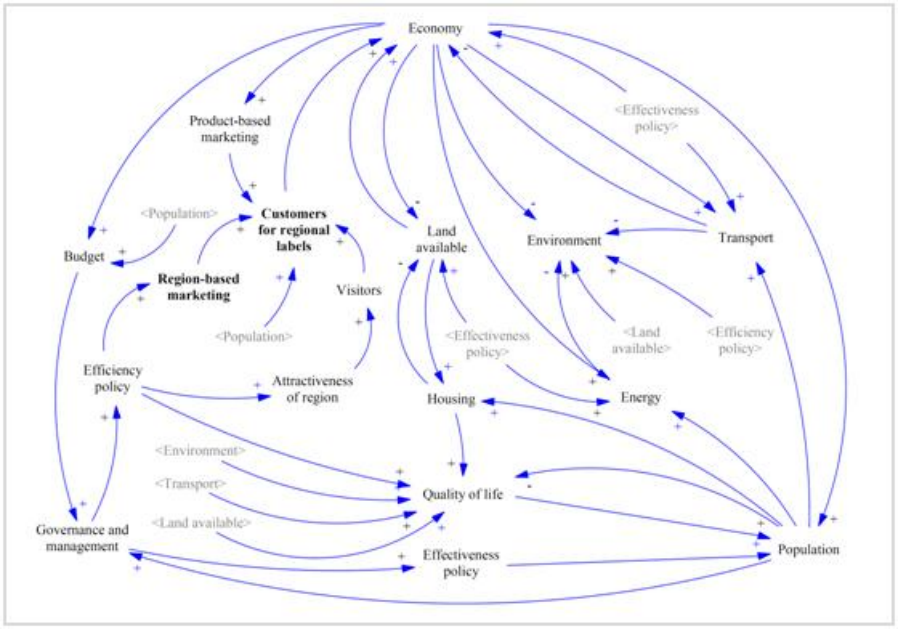

Figure 1 Causal loop diagram of regional labels management system in context of sustainability

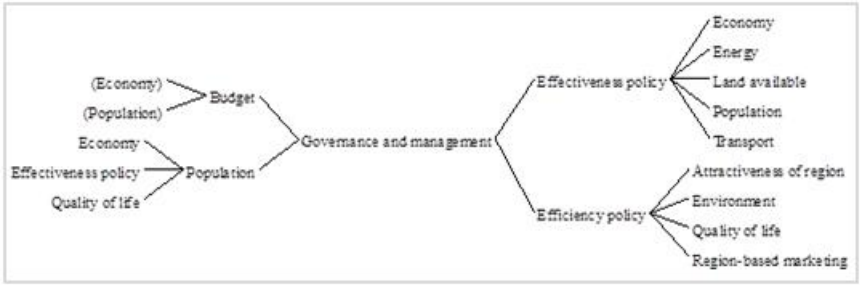

Figure 2 Unrolled loops for regional Governance and management sector

From this overview it is evident, that the regional labeling belongs to the latter branch. We believe, that comprehensible, imaginative, straightforward and multifaceted marketing is the best way how to promote these labels, preferably in parallel with other topics of regional interest. Only such colorful and natural persuasion can activate broad

spectrum of purchase motivation, insisting in, e.g., identification with region, preference of its traditions, natural, cultural or historical features and monuments, perceived familiarity, quality, safety, uniqueness or exclusiveness of regional products.

Figure 3 shows, that we suggested to address prospective customers both with specific *regional messages and stories*, altogether with *standard industrial marketing practices*. Beyond the local *population*, these campaigns target on tourists and people on business or shopping trips (*Visitors*). It is also useful to develop packages of thus originated sets of services and products. Overall *Attractiveness of region* is yet another indirect lever, stimulating the successfulness and permanence of regional labels. Finally, although rather distant, *Quality of life* is also important attractor for regional labels because happy people have tendency to support local products. From the fan of consequences of variable *Customers for regional labels* it is evident, that properly established labelling system can positively contribute to all key segments of sustainability.

Figure 3 Unrolled loops for temporal development of number of Customers for regional labels

Figure 3 also shows that the performance of regional labelling system can be measured with a scalar Labels Productivity Index (LPI), which is normalized ratio of impacts, propagated to single key sustainability sectors, divided by particular inputs as follows:

$$LPI = \frac{f(Budget, Energy, \dots, Transport)}{g(Total\ marketing, Attractiveness)}$$

Let's assume the following three strategies of label management:

- A: no label management,
- B: moderate level of label management, which is aware of single activities, but lacking their systemic view,
- C: optimal level of label management, integrating properly all its aspects into the existing regional governance and management processes.

Illustrative qualitative diagram of temporal evolution of particular LPIs is in Figure 4.

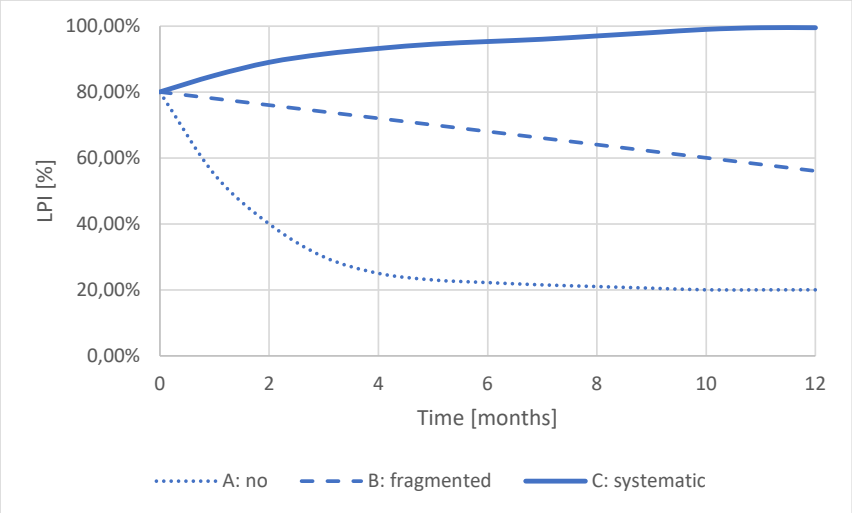

Figure 4 Development of label productivity index (LPI) for different label management strategies

It is seen and justified by our model, that productivity of systematically unmanaged labels drops rapidly. This is, however, typical example of the current sustainability policies. Distributed knowledge and nonsystematic maintenance of isolated structural LPI components can eventually result in its slower deterioration. Finally, an optimal holistic management could achieve the planned level of LPI. The rest of causal loop diagram serves as a background stub for the above-characterized system. Because it deals with large and well-known structural items, particular meanings of which are easily traceable from the Figure 1, detailed description is omitted.

5 Conclusions

On a sustainability model we demonstrated that there is a need for systematic institutionalization of regional labels management system. Only in context of other key sustainability indicators the usefulness and profitability of regional labels can be achieved. During the development of labelling system, we suggest to concentrate of sophisticated joint marketing, combing regional and product-related features and addressing different needs of wide group of prospective customers. Finally, we propose a predictive scalar label productivity index, which can be smoothly incorporated into regional controlling processes. A process of dynamic modelling of relations and mechanisms within a regional labeling networks may aim at, for example, finding solutions in the form of qualitatively better plans, better information in the system (more information or better transfer of information, sharing of relevant information, etc.), building a better business environment, better coordination, or a more significant and better role for the small and medium producers and agriculturists. Fragmented activities,

especially in the field of marketing communication activities may result in poor performance of the umbrella regional labelling scheme (such as ARB). To overcome this bottleneck, the following improvements may be suggested: (i) establishment and systematic management of the planned activities, with emphasis on brand management and focused marketing, to build an awareness and trust in the regional labels and attract the consumers, building the functioning distribution system in the form of network of specialised shops that would offer certified regional food. (ii) more focus on counselling and help with fundraising, with focus on development and structural funds. (ii) Shortening of delays in basic managerial cycle, including identification of needs of the stakeholders - local stakeholders - authorities, LAGs, environmental distribution and performance management.

In or future research, we will concentrate on sample implementation of presented framework in the language of system dynamics.

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Anti-Terrorism Policy for International Students' Mobility: a Conceptual Model

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Abstract

We propose a conceptual dynamic policy-modelling framework for sustainable development of international students' mobility in higher education. This model provides a transparent internal representation of this phenomenon, influenced by various external factors with particular respect to terrorism. Based on extensive literature review, available data and personal experience, we sequentially structure and refine related knowledge from initial mind map through business model canvas and system diagram to final causal loop diagram. These partial outputs allow formulation and justification of viable policies and related strategies. Our main contributions include (i) holistic interconnection of particular performance sectors and their alignment with university core processes, (ii) continuous identification, quantification and management of risk of terrorism and (iii) distinguishment between steady level of terrorism and its emergency effects.

Keywords – Terrorism, Students' mobility, Conceptual modelling, Dynamic hypotheses

Paper type – Academic Research Paper

1 Introduction

Over the past decades, students' mobilities have increased significantly due to globalization of higher education institutions (HEIs), as they represent a valuable opportunity for students to gain considerable skills, knowledge and experiences by staying abroad to study or execute training (Beine et al., 2014; Roy et al., 2019; Tosi et al., 2019). Results of the European Universities Initiative survey, that analysed data from 219 HEIs from 34 systems across Europe, that internationalisation has been a strategic issue at most institutions for quite a while: more than half of respondents have 10% or more international students (Claeys-Kulik, Jørgensen, Stöber et al., 2020).

Terrorist attacks, as unexpected events that cause damage, fear, and increased uncertainty, represent a global challenge of huge proportions (Estrada et al., 2018; Nail, 2016; Papakyriakou et al., 2019). Universally accepted definition of terrorism does not exist, but it is commonly defined as *'the deliberate use of violence and intimidation directed at a large audience to coerce a community (government) into conceding politically or ideologically motivated demands'* (Krieger, Meierrieks, 2011). Obviously, terrorism affects diverse aspects of social interactions in general, including the internationalisation of higher education. Historically, higher education institutions have been founded in the centres of the vibrant regions, important for the business and culture. Dostál et al. (2018) have pointed out that terrorists usually attack the same cities to achieve their political goals: to cause societal shock with and extensive publicity. It can be predicted that future terrorist incidents will quite likely impact cities or areas with a HEIs. A sense of urgency requires for the HEIs managements to create a supportive infrastructure, that should be composed of the basic elements of leadership, including systems of decision making, that can be swift in responding to external (and internal) pressures (Bain, 2007).

The concept of internationalisation is strongly anchored in institutional mission statements, policies and strategies, including national policy frameworks, it represents a complex of issues and policies with different approaches and strategies in constantly changing contexts (Knight, de Wit, 2018). Wihlborg and Robson (2018) call for readjustment of research approaches of the HEIs' international activities, becoming more cross-disciplinary and transversal, to be able to address various types of modern challenges. De Wit and Hunter, (2015) focused on the future of internationalisation of higher education in Europe and suggested that the main challenges are international strategic partnerships and increasing outgoing student mobility, which remain a key activity of institutional and regional policies in the EU. Other forms, such as academic programmes (i.e., cross-cultural training, exchange programmes, visiting lectures, joint/double degree programs,) collaboration on the research projects or extra-curricular, such as students' associations and external relations (domestic and cross-border), help build the complex international activities (Maringe, Foskett, 2010). Our article focuses on the student mobility, in the form of degree mobility (for an entire study programme) and

credit mobility (for a half-year or a year - e.g. Erasmus+ Programme), as they are the most visible and far more important form of internationalisation (Teichler, 2015). The statistic published by Statista (2013) shows a prediction that by 2025 there will be at least 8 million students pursuing higher education abroad. In 2017, 5.3 million tertiary students crossed an international border for an education (OECD 2019).

The aim of this research is to propose a conceptual dynamic policy-modelling framework for sustainable development of international students' mobility in HEIs. This model provides a transparent internal representation of this phenomenon, influenced by various external factors with particular respect to terrorism.

1.1 Literature overview

Terrorist attacks aim intentionally at non-combatant targets, such as civilians, chosen randomly (Hoffman, 2006), to achieve significant publicity for political, religious or ideological reasons (Matusitz, 2013), the meaning of terrorism is socially constructed Sloan, 2006). Events, such as 9/11 attacks on the US or in Paris in 2015, and the response they provoqued, has attracted academic attention. Some contributions have focused on various dimensions of counter-terrorism policies (Argomaniz, Bures and Kaunert, 2015; Bossong, 2013), others studied impacts of terrorism on tourism – identifying fear and insecurity as major barriers to international travel (Liu, Pratt, 2017; Seabra, Reis, Abrantes, 2020), or economic impacts, i.e. investments, foreign trade, consumption, GDP growth (Estrada et al., 2018) or individual welfare (Clark, Doyle, Stancanelli, 2020). However, studies of how the threat of terrorism impacts HEI internationalisation (student mobility) are still sparse (Chalupová et al., 2017; Dostál et al. 2018).

When considering international activities, HEI management must take into account a wide range of factors. Starting at the macro level (political, cultural, social, technological, economic factors), mezzo factors (connected with regional conditions) as well as inner context (Cairns, 2019; Curaj et al., 2018; Van Mol and Timmermann, 2014). To manage complex processes connected with internationalisation, HEI management should prepare additional structures and processes to be able to guide, inform and support their incoming and outgoing students and academics/staff, to minimise impacts of unpredictable and complex events and changes, such as terrorist attacks (Dostál et al., 2018), local crises and conflicts (Cervantes-Duarte, Fernández-Cano, 2016), protectionism or various forms of inequalities (Choudaha, 2017) or the health crises, such as COVID-19 pandemic (Wang et al., 2020). It is certain, that HEI internationalisation and the various types of external risks can be managed with the methods similar to those used for business processes (Al-Zoubi et al., 2018). The benefits might include (Polak, 2018) improvement in management of the internationalisation process, better rationale for decisions, more realistic planning and increased risk and opportunities awareness.

The scope of the HEIs internationalisation in the EU has evolved considerably (de Wit, Hunter, 2015). The most frequent forms include various types of academic programmes

(exchange programmes or joint/double degree programs, lectures from visiting academics, cross-cultural training, etc.), research collaboration, or extra-curricular activities, such as students' associations (domestic and cross-border) (Altbach et al., 2006; Maringe, Foskett, 2010). Research, that analysed data from 34 systems across Europe showed, that internationalisation is considered to be a strategic element at most institutions, almost 90% of HEIs are engaging in the students' credit mobility, EU research projects and staff mobility, and 80% of the respondents aim to attract international degree students and about three-quarters of respondents collaborate on joint degree programmes, and bilateral research activities (Claeys-Kulik, Jørgensen, Stöber et al., 2020). HEIs in Europe act within the European Higher Education Area (EHEA),that was established in 2010 as a part of the Bologna Process; Erasmus+ represents the EU's key programme to support education, training, youth and sport. More than 10 million people have participated in Erasmus+ over the last three decades. In May 2018, the European Commission proposed to double the Programme's budget to €30 billion for the next 7-year period, which. It should aim to enhance mobility and cooperation, in EU and with the rest of the world (European Commission, 2018).

1.2 Student mobility

Choudaha (2017) has divided changes in international student mobility into three overlapping 'waves', spreading over between 1999-2020, with the major events and trends in international politics and economics as a cornerstone. The first two waves coincided with terrorist attacks on the USA in 2001 and the global financial recession, which triggered financial motivations for recruiting international students. The most recent one is being shaped by the slowdown in the Chinese economy, BREXIT and change in immigration policy after the 2017 American presidential elections. It can be predicted that the COVID-19 pandemic will have an enormous impact on the recent forms of HEIs internationalisation.

Beine et al. (2014) studied the determinants of international mobility of students. The authors specified among other things the motivation for going abroad, for example the socialization, the development and the destination country. Heirweg et al. (2019) states it depends on the disabilities of the students, there are financial, organisational, linguistic, psychological, technical and practical barriers to participation.

Cairns (2019) describes the student mobility in Europe like means of providing measurements of programmatic success to stakeholders and policymakers. The author claims institutions are responsible for the number of students going abroad and there are big differences between approaches of individual universities. It depends on organizational support, image of the university and the possibility of choosing schools where to go. According to Beine (2019), the studying abroad opens the access to the local labour market.

Agarwal et al. (2008) and Caruso and De Wit (2015) defined the push and pull factors of international student mobility, composed from (i) educational, (ii) political, cultural, social and (iii) economic factors. Shields (2019) extends this scale also with environmental impacts.

2 Methodology

Real-life implementations of high-level organizational policies and strategies result in complex, dynamic, heavily interconnected systems with a considerable portion of human-related soft factors and accompanied by uncertainty, nonlinearity, and parametric nonstationarity. Such kinds of nontrivial problems cannot be solved purely formally. Still, researchers have to search also for modern representational and computational techniques, facilitating the modelling in such naturally ambiguous environments. Because of the qualitative and time-varying nature of studied phenomenon, we applied dynamic knowledge-based tools and methods for analysis and design of the proposed conceptual model. These innovative methods are holistic and systemic, i.e., work with properly bounded and internally structured problems, allow straightforward inclusion of domain and expert knowledge, are representationally transparent, user friendly, and architecturally scalable. Their application range is extensive and varies from the support of an individual or team decisions through parametric prediction and explanation of expected behaviour to the provision of a safe training and improvement platform.

Consequently, related methodology combines theoretical foundations and methods from the following domains:

- Systems thinking and organizational learning
  According to (Senge, 1990), modern management must be holistic and systemic with a large involvement of human-related factors, namely personal mastery, mental models, shared vision, and team learning. His concepts were extended, practically focused, and also introduced to the academic domain (Bui, 2020).
- Knowledge elicitation, specification, modelling and management
  This resource covers a wide range of miscellaneous activities, from psychology to technology. Influential texts with direct applications to management are, for example (Diaper, 1989), (Firlej & Hellens, 1991), (Pasher & Ronen, 2013) or (Milton & Lambe, 2019).
- Business modelling, value management, and strategic planning
  All these activities represent sound outputs of knowledge engineering, transforming so far abstract structures into the real value for stakeholders. Sophisticated awareness concerning the value originating mechanisms and their supportive structures directs managers towards the well-justified targets prioritizations and focusing them on the right things (Osterwalder et al., 2014), (Allison & Kaye, 2015), (Bryson, 2018).

Numerous specialized tools are available to explore, represent, and interconnect these areas. We selected and gradually applied the following ones:

- Mind map (Buzan, 2018) creatively summarizing and structuring processed concepts. The central theme is distinctly placed in the middle of the diagram and surrounded with several main branches, further expanded to thematically disjoint sub-trees. After facilitated interaction with stakeholders, the resultant chart shows potential subsystems, altogether with their approximate internal stricture. The absence of loops drives users to focus on fundamental aspects, and a minimalistic set of formal rules results in a fast design.
- Business model (Bock & George, 2017) characterizes the main structural and parametric aspects of value creation and delivery. From numerous templates and frameworks, we adopted the Business model canvas (Osterwalder & Pigneur, 2010), introducing the following sectors and subsectors:
    - Key infrastructure: partners, activities, resources
    - Value proposition
    - Customers: segments, channels, relations
    - Finances: costs, revenues

  This diagram is somewhat complementary to the mind map as it already shows the leading strategies and resources in the context of surrounding environment.
- System diagram (Ferrario et al., 2016) identifies particular key performance subsystems and factors with respect to their internal structure, including fundamental interconnections and loops. It represents an aggregate overview of qualitative dynamics.
- Casual-loop diagram (CLD), described, e.g., in (Sterman, 2014) opens boundaries of subsystems and shows their most important structural features. Relational directionality optionally applied already in system diagram, is extended to the whole system and completed with the polarity of arrows. The plus sign represents direct proportion, minus holds for the indirect one. Mutual influence of contributions of internal loops, delays, and time constants establishes the dynamics of the whole system.

The last modelling stages include verification and validation. In qualitative modelling, verification represents mainly testing of logical functionality and validation checking the level of compliance with initial assumptions, resulting from the literature review and accompanied with experts' opinions. During the routine utilization, various strategies can be proposed and either justified or refuted with the help of the model. Such usage can happen under different scenarios, realizing selected configurations of external environment. Described methodological procedure is in accordance with the generic research framework proposed in (Mitroff, 1978).

3 Results and discussion

The majority of achieved results are represented in a graphical format. Mind map in figure 1 shows the four key components of students' mobility concept. Although the other "standard" aspects of university management and governance were omitted in the mind map, they still can be considered in the subsequent modelling stages. Thus, the *University* and *Students* branches contain characteristics, particularly crucial for internationalization and mobilities. Also, *Environmental* aspects thoroughly evaluate the situation and future trends in target countries. *Terrorism*, as particualy analysed phenomenon, is excluded from the general environment and described with indicators, which should be of specific interest of internationally cooperating universities. Thus, they can efficiently indicate either smouldering or immediate risk of terroristic threat.

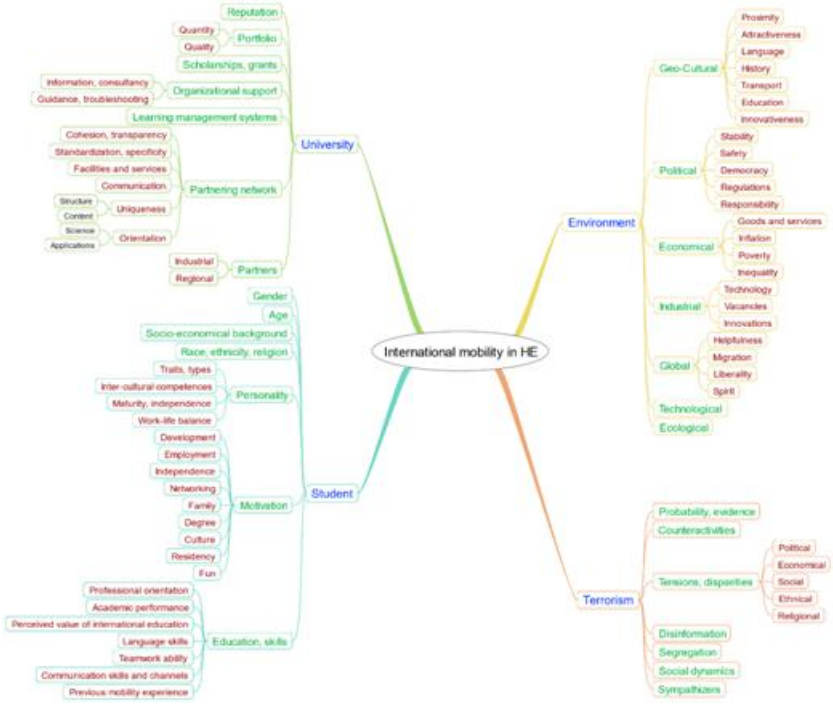

Figure 1 Mind map of analysed domain

Investments into the safety of incoming or outgoing students cause additional costs, which should be compensated with reasonably added value for all involved parties, i.e., stakeholders. These strategic decisions must be evaluated in the context of existing business strategies, evolving in accordance with changes of the surrounding environment, as it is shown in figure 2. Internal business model canvas are in its centre and marked with a white background. Selected endogenous sectors, generating alternative scenarios,

incorporate mobility *Domain* subjects, *Environmental* descriptors including terrorism, characteristics of students' mobility *Market,* and *Economic* background of original and target countries.

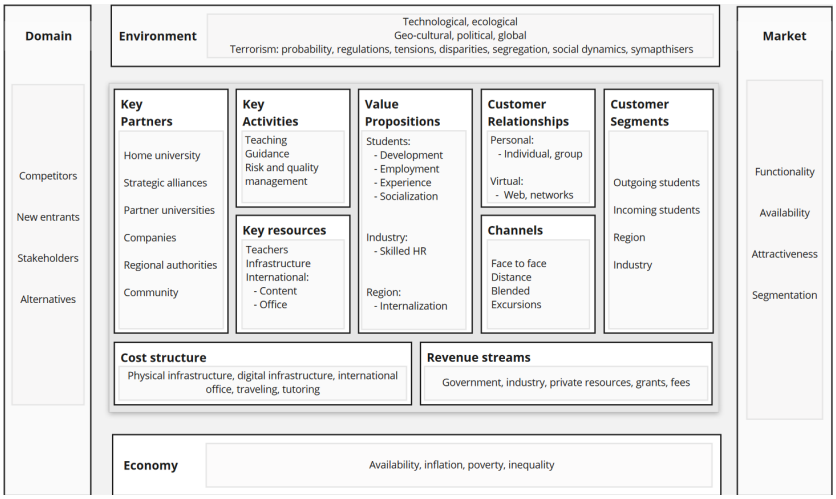

Figure 2 Business model of academic mobility subsystem

The system diagram in figure 3 takes over the most important variables and relations from the previous two graphs and structures them following the aim of this research. The key relations are marked with bolded arrows. The upper part of this diagram shows two directions, how the *terroristic* attacks can affect university students. The first possibility is their pervasive, indirect, evolutionary perception through other *environmental* factors, listed in the mind map. Relative advantage of this input is its slow and generally anticipable dynamics, giving university board and *management* time for strategic planning of adequate resilience. The second entry of consequences of terroristic activities is direct and fast. In this case, immediate reactions, according to pre-prepared scenarios, must be applied in close cooperation with international partners.

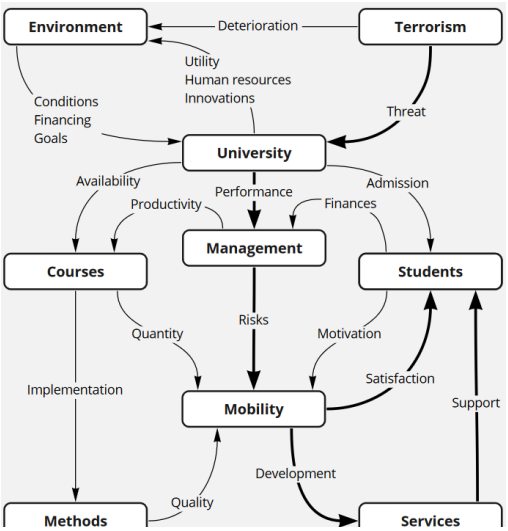

Figure 3 System diagram of the proposed mobility management system

Although no emergency plan can fully reflect reality, in conjunction with systematically applied risk management procedures, it can efficiently minimize undesirable implications. Such additional activities, elementary dynamics of which is shown in the right lower quadrant of figure 3, are provided, altogether with standard *mobility*-related duties, by a local *services* unit, responsible for international relations. Disregarding particular details, primary goal of this department is to motivate *students* to travel. Mobility is further determined with the availability of appropriate *courses* and related set of applicable teaching *methods* and technologies, facilitating students' exchange.

Our final dynamic model, represented with the Causal loop diagram in figure 4, provides a more detailed insight into these mechanisms. Its upper part with textually annotated dashed arrows (*induce, influence,* etc.) serves as an informative interface to the external world. The same holds for activities, characterizing *Research,* and *Third role* of universities, which are out of scope of this study. These factors are included mainly for completeness, and related loops do not contribute to the overall dynamic of modelled phenomenon. Overall *Performance* of *University* operations is composed of several fundamental factors, including also *International services* and is limited with available *Finances*.

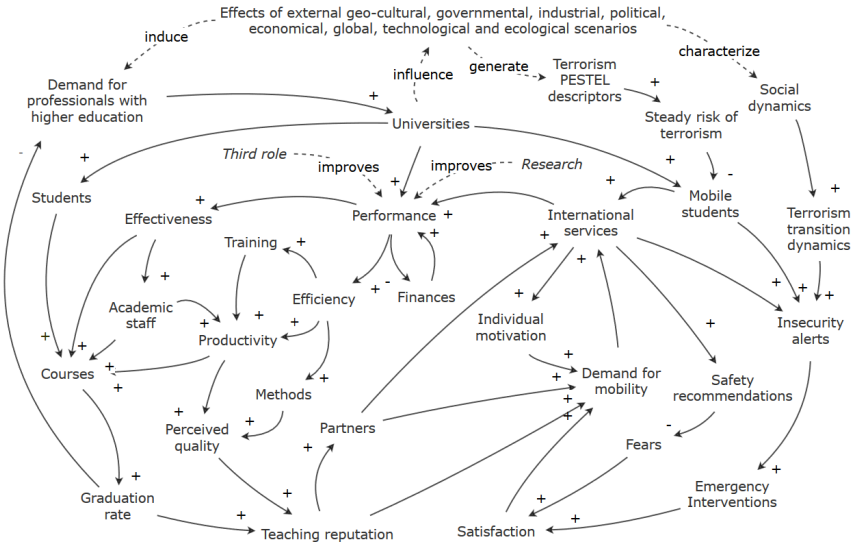

Figure 4 Causal loop diagram of the proposed mobility management system

Performance is traditionally decomposed into *Effectiveness* and *Efficiency* parts focused on quantity and *Perceived quality* of provided *Courses*. These factors increase *Teaching reputation* and address international *Partners*. The slow dynamics of terrorism propagation (*Steady risk*) affects the total number of *mobile students*, which is out of university control. Anyway, all other students, who are in charge with international services, are continuously motivated to travel and informed about actual threats and limitations, minimizing the fast *Transition dynamics* of terrorism through the rightmost loop implementing *Emergency interventions*. Because the nondecreasing *Demand for mobility* is one of the key performance indicators of *International services* unit, all related loops are reinforcing (growth supporting), which is represented with absence of zero or odd number of arrows' minuses along particular loops. *Fears* resolving loop is balancing (stabilizing) and strive to maintain the level of *Safety recommendation*s on an appropriate level.

Even such a simplistic Causal loop diagram has 32 loops with adjustable parametrization, which can be either linear or nonlinear – for example, in case of subjective or risk-related variables. Also, the duration of particular loop cycles can affect the resultant behaviour and performance significantly.

4 Conclusions

To summarize the usefulness and applicability of the proposed framework, let's consider the following scenarios and strategic decisions (situations):

- S1: Operations in an externally safe environment without explicit internal anti-terroristic activities (base run),

- S2: Operations in an externally safe environment with a minimalistic level of anti-terroristic risk management and partially applied set of corresponding preventive and reactive rules,
- S3: Operations in an externally safe environment with an optimal level of anti-terroristic risk management and fully developed set of corresponding preventive and reactive rules,
- S4: Operations under particular risk of terrorism without explicit anti-terroristic activities, implemented on the university level,
- S5: Operations under particular risk of terrorism with a minimalistic level of anti-terroristic risk management activities and partially applied set of corresponding preventive and reactive rules,
- S6: Operations under particular risk of terrorism with an optimal level of anti-terroristic risk management activities and fully developed set of corresponding preventive and reactive rules.

Evaluated with the following set of relative indicators, changing from 0 to 100%:

- Terrorism risk index (TRI), regularly evaluated by international services unit (external lagging indicator),
- Impact resilience index (IRI), given by university governing board and maintained by its management (internal lagging infrastructural indicator),
- Demand for mobility (DFM), planned by international services unit as its key performance indicator (internal leading process indicator),
- Performance (PER): planned by university management as a cumulative internal measure (internal leading overall indicator). This quantity is used for mutual comparison of the below presented cases S1 – S6.

Qualitative conclusions, estimated under the presented innovations of mobility system management, are outlined in Table 1.

Table 1 Qualitative comparison of sample scenarios and strategies

Situation	TRI [%]	IRI [%]	DFM [%]	PER [%]
S1	0	0	100	100
S2	0	20	100	95
S3	0	80	100	90
S4	80	0	20	80
S5	80	20	50	90
S6	80	80	80	95

The first three situations S1 – S3 illustrate the fact that preventive activities require additional resources in comparison with the base run, simplistically assuming that other

performance drivers and enablers remained untouched. In a stable, quiet world, additional processes logically cause security overhead.

Unprepared university in situation S5 faces not only a considerable drop of mobile students but also loses its own performance because of forced invention of mandatory ad-hoc recovery solutions. Finally, the proposed extension of international infrastructure supports more sophisticated quantitative (S5) and qualitative (s6) responses on the gradual escalation of terrorism or direct attacks.

Consequently, our main recommendations are the following: (i) universities must classify destination countries according to the steady risk of terrorism occurrence, (ii) systematically prepare outgoing students for this eventuality, (iii) continuously monitor transition part of social dynamics in risky destinations and (iv) altogether with international partners design immediate and efficient counteractivities. Although our research deals mostly with EU related resources, we believe that the identified conclusions can be applicable in a broader context.

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Top-Down and Bottom-Up Approaches to Company Competitiveness

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Abstract

The main goal of management is the gradual fulfilment of company vision with respect to the changing environment. This capability is also an essential prerequisite for continuous maintenance of desired levels of performance and competitiveness. The later metrics, reflecting responses on internal and external changes, is defined, justified and aligned with the organisational structure in this paper. The inherent complexity of competitiveness planning and management resulted in the introduction of specialised frameworks, decomposing and formalising related managerial tasks, both structurally and temporally. Consequently, this paper also compares and finally conceptually combines two widely used but qualitatively different approaches: heavyweight, top-down, strategy-based Balanced Scorecard system (BSC) with the nowadays-reinvented Objectives and Key Results approach (OKR). In contrary, OKR is a representative of agile, decentralised and bottom-up planning and execution methods. As management is a dynamic task with different durations of decision-making cycles, the positives and drawbacks of both methods are analysed and discussed. Finally, a theoretical concept of their beneficial integration is proposed.
Based on the literature review and the latest methodology of the World Economic Forum, we designed qualitative competitiveness monitoring and evaluating framework, compatible with BSC architecture. To demonstrate its applicability, we projected single indicators through a sample strategy map to a causal-loop representation of BSC. Such way of qualitative modelling allows transparent representation of structural and behavioural aspects of analysed phenomena, as well as formulation, justification and discussion of underlying dynamic hypotheses and suggestion of viable scenarios for problem elimination. For the OKR-related alternative, we proposed an agent-based framework, mimicking the fulfilment feasibility of particular objectives for concrete structures and skills of single teams. Finally, we suggested a simple process model, integrating both presented techniques. Although the problem of bidirectional and two-speed competitiveness management is nontrivial, we believe that our knowledge-driven explanation can overcome this inherent complexity and attract the interest of the research community.

Keywords – Competitiveness, Balanced scorecard, Objectives and key results, Agility

Paper type – Academic Research Paper

1 Introduction

The essential goal of management is to keep the organization continuously competitive despite any internal changes and within a considerable range of external disturbances. Dramatic environmental dynamics results from multiple interrelated factors, such as globalization, hypercompetition, continuously increasing role of innovations or introduction of new technologies. Complexity and variability of modern businesses force managers to make high-quality strategic plans and related complex decisions and in a short time. Thus, the main related difficulties are given by the dramatic difference between well-established internal processes and properly formalized cooperation with suppliers or partners and generally decentralized, global character of the market with numerous vague or ambiguously defined structural elements and rules. It is evident that such complex, turbulent and non-deterministic processes require the introduction of advanced managerial procedures, capable of projecting business dynamics into the systematic execution of appropriate competitive strategies.

Consequently, this research aims to propose and justify an innovative managerial framework, capable to efficiently execute optimal and permanently aligned competitive strategy, as well as flexibly minimise impacts of internal and external changes.

1.1 Competitiveness

The Longman Advanced American Dictionary (Duckett, 2007) defines competitiveness as "*the ability of a company or a product to compete with others and the desire to be more successful than other people*". In other words, the term deals with the ability of firms to stay competitive, which insists on their potential to develop and retain position among the competitors operating in the same market. It means that firm competitiveness can manifest its capability to function better than comparable institutions in term of sales, market shares, or profitability (Lall, 2001).

The scientific foundations of national competitiveness were formulated in the theory of comparative advantage (Ricardo, 1817), which was gradually developed over decades and finally put into the strategic management context as the Theory of competitive advantage (Porter, 1990). From then on, various theories and qualitative models of competitiveness were proposed like the Resource-based view (Madhani, 2010) or Six forces model (Brandenburger & Nalebuff, 1997). There is also extensive research concerning the dynamic nature of competitiveness, arising from persistent offensive and defensive interactions among market competitors (Ketchen et al., 2004), (Zhang & Gao, 2014), (Efrat et al., 2018), (Baden-Fuller & Teece, 2019) or (Ferreira et al., 2020). The importance of sustainable competitiveness is emphasized by (Barney, 2016) or (Kalender & Vayvay, 2016). As a result of analysis of competitiveness with limited internal resources, Barney suggested a necessity of a unique product which cannot be replicated by competitors and forms the desired competitive advantage.

Another influential input from this category is the factor-based competitiveness research. In contrast to above-mentioned qualitative, larger-scale top-down models, this approach investigates and composes competitiveness from selected specific components. Employed empirical, statistical, mathematical or business intelligence methods usually identify most influential internal relations, frequently appearing attributes or typical patterns as particular performance drivers. Sometimes they even transform the original data into a new system of coordinates, which leads to the brand new, compositional set of competitiveness factors. For example (Cantele & Zardini, 2018) proposed layered unidirectional network, constituting competitive advantage from partial dimensions (social, environmental, economic, formal practices, organizational commitment, reputation and customer satisfaction) and evaluated the strength of determinism of selected intermediate connections. Methodologically similar research was conducted, e.g., by (Andrews & Boyne, 2010), (Artiach et al., 2010), (Sun et al., 2010), (Valdez-Juárez et al., 2018) or (Likumahwa et al., 2019). A general structural framework for synthesizing and structuring both reflective and formative resources of competitiveness was proposed by (Becker et al., 2019).

1.2 Dynamics

Competitiveness arises from perpetual interactions between market, consisting of buyers, sellers, structure, rules and information, and individual performances of single involved subjects. As a result, a dynamic market price equilibrium is established. To be competitive, the company must continuously innovate competitive strategies in accordance with external changes and also reflecting its internal dynamics. There are several behavioural archetypes (Senge, 1990), knowledge of which can facilitate this effort.

1.2.1 Information latency

This apparent phenomenon, illustrated in figure 1 and described, e.g., by (zur Muehlen & Shapiro, 2010), results from slow decision-making cycles, produces by non-optimal business architecture. This effect also corresponds with the Mathematical theory of information (Shannon, 1948), according to which the rare and recent events have higher information content. The longer time passes from their occurrence; the lover value can be obtained from their exclusive ownership as the initial message gradually become public.

1.2.2. Delay

Another undesirable result of slow business cycles is the forced harmonic response in control loops, technically caused by the presence harmonic components in the analytic solution of transition response. This feature is illustrated in figure 2. The corresponding causal loop diagram in its left part has single balancing loop, saying that the larger

(negative) difference between the current and desired value, the larger need for correcting decisions, positively affecting the original value.

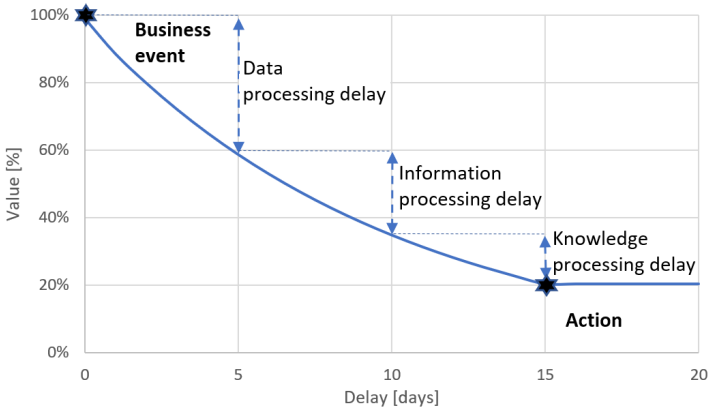

Figure 1: Eroded value as a result of slow internal processes

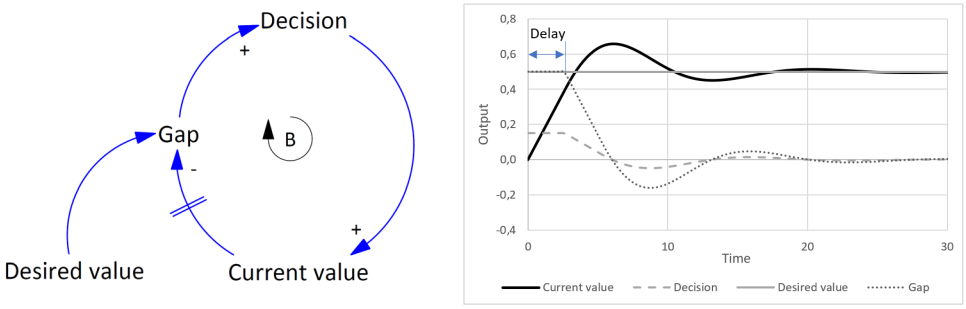

Figure 2: Schematic causal loop diagram and time response of delayed control decision

This loop is balancing (B), as it has an odd number of indirectly proportional (minus) connections. The delay of recognition of the gap existence is marked with the double-crossed arrow. Time graph says that disregarding the history, need for correction of difference 0.5 between current and desired value was recognized after three days of its appearance. During this time, output (current value) was out of control. Then the delayed decisions started to act against the gap, which resulted in the achievement of the desired state 30 days after the first occurrence of this need, which could be too much. Compensations of oscillatory behaviour represent yet another managerial burden.

1.2.3 Competition

The basic situation in the market can be represented with the behavioural archetype Success to successful (Senge, 1990), in figure 3. It consists of two unlimited growth supporting (reinforcing) loops, sharing the same resource, i.e., customers. Because of market closeness, the success of one competitor means the lost for the other and vice-

versa. Price equilibrium must be carefully maintained by both companies; otherwise, the winner can quickly undertake the whole market. Time graph shows the situation when market share is 80:20 in favour of A, which also mainly dictates the price policy (similar phases of price fluctuation and growth of A). Also, the success of B is opposite to the success of A.

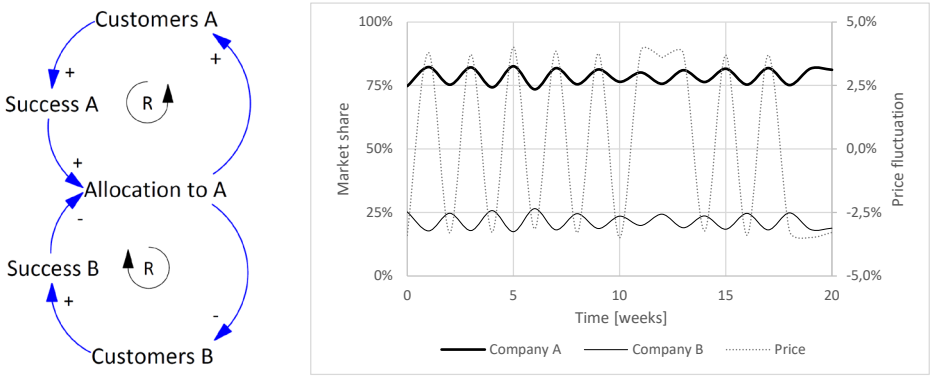

Figure 3: Schematic causal loop diagram of price fluctuation due to market competition

1.2.4 Agility

The introduction of agility represents a powerful way of minimisation of unavoidable side effects of business dynamics. It can be understood as the result of integrating vigilance to change management by recognizing opportunities, challenges and threats using both external and internal resources in a relevant, timely, accessible and way (Elkareem et al., 2011). The favourable conditions for being agile ban be summarized as follows:

- Changing market environment,
- Collaboration with customers,
- Need for continuous innovations and improvement – problems are complex and solutions are unknown, product specifications changes, time to market is crucial,
- Cross-functional cooperation is beneficial,
- Value can be delivered incrementally, and changes are manageable,
- The organization can learn from history.

Well formalized needs for agility appeared first in the software industry. In (*Manifesto for Agile Software Development*, 2001) there are formulated the following four foundational values of agility:

- Individuals and interactions over processes and tools,
- Working software over comprehensive documentation,
- Customer collaboration over contract negotiation,
- Responding to change over following a plan,

further defined with twelve supporting principles, including:

- Customer involvement and satisfaction, accommodation of changes, frequent delivery, teamwork, motivation, face to face communication, working outcomes, constant pace, sound design, simplicity, self-organization, reflection and adjustment,

and implemented through different team-based frameworks, among them Scrum (Hossain et al., 2011), (Rubin, 2012) and Kanban (Brechner, 2015) are the most significant. Over the time, agile principles moved from the level to organizational level, which was reflected with the invention of the Scaled agile framework (SAFe), characterized, e.g., by (Dikert et al., 2016), (Rigby et al., 2018), (Barroca et al., 2019). The current final phase of agility penetration is the business agility (Mathiassen & Pries-Heje, 2006), (Waldock, 2015), (Nejatian et al., 2018), which naturally supports also the main topic of this research.

1.3 Strategy

Regardless of particular implementations, management processes must always address three essential questions: *Why, What* and *How*. Answering the *Why* is rather straightforward as it is connected with company vision, mission and business values. Mechanisms behind the other two questions are, however, more complicated. The *Whats* are related to objectives on different levels while the *Hows* are projected into actions, or, more precisely, corresponding metrics. Although all management frameworks start to form the top posting *Whys*, they differ in scope of *Whats*, because objectives can be defined for different business levels, from operations to particular visions. Accordingly, also the related metrics, i.e. *Hows*, must unambiguously cover a wide range of internal and external quantitative and qualitative variables. They can be either leading (predictive, evolving, related to inputs and states) or lagging (retrospective, static, related to outcomes). Sometimes, they are attributed as "key" which means that their total number should not exceed five. In case of competitiveness, numerous sets of indicators, characterizing past or future evolution of company finances (profitability), operations (capacity, time to market, quality), customers (market share, price) or growth and innovativeness (productivity) can be used. This topic was studied, e.g., by (Díaz-Garrido et al., 2011), (Turi et al., 2014), (Torjai et al., 2015) or (Šegota et al., 2017). The indicated values must be somehow originated. For this purpose, the concept of performance drivers was established.

In contrast to the more or less direct and well-focused indicators, drivers are usually composite and hierarchical. They are primarily formed with business-aligned and continuously developing processes, consisting form resources, capabilities and skills. For example, (Christensen, 2010) proposes the value for customers as a competitive advantage, (Henderson, 2011) recommends sustainable event management, (Reed et al., 2012) suggest open innovations, (Finch et al., 2016) opt for dynamic capabilities. In (Delbari et al., 2016) performance is composed of the bargaining power of customers and

suppliers and the threat of substitutes, new entrants and competitors. Finally, (Singjai et al., 2018) describe the competitive power of green initiatives in the hotel industry.

Exhausting set of strategic drivers and indicators, altogether with related processes, form standardized multifaceted planning and management frameworks. This research combines two of them, Balanced scorecard (Kaplan & Norton, 2005) (BSC) and Objectives and key results (Doerr & Page, 2018).

1.3.1 Balanced scorecard and strategy map

Although BSC was initially designed for cross-sectionally balanced measurement of organizational performance, over years it developed into a dynamic tool, supporting all stages of strategic management. It represents a holistic, exclusively top-down acting platform with a yearly planning cycle. Optionally, BSC can be merged with company vision and strategic documents through the corresponding Strategy map (Kaplan & Norton, 2004). The later, binding structured diagram acts mainly as a systemization and communication tool, helping managers to sort, prioritize and explain significant objectives in a simplified, layered graphical way. Strategy map, as well as BSC, combines the following four levels:

- Financial (generation and use of financial resources),
- Customer (attracting customers and meeting their expectations),
- Operations (excellence of internal processes),
- Learning and growth (innovativeness, skills, knowledge, development),

the order of which can be rearranged in accordance with organizational mission. In the case of for-profit organizations, the performance is driven by human resources, their development and innovations, which leads to growing productivity of internal processes, stimulates market share and improves financial results.

Balanced scorecard follows and refines the flat structure of the strategy map. It newly incorporates significant interconnections among selected performance drivers and key performance indicators (KPI).

In our case, the resultant BCS diagram includes loops with different length, complexity and duration, altogether forming dynamic behaviour of the modelled business. This feature is frequently used for subsequent computational modelling and simulation of performance, either in its planning or execution stage (Forrester, 1961), (Sterman, 2014).

1.3.2 Objectives and key results

The main difference of the Objectives and key results (OKR) framework in comparison with BSC is its support of decentralized design and execution of desired performance. It evolved from the Management by objectives approach (Drucker, 1954) and gradually developed especially inside innovative, technological companies to its current form (Wodtke, 2016), (Niven & Lamonte, 2017), (Klanwaree & Choemprayong, 2019). Typical OKR lifecycle is two-speed, including yearly directing cycles, when company-wide business objectives are presented to single teams or, sometimes, individuals. Based

on them, sets of the quarterly business-aligned team objectives are formulated and from the bottom implemented with the corresponding SMART (i.e., specific, measurable, achievable, relevant and time-bound) key results (KR) and daily individual initiatives. Thus, the typical OKR lifecycle includes regularly recurring set, align and achieve activities.

1.3.3 Comparison of BSC and OKR

From the previous brief introduction, it is evident, that both methods differ in cadence, which favours OKR from the agility viewpoint and helps to execute up-to-date strategies more efficiently. OKR also accommodate decentralization, individual preferences and attitudes. It primarily does not focus on everyday business, but rather on challenges, improvements, changes or innovations to provide sustainable growth of performance. These features are also reflected in the nature of corresponding metrics. The objectives in OKR framework have dynamic character and express changes like increase revenue, improve a service or implement a process. That is why also the related key results need more frequent monitoring in comparison with BSC-like key performance indicators, which are rather steady, have lagging nature and usually does not require daily revisions.

On the other hand, OKR introduces the risk of not seeing the forest for the trees, while the systematic viewpoint of BSC naturally put all activities in the right context. It also assures that the final impact of a single OKR-driven target does not induce unintended changes in other areas of performance. It is evident that both techniques are complementary, and in specific cases, KR can even correspond with KPI. Accordingly, their creative combination could contribute to competitive advantage, as it is presented in the rest of this paper.

1.3.4 Execution

The term competitiveness can be more precisely characterised as the competitive advantage (Sigalas et al., 2013), (Davcik & Sharma, 2016), (Lee & Yoo, 2019) and implemented with appropriate competitive strategy (Pisano & Hitt, 2012), (Czakon, 2013). (Porter, 1985) divided them into the four main groups, including cost leadership, differentiation leadership, cost focus and differentiation. Thus, the problem of competitiveness can be considered as a problem of the continuous implementation of the most convenient (competitive) strategy, which is not such a straightforward task as it might look at a glance. Morris Chang, Taiwanese-American businessman and former CEO of Taiwan Semiconductor Manufacturing Company it appropriately characterized as follows: "*Without strategy, execution is aimless. Without execution, strategy is useless*." This phenomenon was researched by (Kaplan & Norton, 2008),(Srivastava & Sushil, 2017), (Duggal, 2018) or (Radomska & Kozyra, 2020) and various related reasons and recommendations were suggested. It is estimated that 50-90% strategies fail not because they are wrong, but because they are not executed (Jones & Parker, 2008), (Rumelt, 2011), (Cândido & Santos, 2015), (Busulwa et al., 2018), (Rodríguez et al., 2019),

(Oliveira et al., 2018). Also, Gartner's (*Personalization Strategy and Execution Survey*, 2019) concluded that more than 80% of contacted strategists consider strategy execution more import than three years ago. Only 30% of them claim the alignment between regular execution efforts and strategy, as well as the belief that they really drive this execution. This resource also suggests the following three main reasons for this unsatisfactory situation:

- Strategic managers are generally unaware of the operational impacts of their decisions.
- Because of recurrently appearing unexpected events, they have a problem to keep mainline of execution.
- Shifts in execution suffer from limited information of their bearers. Senior leaders are usually too far from operational realities, and middle or front-line managers lack the big picture concerning the overall business impacts.

2 Methods

This research is based on a gradual formalization of information, collected from the literature review and enhanced with expert and domain knowledge, represented namely by The World Economic Forum (WEF) methodology for ranking of national competitiveness. Because our long-time goal was to design an applicable computational model of competitiveness, also the methods and tools used later in this study, supported this strategic orientation. As a unifying platform we adopted the System thinking approach, dealing with bounded, internally structured and interconnected problems with emergent behaviour, arising from either centralized (loops-based) or decentralized (agents-based) interactions (Sterman, 2014), (Morecroft, 2015). In the initial analytic stages, ill-structured and creativity encouraging techniques were used to elicit the relevant knowledge and facilitate its common understanding. It usually happens through a set of intuitive diagrams, describing the structure and behaviour of analysed problem.

For the introductory overview, we used mind mapping (Chik et al., 2007), (Buzan, 2018) and achieved results further structured with the competitiveness characterizing strategic map and casual-loop diagram. Such outputs provided adequate support for possible further detailed qualitative analyses of competitiveness and improvements of the initial model (Warren, 2008), (Meadows & Wright, 2015).

For conceptual formalization of the decentralized way of strategy execution, corresponding with OKR framework, we selected the agent-based approach, principles of which can be found in (North & Macal, 2007), (Wilensky & Rand, 2015) or (Abar et al., 2017). These models synthesize the behaviour of a complex system from mutually interconnected contributions of continuously evolving, structurally layered and spatially movable elements, called agents. Hereby encoded domain knowledge is dynamically reused during the execution stage, when single agents are interacting, evolving or moving according to their expected utilities. Such solutions are built from the bottom, whilst the

resultant mission of the simulated system is synthesized from thousands or even millions of local interactions. Beyond the direct functionality, agents move among explicit states and inherit their specific features. A state-transition diagram usually models these discrete conditional changes. Besides the immediate response on activities in the nearest neighbourhood, agents' decisions can also be influenced by external stimuli.

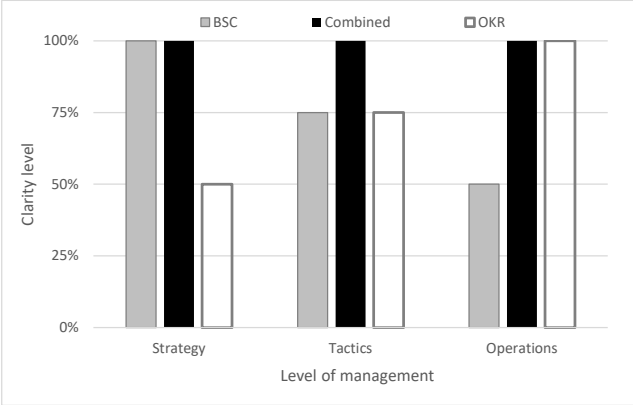

Figure 4 BSC and OKR, comparison of executive clarity

Because we believe that for the efficient execution of competitive strategies it is necessary to combine both aggregated (BSC) and decentralized (OKR) viewpoint, we finally outlined a sample process model of such compound interactions. Figure 4 schematically shows uneven organizational clarity of BSC and OKR approaches, as well as usefulness of their combination. Related heterogeneous solutions were recommended, e.g., by (Elsawah et al., 2015), (Pluchinotta et al., 2019) or (Lai et al., 2020).

3 Results and discussion

3.1 Mind map

The main components of the studied concept are shown in figure 5. Due to the market nature of competitiveness and compatibility with WEF methodology, they are divided into the group of internal aspects, located in the left part of the map, and the set of external ones on its right side. The proposed managerial framework can structurally and parametrically adjust internal drivers, a resultant combination of which determines the viable strategy. Although the external factors cannot be affected, their power must be considered, e.g., in the form of scenarios.

3.2 Quantification of organizational competitiveness

In its innovated (*Global Competitiveness Index 4.0*, 2019) (GCI 4.0), The World Economic Forum (WEF) evaluates the national competitiveness according to 103 indicators distributed within 12 pillars from 4 sectors. Our idea was to propagate these cumulative metrics to the company level. This assumption is based on the linearized model of national competitiveness, which is accordingly understood as a weighted sum of partial contributions of single market subjects. That is why the transposed WEF indicators are applicable also on single companies, which makes partial evaluations more transparent and comparable. Sample correspondence between WEF and BSC variables is shown in table 1.

Table 1 Relation between WEF index of competitiveness and its organizational counterpart

WEF GCI pillar	**Competitiveness**	
	National level (GCI 4.0)	**Company level (BSC)**
Enabling environment	Institutions	Organizational structure
	Infrastructure	Infrastructure, capacity
	ICT adoption	Enterprise content management
	Macroeconomic stability	Stability of performance
Markets	Product market	Market efficiency
	Labour market	Labour market
	Financial system	Financial health
	Market size	Market size
Human capital	Health	Organizational culture
	Skills	Organizational learning
Innovations ecosystem	Business dynamism	Governmental regulations
	Innovation capability	Innovation capability

3.3 Strategy map and dynamic balanced scorecard

Strategy map in figure 6 merges general characteristic from mind map with concrete indicators of competitiveness and organizes them in accordance with the layered BSC architecture. This structure is projected into the corresponding causal loop diagram, shown in figure 7. The dynamics behind the execution of competitive strategy is composed of mutual interactions of 20 loop with the lengths varying from 1 to 6. The majority of them have reinforcing character, and *Finances* are used as the overall limiting factor. Balanced are also the primary direct strategic outcomes, *Customers, Operations* and *Productivity*. For representational clarity, branches with their desired levels were omitted. External variables, which are out of organizational control, are boxed, and their dashed edges lack the directionality. The causal loop diagram shows that the formulation

of Competitive strategy must primarily reflect external factors, including *Collaborative relations, Market efficiency, Labour market and Regulations*.

The execution of Competitive strategy can in a selected combination and timing influence the following factors: Price, Customer relationship management, Staff, Learning and growth, Quality, Technology and Innovations and Corporate social responsibility. All these activities require financial resources, the amount of which determines the type and range of currently realized strategy.

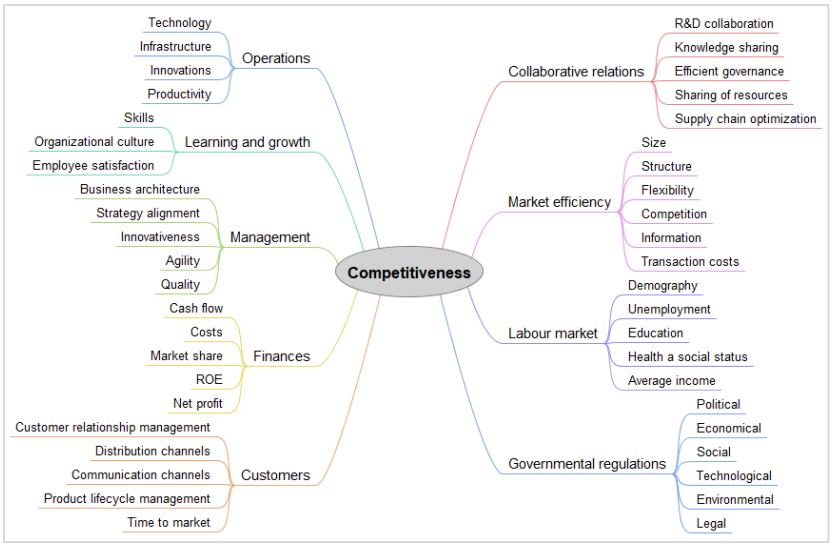

Figure 5: Mind map of selected internal (left) and external aspects of competitiveness

3.4 Agent-based architecture

The unique feature of agent-based modelling insists in its representational transparency. Agents are considered either as standard human beings or, more generally, as specific services, devices or subjects. That is why the agent-based definition of a real-world problem is similar to the formal principles of object-oriented business process modelling. Thus, every agent has attributes and functionalities, which can be either internal (individual decisions and actions) or external (perceptions, communication, services). Some of these characteristics can be inherited from its momentary role. During lifecycle, an agent can move among different states with specific transition probabilities. This nontrivial structural and behavioural environment can be in terms of presented research formalized as follows:

- Roles: manager, leader, team member, customer representative.
- States: core work, administrative work, training, learning, communication, idle.

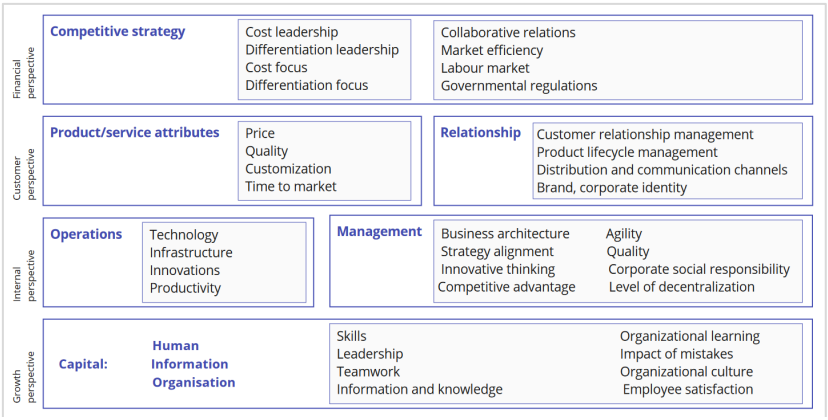

Figure 6: Strategy map of the proposed framework for execution of competitive strategies

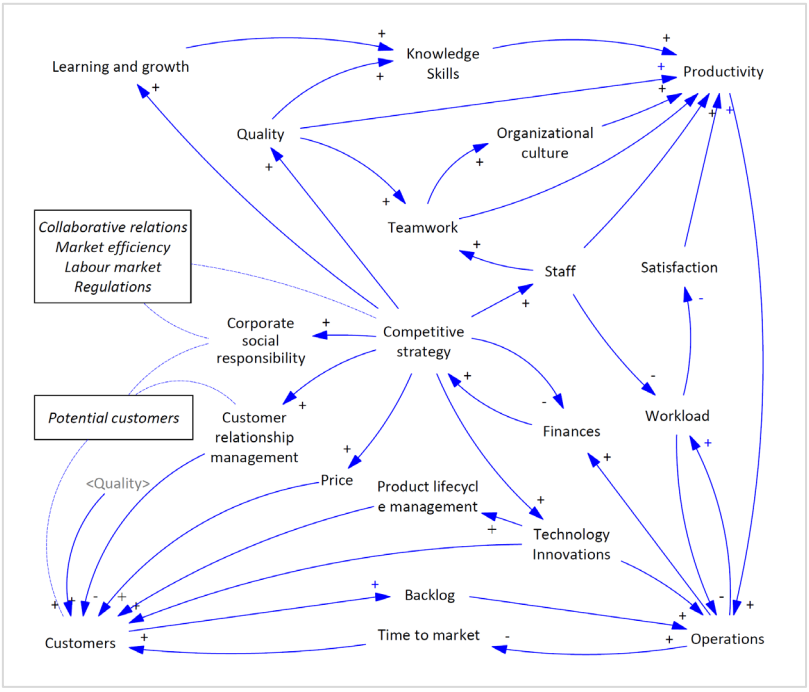

Figure 7: Causal loop diagram with sample execution dynamics of competitive strategy

- Tasks characteristics: state (to do, work in progress, done), priority, complexity, innovativeness, interconnectedness, communication, business criticality, confidence.

- Attributes: personal status (age, education, social status), professional capabilities (knowledge, skills, learning ability), general personal and team/social behavioural features, e.g. according to Myers-Briggs classification (Kuipers et al., 2009).
- Behaviour: specific functionalities, required for agent's updates, decisions and collaborations.

For the initial simplicity, we expected that the teams are established administratively, which means that the necessary characteristics are known in advance. The emergent development of competitiveness index assumes that in every computational cycle, each agent, aware of own role, state and attributes, collects available external information and accordingly maximises own utility, also incorporating the team priorities. These actions update parameters of the whole population and establish initial conditions for the next round of calculations. Simulations can run either for a predefined number of cycles or until stopping criteria are met. In contrast to the aggregate causal loop diagram, the behaviour of the agent-based model is significantly less predictable. Also, technical adjustment of such models is harder, because the order of their internal dynamic is many times higher in comparison with CLD.

3.5 Process proposal

The proposed frameworks and tools can be used in the following way:

- Define and publish yearly strategic company-level objectives (CYO) and execute them within a traditional, centralized, top-down framework.
- Quarterly refine and specify CYO into the company quarterly objectives (CQO) and publish them.
- According to publicly available CYO and CQO, single teams formulate own quarterly objectives (TQO), altogether with the related key results (KR).
- During the planning and execution stages, the immediate efficiency of strategies towards CSO and CQO can be parallelly monitored using the suggested computational tools for BSC and OKR frameworks. Undesirable steady differences or improper trends between levels indicated by CSO and CQO can be eliminated in the subsequent quarter.
- These corrections can affect the next planning cycle in both directions:
    - Team initiatives and preferences can be added to the next set of CQO by executive management,
    - Discovered discrepancies are discussed during the team quarterly retrospectives to eliminate them in the next cycle.

Organizations, adopting this process, can prepare and evaluate responsive plans in a safe environment and immediately and systematically react on substantial external of internal changes.

4 Conclusions

Frequently toothless realization of strategies prevents firms from higher performance achievement. Authors showed that the long strategic management cycles, accompanied with overall complexity, rigidity, non-personality or weak institutionalization of a competitive strategy, are the main reasons for company market failures. Decentralized, transparent and agile approaches, like OKR, do not suffer from such strategic deviations, as their overall strategy is synthetized from particular contributions from single teams and individuals. Due to their frequent revisions and gradual specifications, the problem of delayed responses and silent erosions of centralized objectives is minimized. Business value is delivered gradually, and flexible architecture can efficiently accommodate the changing environment. There is, however, a risk of losing the global vision because of inappropriate horizontal a vertical synergy of single objectives.

Thus, this paper suggests symbiotic collaboration of both frameworks. BSC key performance indicators can serve as steady long-time targets, while OKR key results are useful for the inclusion of internal innovativeness and market appeals. In case of any considerable deviations, management has can efficiently identify their causes and quickly respond. Moreover, proposed supporting aggregate and decentralized tools and processes can serve as dynamic simulators, capable of explaining and enhancing conclusions, obtained from traditional analytical or statistical methods. This is namely because the knowledge-based modelling and simulations can recognize emergent behavioural features, identify counterintuitive patterns or simplify and visualize multidimensional nonlinear relations.

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Research Challenges of Knowledge Modelling and the Outline of a Research Agenda

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Abstract

Faced with a new kind of presence of digital knowledge carriers because of the digitalization and Industry 4.0 settings, research agendas need to be updated by arising research challenges. Particularly novel kinds of knowledge-intensive interactions among individuals, teams and autonomous systems need to be addressed in contemporary knowledge modelling approaches and a state-of-the-art knowledge management.
This research presents the most relevant research challenges gathered by experts from relevant at the 15th International Business Informatics Congress 2020 in Potsdam in an interactive workshop. Based on a reality check, their relevance has been confirmed in scenarios and first ideas about solution approaches have been identified. Due to individual-based, team-based and plenum-based expert evaluations, a research agenda has been set up, to whom the research community's attention shall be drawn to, so that the most beneficial research steps can be issued next and research streams can be realized efficiently.

Keywords – Knowledge Management, Process Modelling, Research Challenges.

Paper type – Academic Research Paper

1 Introduction

The effective and efficient diffusion of knowledge within organizations is one of the most important performance indicators of contemporary knowledge management. It demands for numerous knowledge-intensive interactions among individuals, teams and - being enabled by the digitalization - autonomous systems as well as further ontological entities. Thus, new research challenges must be addressed at knowledge flow modelling or rather the modelling of knowledge-intensive business processes (BP) in organisations. In particular, the process- and activity-oriented modelling (Davenport, 1992; Hammer and Champy, 1993) of tacit and explicit knowledge (Nonaka and Takeuchi, 1995) as well as the differences between the two types of knowledge, should be addressed appropriately in the new contexts of digital work, a cyber-physical collaboration and human-intelligence-based as well as artificial-intelligence-based decision making and knowledge generation and forecasting (Grum and Gronau, 2018) and the process prediction (Rehse et al., 2019).

Faced with plenty attempts for outlining a research agenda, one can find relevant agendas in the following: First, agendas issuing the act of modelling, such as the collaborative modelling (Render et al, 2008). Secondly, the design of corresponding process models is issued, such as the inter-organizational BP design (Legner and Wende, 2007) or the external acquisition of knowledge (Hausschild, 1992). The third kind of agenda focus is put on the act of management BP, such as by agenda outlines about the process management (Ghose et al., 2010) and the knowledge management (Varun Grover, 2001). Fourth, agendas issuing the design of process supporting systems, such as by agendas about knowledge-flow addressing systems (Al-Mashari, 2003) and performance measurement systems (Neely, 2005). Lastly, a specialized focus is set on trend topics, such as by agendas about process mining (Van der Aalst and Weijters, 2004). Since the role of new technical and digital actors as well as the corresponding modelling of knowledge-intensive interactions has not been addressed by any relevant agenda. Thus, potentials for companies and science, which can result from the in-depth analysis of knowledge flows, remain unexplored and untapped at contemporary research agendas.

So, it is not remarkable, although being well-appointed with attempts for a process-oriented knowledge modelling, that these do not adequately consider challenges from the knowledge flow modelling. Faced by the following examples, it becomes clear that the allocation of knowledge resources within business processes still is insufficient: First, the conceptualization of machine-based knowledge. This overcomes the contemporary opinion of having humans as the only kind of knowledge carrier (Gronau, 2019). Second, the embodiment of knowledge in physical objects, as these can represent a further kind of knowledge bearer. This overcomes the contemporary opinion of only issuing material flows of physical objects (Scheer, 2012). Third, the quantitative characterization of knowledge and its artefacts. This includes but is not limited to the dimension of time and quality of knowledge transfers as well as knowledge-based process outcomes (Gronau and Grum, 2019) and, thus, overcomes the missing of quantitative analyses as well as simulations of knowledge transfers. Fourth, the anchoring of knowledge models within

the real world, which considers physical as well as virtual dimensions (Grum and Gronau, 2017). This overcomes limitations of a modelling only in two dimensions.

Faced with numerous challenges in the knowledge flow modelling and outdated research agendas, the following research question is pertinent: *How can issues emerging from the digitalization and future horizons in the area of modern knowledge modelling be transformed to a research agenda?* If it would possible to draw the attention of the research community to these kinds of issues, the most beneficial research steps can be issued next and research streams can be realized efficiently.

This paper is structured as follows: The second section provides the methodological approach, which is based on a workshop-method. Workshop outcomes are discussed in a third section, so that a research agenda can be presented at a fourth section. The final section concludes the research presented.

2 Methodology

Being framed by a workshop design, experts from the domain of knowledge management (1), process modelling (2) and practice (3), were faced with the analysis of the theoretical background of business process modelling and knowledge management. Then, in a plenum session, a clear and joint objective understanding was created. The workshop structuring and its basic parameters have been visualized by Fig. 1. The following describes its phases in more detail and presents background information.

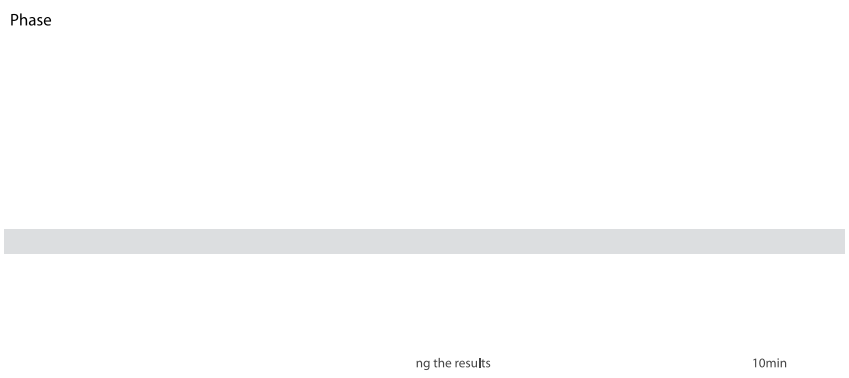

Fig. 1 – Basic Information of the Workshop Methodology Designed.

The first phase was structured by the method called "*Conversation Carousel*" (Klippert, 1995). As can be seen at Appendix 1, experts were asked to sit opposite each other and discuss in teams of two the most important current challenges from their point of view. After two minutes of discussion, the experts of the inner circle were asked to switch to the next discussion partner on the right, which was repeated for three times. Then, the experts have had ten minutes for the documenting of the most attractive ideas with the aid of the "*Research Issue Template*" (see Appendix 2). By this, the

identification of the most relevant research issues was supported because first, ideas were relativized by practical discussion partners, second, the variety of topics was increased by experts from different fields, and third, the preciseness of topics was increased by experts from the same field. In the first phase, this carousel has been realized for two times. The final issues were pinned on the pinboard for the further proceeding (Appendix 3).

In a second phase, the relevance of issues identified in the first phase were addressed for process modelling scenarios, so that the relevance was addressed. Since experts have been assigned to teams of not more than three persons, they were asked to first individually work out a scenario for each research issue documented in the first phase. This was realized with the aid of the "*Scenario Template*" (see Appendix 4). Then, they were asked to present the issues and corresponding scenario description within the groups. If new ideas came up, the templates were to be supplemented. Best research issues were selected by the group, so that a focus on the key issues was established.

As a kind of inspiration, first attempts to overcome relevant issues have been developed by a group work in phase 3. For the documentation of the solution designed, the template called "*Solution Design Template*" (see Appendix 5) was used. Then, solutions have been evaluated individually with the aid of the "*Evaluation Template*" (see Appendix 6) and discussed. Finally, this kind of solutions was selected by the teams that seemed to have the most potential for the research community and the highest relevance for practitioners.

In phase 4, the selected set of research issue, scenario-based relevance description, first solution attempt and team-evaluation was presented within the plenum. Here, the templates were used, that have been created in previous phases. After each presentation, the plenum has discussed challenges and opportunities for the exploration of research issues presented. Further, the complexity and dependencies of the issues presented so far were characterized. As a kind of research issue specific conclusion, the entire group of experts was asked to finally characterize the agenda item by supplementing the documentations on the pinboard individually. This was realized by walking from pinboard to pinboard. If questions occurred, the plenum attention was drawn to the corresponding agenda item.

Finally, in a frontal teaching setting, the outline for a research agenda has been derived, which refers to the temporal ordering of agenda items and their connecting to a solution path.

3 Workshop Outcomes

Having realized the methodological workshop design presented at the previous section, the following presents the most important workshop outcomes from the viewpoint of the workshop plenum. Because of the relation of the outcomes of (1) research issue, (2) scenario description, (3) solution attempt and (4) evaluation, these are interpreted as agenda items from hereon and presented jointly per agenda item. They will build the base for the derivation of a research agenda in the next section.

Agenda Item 1: *Dimensioning and measurement of the knowledge transfer quality*.

Since an instrument is missing, which measures the quality of knowledge transfers, the relation of the quality of knowledge transfers on knowledge transfers has not been issued, yet. The challenge here is to objectively evaluate the quality of knowledge transfers and to develop an instrument, which is usable in various knowledge transfer situations, such as different tasks. As the quality of knowledge transfers can be found at all SECI conversions of Nonaka and Takeuchi (1995), any knowledge intensive process is affected. Hence, the relevance for organizations is very high. A first attempt to design an adequate instrument can be identified by an empirical approach similar to (Gronau and Grum, 2019): in an experiment setting, different kinds of influence factors on knowledge transfers can be examined. This was evaluated to refer to a complex fundamental research having a duration about 30 months.

Agenda Item 2: *Dimensioning and measurement of the quality of knowledge*.

Since an instrument is missing, which measures the quality of knowledge transfer outcomes, the relation of any kind of influence factor on knowledge transfer outcomes has not been issued, yet. For example, one can assume a relation of the quality of knowledge transfers on the quality on knowledge transfer outcomes. The challenge refers to the distinct and clear definition of knowledge quality because its operationalization follows the definition. Similar to Agenda Item 1, this can be addressed in an experimental setting and result in knowledge transfer optimization (Albers et al., 2019). Hence, it was evaluated to demand for a high priority and to have a duration of 30 months.

Agenda Item 3: *Modelling of the knowledge transfer situation*.

To what extend modelling items are to be considered within a knowledge transfer situation needs to be conceptualized (Agenda Item 3a) and empirically proven (Agenda Item 3b). Faced with a variety of influence factors, the challenge refers to the consideration of adequate principles of modelling: It must guaranteed that models stay clear and efficient, e.g. Further, it is essential that items are generalizable and thus describe the majority of specific knowledge transfer situations. Attempts can be found at Grum et al. (2019). Since training situations occur often in organizations, the relevance of this issue is very high. Being characterized as fundamental research, the feasibility was evaluated to be moderate. Its realization demands for a systematic experimentation of relevant situation components, which is assumed to last about 15 months.

Agenda Item 4: *Comparability of knowledge among persons*.

In order to compare knowledge of any kinds of knowledge carriers, the context-independent and person-unbound description of knowledge must be enabled, which is adequate from knowledge management perspectives. Faced by heterogeneous knowledge domains of contemporary contexts, such as the Industry 4.0 context, in which all the trainees know a different kind of bit, the comparison with a required reference knowledge has a high relevance. Blended learning methods seem attractive for the verification of comparison concepts created. Particularly the suitability of survey methods and

ontologies seem attractive for comparisons. Being evaluated as complex fundamental research project with a duration of 20 months, its priority is high.

Agenda Item 5: *Automatization of the modelling of knowledge flows*.

Faced with the huge effort of identifying and modelling of knowledge flows in business processes, its automatic modelling has a high practical relevance. Since concepts for an automatic recognition and modelling of knowledge flows are missing, this research has a fundamental research focus, which was evaluated to be complex. First ideas refer to the derivation of knowledge flows from the mapping of tasks and enterprise resource planning systems. Because of this interim research step, the feasibility can be lowered. Having a high research priority, the realization time was estimated with 22 months.

Agenda Item 6: *Process prediction*.

Intending to predict the process behaviour with the aid of artificial intelligence techniques, a research focus lies on the identification of next process steps, risks arising, task duration, artefact outcomes, etc. Since it is not clear, which kinds of concepts, methods and tools are suitable for these purposes, this research follows fundamental research characteristics. Although insights are relevant for numerous organizational situations and the probability of occurrence is high, one still can identify challenges in the availability of huge datasets, small datasets and unknown causal relations. A solution approach should follow design-oriented research methods and could be based on deep learning techniques that represent process sequences (Grum and Gronau, 2018). An alternative research path can be identified at big process analytics approaches, with which situations are not arduously modelled, but simply prediction are created for next process steps (Evermann et al., 2017). Because of a complex research having risks to provide outcomes, the duration refers to 4 years.

Agenda Item 7: *Objectivation of the assessment of knowledge*.

Facing contemporary approaches to assess knowledge, one can identify subjective influences on the evaluation of knowledge. Ideally, with the aid of a tool, the assessment can be realized on an objective level. The challenges refer to the conceptualization of an objective kind of knowledge assessment and the development of an adequate infrastructure. Hence, this research was evaluated to be a fundamental research. Since its outcomes would enable the entire value chain of organizations, results will have a high impact in business processes. The feasibility was evaluated to be complex and have an expected realization time of 30 months.

Agenda Item 8: *Efficient recognition of tacit knowledge*.

Further research issues refer to the recognition of knowledge that is not observable by third parties. As tacit knowledge is known to be difficult to observe, ideally, a self-recognition is supported. The most promising solution approach referred to the development of a guided self-critical surveying method. Since the feasibility was evaluated to be moderate and to be a translational research, the realization duration was evaluated to be one year. Based on the digitalization of knowledge transfers in Industry 4.0 settings, in which workers are instructed by context-sensitive video tutorials and

remote workers, the research has a high priority because the autonomy of workers is supported.

Agenda Item 9: *Automatization of the identification of knowledge deficits*.

Intending to recognize the knowledge base of employees automatically, so that knowledge deficits can be recognized, the development of a task- and context-sensitive system is required. Since this kind of system was able to analyse any kind of task realization, the occurrence in business process scenarios is high. The most promising solution approach refers to the derivation of knowledge deficits if employees get stuck at certain tasks. Because of the dependency to Agenda Item 8, the realization duration is expected to be around 30 months and the research has a high priority.

4 Research Agenda

Based on research challenges identified by the workshop, the following outlines a research agenda. Fig. 2 presents agenda items in accordance with the numbering of in section 3 presented agenda items.

In a first step, these have been put in a sequential ordering, so that research paths consider the dependencies that have been identified by the plenum evaluation of the workshop. Then, agenda items have been arranged, so that their positioning with regard to the x axis schematically reflects durations, that have been identified by the plenum evaluation of the workshop. Please remark here, that the realization duration of the entire collection of research issues does not have to consider a semi-sequential examination having a duration of about 15 years. It refers to one of many possible arrangements assuming to have one starting stream of research. Hence, although having created and discussed the schematic visualization of Fig. 2 at the wrap up session with the plenum, in a post-processing, each research path has been re-evaluated in regard with the identification of individual research streams. From the perspective of the authors of this contribution, this is promising since the provision of different research paths supports the accessing of research challenges from various sides.

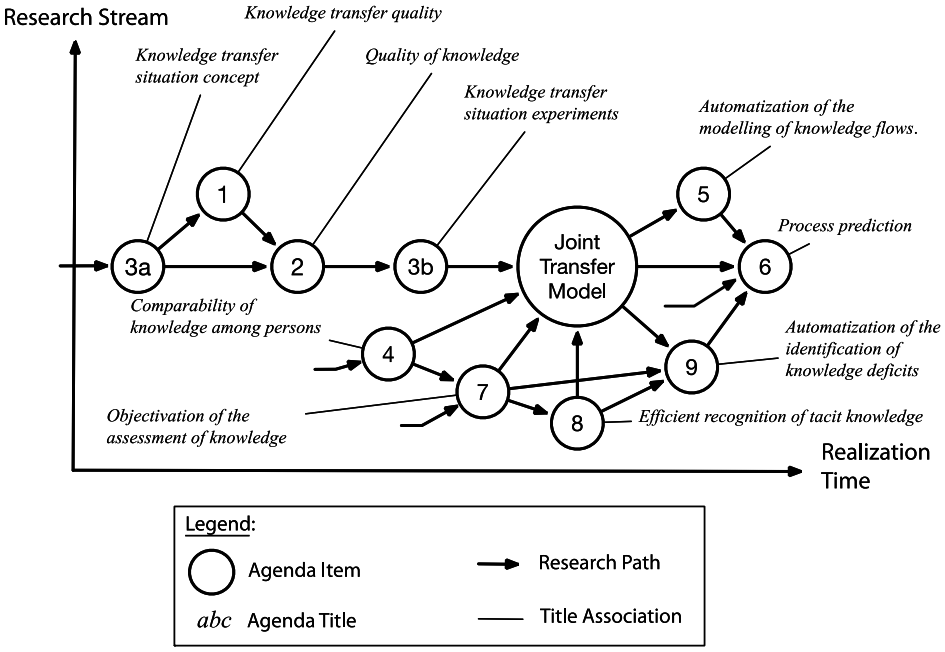

Fig. 2 – Research Agenda.

Although one can access research issues via different research streams, the research agenda does not demand for completeness or rather to be the one and only agenda possible. Further, it does not claim to present the most realistic as well as efficient kind of realizing the research proposed. In the limited context of knowledge flow modelling and the challenges because of digitalization and its future horizons, the research agenda represents the recommendations of the workshop group of experts.

5 Conclusions

As an outcome of this research, a list of emerging issues coming from the digitalization and future horizons in the area of modern knowledge modelling has been set up. This includes the characterization of individual research issues. Further, since complexities and dependencies of them have been characterized on behalf of concrete scenarios as well as challenges and opportunities for their exploration have been emphasized, their arrangement by research streams has been set up. Jointly, they form the proposed research agenda.

With regard to the research question proposed (*How can issues emerging from the digitalization and future horizons in the area of modern knowledge modelling be transformed to a research agenda?*) has been answered as follows: experts from the domain of knowledge management (1), process modelling (2) and practice (3) have been

faced by a workshop design, with which emerging issues and its scenario-based relevance has been characterized. Further, the joint evaluation has been identified with regard to the research characteristics and dependencies and durations have been estimated. The results have been transformed to a rough research agenda, so that the sequence of research has been based on a by content plausible and by dependencies required ordering. Although the results do not claim for completeness or rather to be the one and only possible research agenda, the authors intend to draw the attention of the research community to these kinds of issues, so that the most beneficial research steps from the viewpoint of the group of experts can be issued next and research streams can be realized efficiently.

The resulting agenda must be limited in the representativeness, which is due to the limited number of workshop participants. As experts were mainly part of the German community, the research agenda outlined is intended to serve as a starting point for discussions.

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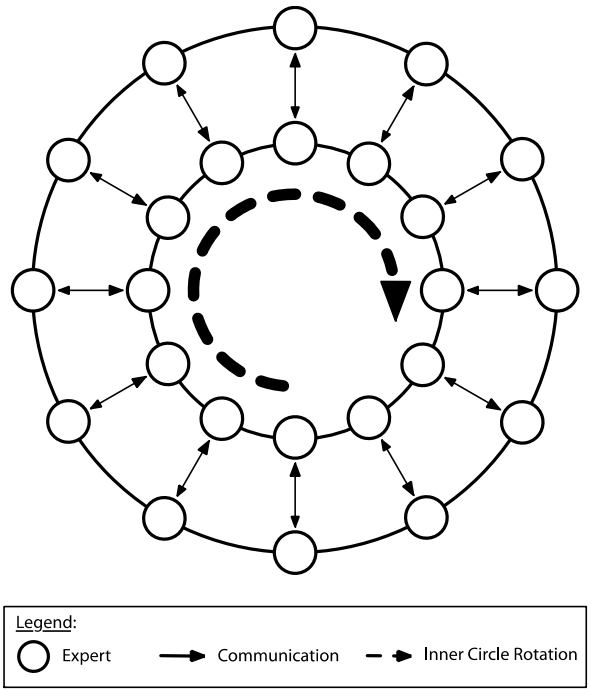
Appendix 1 – Communication Carousal



Appendix 2 – Research Issue Template

Research Issue Template

RI. ID: [Number] 1

Name: [Text] Marcus Grum

Group ID: [Number] 0

Idea Collection from Communication Circle: [Keywords]

Discussion 1	Discussion 2	Discussion 3
...	...	...

Title: [Description as Text]

Measurement and Dimensioning of Knowledge Quality

Problem Statement: [Description as Text]

The quality of knowledge cannot be measured on an objective level. Hence, an instrument for the operationalization is to be created.

Motivation: [Description as Text]

Foundation of a quantitative dimensioning of knowledge transfers

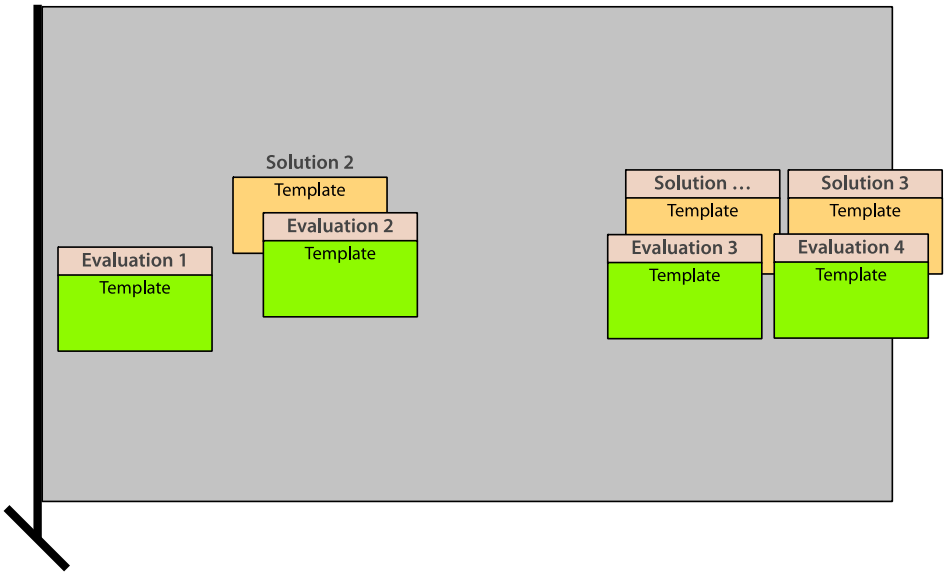
Research Question: [Description as Text]

How can the quality of knowledge be measured?
Which kinds of influence factors affect the quality of knowledge?

Challenges: [Description as Text]

Operationalization of knowledge, Subjectivity

Appendix 3 – Pinboard Layout



Appendix 4 – Scenario Template

Scenario Template

Sc. ID: [Number] 1

Name: [Text]
Marcus Grum

Title: [Description as Text]
Dimensioning and Measuring of Knowledge Quality in Product Development Contexts

Scenario Description: [Description as Text]
In product development contexts, one can finde various knowledge-intensive processes, that are based on SECI activities: reading of requirements (Internalization), develop product artifact (Externalization), combine concepts (Combination), discuss with customers (Socialization).

Occurrence Probability: [Stroke] Please complement in group working!

seldom	sometimes	often	very often
			I

Practical Relevance: [Stroke] Please complement in group working!

none	a bit	moderate	high
			I

Special Suitability of a Research Method: [Description as Text]
Experimentation

Appendix 5 – Solution Design Template

Solution Design Template

SD. ID: [Number] 1

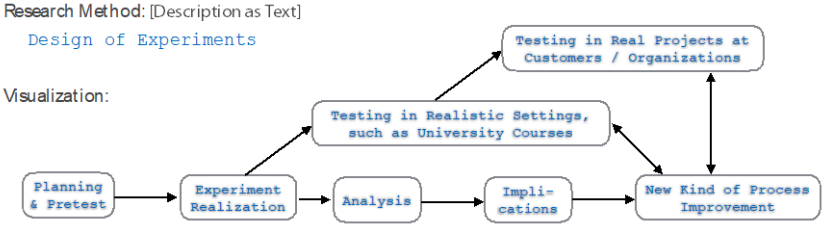
Name: [Text]
Marcus Grum

Title: [Description as Text]
Quantitative Examination of Knowledge Transfers

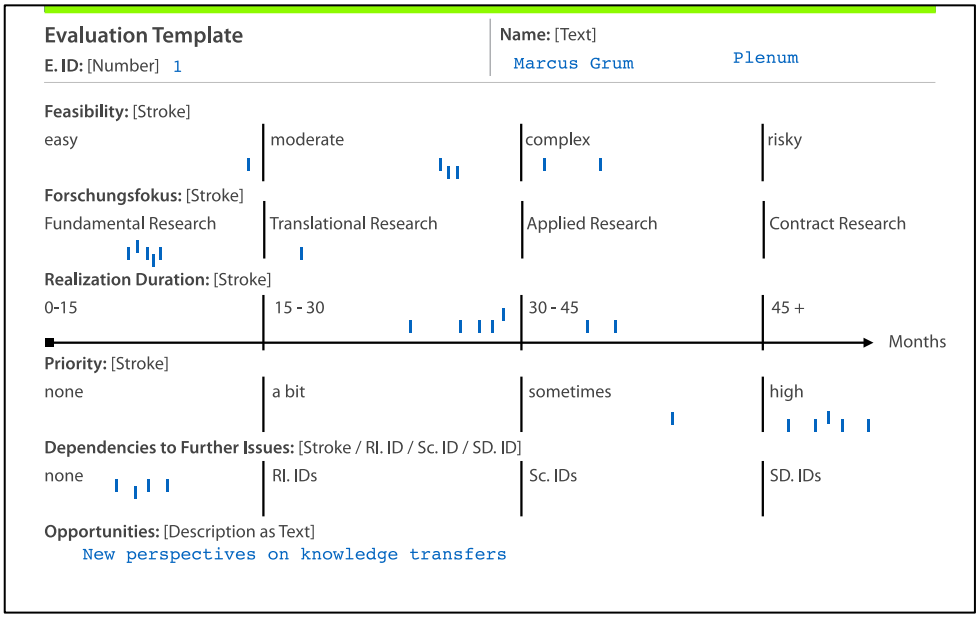
Solution Idea: [Description as Text]
An experiment is designed, in which factors are observed, that seem to affect the quality of knowledge and artifacts being constructed during knowledge transfers. The laboratory study is ideal since relevant factors can be controlled effectively.
The most relevant factors appear to be the competence, complexity, stickiness and time pressure.

Research Method: [Description as Text]
Design of Experiments

Visualization:



Appendix 6 – Evaluation Template



Toward a Conceptualisation of a Maturity Model for Business Model Innovation

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Abstract

This conceptual study seeks to bridge established theory on maturity models (MMs) and business model innovation (BMI). Extant literature discusses BMI as a source of competitive advantage (Casadesus-Masanell and Ricart 2011; Chesbrough 2007; Mitchell and Coles 2003) and potentially the most challenging type of innovation (Björkdahl and Holmén 2013, Lindgardt et al. 2009). A study by Christensen et al. (2016) shows that the BMI success rate for firms is low, which is reflected in high error indices. The high degree of uncertainty, ambiguity and complexity associated with BMI carries a high risk of corporate failure in the transformation of business models, especially due to the lack of required skills, knowledge as well as suited processes and mechanisms to support successful BMI. Moreover, De Fazio (2017) suggest that in order for companies to reap the full benefits of innovation, it should be ubiquitous, controlled, measurable and strategically implemented, and must therefore be supported by appropriate analytical models, processes and tools.

Whereas BMI is often triggered by unpredictable changes in an organization's external environment (Brasseur et al. 2017; Şimşit et al. 2014; Steinhöfel et al. 2016), we base our study on the assumption that organizational change and development occur in predictable patterns. MMs represent theories about how organizational maturity evolves in a stage-by-stage manner along an anticipated, desired, or logical maturation path (Röglinger and Pöppelbuß 2011). Following this rationale MMs are utilized as diagnostic tools that enable organizations to describe maturity in the context of an as-is assessment, thus providing guidelines on how to reach the next, higher maturity level (Ofner et al. 2009; Röglinger and Pöppelbuß 2011). Röglinger and Pöppelbuß (2011) suggest that attention to MMs is expected to increase a prediction corroborated by the numerous proprietary models proposed by software companies and consultancies (Scott 2007). Recent literature also

reports an increasing academic interest in maturity models (Becker et al. 2010). Despite the existence of various innovation MMs, there is, to the best of the authors' knowledge, no specific MM for BMI.
This study contributes to the innovation management and business model literature by assessing how BMI and MMs can be conceptually bridged. The aim of the paper is to identify boundary conditions for a subsequent design of an integrated MM for BMI that enables the assessment, benchmarking and progress of organizational maturity with regard to BMI.

Keywords – Business Model Innovation (BMI), Innovation Management, Innovation Maturity Model (IMM), Maturity Model for Business Model Innovation.

Paper type – Academic Research Paper

1 Introduction

In today's fast-changing and unpredictable business environment, companies are increasingly confronted with globalisation of markets, dynamic technology developments, short product life cycles, shifting patterns of demand, growth demands and new regulatory requirements (Brasseur et al. 2017; Şimşit et al. 2014; Steinhöfel et al. 2016). To succeed in this fast-changing environment, companies are forced to grow, outperform and adapt at a rapid pace (Şimşit et al. 2014). As a result, companies are under constant pressure to innovate for remaining competitive (Brasseur et al. 2017). As products, services and processes tend to become quickly obsolete due to imitation, innovations in these areas can only provide firms with short- to medium-term competitive advantage (Amit and Zott 2010; Chesbrough 2010). BMI has recently attracted increasing attention as a promising approach for providing sustainable competitive advantage, particularly in the face of saturated markets, inter-industry competition, and substitutability of product and process innovations (Brasseur et al. 2017; Steinhöfel and Inkinen 2016; Steinhöfel et al. 2016). Thus, the literature discusses BMI as a main determinant of competition and at the same time as the most challenging type of innovation (Brasseur et al. 2017; Minatogawa et al. 2018) with a high rate of failure (Christensen et al. 2016), especially due to the lack of the required skills, knowledge as well as suited processes and mechanisms to support BMI (Brasseur et al. 2017). Any innovation, including BMI, must be ubiquitous, controlled, measurable and strategically implemented, which is why it must be supported by suitable analytical models, processes and instruments (De Fazio 2017).

Maturity models (MMs) are helpful tools to assess the maturity (i.e. competency, capability, level of sophistication, degree of progress) of a selected domain based on a more or less comprehensive set of criteria (de Bruin et al. 2005; Ofner et al. 2009; Becker et al. 2009; Röglinger and Pöppelbuß 2011). Based on the assumption that organizational change and development occur in predictable patterns, MMs represent theories about how organizational maturity evolves in a stage-by-stage manner along an anticipated, desired, or logical maturation path (Röglinger and Pöppelbuß 2011). Despite a large number of

different types of MMs in various application domains and different levels of detail, the structure of these models is very similar: They define a number of discrete stages or maturity levels for one or multiple dimensions, with descriptions of the characteristic performance per level building upon each other (Fraser et al. 2002). The value for organizations applying such models varies according to the application-specific purpose. First, MMs are diagnostic tools that enable organizations to describe maturity in the context of an as-is assessment. Secondly, a MM provides guidelines on how to reach the next, higher maturity level. Descriptions of higher maturity levels can be seen as best-practice guidance. Finally, MMs can be used for the purpose of comparison and facilitate, for example, internal and external benchmarking (de Bruin et al. 2005; Ofner et al. 2009; Röglinger and Pöppelbuß 2011).

Despite the existence of various innovation maturity models (IMMs), there is, to the best of the authors' knowledge, no MM available related to BMI, yet. Therefore, this study provides an assessment of how theory on MMs can be fused with theory on BMI in order to establish a foundation upon which subsequent research can propose a MM for BMI that allows managers to assess and guide BMI in their company. This paper aims to contribute by systematically assessing current literature to establish ontological consistency in our bridging attempt, as well as defining boundary conditions for subsequent model development.

2 Methodology

In order to identify and select appropriate IMM frameworks that could be fused with BMI theory, we applied a three-step approach.

2.1 Identification of MMs and methodologies for developing a MM

The expediency of MMs, even if they differ with regard to the field of application, granularity, number of dimensions or maturity levels, lies in the demarcation between clearly defined levels of maturity, which are building upon each other and represent a logical evolution path (Igartua et al. 2018; Röglinger and Pöppelbuß 2011). In this way, MMs offer a good balance between standardisation and flexibility (Achi et al. 2016), which is necessary for the successful application in different types of organisations of various industries. Another advantage is the simplicity that comes with the structure of MMs that makes them very easy to understand and communicate (Igartua et al. 2018). This simplicity is at the same time the starting point for criticism regarding the concept of MMs. They are, for example, often characterised as 'step-by-step recipes' that oversimplify reality and lack empirical foundation (Igartua et al. 2018).

Against this background, management research increasingly addresses MMs from a product design process perspective, and thus a great amount of research focuses on methodologies for developing MMs (Igartua et al. 2018). Table 1 shows various articles on the methodology of developing a MM systematically.

Table 2: Identified articles on methodology of developing a maturity model systematically

Author (Year)	Name of Article
Ahlemann et al. (2005)	Kompetenz- und Reifegradmodelle für das Projektmanagement
Becker et al. (2009)	Developing Maturity Models for IT Management
de Bruin et al. (2005)	Understanding the Main Phases of Developing a Maturity Assessment Model
Fraser et al. (2002)	The use of maturity models/grids as a tool in assessing product development capability
Kulkarni and Freeze (2004)	Development and Validation of a Knowledge Management Capability Assessment Model
Mettler (2011)	Maturity assessment models: a design science research approach
Ofner et al. (2009)	Dealing with Complexity: A Method to Adapt and Implement a Maturity Model for Corporate Data Quality Management
Röglinger and Pöppelbuß (2011)	What makes a useful maturity model? A framework for general design principles for maturity models
Simonsson et al. (2007)	Model-based IT governance maturity assessments with COBIT
Solli-Sæther and Gottschalk (2010)	The Modeling Process for Stage Models

Among the approaches listed in Table 1, those were sought that offer both practical and pragmatic support for a systematic MM development. Using this selection criterion, only two approaches meet our requirements, namely: Mettler (2011) and Röglinger and Pöppelbuß (2011). Both approaches propose a framework aimed at supporting the design, improvement or application of MMs for researchers and practitioners in a pragmatic yet substantiated way. For further consideration the framework by Röglinger and Pöppelbuß (2011) was selected based on the number of citations in Google Scholar.

Röglinger and Pöppelbuß (2011) propose a framework which consists of general design principles (DP) and several related sub-aspects of DP, that are helpful to design useful MMs for specific application domains and purposes of use. According to the different application-specific purpose of MMs[1], the proposed DP are grouped into (1) basic principles, (2) principles for a descriptive purpose of use, and (3) principles for a prescriptive purpose of use (see Figure 2). Röglinger and Pöppelbuß (2011) have deliberately not considered the comparative purpose of use in their framework. In their opinion, DP for this purpose of use largely depend on external factors, such as standardized and publicly available specifications, and can therefore only be partially influenced during MM design (Röglinger and Pöppelbuß 2011). Röglinger and Pöppelbuß (2011) neither require a maturity model to meet all proposed DPs (basic, descriptive and prescriptive DPs) nor their sub-aspects. Instead, the framework intends to assist practitioners and researchers in comparing existing maturity models (see part 3) and

[1] *As described above, MMs are tools for as-is-assessment (descriptive), best-practice guidance (prescriptive) and/or benchmarking (comparative).*

serves as a "checklist" for designing new maturity models. Due to the scope and objective of the paper, focus is on basic DPs (see Table 2) when comparing IMMs as well as when defining boundary conditions for developing a MM for BMI.

Table 2: Framework of general DP for MMs according to Röglinger and Pöppelbuß (2011)

Group		Design Principles
(1) BASIC	1.1	**Basic information** a) Application domain and prerequisites for applicability b) Purpose of use c) Target group d) Class of entities under investigation e) Differentiation from related maturity models f) Design process and extent of empirical validation
	1.2	**Definition of central constructs related to maturity and maturation** a) Maturity and dimensions of maturity b) Maturity levels and maturation paths c) Available levels of granularity of maturation d) Underpinning theoretical foundations with respect to evolution and change
	1.3	**Definition of central constructs related to the application domain**
	1.4	**Target group-oriented documentation**
(2) DESCRIPTIVE	2.1	**Intersubjectively verifiable criteria for each maturity level and level of granularity**
	2.2	**Target group-oriented assessment methodology** a) Procedure model b) Advice on the assessment of criteria c) Advice on the adaptation and configuration of criteria d) Expert knowledge from previous application
(3) PRESCRIPTIVE	3.1	**Improvement measures for each maturity level and level of granularity**
	3.3	**Decision calculus for selecting improvement measures** a) Explication ofrelevant objectives b) Explication of relevant factors of influence c) Distinction between an external reporting and an internal improvement perspective
	3.3	**Target group-oriented decision methodology** a) Procedure model b) Advice on the assessment of variables c) Advice on the concretization and adaption of the improvement measures d) Advice on the adaptation and configuration of the decision calculus e) Expert knowledge from previous application

2.2 Literature review and identification of existing IMM

For the identification of existing IMMs, a systematic literature review was conducted. The objective of the literature review was to identify articles presenting and discussing one or various MMs related to innovation in general or BMI in particular in the context of business and management topics (inclusion criterion). For this purpose, scientific

databases[1] such as ECONIS (ZBW), Scopus and Wiley Online Library were searched using the meta-search engine Fraunhofer eLib, as well as Google Scholar was searched for relevant literature. In this context, the following six search terms and combinations of search terms using the operator 'and' were applied: (1)'innovation maturity model', (2)'innovation maturity models', (3)'innovation' and 'maturity model', (4)'innovation management' and 'maturity model', (5)'business model innovation' and 'maturity model' and (6)'business model' and 'maturity model'. English publications until June 24th, 2019 were examined to determine whether the defined search terms appear in the title. As a first result, 210 potentially relevant publications were obtained. It is particularly noteworthy that no results were found for the search term (5)'business model innovation' and 'maturity model'. This can be seen as an early indication of the fact that no MM for BMI has been published yet. In subsequence, duplicates as well as master and doctoral theses were removed by hand and a total of 82 articles was obtained. These articles were examined in 3 screenings, first the title, then the abstract and finally the full text. Through screening 33 articles whose titles indicate that they present and discuss one or more MMs related to innovation in general or BMI in particular were identified. By screening their abstracts the number of articles was further reduced to 25 articles. The subsequent screening of the full text was to verify the positive rulings of the screening of titles and abstracts. Since six articles could not be retrieved and three articles did not meet the inclusion criterion of presenting and discussing one or various MMs related to innovation in general or BMI in particular in the context of business and management topics, 16 articles were identified by screening the full texts. Using these 16 articles, 13 further articles were identified by forward/backward referencing, that meet the inclusion criterion as well. Therefore, 29 articles were finally considered. As some MMs are dealt with in more than one article (Achi et al. 2016; Carlson and Gupta 2014; Jansson 2011b), the 26 MMs that have finally been discerned are listed in Table 3.

Table 3: Identified Innovation Maturity Models (IMM)

Author (Year)	**Name of IMM**
Berg (2013)	Innovation Maturity Model (Berg Consulting Group)
Bezard (2006)	Innovation Maturity Model (IMM© [Club 03])
Corsi and Neau (2015)	Innovation Capability Maturity Model
Cross (2013)	Model of An Adaptive Organization (MAO)
Demir (2018)	Strategic Management Maturity Model for Innovation (S3M-i)
Enkel et al. (2011)	Open Innovation Maturity Framework (OIMF)

[1] *The following scientific databases were searched by the meta-search engine Fraunhofer eLib: CEEOL Journals, Directory of Open Access Journals (DOAJ), Ebook Central Perpetual and DDA titles (ProQuest), ECONIS (ZBW), Fraunhofer-Publica, HAL (CCSd), IEEE (CrossRef), Informa - Taylor & Francis (CrossRef), Science Citation Index Expanded (Web of Science), Scientific.Net (Trans Tech Publications), Scopus (Elsevier), Social Sciences Citation Index (Web of Science), Springer (CrossRef), SpringerLink, SpringerLink Books – All, SpringerLink Open Access, Wiley (CrossRef) and Wiley Online Library.*

Essmann and Du Preez (2009)	Innovation Capability Maturity Model (ICMM)
Esterhuizen et al. (2012)	Knowledge Management Framework (KMF)
Fenn, J., Harris, K. (2011)	Innovation Management Maturity Model (Gartner)
Forrester Research (2013)	Continuous Delivery Maturity Model (Forrester Consulting)
Funchall et al. (2011)	People Innovation Capability Maturity Model (PICaMM)
Gupta (2011); Carlson and Gupta (2014)	Breakthrough Innovation (Brinnovation™) => Business Innovation Maturity Model (BIMM)
Habicht et al. (2012)	Open Innovation Maturity Management Framework (OIMMF)
Igartua et al. (2018)	Innovation Maturity Model (IM2) approach for small SMEs
Jansson (2011a); Jansson (2011b)	Innovation and Engineering Maturity Model (IEMM)
Knoke (2015)	BIVEE Framework and Collaborative Innovation Capability Maturity Model (CICMM)
Mann (2015)	Innovation Capability Maturity Model (ICMM)
Mohammad and Romeri (2007)	Innovation Maturity Model (PRTM and Microsoft Corporation)
Müller-Prothmann and Stein (2011)	Integrated Innovation Maturity Model (I²MM) for Lean Assessment of Innovation Capability
Narayana (2005)	Framework Approach to Measure Innovation Maturity
Narcizo et al. (2019)	Reference Model for Innovation Capability Maturity in low-tech companies or non-R&D practitioners
Nauyalis (2013)	Innovation Management Maturity Model™ (Planview)
Rübel et al. (2018)	Maturity Model for Business Model Management in Industry 4.0
Stahl et al. (2017)	Responsible Research and Innovation (RRI) Maturity Model
Toole et al. (2010)	Innovation Maturity Model (IMM)
Williams (2010)	Innovation Maturity Model (IM2)

2.3 Selection of identified innovation maturity models

In order to reduce the number of IMMs identified through the systemic literature research for our analysis, six IMMs were selected in a two-stage selection process.

The first selection step focused on the dissemination of the different IMMs in the scientific community. Therefore, the number of citations in Google Scholar was used to determine which of the identified IMMs are most prevalent. These were the IMM by Enkel et al. (2011) with 117, Essmann and Du Preez (2009) with 84 and Gupta (2011) with 59 citations, respectively. In a second step, additionally to the before selected IMMs a further three were considered that represented the most current state of research. According to the publication year these were the IMMs by Demir (2018), Igartua et al. (2018), Narcizo et al. (2019) and Rübel et al. (2018). Two of these IMMs were selected for their underlying definition of innovation and for establishing a link to BMI. Both Demir (2018) and Igartua et al. (2018) understand both, the transformation of value propositions such as products and services as well as of business models, as innovation

(Demir 2018; Igartua et al. 2018). Although the MM by Rübel et al. (2018) does not focus on innovation, but on process mastery it was taken into account due to the explicit consideration of business model management. The IMM by Narcizo et al. (2019) was discarded as it does not establish any link to BMI.

3 Analysis of selected innovation maturity models

In the following part, the six selected IMMs are analysed regarding the group of basic DPs and their related sub-aspects proposed by Röglinger and Pöppelbuß (2011) illustrated in Table 2 as well as regarding considering aspects related to business models.

3.1 DP 1.1 - Basic information

The analysis regarding the application domain (DP 1.1a) shows that the major domain of the MMs is innovation management apart from strategic management with focus on innovation in terms of products services and business models (Demir 2018) and business model management towards Industry 4.0 (Rübel et al. 2018). In this context, the MMs with the domain of innovation management focus on open innovation (Enkel et al. 2011), innovation of products, processes and/or strategies (Essmann and Du Preez 2009), product, service, process and business model innovation (Carlson and Gupta 2014) as well as services, products as well as business models in the light of innovation (Igartua et al. 2018).

Regarding the intended purpose of use (DP 1.1b) it shows that the majority of MMs pursue a descriptive, prescriptive and comparative purpose of use. Exclusively, Demir (2018) and Rübel et al. (2018) do not consider the comparative purpose.

With regards to the target group (DP 1.1c) it shows that focus is mainly on executives and in addition on decision makers in SMEs (Igartua et al. 2018) or more broadly practitioners (Rübel et al. 2018).

The analysis of the MMs regarding the class of entities under investigation (DP 1.1d) shows that some MMs are intended for any type of organization in any industry (Carlson and Gupta 2014; Demir 2018; Enkel et al. 2011; Essmann and Du Preez 2009) while Rübel et al. (2018) refers to organizations which can implement Industry 4.0 components and Igartua et al. (2018) to micro-enterprises and small SMEs.

In line with the before mentioned application domains (1.1a), which is often indicated by the name of the respective MM, all MMs elaborate on differences regarding related maturity models (DP 1.1e) of the same or similar domains.

A major difference can be observed with regard to the documentation and communication of the design process and extent of the empirical validation (DP 1.1f). Some authors document and communicate the design process in detail (Enkel et al. 2011; Essmann and Du Preez 2009; Rübel et al. 2018) whereas others touch the design process more briefly (Demir 2018; Carlson and Gupta 2014; Gupta 2011; Igartua et al. 2018). In this context it shows, that the scope of the design process differs greatly. While all authors

consider existing MMs and the majority conducts literature research to some degree for developing their MM, Enkel et al. (2011) and Essmann and Du Preez (2009) additionally conduct qualitative, exploratory research in the form of workshops or interviews for this purpose and for refining their MM. Furthermore, Essmann and Du Preez (2009) applied Latent Dirichlet Allocation (LDA) based topic modelling analysis to identify structures for their MM in the relevant literature in addition to manual research. Besides, it is noteworthy that Igartua et al. (2018) also applied the framework by Röglinger and Pöppelbuß (2011) while Rübel et al. (2018) used the procedural model by Knackstedt et al. (2009). According to the articles, empirical validation has so far been provided for 50% of the MMs (Enkel et al. 2011; Essmann and Du Preez 2009; Igartua et al. 2018).

3.2 DP 1.2 - Definition of central constructs related to maturity and maturation

The analysis regarding maturity and dimensions of maturity (DP 1.2a) shows that only one MM is one-dimensional comprising maturity levels for 'culture of innovation' (Carlson and Gupta (2014); Gupta (2011), whereas the other MMs are multi-dimensional. The latter, MMs differ greatly with regard to the number of dimensions, which ranges from three to eleven dimensions, and descriptors as well as the respective descriptions. These differences can be assigned differences of the MMs with regard to the respective application domain and the purpose of use. In this context, it is noteworthy, that it is difficult to determine the number of dimensions for the MM by Essmann and Du Preez (2009). According to Röglinger and Pöppelbuß (2011) a one-dimensional MM comprises for example process or object maturity (one axis) whereas a multi-dimensional model comprises multiple dimensions for which maturity levels are defined individually (two axis). Thus, each dimension has a different description for each maturity level (own maturity path). The MM by Essmann and Du Preez (2009) does not comply with either of these descriptions, as it combines maturity with an innovation capability construct and an organisational construct (three axis), making it obviously more complex and difficult to comprehend.

With regard to maturity levels and maturation paths (DP 1.2b) it can be observed that all MMs end at level five, whereas Demir's (2018) MM can be considered a minor exception as it formally suggests six maturity levels, starting at level 0. With regard to the descriptors and the description of the maturity levels, there are differences depending on the application domain and purpose of use. The almost only common feature is that they start at level 1 except Demir (2018) and end at level 5.

The available levels of granularity of maturation (DP 1.2b) show a large variance. Essmann and Du Preez (2009) provide several levels of granularity of maturation and thereby a very high level of detail. As outlined above, the framework comprises three axes whereas the innovation capability construct is further broken down into three capability areas and 11 underlying items and the organisational construct comprises five items. The IMM of Enkel et al. (2011) present a high level of detail with a detailed

matrix, in which a maturity level description is provided for each dimension and the operationalization of dimensions takes place through underlying sub-elements. Similarly, Rübel et al. (2018) measures maturity through underlying items of the business model building blocks. A lower level of detail can be determined for the MM of Demir (2018) and Carlson and Gupta (2014)/Guptas (2011) as they assess maturity on the level of dimensions providing different level descriptions for each dimension. Igartua et al. (2018) provide the lowest level of detail, as maturity levels apply to all dimensions and are only listed in the form of key points.

The analysis regarding the underpinning of theoretical foundations with respect to evolution and change (DP 1.2d) is complied with by all selected models as they build op on previous work and expedient literature from the respective application domain as well as about drivers and barriers of maturation.

3.3 DP 1.3-1.4- Definition of central constructs & target group-oriented documentation

The definition of central constructs related to the application domain (DP 1.3) is predominantly provided by the different authors. In this context it shows thought that the different constructs related to the application are not all defined explicitly. Often the constructs are explained and thereby defined to some degree. As outlined by Röglinger and Pöppelbuß (2011) the definition of central constructs secures understandability and language adequacy. The analysis regarding target group-oriented documentation (DP 1.4) shows that all MMs document basic information as well as central constructs (see above) and their interrelations are mainly documented in a target-group-oriented manner complying with the quality of communication.

3.4 Consideration of business model aspects

The analysis regarding business model aspects shows that four of the six MMs take into account business models to some degree. Demir (2018) considers the business model as an aspect of one of seven dimensions, namely the dimension “structure & model”. Here, organizational structure and business model are understood as tools to foster innovation and to support corporate strategies. The maturity levels of this dimension with regard to BM aspects are defined as follows: At level 0 the BM is unknown, at level 2 some of its components are known, at level 3 the BM is not innovative and strategies are not supported, at level 4 the BM is redesigned to foster innovation and empower strategies and at level 5 the BM is unique/innovative and fully integrated into strategies.

Rübel et al. (2018a) use the building blocks of the business model canvas according to Osterwalder und Pigneur (2010) as the structure for their MM. In this context, maturity is determined by the degree of process mastery with regard to Industry 4.0 of 28 business model elements underlying the nine building blocks. Each element is assessed using five generic maturity levels. Igartua et al. (2018) take into account the business model through

the MM category "Value propositions and business model", which is focused on the definition of offered products and services as well as the related benefits for customers and differentiation potential. To assess the maturity of each of the in total 11 categories, five generic maturity levels are defined. Carlson and Gupta (2014) state that their model aims at innovating products, services and business models and in the frame of the first (lowest) stage's description it is mentioned that organizations must develop a dynamic portfolio of innovations that include product, process, services and business model innovations. Additionally, the description of the fourth stage comprises that most departments are innovating new solutions on an activity, process, product, or business model level as a lever of that stage. Besides, no specific BM aspects are taken into account.

4 Boundary Conditions and Steps towards a MM for BMI

The above analysis revealed several important insights that can be used to define a first set of boundary conditions and outline further steps to design an integrated MM for BMI. Doing so in the following, the structure of basic design principles for MM according to Röglinger and Pöppelbuß (2011)is used.

The application of the envisioned MM focuses on the domain of BMI putting the process of innovating business models in the foreground (DP 1.1a). The purpose of the model persists in enabling the analysis of organisations or organisations' units' business model innovation capabilities and in providing them with guidance on how to prosper with regard to BMI as well as to allow benchmarking (DP 1.1b). The target group of such analysis, derivation of measures and comparisons may comprise executives, managers, business developers as well as entrepreneurs (DP 1.1c). In this context, organizations no matter of which age, size, and industry, ownership, public or private as well as units of such organizations are potential entities under investigation (DP 1.1d). Considering that no MM to date focuses on the domain of BMI and follows the above described purpose of use a clear differentiation from existing MMs is evident and will become even clearer once maturity, respective dimensions and maturity levels are defined (DP 1.1e). At this point of the MM conceptualisation, the design process of the MM is not concluded and has so far been documented in detail. The research and development process of the envisioned MM will be guided by the framework according to Röglinger and Pöppelbuß (2011) and the procedural model to develop MM by Knackstedt et al. (2009) as well as further approaches to MM development will be considered. In this context, the empirical validation is planned as a fundamental step in subsequence to conceptualising an initial version of the envisioned MM for BMI (DP 1.1f).

The conceptualisation of maturity and dimension of maturity needs to take into account different aspects related to the application domain of BMI. On the one side, the content and architecture of business models (business model components and relationships) as well as the process of innovating business models (e.g. analysis and design) and organizational (e.g. culture) as well as environmental aspects (e.g. partners) will be taken

into account. For this purpose the application of LDA on BMI literature and related fields and qualitative, explorative research represent promising approaches (DP 1.2a). Maturity levels should orientate on existing models for ease of understanding and be complemented by detailed maturation paths for the same purpose (DP 1.2b). As the MM for BMI is intended to support organizations in applying it, the available levels of granularity of maturation should allow a detailed analysis but should not be complicated by unnecessary complexity (DP 1.2c). Through this study, the underpinning theoretical foundation with respect to evolution and change (DP 1.2d), are commensurable between the two domains of MM and BMI, and thus the ambition to fuse the two withheld. Central constructs related to the application domain that will be defined in detail in course of the conceptualisation comprise the business model construct and the construct of BMI (1.3). In the frame of the conceptualisation all results will be documented target-oriented to comply with the requirement of communication.

5 Conclusion

As outlined in the above sections the objective of this paper is to define the boundary conditions for the conception of a maturity model for BMI. For this purpose, a suitable framework to develop maturity models was selected and applied to analyse six of 26 identified IMMs by means of a literature review. This approach constitutes a first step towards the conceptualization of a MM for BMI and provides some first valuable insights on how to proceed. One fundamentally important finding is that no maturity model exists to date that is dedicated to BMI, justifying this research endeavour. In addition, we defined fundamental boundary conditions in the form of design principles according to Röglinger and Pöppelbuß (2011) which will guide the subsequent steps towards developing a MM for BMI. This study thus contributes with an important foundation for subsequent model development for a MM for BMI. The envisioned model should support executives (target group) from established as well as new ventures (class of entities under investigation) in assessing the maturity of a company's BMI capabilities Furthermore, the envisioned model should provide indications of necessary adjustments and possibilities for improvement (purpose of use) and enable benchmarking of organizations or units.

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Bibliometric Big Data Analysis in Economics

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Abstract

Over the last years there has been a relevant increase of large scale data. "Volume", Velocity", "Variety", "Veracity" and, more importantly today, "Value" are the dimensions that characterize Big Data. Big data are increasingly important in the real world. In this paper, we deal with bibliometric datasets which represent relevant information and value for applications, usually difficult to identify. In economic analyses, bibliographic networks are useful to represent the data and provide relevant insights on research findings. In this work we will propose to apply a framework based on symbolic data and, in particular, one based on data-based symbolic observation interval which represent relevant patterns and information from complex data. These results are important because they consider a relevant case of complex information which is transformed into a representation useful to be analysed as network data. From these network representations of the information (considering a co-occurrence network from the relevant concepts of the studied literature of "regression discontinuity") we are able to identify the most relevant patterns in data, as "communities" of concepts maximally connected to each other. From the communities we are able to represent the semantic cores of the literature.

Keywords – Bibliometric Analysis, Big Data, Symbolic Data Analysis, Regression Discontinuity, Causal Inference

Paper type – Academic Research Paper

1 Big Data Analysis and Bibliometrics in Economic Science

Over the past 20 years, there has been a strong increase of large scale data in many different businesses. In this context the use of big data represents a relevant possibility and it could be very promising. Big data is the term which is generally used to describe large data sets and more generally large amount of data (Chen Mao Liu 2014). Big data represent a revolution in management for various reasons, which typically are described as "the five "V": "Velocity", "Variety", "Volume", "Veracity" and more importantly today "Value". The last dimension is particularly important and it is recognized in literature as one of the most recent V dimensions of Big Data.

In fact, during the last years there has been a relevant exigency to transform the large existing data quantities in profits for businesses (Hadi et al. 2015). Social big data is another relevant concept. In fact, if data are everywhere, social big data are at the same time a relevant possibility to be exploited in order to obtain advantages (Bello-Orgaz, Jung and Camacho 2016).

In this sense, big data and social big data should be seen as a revolution in many different contexts not only the business one, but also contexts such as government, science etc. (Kitchin 2014).

Big data are increasingly common in data analyses in different contexts. In Scientometrics, for instance, big data are pivotal in allowing the study of the increasing corpus of literature. Bibliometrics can be considered a big data science and the approaches need to be implemented by considering methodologies of big data analysis. A first relevant point is an increasing availability of bibliometric data (Moed Luwel and Deraio 2014). The datasets can be also combined and reconsidered in order to address different research questions. Secondarily, there is the availability of different types of structured, unstructured and semi-structured data (Gandomi Haider 2005) which can be merged differently. So, in past years, there has not only been a growth of large scale databases, but also the growth of different typologies of data types as full texts, abstracts, citations, keywords, co-authorships etc. (Halevi 2014).

Scientometrics is a relevant field which is developing. Mingers and Leydesdorff (2015) show the different evolution phases of fields. According to the work of the authors, there are different phases of the development of the field. Scientometrics has relevant phases which can be explicitly defined in this way: Garfield defined the citation relevance and proposed the Science Citation Index (see Garfield 1955). However, the relevance was relate to the network analysis of the different papers, considering the work of de Solla Price (1965), which stressed the relevance of the paper networks. After year 2000, there was a great development of different analytic techniques which was useful to measure some bibliometric relevant factors. We can consider the h-index by Hirsch (2005) a relevant way to measure the scientific impact of a specific author. Another phase that may be considered is the 1964-2011 period, which led to a greater development of analytical techniques, and in the latest years also computational techniques to perform some specific and important statistical analysis to extract relevant insights from the data. In the

literature on Symbolic Data Analysis (Billard and Diday 2003) there has been an approach to work with aggregate observations ("higher observations" representing "concepts of higher level") and not only dealing with single observations. The approach was considered by Drago (2005). In this sense this approach allows to take big data into account.

The aim of this work is to show some analytical techniques in bibliometric big data analysis that are useful to extract relevant information from this type of data. In particular, we will show how it is possible to use symbolic representations to adequately represent relevant concepts which can be extracted from big data. These concepts can be very relevant in order to extract knowledge from the relevant corpus.

The impact of the bibliometric and scientometric analyses is significant because of their capability to underline the relevant impact of the scientific research (Halevi 2014). From the richness of the data available in these contexts, we want to show how it is possible to extract the relevant "signal" from the data and the relevant meaningful patterns that emerge from the big datasets. The context is Economics, in which there often is the need to synthesize the relevant literature available.

So the relevance of this work needs to be considered in different contexts. Bibliometrics can be applied in every different scientific field and so its relevance cannot be undervalued (Ball 2017). In fact, Bibliometrics can help to analyse and explore the impact of innovative ideas and technologies in various fields. More in particular, in this work we will explicitly consider and we will analyse the experimental design literature and more in particular regression discontinuity (White Raitzer 2017). The topic is growing in importance in modern economic analysis and econometrics. An example of the application of the bibliometric big data analysis in practice is in Harle, Vest and Menachemi (2016) with the analysis of the research productivity in health policy and management.

The different classical quantitative methodologies of data analysis need to be reconsidered in this context. Classical data analysis should be reconsidered to take in to account this data volume. Big Data lead to relevant new challenges which need to be tackled by researchers and practitioners in every field.

A relevant problem is how to represent the original bibliometric datasets. In this sense, it is very important to also consider the different data typologies which can be observed in these analyses.

A relevant problem to be considered is the analysis of the relational data, which are very useful to understand the structure of the research and literature for a specific topic in a certain sector. In this sense, various possibilities arise in order to evaluate the different relationships of the different statistical units in the original data. We can consider citations, co-authorship, collaboration, co-occurrence networks between the others.

In this sense the use of social network analysis techniques can help to extract the relevant knowledge from these data. Various big data analyses can be performed in this context. For instance, networks of co-authorship, co-citation, and collaboration can be

usefully considered. These datasets can be considered by taking into account different topics and can be easily merged.

In this way, a problem in managing these big data arises very quickly, which is the difficulty of extracting the relevant information from these data. A relevant approach can be the use of symbolic data analysis (Billard and Diday 2003) and more in particular interval data, which allow to keep the relevant information from the networks. Drago in 2016 and 2019 considered this approach to network communities which can be considered as the leading elements of the analysis. The final result is that we are able to compose and decompose the network considered to extract the information from the data.

The relevant aspect of the networks considered are the communities which determine relevant patterns to be analysed (Drago 2017). In this sense the approach proposed is relevant to represent in a meaningful way these networks and extract the relevant information from the data. In this sense the expected results from this work are related to the possibility of managing these datasets and extracting the relevant information on the regression discontinuity design literature (which is very relevant in Economics and in Social Sciences).

2 Data and Methodology

We started with the creation of the bibliometric dataset. In this sense, data were collected by SCOPUS database on 1/6/2020 considering the query "regression AND discontinuity" which was subsequently restricted to the Economics area. In this way, we were explicitly searching papers which are part of the Economics, Finance and Econometrics area. At the end we collected 969 papers. These papers were collected considering at the same time different bibliometric information such as the "title" of the work, the "authors", the "abstract", the "keywords" etc. At the end we obtained a first summarization of the literature considered, by analysing the general bibliometric trends of the considered literature. It is important to note that we explicitly took into account different types of data: numeric (the year for instance) textual (the abstract), etc. A first relevant transformation on the initial data matrix is the possibility to obtain a network which represents the co-occurrences of the keywords considered in the works. From the network considered, we were able to perform a community detection analysis, in order to extract from the network the relevant communities which represent interesting patterns that it is important to extract from the literature. We used the walk trap community detection approach (Pons Latapy 2006) which has shown relevant results in literature.

The symbolic data analysis (Billard Diday 2003) approach allows to identify the relevant communities of symbolic data which can be considered as "data" of their own. So we could compare the different groups of observations and of course interpret them as a relevant group. R was extensively used for the computations (Aria Cuccurullo 2007 and Csardi Nepusz 2006).

A limitation of the approach is related to the generability of the proposal. Probably, the adoption of a big data approach can be useful in a theoretical field where the dimension of bibliographic resources is assumable as big data.

3 Results

The analysis was conducted from the initial network which is visualized in figure 1 "keyword co-occurrences network" (with 50 vertices as keywords to visualize) performing a network analysis useful to characterize our networks. The network analysis was conducted to consider the general characteristics of the networks examined. In particular, we have considered the keyword co-occurrence network as a key network to be analysed. The co-occurrence network considers if in the same text there is a co-occurrence of two keywords.

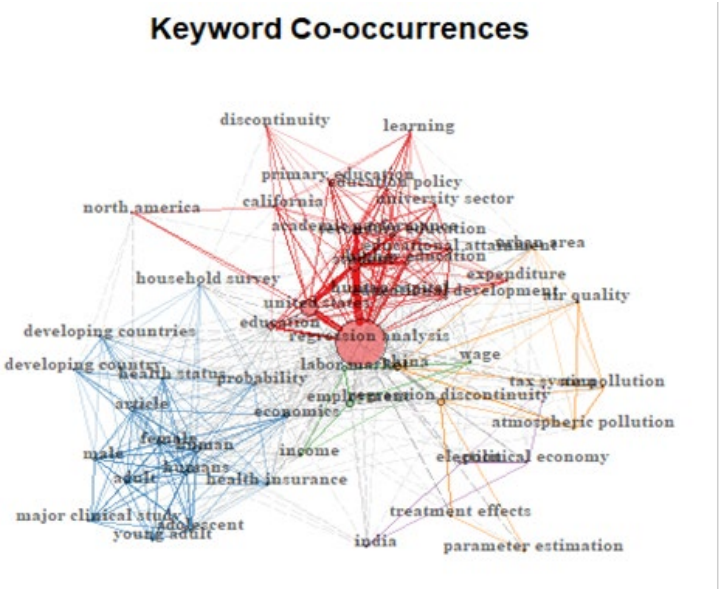

Figure 1. Keyword Co-occurrences network (number of vertices as keywords to visualize: 50)

So in the end we took into account 1207 keywords in our network analysis (see Wasserman and Faust 1994, Hannemann Riddle 2011). The different keywords were analysed considering centrality indexes such as Freeman degree, betweenness and etc. These two specific approaches are particularly important in our analysis because they allow to represent the centrality patterns in our network. In literature centrality on a network can be characterized by considering various measures. In particular, betweenness is a global measure of centrality and it is based on the ratio of the paths through which it is possible to pass from the specific node to the whole. The degree is a local measure of centrality and measures the number of connections of the node with its neighbours (the

different nodes which are connected to it). So the degree is simply the number of connections (also defined as "edges") a single node can have with other nodes (Wasserman and Faust 1994, Newman 2008).

Most importantly the community detection is aimed at identifying the groups of keywords maximally connected in the works (Fortunato 2010). This could be relevant to visualize and detect the relevant groups of keywords between the different works. The results allows the identification in literature of a number of 40 communities related to different groups of keywords.

The general results on the interpretation of the communities show the interconnection between different topics, in which regression discontinuity is applied specifically, and different methodologies, which are connected to the regression discontinuity or characterize them. The symbolic data itself allow to give the comprehension of the interval of centrality considered for each specific community or group. In this sense, each community can be considered as a sort of "semantic core" of the literature. The fact of identifying the variability of the centrality of the different keywords which are part of the semantic core allows to understand if the keyword components of the semantic core are relevant or not in the development of the literature. In particular, it is interesting to note that the community "1" that is very central to the development of the literature, is based on the regression, and has relevant applications in policy designs and also in labour markets and education. The community "8" shows relevant elements on health issues. So this community is related to topics which are part of the relationship between health economics and regression discontinuity. This community, at the same time, is based on the fact that in health it is crucial to consider the approach of regression discontinuity, or in general in this field the causality analysis is very relevant. In general, it is interesting to note that the word "propensity score" is also part of this semantic core. That means there exists, in this specific field, a call for the use of this specific methodology. In this sense it is interesting to detect this fact.

4 Conclusions

In this work we have considered a relevant a problem in the application of big data. We have considered big data based on bibliometric datasets. These datasets show relevant problems and they need to be adequately managed in order to extract the relevant knowledge from the data. In particular, we have considered an approach based on symbolic data analysis and an approach which transforms the different communities of the networks representing the original data into symbolic observations. These "special" data typologies allow us to consider in our case the semantic cores opposed to the single keywords considered on their own. In this context we were able to identify the different communities by means of the walk trap community detection technique (Pons Latapy 2006) and to transform the original data into interval observations. The interval observation was very useful to identify and interpret the real concept based on the interval measurement of the network centrality characteristics as well. In this sense the final result

was to identify the general characteristics for the semantic cores defined as the communities in the analysis. In particular, the general relevant result is the fact that we identified both the most relevant characteristics of a literature in Economics related to the "regression discontinuity" in term of important applications and methodologies used. At the same time, we detected relevant raising fields of new implementation of the approaches and also new insights on this literature. The value extracted from the literature is based on the results which can be obtained by examining the different topics and keywords which are part of the different communities extracted. In this sense, the value is obtained directly by considering the results related to the different communities and the different applications and methodologies which can be taken into consideration from the communities extracted.

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Metaphorical Images and Knowledge in Art and Medicine

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Abstract

Images and metaphors are an integral part of knowledge in the world around us. Therefore they can be put to a purpose in knowledge management. Images, including metaphorical ones, can serve as arguments in the decision-making process. To increase efficiency of this process by the means of comparative analysis, they should be used in the form of image tuples. Differences in the elements of the image tuple should be evaluated by experts with the use of confidence factors. In future, context-image-based knowledge management systems can be used in a variety of directions from archaeology to painting to medicine.

Keywords – knowledge management, arguments, image rows (tuple), healthcare, art.

Paper type – Academic Research Paper

1 Introduction

Images are integral elements of a holistic view of the world. In natural sciences and in humanities, holistic images take an important place. The value of holistic images is determined by the fact that the verbal equivalent is often too crude or erroneous. An attempt to decompose them often leads to loss of content, of identity. In turn, visual recollections or pseudo-memories (altered, or deformed visual images) and metaphors reinstate the meaning of a name – a concept, and return to the original essence. Such images are part of the knowledge. They can be either clear or vague or sketchy. However, intact core of an image allows you to identify a phenomenon or a scene, that undergoes a

change in time. Comparison of a "new", unfamiliar image with a known one may permit some uncertainty of the details; however, the key concepts must coincide to allow the identification.

The inclusion of visual images in the knowledge bases of intelligent systems can significantly increase their effectiveness in a number of areas, such as, for example, archaeology or art. They have distinctive meaning n medicine: in the diagnosis of a number of diseases according to the appearance of patients, and also to the images obtained during instrumental studies of human internal organs. The images of patients may be paralleled with images in art, and this approach should also have a place in artificial intelligence systems. Art, as Karl Popper writes [1], is in some sense different from science, but alike in other. The same can be said for other fields such as medicine or history of arts.

The situation in artificial intelligence is determined by the search for new approaches to reflect the mental activity of a person in making decisions. An attempt is made to transgress from the analysis of entities to an integral reflection of verbal and visual images, including the metaphor of human thinking. We have to create a hybrid version that includes both approaches used by natural intelligence, and to ensure a free transition from one type of situation recognition to another in artificial intelligence systems.

An image as a symbol can become, and should become the centre of logical-linguistic-imagery or imagery-contextual knowledge bases, with argumentation systems based on visual images.

The purpose of this study is to analyse the use of the imagery approach in knowledge management. This can serve as a foundation for new ideas in healthcare, in art history and management, and in other areas.

2 Knowledge management and images

The knowledge-driven system is constructed upon a unified knowledge base, that involves the technology of component design and stores information in a systematic form [2]. In this paper, the concept of image rows [3] is considered as an additional principle of systematization, i.e. when many close or relatively close images are embedded in logical-linguistic models in various loosely structured areas (history, archaeology, art, medicine). Image rows are discussed in more detail further in the text.

Application of the modular principle to the representation of knowledge serves to increase the management effectiveness in information systems [4]. This approach provides an efficient search and exchange of knowledge in modular form (semantic and / or image blocks). Integration "from above", that is, a general field of knowledge in a subject or problem domain, in combination with "internal" modules for displaying various specific information in certain areas will accelerate the creation of integrated knowledge bases or supermodules for solving new problems (provided that the principle of semantic interoperability is fulfilled).

The managing metabase of knowledge through special modules or sub-bases of knowledge associated with databases of relevant subject areas will allow, based on the generated hypotheses, to ensure the identification of necessary facts or the selection of necessary data, including images. As follows from the figure 1, the storage system of domain meta-knowledge manages lower located knowledge bases of problem areas and sub-bases of knowledge in narrower directions. If we turn to such a subject area as painting, then as examples of the first level we can consider, for example, the following problem areas: the Renaissance, the impressionism, the abstract art, and as examples of the second level – the high Renaissance, the pointillism, the suprematism. In medicine, respiratory diseases, cardiovascular pathology can be examples of problem areas, and subclasses or individual nosologies (types of diseases) – respiratory infections, bronchial asthma can be examples of subbases. It is possible to organize metabases in art by epochs, and diseases by their causes (trauma, etc.).

A module or a knowledge subbase in a specific area includes knowledge about images and the corresponding context. On this linguistic-imagery basis, the generation of rules and output mechanisms for knowledge bases is possible.

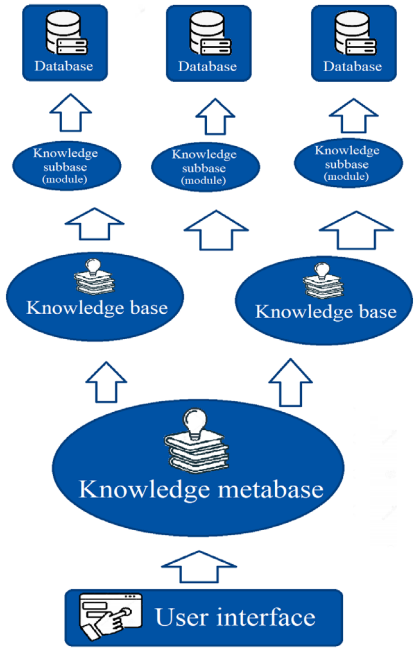

Figure 1. Knowledge-driven information systems (databases)

The transition to knowledge-driven systems involves the formation of image rows in completely different subject areas – like art, or museology, or medical diagnostics.

3 Arguments in knowledge systems

Knowledge systems can be constructed in various ways, including using argumentation trees, which present a sequence of features that argue downward on the tree [5]. Let's take as an example a medical database of lung diseases, constructed with argumentation trees. After we consider a combination of such characteristics as moderately elevated temperature, headache, muscle pain, dry cough, which are arguments to look for harsh respiration and isolated wheezes in the bronchi simultaneously with the reticular opacity on x-ray, we can argue for the hypothesis of an acute respiratory illness. A similar set of signs in the presence of a wet cough is an argument to check the second branch – for the presence of moist fine crackles the lungs and a shadow on the lung on the x-ray, which indicates to the hypothesis of bacterial or typical viral pneumonia. The third branch is focused on shortness of breath with fever and dry cough. These signs are arguments for identifying specific changes in the lungs observed on computed tomography (an image referred as ground-glass opacity or "frosted glass"). In this case, the diagnostic hypothesis is Covid19 (Fig. 2). The actual number of argumentative branches is much larger. And as you can see, they include facts (signs) and radiological images.

In argumentation systems, the metaphorical concept of a "dialectical image" introduced by the German philosopher Walter Benjamin [6], which is considered to be a "snapshot" of the past in the superposition of the present, can be used. This concept will serve as a basis for discussion in the formation of competing hypotheses that take into account the dynamics of facts.

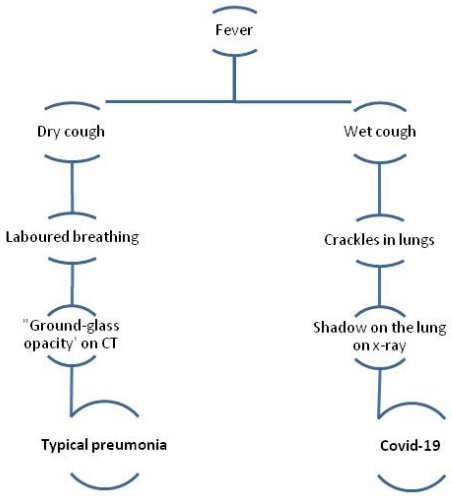

Figure 2. Schematic representation of the argumentation tree

4 Symbolic images and arguments

The first symbolic images were petroglyphs, which can be considered pictorial symbols-messages about the surrounding world. Karl Popper calls them images of stories [1]. Petroglyphs can be considered as a transitional version of imagery-symbolic representations.

The word "symbol" comes from the Greek "symbolon", which means “token, watchword”: in Ancient Greece, a so-called half of a thing cut in half (plates, sticks, clay bowl, coins, medallion, etc.), combining which their owners or descendants could recognize each other. A symbol is also something which stands for something else: an image created by the author, and its designation, content, interpretation, secret meaning. A symbolic image can be an independent artistic image that embodies an idea. Images that correspond with the concept of a symbol can be considered as arguments, and allow us to put forward hypotheses.

A mental image is an alloy of imitation of visual representation with the knowledge in this field, i.e. a kind of fact with a logical conclusion. In the context of this study, the logical-argumentative thought process includes signs and images or imagery-argumentative constructions with an alternating order of including signs and images.

In a person’s memory, an image “surfaces” under the influence of a similar image observed in the past. A characteristic lip fold in women can evoke the image of Mona Lisa in memory and then, by association, other paintings by Leonardo da Vinci. Symbolic images in the form of masks (for example, a threat – the Gorgon, Giotto's fresco depicting anger in the church in the Arena in Padua, frightening African masks) can serve as highlights of essential knowledge in the image, giving the prominence to characteristic features.

In the similarity association, notes A.A. Bogdanov [7], the most intense are the common parts of the combined complexes (the “synthesis form"), and the differences are blurred, merging into a vague mass of experiences. In the contrast association, the attitude is quite the opposite: common features recede into the background and are only vaguely recognized, and the “differences” seem to be emphasized, standing out with ever greater brightness and distinctness (the “form of discrimination”). Thus, in a person, associations are involved in the process of identifying similarities and differences, in the mentally constructed sequence of images including.

In a knowledge-based system, an assessment of the similarities and differences requires an imitation of human thinking, which is impossible without taking into account associative relations, including the imagery characteristics of the view of the world. Thus, in the knowledge system, a combination of arguments with reasoning by analogy and reasoning based on hidden associations is possible.

5 Image Rows

Artistic images, holy icons and faces of people are complex (multidimensional) signs, in contrast to the primitive people's petroglyphs, which are simple (one-dimensional) signs, and in principle can be converted into symbols without significant loss of meaning. However, this cannot be done with multidimensional or polysemantic signs, which are integral as images. At the same time, a number of close or relatively close images — a series of images — can correspond to a certain visual image. Let us consider as an example the various image rows, or tuples, in Figure 3. In the first row we see a tuple of images of sphinxes of different times and peoples (Great Sphinx in Giza; sphinx with the face of Hetepheres II, 25th century BC, Egypt; sphinx with the face of Hatshepsut, 15th century BC, Egypt; sphinx of the 18th century, Spain). In the second row there is a tuple of sculptures depicting chimeras (the gargoyles of Notre Dame Cathedral). In the third row are the faces of patients with hereditary diseases (mucopolysaccharidosis, mucolipidosis).

Figure 3. Image rows.

In an analogy with the topology of the possible [8], the genotype in hereditary diseases can be compared with the archetype image and a number of more or less similar phenotypic images. This "genotype-phenotype" situation demonstrates a one-to-many

relationship. Such an approach corresponds to the formation of image rows in medicine and in other fields. A variety of manifestations of diseases with a progressive course presents, i.e. determines the age-related dynamics of changes with a more severe manifestation of previously detected symptoms an example from the medicine.

A series of images of patients with the same disease or images of angels is a quasicontinuum. A vivid example of an image series characterized by fuzzy transitions can be found in the Ancient Roman coins. As the distance from Rome grew in every next province, the emperor's face was less and less distinguishable due to image disintegration (Fig. 4). Such a series of images can also be associated with a rough set [9; 10] for the description and presentation of the uncertainty of similarity. On the other hand, a tuple of images can be viewed as a multiset [11], i.e. a set with repeating images, where representatives of individual groups can be considered as subsets. Sets and subsets can characterize different art schools, artists of the same school (the master and his students, his followers). In medicine, it can be various forms of the disease, various manifestations of one pathological process in dynamics.

Figure 4. Fuzzy image row of ancient Roman coins

Image rows or tuples (including fuzzy ones) represent cognitive-imagery systems. In medicine, they can serve as markers of disease. In combination with context, they can be considered as a special design option for visualized ontologies, as a development of the paradigm of knowledge structuring [12].

Temporal (dynamic) image series is characterized by the transformation of images while maintaining the general and characteristic features. Everyone changes throughout life. Nietzsche's imaginative series of Zarathustra demonstrates the god's diverse guises, the change in his thinking when addressing various aspects of life on the way to the ultimate goal. The transformation in the appearance of Zarathustra in different periods of his life can be seen in a large cycle of paintings (Fig. 5) by the Russian artist Pyotr Fateev [13]. With the use of knowledge bases containing image series illustrating certain fragments of literary works, literary and art exhibitions can be arranged.

Figure 5. A series of paintings by Peter Fateev from the cycle "Zarathustra"

Artistic image rows can be accompanied by musical ones, which was typical for the works of the Lithuanian artist and composer Čiurlionis [14].

The dynamics of the image and the resulting series of images can be associated with a change in the human face during a serious illness, leading to metamorphoses of a particular image. Cases of cognitive impairments in representatives of creative professions can present a particular version of displaying changes in a person's appearance. In a series of self-portraits written by American artist William Atermolen after he was diagnosed with Alzheimer's disease, he tried to trace the degradation of his consciousness (Fig. 6). Pronounced changes are observed in the course of his illness. Similar image rows created during ilnesses can be used to predict pathological processes in intelligent systems.

Figure 6. Self-portrait metamorphosis with artist's Alzheimer's disease

In general, objects of the image series are characterized by a certain similarity, while images from various differentiable (comparable) series show a difference. In the painting of one row, there can be, for example, similar repeating elements or the type of brushstroke in the paintings of a certain artist or an artist and his followers.

6 Images and metaphors

The impression received from the visual image helps to put forward a certain assumption, to form a primary hypothesis. Pattern recognition can be considered a perceptual concept. Information received is multi-valued and symbolic in nature. At the same time, when the image is associated with the metaphor of a clearly defined phenomenon or object, metaphorical representations, which are inherently a univocal concept, may contain hidden polysemanticity. The identification and presentation of the essential image features of the subject, and metaphors as the mental transfer of the generally accepted name from one phenomenon to another, can serve as a breakthrough element of innovative solutions in various areas of management.

In medicine, it is extremely difficult to convey in a verbal (linguistic) form undoubtfully unambiguous perceptions of such visual images as a "cloverleaf skull syndrome" or a diverse "beaked nose". Metaphorical terms in the form of images can be interpreted differently by doctors who did not see them, but only heard of them, in a linguistic form. In any case, there is at least a partial loss of information. For example, there are extremely significant images that are characteristic and important for the formation of diagnostic hypotheses, such as the 'bird-headed' facial appearance for Seckel syndrome, or the frog leg position for floppy baby syndrome or the 'elf's face' in Williams syndrome, which could have led to the emergence of a legend about the so-called elven changelings. Images of patients with Hurler syndrome, with rough faces, until long called gargoyle-like, were associated with gargoyles at the Notre Dame Cathedral in Paris, shown in Figure 3. In all these cases, previously acquired metaphorical knowledge was extracted.

The idea of involving image information in knowledge systems in the context of the development of modern digital technologies is of particular interest. Computer-aided image analysis is becoming increasingly important to efficiently and safely handle large amounts of high-resolution images generated by advanced medical imaging devices [15]. There is also a tradition of metaphorical association of medical concepts with images from the world of art, cinema and poetry. For example, leukoaraiosis or "periventricular luminescence" observed in computed tomography in the form of a bilateral change in the white matter of the brain around the front horns of the lateral ventricles of the brain is sometimes called. 'Mickey Mouse ears. At the same time, this phenomenon of the luminous substance of the brain can be metaphorically associated with the radiance around the candle flame and the snow gloom outside the window, like in Russian poet Boris Pasternak's poem "Winter Evening": And all was lost in snowy murk / Snowgrey and blurry. / A candle on the table burned, / A candle, burning. [16].

Detection of brain damage should be done as quickly as possible, and physician's intuition is often crucial in these cases. As Leonardo da Vinci [17] wrote: "All our knowledge has its origins in our perceptions". In the end, it seems possible to talk about associative-rational activity on the basis of memories of similar image situations. In this

regard, the importance of an associative approach for medical decision management systems should be noted.

Another area where imagery approach to the analysis of phenomena and style can be applied is museology, in which both scientific research and the construction of expositions take place. Also, a promising area for the study of associative series is management and marketing, since the promotion of various services and goods is often based on the impression [18].

7 Confidence factors for image rows.

True and metaphorical images presented in the form of image rows or tuples in various subject areas can be provided with confidence factors [0,1] of the Stanford model [19]. These factors will indicate the degree of similarity with the archetype (the most typical representative of the considered image tuple). It is possible to assess the similarity with the metaphorical image of this series. The measure of confidence in the similarity is especially important due to the fact that in life we often deal with fuzzy imagery.

For an archetype image, a confidence measure of 1.0 should always be used, and fuzzy images in a series should measure from 0.1 to 0.9. These similarity confidence measures put forth by experts can be applied to any image series. In a pictural series it can be, for example, the early Giotto and Giotto in his height, or Giotto and his students and followers (Giotto school). In medicine it can be externally phenotypically distinct patients or radiological images of patients with one disease.

Image rows can be embedded in frame structures where the frame must correspond to the traditional representation of a certain image (typical representative of a visual series, archetype, parent frame or class frame), and slots are represented by various variants of an image of this type (‘individuals’), which differ in individual characteristics (appearance, visual data of specific studies).

Thus, the inclusion of visual series as a second component, along with the linguistic one, in traditional semantic knowledge bases will serve as the foundation for two symbolic representations – linguistic and iconic.

8 Knowledge management in art

Intelligent control systems with logical-linguistic-imagery knowledge bases can find application in various directions in the field of art.

(1) Attribution of paintings with the use of a metabase, individual modules or sub-bases of which will provide hypotheses for searching databases of information systems that are similar in style, presentation of perspective, prevailing colour scheme and other characteristics of paintings by artists of the same period or direction. At the same time, the possibilities of building databases of different problem areas will be combined. It can be:

– art schools (Florentine, Venetian, Flemish, etc.),

– periods (baroque, classicism, romanticism, etc.),
– individual artists or periods of their creativity.

(2) Arrangement of exhibitions, during the preparation of which databases will be viewed, including collections of various museums and private collections. When selecting paintings, information about the requirements should be reflected in the knowledge management system. Accordingly, the selection of paintings for the arrangement of exhibitions will be carried out:

– by movements (icon painting, pre-Raphaelites, avant-garde, art installations, etc.),
– by periods (neoclassicism, 19th-century European art, post-impressionism, etc.

(3) Film festivals in retrospect. It can be avant-garde, surrealism, neorealism, etc.

9 Images in marketing

There are stable long-term elements of identity that can be considered: colour, shape, type, texture, which are the end product of the deconstruction of the elements and can characterize a certain style. Combinations of these stylistic elements define the emotional 'core' of identity. Similarly, you can approach the choice of brand. The book on marketing aesthetics [20] cites interesting studies that show the appropriateness, or the possibility of separating consumer reactions caused by acquaintance with the brand, its recognition, caused solely by design elements.

10 Conclusions

Creation of non-traditional models of knowledge representation for expert systems suggests that within the framework of a general formalism not only classical quantitative and qualitative characteristics can be used, but also cognitive visual indicators of expert knowledge. One of the options for the implementation of arguments on images is the construction of logical-linguistic-imagery intelligent systems in which hypotheses are based on images and the context that accompanies them in a network of frames or ontologies. Visual imagery can be used at the stages of putting forward and confirming of hypotheses. This will allow the inclusion of poorly verbalized or non-verbalized concepts corresponding to holistic images in the knowledge bases. Multilevel management systems will allow us to move to large distributed knowledge bases and increase the efficiency of their use in practice.

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Beyond Half a Staff: Promoting Authentic Knowledge Diversity through Organizational Justice and Collective Intelligence

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Abstract

The acquisition of marketable knowledge and insight is a key driver of resource decisions among many a corporation in today's highly competitive, global business market. Through knowledge sharing, leading organizations seek to leverage the diverse capacities of their workers in ways which will maximize performance and profit. Paradoxically, there seems to be a cultural dynamic at work within many organizations which runs at cross-purposes with corporate calls for knowledge diversity. That dynamic—personality bias—is one which may be robbing organizations of the diverse employee strengths which they so diligently seek to mine. The current work reviews a modest cross-section of theoretical and empirical papers with an eye toward explicating two constructs—organizational justice and collective intelligence—which are believed to represent promising strategies for addressing personality bias and unequal knowledge sharing in the contemporary workplace. More specifically, the paper suggests that if organizations strengthen and sustain earnest commitments to creating environments which promote interactional justice and group intelligence, increased knowledge sharing—and true knowledge diversity—will be the result.

Keywords – knowledge sharing, organizational justice, collective intelligence, introversion.

Paper type – Academic Research Paper

1 Introduction

The acquisition of marketable knowledge and insight is a key driver of resource decisions among many a corporation in today's highly competitive, global business market (Simmons, 2011). That organizations deem the diversity gained through the regular, open exchange of ideas among employees of great value seems obvious (Simmons, 2011). During the first decade of the 21st century, for example, manufacturing giant 3M is believed to have increased its spending on creativity-boosting pursuits by some 20 percent–a move which pushed their research and development (R & D) budget to a breath-taking $1.5 billion (Simmons, 2011). Around the same time, *BusinessWeek* reported that nearly 20 percent of organizations engaging in mergers and acquisitions did so based on the belief that the employees joining their ranks were creative and innovative

(Simmons, 2011). Paradoxically, a handful of business practitioners and theorists posit that there is another, lesser known dynamic at work in global organizations which works at cross-purposes with corporate calls for the democratization of information, knowledge sharing, and enhanced productivity (Cain, 2012; Howes, 2016; Mauroner & Zschau, 2019; Oram, 2016). That troubling dynamic–personality bias–is one which may be robbing many of the world's leading organizations of the intellectual richness and diversity which they so desperately seek.

2 Personality-Based Bias: True or False?

In 2012, Susan Cain, author of *Quiet: The Power of Introverts in a World That Can't Stop Talking*, posited that Western civilization—along with much of the world which it has so heavily influenced—had a tendency to favor extroverts over introverts across a broad range of contexts (Smith, 2019; Cain, 2012). In order to substantiate her claim, Cain (2012) recounted some of the major historical developments in American psychological research. Two of those developments—(a) the early 20th century promotion of what Cain (2012) has termed the "extrovert ideal," and (b) the subsequent tendency to pathologize introvert-like characteristics (p. 295, "Briefly Noted," 2012; Smith, 2019)—are factors which the author has conceptualized as helping to comprise the cracked foundation upon which extrovert privilege rests (Oram, 2016). Though organized collections of data supporting Cain's bias hypothesis remain outstanding, a cursory review of contemporary literature suggests the plausibility of her claim.

In 2009, for example, Caligiuri & Tarique tested the relations between extraversion, high contact cross-cultural leadership development experiences, and global leadership effectiveness. Drawing on theories of social learning and contact to guide their analysis, the team found that extraversion moderated the relations between high contact cross-cultural leadership development experiences and global leadership effectiveness (Caligiuri & Tarique, 2009). According to the authors, extroverted leaders were the most effective in global leadership activities (Caligiuri & Tarique, 2009). As a result, Caligiuri & Tarique (2009) recommended that corporations use personality testing to identify the individuals most likely to succeed on the global stage–namely, extroverts—and groom them to assume the coveted leadership positions.

One year prior, Anderson et al. (2008) tested the long-held assumption that structural factors (e.g., formal position) were more relevant determinants of organizational influence than personal factors (e.g., personality). Using theoretical conceptualizations of power, influence, personality, and person-organization fit (P-O fit) as a guide, the researchers posited that in organizations where an employee's personal characteristics synergized with corporate values (e.g., outgoing individuals in team-oriented businesses), individuals would achieve higher levels of personal power than those who experienced characteristic-based mismatches (e.g., shy workers in team-oriented cultures) (Anderson et al., 2008). Empirical results were confirmatory (Anderson et al., 2008). In an organization that valued teamwork, extroversion was a significant predictor of individual influence and had

greater impact than formal authority (Anderson et al., 2008). Notably, other research indicates that individuals often perceive extroversion as contributing to superior (a) interpersonal skills (Funder & Sneed, 1993 as cited in Salminen, Henttonen, & Ravaja, 2016), (b) leadership (Judge, Bono, Ilies, & Gerhardt, 2002 as cited in Salminen, Henttonen, & Ravaja, 2016), (c) earnings (Jonason, Koehn, Okan, & O'Connor, 2018), and (d) attractiveness (Meier et al., 2010). Clearly, the aforementioned studies lend some credence to Cain's suggestion of a personality-bias favoring extroverts (Smith, 2019).

According to The Meyers-Briggs' Company (2019), the world's population is nearly evenly split between introverts and extroverts. If that estimate—and Cain's hypothesis—both hold true, then it is highly likely that a great many introverts regularly find themselves on the receiving end of a broad range of organizational processes which play up the strengths of their more gregarious counterparts while simultaneously casting them in a less than favorable light (Cain, 2012; The Myers-Briggs Company, 2019). In organizations where bias may be pushing many to the fringes of the workgroups which they might otherwise strengthen—and robbing them of the intellectual richness which is key to market competitiveness—how might forward-thinking theorists address the problem of personality bias? I wish to suggest sustained commitments to organizational justice and collective intelligence as avenues ripe for exploration.

3 Theoretical Framework and Propositions

3.1 Knowledge Sharing

Organizations are knowledge-integrating (Ibragimova, 2006). When knowledge is withheld, employers are deprived of valuable intellectual capital which holds the promise of enabling greater efficiency, effectiveness, and profit (Ibragimova, 2006; Serenko & Bontis, 2016). Alternatively, when organizations succeed in their efforts to leverage the valuable knowledge which each member possesses, increased organizational performance, capacities for innovation, and profits are the result (Cuguerot-Escofet, 2019; Pfeffer and Veiga, 1999).

Knowledge sharing occurs when employees voluntarily exchange their explicit and tacit knowledge (Serenko & Bontis, 2016). According to Ibragimova (2006), explicit knowledge is that which is easily codified. It includes reports, videos, charts and diagrams, and the like (Serenko & Bontis, 2016). Tacit knowledge is intrapersonal in nature (Serenko & Bontis, 2016). According to Serenko & Bontis (2016), tacit knowledge includes "know-how, know-where, and skills" (p. 1199). Knowledge sharing is dynamic, central to the knowledge management literature, and believed to be driven, in large measure, by interpersonal factors (Ibragimova et al., 2012; Serenko & Bontis, 2016).

3.2 Organizational Justice and Knowledge Sharing

Organizational justice is essentially a study of fairness (Ibragimova, 2006). Fairness refers to equity perceptions which relate to organization practices and bears meaningful impact on a whole host of employee attitudes and behaviors (Ibragimova, 2006). Notably, fairness is recognized as an antecedent to employee cooperation (Ibragimova, 2006; Podsakoff et al., 2000). Given the discretionary nature of knowledge sharing—and the fact that employees who perceive their organizations as just tend to cooperate—contemporary leaders would do well to pursue fairness in earnest (Ibragimova, 2006; Podsakoff et al., 2000).

Mainstream scholarship suggests that organizational justice is multidimensional (Cuguero-Escofet, 2019; Ibragimova, 2006; Konopaske et al., 2018). According to Cuguero-Escofet (2019), four operative dimensions comprise the construct: a) distributive justice, b) procedural justice, c) informational justice, and d) interactional justice (Cuguero-Escofet, 2019). Distributive justice is related to questions of distribution—both tangible and intangible—across individuals within an organization (Cuguero-Escofet, 2019). Procedural justice treats process-related questions (e.g., Are the decision-making procedures which control the distribution of resources in my organization fair and equitable in their conduct and ultimate effect?) (Cuguero-Escofet, 2019). Informational justice is concerned with the fairness perceptions which surround an authority figure's overall communication (Cuguero-Escofet, 2019; Konopaske et al., 2018). Finally, interactional justice refers to the perceptions' of fairness which attend the relatively informal aspects of interaction within the workplace (Cuguero-Escofet, 2019; Ibragimova, 2006). According to Ibragimova (2006), "explanation content and the persuasive features of communication" (p. 25) help to define interactional justice. When dignity and respect are upheld, individuals are more likely to perceive interactional justice (Ibragimova, 2006). When incivility or downright abuse are allowed to take hold, interactional justice perceptions will likely plummet (Ibragimova, 2006; Konopaske et al., 2018). The interactional dimension of the organizational justice construct is a focal point of the current paper.

Recent scholarship indicates that interactional justice is a "strong predictor of subordinates' attitudes and behaviors" (p. 226, Li et al., 2016) and that it may be more predictive than both procedural and distributive justice in certain contexts. In 2016, Li et al., in discussing the importance of encounters and exchanges, helped to underscore the dimension's importance:

> *Procedural and distributive justice are somewhat bounded in resource exchange contexts that may be relatively infrequent. In contrast, interactional justice can be judged in virtually any encounter between managers and subordinates, regardless of whether resource allocation decisions are being made…interactional justice has 'day-in day-out' significance that the other justice dimensions may not possess (pp. 226-227).*

According to Eisenberger et al. (1986), when supervisors engage with subordinates in ways which are fair and just, those subordinates are likely to reciprocate through knowledge sharing. In alignment with the theory of social exchange, I wish to suggest that interactional justice can also be judged through encounters between co-workers and impact knowledge sharing (Fang & Chiu, 2019; Ibragimova et al., 2012; Li et al., 2016; Omilion-Hodges & Baker, 2013). If high levels of group cooperation are to be established and maintained, each member must pass on the temptation to prioritize their own self-interests and look, instead, to create "mutually beneficial scenarios" (p. 22, Ibragimova, 2006). When individual group members do so, justice norms are the result and serve as a guide for productive, intra-team knowledge sharing (Ibragimova, 2006). As members choose to uphold those norms, the sphere of interactional justice should necessarily come to comprise relations between co-workers and, following the logic of exchange and reciprocation, promote knowledge sharing (Fang & Chiu, 2019; Ibragimova, 2006; Ibragimova et al., 2012; Li et al., 2016; Omilion-Hodges & Baker, 2013). As such, I assert:

> *Proposition 1: Interactional justice is positively related to employee knowledge sharing.*

3.3 Collective Intelligence and Knowledge Sharing

For more than a century, psychologists have proven time and time again that a single statistical factor—*g*—provides a reliable measure of individual human intelligence (Woolley et al., 2010). General intelligence, as it is commonly described, demonstrates that "people who do well on one mental task tend to do well on most others, despite large variations in the tests' contents and methods of administration" (p. 687, Woolley et al., 2010). In 2010, Woolley et al. (2010) tested a group of 699 individuals working within groups in an effort to determine whether a similar measure of intelligence might exist among collectives. The results of their research were groundbreaking. Subsequent to the study of nearly 200 groups of varying sizes (i.e., each group included between two and five members), the research team found converging evidence for the existence of a general measure of group intelligence which they termed *"c"* (p. 686). This *c* factor which conveys a group's collective intelligence is analogous to *g* (Woolley et al., 2010). As is the case with individuals, a group's *c*—or collective intelligence—is indicative of the group's general effectiveness on a wide variety of tasks (Woolley et al., 2010). More than that, *c* presents as "a property of the group itself, not just the individuals in it" (p. 687, Woolley et al., 2010). Indeed, it is notable to observe that while Woolley et al. (2010) did not find *c* to be strongly correlated with individual group member intelligence, they did find it to be correlated with group members' social sensitivity and "the equality of distribution of conversational turn taking" (p. 686). Later studies involving MBA students (Aggarwal & Woolley, 2014), online gaming groups (Kim et al., 2015), multicultural groups (Engel et al., 2015), and other collectives (Engel et al., 2014)

replicated the initial work of Woolley et al. (2010) and provided strong support for the existence of *c* (Woolley et al., 2015). While Woolley et al. (2015) conceded that the field was far from achieving a complete process theory of the phenomenon, they observed that groups with higher levels of collective intelligence:

> *"Participate[d] more equally than other groups [such that] collective intelligence was predicted by how equally communication and work contribution were distributed among group members in both face-to-face and online groups…In other words, groups in which one or two people dominated the activity were, in general, less collectively intelligent than those in which the activity was more equally spread among group members" (p. 422).*

Put another way, teams which behaved in a manner which allowed for the equitable sharing of knowledge and work across all members—and teams which were free of dominators—have proven to be effective in performing a broad range of tasks (Woolley et al., 2010; Woolley et al., 2015).

As discussed earlier, knowledge sharing is conceptualized as discretionary behavior which takes place at the behest of individual knowledge holders (Serenko & Bontis, 2016). Collective intelligence, by definition, suggests the regular, equitable sharing of knowledge across groups (Woolley et al., 2015; 2010). In 2015, Woolley et al., in reporting their most recent findings related to collective intelligence, issued a call for research to determine whether and how collective intelligence might be increased for groups. In a most intriguing way, recent findings published by Theobald et al. (2017) suggest that collective intelligence—and knowledge sharing by extension—can be engineered through tactical manipulation.

In "Student perception of group dynamics predicts individual performance: Comfort and equity matter," Theobald et al. (2017) described an intervention designed to explore how group dynamics effected student learning in a university biology class (Theobald et al., 2017). Study participants engaged in one of two types of structured group activities: a) a "loosely-structured activity" (p. 1, Theobald et al., 2017) which required teams to collaborate for an entire class period, or; b) a "highly-structured 'jigsaw' activity" (p. 1, Theobald et al., 2017) which required team members to peer-teach. "Importantly, the two activities were identical in terms of topic and content, but differed in how groups were structured and in how instructions specified how the learners should interact" (p. 4, Theobald et al., 2017). In connection with the loosely-structured activity, student teams were instructed to work through three sections of a worksheet sequentially (Theobald et al., 2017). Jigsaw group members, on the other hand, were instructed to: a) master an assigned section of the worksheet independently; b) confer with other students who had been assigned the same topic, and finally; c) join in groups of three with students who had been assigned other topics in order to teach the material which they had been assigned and discuss the material which had been assigned to others (Theobald et al., 2017). Jigsaw group members were also provided with explicit prompts designed to ensure dialogue, individual accountability, and turn-taking (Theobald et al., 2017).

Subsequent to the group activities, students were surveyed regarding their perceptions of group work (Theobald et al., 2017). Each participant also completed a pre-test before the scheduled activities and a post-test immediately afterward (Theobald et al., 2017). Both tests assessed conceptual knowledge related to worksheet content (Theobald et al., 2017). In all, 770 students participated (Theobald et al., 2017). Study results were striking (Theobald et al., 2017). Students who noted the presence of a dominant group member demonstrated lower levels of content mastery (Theobald et al., 2017). In addition, students who reported feeling comfortable in their groups——a factor which correlated with reports of working with a friend and may be considered analogous to the well-known psychological safety construct—demonstrated higher levels of content mastery than those who felt uncomfortable/unsafe (Theobald et al., 2017). Finally, students who participated in the carefully structured jigsaw activity reported the presence of a dominant group member less often—*nearly 70 percent less often*—than those engaged in the loosely-structured group activities (Theobald et al., 2017). Theobald et al.'s (2017) findings were clear: a) dominators influenced groupwork and student performance negatively; b) comfort/safety influenced groupwork and student performance positively, and; c) carefully structured activities designed to ensure cooperation and interdependence significantly reduced instances of dominance (Theobald et al., 2017).

In alignment with the logic and empirical findings related to collective intelligence, it seems that Theobald et al.'s (2017) higher performing teams attained higher levels of knowledge sharing and overall group success as a function of relatively higher levels of *c*—a condition which the researchers engineered through the administration of a highly-structured jigsaw activity. As such I assert:

> *Proposition 2: Collective intelligence is positively related to employee knowledge sharing.*

4 *Authentic Knowledge Diversity: A Way Forward*

Though the matter of knowledge sharing has rarely been considered through the lens of personality, the literatures spanning multiple disciplines (Duan et al., 2018; Li et al., 2019; Theobald et al., 2017; *Venkataramani et al., 2016)* confirm that working groups are often plagued by disparate levels of member participation which can be traced, at least in part, to unique and characteristic differences in thought, feeling, and behavior ("Personality," n.d.). While some theorists imply that the disparate participation problem is owing to some character deficit on the part of quiet group members (*Caligiuri & Tarique, 2009; Mauroner & Schau, 2019)*, a more balanced view of the available scholarship suggests that a whole host of nuanced contextual factors may provide a more reasonable explanation (*Fang & Chiu, 2019; Ibragimova, 2006; Ibragimova et al., 2012; Li et al., 2016; Omilion-Hodges & Baker, 2013).* Two such factors—interactional justice and collective intelligence—have provided the foci of this paper.

Simply put, when individuals perceive that the treatment which they are receiving within a workgroup or workplace is inconsiderate, unfair, or abusive, the chances that

they will actively participate are diminished (*Fang & Chiu, 2019; Ibragimova, 2006; Ibragimova et al., 2012; Li et al., 2016; Omilion-Hodges & Baker, 2013)*. In the same way, when individuals are assigned to groups with little or no structure with the expectation that they will "sink or swim," those less accustomed to the water may, in fact, sink (Theobald et al., 2017). In workplaces where behavioral norms establish quick thinking, quick speaking, and interpersonal dominance as the measure of professional success, introverts who naturally tend toward thoughtful reflection, metered communication, and interpersonal cooperation may ultimately experience groupwork as unjust and unintelligent (Cain, 2012; *Ibragimova, 2006; Ibragimova et al., 2012; Woolley et al., 2015)*. If they do, the likelihood that they will engage in knowledge sharing will probably prove quite slim. Thankfully, the empirical results presented here suggest that organizations have the capacity to create tailored environments which support knowledge sharing on the part of all of their employees.

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Air Transport Value Taxonomy

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Abstract

Improving variety of business aspects such as operations and innovation are often accomplished via systematization that taxonomies provide. Taxonomies have been proven effective in many industries e.g. medicine, material science etc.; recently also becoming adopted in aviation – IATA airline taxonomy was created in 2019. Availability of multiple taxonomies is beneficial since each provides a different view. We aim at developing taxonomy with the following important differentiations: customer-centric bottom up development via customer questionnaires and interviews (vs top down approach of IATA where taxonomy was created by a governing body), focusing on innovation and new value creation (vs operational focus of IATA of standardizing the descriptions and contexts of products and services of multiple providers). We show that our taxonomy is conductive to identifying novel innovation opportunities, which could then be integrated into existing operations by being partially aligned with the IATA's taxonomy.

Keywords – COVID-19, Value Proposition, Taxonomy, Air Transportation

Paper type – Academic Research Paper

1 Introduction

Taxonomies are important as a foundation in any scientific endeavour. The reason for this is that it is necessary to agree on a common and unambiguous frame of reference to advance the understanding of the nature, origins and causes of a specific phenomenon of interest. Only by agreeing on a particular set of classifications can research results be

compared and knowledge be accumulated (Bove, 2002). There are different types of taxonomies used in the aviation industry focusing on:

- safety and security
- products and services.

The typical representatives of the safety and security taxonomies are The International Civil Aviation Organization (ICAO) ADREP (ADREP, 2013) and HEIDI (HEIDI, 2014). These are complex and detailed taxonomies used by industry experts in the process of event description and categorization. Standardization Workgroup of the Safety Management International Group (SMICG) introduced another one, called SMICG hazard taxonomy, which was further developed by Civil Aviation Safety Team/ICAO Common taxonomy Team (SMICG, 2013). Another group of taxonomies could be the one consisting of those primary oriented on the human factor and its relations to specified events and errors. Such taxonomies are HFACS, CHIRP, or TEM taxonomy (Stojić, Vittek, Plos, and Lališ, 2015).

Taxonomy type standardizing the descriptions and contexts of products and services was introduced only recently by the International Air Transport Association (IATA) in late 2019 (IATA Airline Taxonomy, 2019). IATA gives the following description of the taxonomy: The Taxonomy is a hierarchy of related items which is used to convey the context of the product or service, and serves as shared language for describing products and services (IATA Airline Taxonomy, 2019).

This paper creates a new type of taxonomy with the focus on Value Proposition (VP) in Air Transportation (Figure 1); a taxonomy that reflects hierarchical classification and relations between conventional kinds of the categories and entities that exist in the society, aim at air transportation industry and could be proved by empirical investigation. (Goodman, 1978) states that a taxonomy shows the hierarchy and relationship between the different elements and capabilities that exist. All objects, properties, relations and, propositions make sense and justification only within the framework of a specific conceptual scheme.

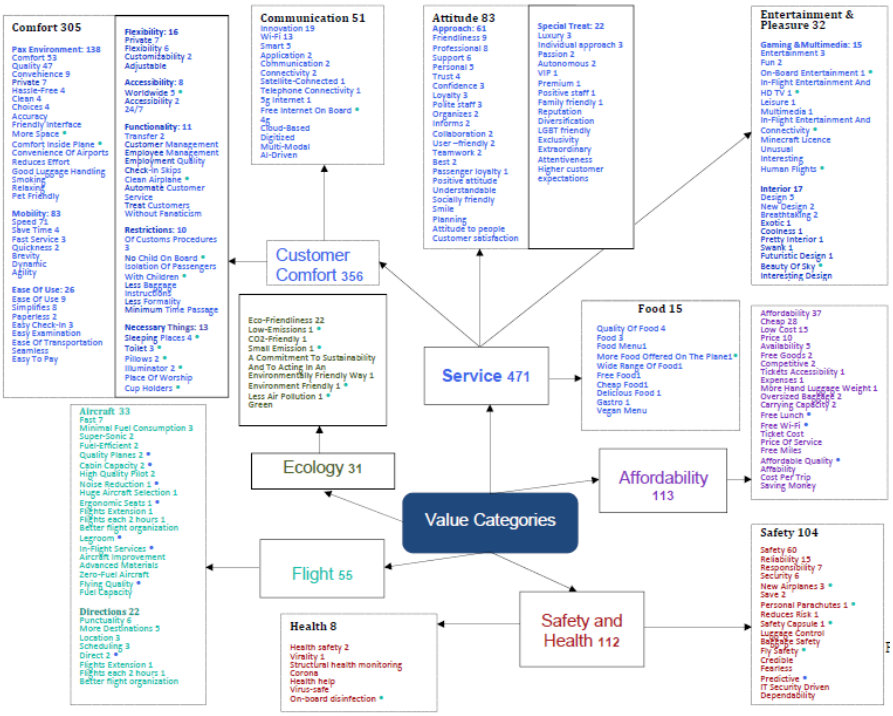

Figure 1. Air Transport Value

The authors of this paper conducted research in the time of a dramatic change in the circumstances (COVID-19) that has a great impact on the norms and practices in aviation. The research reflects both pre-COVID and COVID-time value proposition assessment. The proposed taxonomy is limited by opinions of millennials related to transportation area (students of a transportation university). Categories of comfort, safety, health, affordability are general for human wellbeing and are a natural claim of air transport consumers. Of practical importance are the weights of those general characteristics and their relative importance, evaluated by the potential consumers.

The significance of the taxonomy lies in its potential application to aviation management and industry analysts. There are lots of benefits to adopting this disciplined approach (Product Focus, 2019) to what air transportation industry can offer, including:

• A better focus on clearly defined value proposition generates revenue based on customer value

• Improved allocation of the scarce commercial product management resource

• Clarity around strategic vs legacy products and platforms

• Help in the adoption of consistent and transparent prioritization frameworks

• Clarity for Sales on whom a request for changes and features should go to

• Better ownership and proactive management of internal products, platforms, and enablers.

To evaluate comprehensiveness and contextual factors we adopted empirical-to-conceptual approach (Nickerson, R. C., Varshney, U., and Muntermann, J., 2013): if the researcher has little understanding of the domain but significant data about the objects is available, then starting with the empirical-to-conceptual approach is appropriate, that is shown in Figure 2:

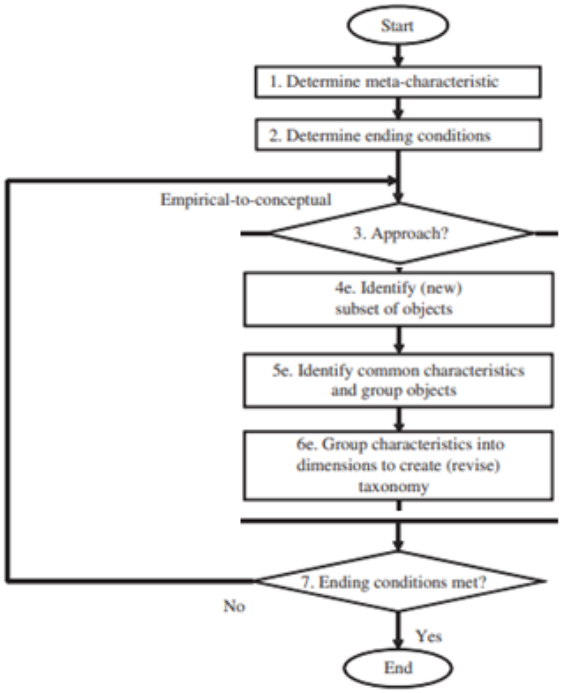

Figure 2. The taxonomy development method (Nickerson, R. C., Varshney, U., and Muntermann, J., 2013)

Following the empirical-to-conceptual approach, we identified a subset of objects (terms) that we wished to classify: low priced, friendly, multiple destinations, Wi-Fi on board, etc. These objects were value propositions from the surveys. Next, we identified common characteristics of these objects. The characteristics were logical consequences of the meta-characteristic. Thus, the authors started with the meta-characteristic and identified characteristics of the objects that follow from the meta-characteristic. Once a set of characteristics had been identified, were grouped formally using statistical techniques. The resulting groups formed the initial dimensions of the taxonomy.

The research interest of this paper is limited by the possibility of adding new value proposition through education not considering Added Value or Value for Money; for

incremental operational improvement IATA's taxonomy and regular surveys would probably be more efficient.

2 Background and related work

Taxonomy in air transportation are primarily developed according to the industry requirements and gained experiences. The experts engaged in the taxonomy development are those actively involved in the reporting or analysing processes. The main reason for such approach in taxonomy design is a desire for achieving a higher level of the taxonomy quality, which will enable effective provision of relevant and valuable data concerning reported events. Logically, this state could be reached in case that reporting system and appropriate training are set in a way convenient for personnel actively involved in the processes (Stojić, Vittek, Plos, and Lališ, 2015).

The suggested in this paper value proposition taxonomy is a combination of Services/Products with Innovation reflected by values from surveys. As the aim of this paper was to develop a taxonomy focusing on innovation and value proposition in air transportation, two existing taxonomies seem related; and their different focus could be interesting to examine. Also, a recent development in Value Proposition theory is worth of mentioning.

2.1 IATA Airline taxonomy (AT)

The IATA Airline Taxonomy (IATA Airline Taxonomy, 2019) is a codeset managed by Airlines through the Standards Settings Governance. The Airline Taxonomy is a shared language for Airlines to describe their products and services to Sellers and a way for Sellers to optionally request specific features in an Offer. It was adopted in October, 2019 and according to the experts' it is yet not of common usage by airlines.

Airline Taxonomy (AT) offers 4 major categories: Ground, Airport, Journey, and Flight and 108 basic level terms. Here is a top down approach of IATA where taxonomy was created by a governing body and an operational focus of IATA for standardizing the descriptions and contexts of products and services. AT does not provide any weight for its categories, as it offers a universal approach to enlisting all existing product and services experts accounted, as it stated in AT Codeset (IATA Airline Taxonomy codeset, 2019):

Table 1. Sample of IATA Airline Taxonomy codeset

Taxonomy ID	Parent ID	Name	Description
0000		Airline Taxonomy	
0064	0000	Flight	Any Product or Service related to a Flight

00C8	0064	Servicing	Any Product or Service related to Servicing of that Flight
012C	00C8	Change	Any Product or Service relating to Change Conditions
0190	00C8	Refund	Any Product or Service relating to Refund Conditions
01F4	0064	Entertainment	Any Product or Service related to Entertainment on board a Flight
0258	01F4	WI-FI	Any Product or Service which is transmitted through
02BC	01F4	Television	Any Product or Service which plays Video related Content

2.2 A Taxonomy of Innovation

A comprehensive Taxonomy of Innovation (Figure 3) was created by (Luma Institute, 2014). Thousands of tools and methods are available to help innovators discover what users want and how to deliver on their expectations. The challenge is to figure out which ones to use when. Luma Institute has created a framework to help you choose the best tool for each step of the innovation process, based on the people you're designing for and the complexity of the systems in which you operate.

(Luma Institute, 2014) distilled the portfolio down to 36 of the most effective tools for innovation - the majority of them in common use - organized in three categories: looking, understanding, and making. Each category contains three subcategories, and each subcategory contains four innovation tools. This hierarchical model makes it much easier to identify the tools you need and then put them to use.

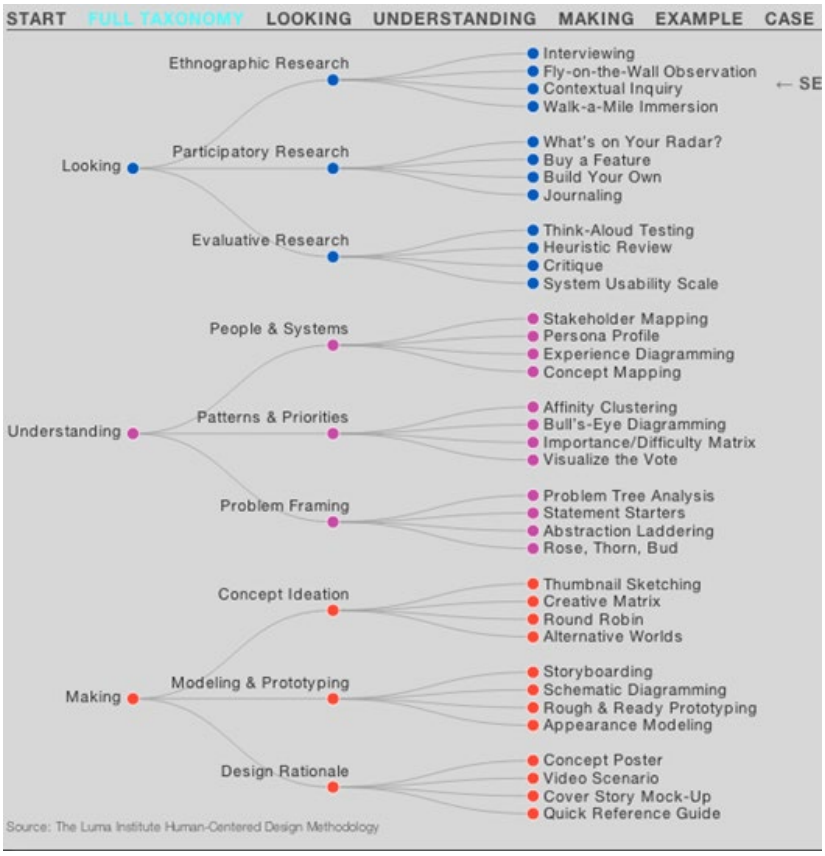

Figure 3. Taxonomy of Innovation by (Luma Institute, 2014)

Both above mentioned taxonomies seem to be ready inclusion of for new elements. (Nickerson, 2013) stated that a useful taxonomy should allow for inclusion of additional dimensions and new characteristics within a dimension when new types of objects appear. A taxonomy that is not extendible may soon become obsolete. Value Proposition Taxonomy allows extensions at every dimension level. As an example, the concepts of affordability, comfort, eco-friendliness, health & safety, and flight can be viewed as not sufficient enough applying for cargo flights or companies offering technical maintenance for private jets. Classes of technical maintenance or cargo handling can be included without loss of general idea of the Value Proposition Taxonomy.

2.3 Value Proposition

A rich theoretical and empirical literature can be applied to the question on how to identify Value Proposition in start-ups texts. As the current research focuses on linguistic patterns of start-ups landing pages, the authors reviewed theoretical and empirical

literature on specific online text features, textual value proposition methods, value proposition comprehension by consumers of different level of expertise.

(Lanning and Michaels, 1988) first used the expression "value proposition" (VP) in a 1988 work document for the consulting company "McKinsey and Co". In the article, which was entitled "Delivering value to customers", the authors define value proposition as "a clear, simple statement of the benefits, both tangible and intangible, that the company will provide, along with the approximate price it will charge each customer segment for those benefits".

(Almquist, 2016) suggested a strategy based on a differentiated customer value proposition. A suggested set of value was called Elements of Value. Elements of Value (Figure 4) where categories are based on the classic Maslow's Hierarchy of Needs.

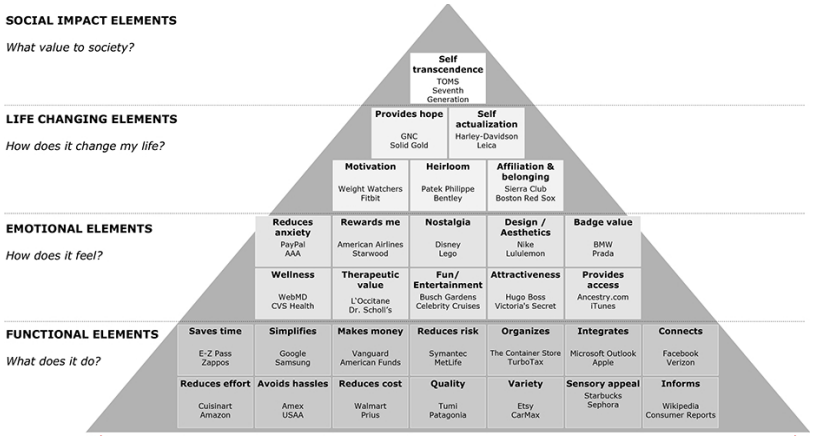

Fig. 4. Heuristic model of value with examples of companies exhibiting elements of value (Almquist, 2016)

There are comparatively few researches on analyzing value propositions in online startups. (Su-C Li, 2007) argues that a properly constructed value proposition is essential to the value creation process in e-business, and value co-production is the building blocks for value protection mechanism in network economy.

(Äyväri, Anne, and Jyrämä, 2017) provide a conceptual analysis on value proposition tools to be used in future empirical research and in building managerial insight. The conceptual analysis focuses on a living lab framework and recent theoretical developments around the concept of value that are reflected in the context of three managerial tools for creating value propositions. Among findings in the context of the living labs approach, the Value Proposition Builder seems to conflict with the ideas and premises of user-centric innovation processes (Äyväri, Anne, and Jyrämä, 2017). (Guo, Hai, Jun Yang, and Jiaping, 2019) examined the fit between value proposition innovation and technological innovation (exploitative vs explorative) for the performance of start-ups in the digital environment. They based their research on on-site survey data of 285 digital

start-ups in one of the world's largest digital economies and found that explorative innovation strengthens the positive impact of value proposition innovation on the performance of start-ups, but exploitative innovation weakens this positive effect (Guo, Hai, Jun Yang, and Jiaping, 2019).

3 Research design

For internal value study, authors showed the possibility to improve value adoption via training via the following steps: (1) baseline values, (2) wide variety of values identification, (3) values adoption. Baseline was established via a pre-survey where participants were asked to list as many values as possible (in the context of air transportation). For value identification, authors designed an exercise where participants were tasked with identifying wide variety of values (100+) by looking at 1,000+ startups' landing pages (startups are frequently the first to identify novel values). Finally, to evaluate how well participants were able to adopt the values that they were exposed to (the previous step) as well as improve their creative thinking (values that they haven't been exposed to), authors conducted a post-survey.

The last step was interviews with 20 participants. They discussed the learning outcomes and the impact of COVID-19 pandemic on their answers.

3.1 Participants

In order to collect generalizable observations on air transportation value proposition, we recruited 100 students from transport university with a connected, but still diverse range of majors and/or professional roles in a transportation field: Aviation Management, IT, Logistics.

All participants were between 20-42 years of age. Many participants had multiple years of experience in different types of professional roles, including 13 aviation mechanics (1-15 years), 14 middle level managers (1-5 years), 21 programmers (1-5 years), 16 administrators (1-7 years), and others. Most participants were not aviation management experts - 65 reported that they had never heard of Value Proposition before, but never built a model, 35 reported that they had taken some classes about marketing and management with value proposition as a study material. No one reported being an expert in the field of air transportation marketing or management.

Three industry experts from the top air transportation organizations' management were introduced with the research results and interviewed: two commercial directors of international airports and one IT director of an international airline.

3.2 Procedure

There were four stages of the procedure:

1.Pre-Survey

2. Trainings

3. Post-Survey + interviews

4. Taxonomy construction

A total of 800 different start-ups in the field of air transportation were chosen, their landing pages consist the research base for analysis on Value Proposition. 100 participants - IT, Aviation, and Management undergraduate and graduate students – were involved in a preliminary survey, post-survey, training and post-training annotation of start-ups' landing pages. A separate webpage was created for conducting surveys, two-level training and annotation process. The quality of annotation was re-assessed by industry experts.

The aim of a preliminary survey is to understand the level of expertise for non-trained participants and to determine value proposition volume and structure before the education process. The students were told about the basic concept of value proposition. Also, they were given some examples of Value Proposition such as typical ones: affordability, quality, speed; less typical: eco-friendliness. After that they were asked to list as many values as they can, that are provided by the Air Transportation start-ups and companies.

After the participants are told the start-up concept, they learned existing Value proposition major theories. After that they were offered two trainings. Training 1 shows five relatively simple examples of how to determine VP on start-ups landing pages. Training 2 presents five landing pages where the VL cannot be easily identified due to its vague expression or the creators of the webpage use non-standard ways to promote their start-up, e.g. video or non-trivial words.

The participants have options to identify a landing page as not a start-up, can state that the value is very difficult to identify, and can name the page as not from the air transportation industry. Also, they are asked to click a Like button if they think this start-up clearly deliver the VP.

Categories are not collapsed by excluding partial synonyms as to preserve semantic difference might be important for marketers and customer service.

15 interviews were conducted online on a Moodle chat platform, 5 respondents were interviewed face-to-face.

4 Results

We modelled the taxonomy as a tree diagram. A term in the taxonomy is either an object term (e.g., seat), or an attitude term (e.g., friendly), or an approach term (e.g., no child on board, save time). Taxonomy groups of all levels contain all types of terms and are united by the same concept.

Differentiating object terms from approach or attitude terms is natural in our taxonomy and does not influence on the concepts.

Taxonomic classes, divisions, subdivisions, and categories (Figure 5) were developed from the 241 values describing activities, procedures, objects, emotional experience and considering the context in which they could be possibly associated with in air transportation.

By analyzing the terms and the context, five taxonomic classes, one subclass, three divisions, and eighteen categories have been developed. Each of the 241 lowest level terms fits into at least one taxonomic group. However, many of them belong into more than one taxonomic group. Categories are not mutually exclusive.

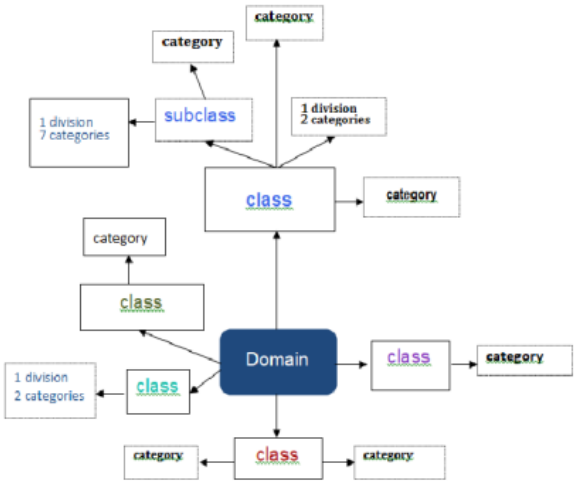

Figure 5. Taxonomy grouping

Every group and each term present a number of people that name this value / group of values. The most frequent terms are:

- speed 71
- safety 60
- comfort 53

The weight of each group is a sum of its components. The biggest group is Service with 356 and the smallest one is Ecology with 31.

Terms that could belong to several classes are noted with a bullet of a corresponding class' color.

5 Discussion

Primary purpose of companies is to create value; in aviation traditional dominant values are price, quality, and speed (IATA Passenger Survey, 2019). Taxonomies usage and help and the degree it can be useful for industry and analysts is a subject of a special discussion.

5.1 IATA and Value Proposition taxonomies

There is an overlap with IATA taxonomy: categories are partially overlapping, but terms are different. This can facilitate industry implementation, as categories are quite familiar from previous taxonomies. So, requires less department coordination.

Table 2. Number of categories in IATA taxonomy and Value Proposition (VP) taxonomy

IATA Taxonomy		**VP Taxonomy**		**IATA Taxonomy**	**VP Taxonomy**
1st level categories				2nd level cat.	2-4th level cat.
Ground		Service		Meal	Comfort
Journey				Beverage	Pax Environment
Flight		Affordability		Medical Equipment	Mobility
Airport				Escort	Ease of Use
		Flight		Loyalty	Flexibility
				Upgrades	Functionality
		Ecology		Charity	Restrictions
				Purchases	Necessary Things
		Health&Safety		Cabin Baggage	Communication
				Checked Baggage	Attitude
				Seat	Approach
				Assistance	Special Treat
				Lounge	Entertainment&Pleasure
				Terminal	Gaming&Multimedia
				Check In	Interior
				Boarding	Aircraft
				Security	Directions
				Medical	Health
				Escort	Safety
				Transport	
				Parking	
				Accommodation	
				Insurance	
				Visa Services	
				Book and Hold	
Total:	**4**	**5**	**5**	**26**	**19**

Authors aim at developing VP taxonomy with the following important differentiations: customer-centric bottom up development via customer questionnaires and interviews (vs top down approach of IATA where taxonomy was created by a governing body), focusing

on innovation and value (vs operational focus of IATA of standardizing the descriptions and contexts of products and services of multiple providers). Authors show that VP taxonomy is conductive to identifying novel innovation opportunities, which could then be integrated into existing operations by being aligned with the IATA's taxonomy.

Some of our classificatory categories and practices though they may appear inevitable are actually contingent and relative to the practice of classification in the context of social institutions and norms (Hacking, 1999). As an example, the category of entertainment during air travel seems to be constructed by marketers, however, according to (Hacking, 1999), some constructed categories reflect real divisions, and so we need not be constructivists in the strong sense. There is still room to distinguish between constructed kinds that reflect real categories and those that do not. Human beings start to present extra worries when evaluating the naturalness of their human kinds. That way there is a place for a question if the value, for example, of eco-friendliness is a human kind or a natural kind from the given world. And if it is possible to educate consumers to feel the necessity of proposed values.

Kinds in the social sciences, such as economics or sociology, are problematic, since the changing norms and practices of individuals and societies may also be held to be constitutive factors in kind membership, and these norms and practices may themselves respond to our classification of people into kinds (Stanford Encyclopedia of Philosophy, 2017).

Evaluation of taxonomy's utility is difficult, since there isn't a recognized sdandart criteria. However, (Wiegmann and Shappell, 2005) have suggested that for an error check framework to be successful it should be able to satisfy the following main requirements or product criteria among others:

Comprehensiveness For any given taxonomy it is important to consider whether the framework is able to cover all of the relevant variables that it purports to cover. In the current context this means that it should cover all the relevant categories related to the individual error event and its surrounding context. It also important that the framework is able to analyse both normal and abnormal situations since important lessons about error management might be obtained by not only focusing on critical events, but also normal everyday events where most errors are prevented from developing into serious consequences (Helmreich et al., 2001; Maurino, 1999). Even though it is important that the framework is able to capture all relevant categories it is at the same time also important to avoid irrelevant categories (Wiegmann & Shappell, 2002). The proposed Value Proposition Taxonomy was revised by industry experts to align researchers' categorization skills with practitioners' expertise.

Contextual factors. Since errors and their capture do not happen in a vacuum but in the interaction between people and the general work environment – including the technological, psychosocial and organisational context – it is critical that the framework is able to capture the dominant characteristics of the context that affects performance. The

proposed Taxonomy offers some terms to belong to different groups considering the potential context.

5.2 Business aspects

Improving variety of business aspects e.g. operations and innovation are often accomplished via systematization that taxonomies provide. There are a number of activities air transportation management and industry analysts can take to think about the Value Proposition Taxonomy:

• **Define – define and** clarify what value proposition is being offered to customers. Also, which elements are less visible to customers but essential for delivering products and services.

• **Structure –** logically structure the elements within organization and its procedures. For example, which elements are common for many products but not specifically visible to purchase by customers.

• **Responsibility –** consider what department is in charge with various elements across the organization – Product Management, Technology, Operations, Support, Services, Technical Sales Support, etc.

• **Promotion –** use the taxonomy as the basis for product proposition, i.e. the definitive source of what can be valued by customers.

• **Education and Communication –** communicate across the company to make key professionals aware of customers' expectations from the industry. This helps to create a consistent understanding of the business.

5.3 COVID-19 impact

Comparing results from pre/post survey gave authors a unique opportunity to see how the external factor (COVID-19) influenced the value adoption. Surprisingly, the results show that recent dramatic change in circumstances (COVID-19) has little affected the participants' general idea on value proposition in air transportation; in particular health value was not explicitly mentioned (8 terms were named) and seems to have been simply accepted as a "new reality". The hypothesis is that it is due to overly positive view (such as happened after WWII - baby boomers; art, style, and culture dramatic liberalization). However, the sampling is biased to participants that closely related to transportation area as well as age (millennials); this might not generalize to wider population and e.g. the overly negative reaction might be possible as was the case after WWI (Lost Generation, Dadaism).

5.4 Industry Experts on taxonomies

Three air transportation industry experts of a high level of expertise were asked to compare our Value Proposition taxonomy with IATA Airline taxonomy. They also shared

their ideas about the way taxonomies can be useful for industry and COVID-19 surprisingly little significance from respondents in April, 2020.

IATA and Value Proposition taxonomies difference. Value Proposition taxonomy focuses on innovative values, reflects consumers' requests for new technologies and attributes like speed, super-sonic, unmanned. IATA taxonomy is more conservative. Also, IATA AT offers top down approach where taxonomy was created by a governing body and reflects the aviation industry ideas on products and services, while Value Proposition is created using bottom driven approach asking what consumers' wants and needs are.

COVID-19 and consumers' expectations. Experts admit that the inertia plays a great role in such conservative industries as air transportation. Consumers may still not realize their expectations for health issues. Also, little attention towards COVID-10 could be due to the well-known fact that in a pandemic, all industry participants (airports, airlines, handling companies, etc.) give priority attention to the safety issues for the health of passengers and employees; therefore, by all passengers / clients (including respondents), this is already taken for granted (the must) and is no longer perceived as a value (added value).

Benefits for the industry. These taxonomies are extremely useful for the following purposes: to understand the essence and systematization of services / services, to formulate KPIs by directions, to distribute areas of responsibility between all the links in the value chain. Also, the unexpected finds and formulations of values that were not previously in sight are of great interest for marketers. Good perspective can be seen in using VP taxonomy in Project Management.

6 Conclusion

There already exist different classification systems that could be of relevance in relation to developing a Value Proposition taxonomy. Even though there are some variations in the structure of the main groups and the level of detail in the individual frameworks their overall structure is fairly similar, but the Value Proposition taxonomy is the only one that has been extensively validated and that has been directly aimed at Value Proposition in Air Transportation. It is also characterised by the fact of having been derived in the time of substantial external change of circumstances. Widening values is being considered as one of the main purposes for constructing Value Proposition taxonomy.

Ability to operationalize rapid identification and adoption of new values allows corporations not only to improve profitability; but even to become resilient to unexpected external factors that suddenly impose new values.

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ICTs as an Important Educational Tool (Gender Perspective): Moldova vs Europe

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Abstract

The current paper is dedicated to analysis of the ICTs as an important educational tool through gender perspective. Nexus between Gender, Education and ICT is explored. Comparative analysis of situation in Moldova and EU countries in the ICT and education through gender lens is provided.
ICTs were recognized as tools through which gender equality and women's empowerment can be advanced in many ways (Intel, 2014). Therefore, the gender ICT gap is valid globally, including in Europe, in Moldova (P8_TA(2016)0204*;* NBS, 2019a).
Women are significantly under-represented in ICT, accounting for only 3% of ICT graduates globally. In Europe, only 29 out of 1,000 female graduates have a degree in computing in 2015, and only four went on to have ICT careers (European Union, 2013).
In the Republic of Moldova, women and girls occupy only 31% of jobs in the ICT sector and only 19% of digital professions. Only 4.6% of the girls studying in higher education choose STEM as their study profile. As a result, women get jobs with a lower level of qualification and, respectively, of remuneration in this sector (NBS, 2019a).

Several publications analyse the impact of ICT on girls and boys education, gender differences in ICT use in the school, women's access in ICT sector etc. At the same, there are few studies regarding the ICT use in architecture education through gender lens. This paper aims to present some of the recent research's findings on gender and ICT and education (based on architecture education in Moldova). The novelty of the research – for the first time the interlinkage between ICT use in the architecture education and gender are clarified.
Based on countries' comparative analysis and focus group with architecture female and male students we note the similarities and differences on ICT use and ICT perceptions. The research found that there is a significant association between the levels of education and skills of use of computers and gender. At the same time, the importance of "gender friendly" environment in educational institutions was identified as important condition to maintain female students in the system.
The recommendations how to explore ICT in education sector in gender sensitive ways are proposed.

Keywords – ICT, gender, education, architecture, development

Paper type – Academic Research Paper

1 Introduction

The importance of access to Information and Communication Technologies (ICTs) in order to ensure full participation of all people in new opportunities related to employment, education, health, governance and other sectors is recognised by several international documents (United Nations, 2015; P8_TA(2016)0204).

It has been shown in different sources that women's active participation in the ICT sector is essential for long-term growth and economic sustainability (European Union, 2013) of any country. The importance of ICT for gender equality is acknowledged in SDG target 5.b "Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women" (United Nations, 2015).

We would like to mention the increasing number of researches dedicated to interlinkages between gender and ICT. While some progress has been made in increasing the number of women in top jobs in business and in narrowing the gender pay gap, major challenges remain. Therefore, the gender ICT gap is valid globally, including in Europe, in Moldova (confirmed by evidences provided in many studies (European Union, 2013; NBS, 2019a; UNESCO, 2017).

At the same time, education is essential for the training of women and men with the necessary competencies (including digital competency) to enter the labour market, to face the challenges in regards a competitive economy.

Despite of increased number of international documents and researches in ICT and gender, there are several arguments in favour to continuously explore the subjects.

First, due to the increasing importance of ICT in the society and in daily life in the context of the information era, exploration of different dimensions such as gender, age,

education, inclusiveness and other is needed to ensure equal opportunities for all to benefit of ICTs.

Furthermore, taking into account disruption of the educational process (classes have been ceased) due to the COVID-19 epidemic and the fact that distance learning allows students to continue the study process, the forming/strengthen skills to use ICTs is strongly needed.

Information and communications technology sector (ICT) is one of the most important sectors of the economy of the Republic of Moldova (contributes annually at the formation of GDP by about 11-12%) (NBS, 2019a). Considering the demographic prevalence of women in the country, but also the higher share among persons with higher education, women need to fully participate in all spheres of society and economic development, from execution phases to decision-making level. At the same time, in the context of dynamic socio-economic transformations, the formation of digital competences is necessary, to contribute ICT-related productivity growth and development. Thus, ICT can be both a goal and a tool for increasing participation of women in society and in the workforce (especially ICT-connected sectors).

The publication aims to contribute to debates on interconnections between Gender and ICT, with special focus on Education at regional and national level. More specifically, the objectives are as follows: 1) analyse ICTs and Education through gender lens (comparing Moldova and the EU regional context); 2) establish interconnection between ICT and architecture education and gender; 3) explore the perceptions of architecture students on ICT use and identify recommendations to engendering architecture education.

As **Methodology**, desk review of documents and researches; gender analysis of statistics and materials were used to identify nexus between ICTs, education and gender. Also, two focus groups with participation of 16 females and 16 male students from the upper years from Technical University of Moldova were organized in order to explore the youth's perceptions on ICT in architectural education through gender lens.

The following hypotheses were formulated and tested based on desk analysis and focus groups:

- There is an association between the level of education and use of computers and the gender of the students.
- There are similarities and differences in female and male students' perceptions of ICT in architecture education.

Thus, the research questions are the following:

- What is nexus between Gender, ICT and Education?
- What is the specificity of Moldovan experience in the EU regional context?
- What are the perceptions of girls and boys about ICT in architecture education?

The first paragraph includes introduction information about the importance of ICT and Gender and Education based on international documents, arguments in favour of theme,

methodology of current research. The second paragraph presents nexus between ICT, education and gender, based on comparative analysis of situation in Moldova and the EU regional context. The third paragraph provides an overview on interconnection between ICT and architecture education and gender. The perceptions of female and male students about ICT in architectural education are presented. The final paragraph includes conclusions and a set of key recommendations.

2 Nexus between ICTs and Gender and Education

Education is recognised as an indispensable part of the development process. The importance of education has been widely recognised in the process of forming necessary competencies to enter the labour market, in a competitive economy and social transformations. We note that competence in the fundamental basic skills of language, literacy, numeracy and in ICT (digital competency) is an essential foundation for learning (2006/962/EC).

At the same time, Gender equality is inextricably linked to the right to education for all, that ensures that girls and boys, women and men not only gain access to complete education cycles, but are empowered equally in and through education (Education 2030, 2016). In such a prospect, we reiterate the fact that ICT is recognised as an important tool to women and girls' empowerment (Intel, 2014), giving them access to knowledge about importance of multifunctional gender roles (productive, reproductive and community roles), as well as forming skills how better to apply the knowledge in professional and personal development.

Based on mentioned and other documents, the nexus between Education and ICT and Gender is clearly outlined. However, the subject should be analysed taking into consideration several factors such as: countries' socio-economic context, cultural norms, access to ICTs, family's impact on education and career strategies, opportunities for education and job in ICTs-relating sectors and others.

Researches on ICT, gender and education identifies gender differences in several fields, like learners' performances, attitudes towards computers and skills as well as the impact of teachers, parents and peers (UNESCO, 2017; Intel, 2014; Becta, 2008 etc.).

The differences between women/girls and men/boys in terms of time consumption, frequency and patterns of use of ICT have often been used as possible explanations for why girls do not choose education in computing nor become ICT professionals (Ferreira, 2017; Cristei, 2017 etc.). As consequence, much of the focus has been on what kind of efforts that have to be taken into action to help girls reach the same level as boys within the field of ICT (Tømte, 2008).

Some aspects related to connection between education, gender and ICT are explored in Moldova: PISA 2018 results through gender perspective (MECC/ANSA, 2019); gender differences based on PISA 2015 (Cristei, 2017); education in ICT through gender perspective (NBS, 2019a).

In this regard, it is crucial to highlight the gender gap in the field of education for several reasons. First, persistence of gender stereotypes conducts to visible gender segregation of high education and career's choice. For example, in the Nordic countries girls are, on average, attaining higher marks than boys in all subjects, except physical education; in addition, girls are approaching 60% of university student population (Tømte, 2008). Research and reports also indicate that boys experience more problems in school, drop out of school to a higher degree than girls, and this appears to be a problem in many countries (Becta, 2008; Tømte, 2008; UNESCO, 2017 etc.).

In Moldova we note the similar situation: on average, girls are attaining higher marks than boys in majority of subjects, girls are approaching 56% of university students and 65% of Master Degree students; the rate of drop out of education system for persons aged 18-24 years constitutes 21.0% of men as compared to 17.6% of women (NBS, 2019b).

PISA 2018 suggests that amongst the 15-year-olds assessed by PISA, only 1% of girls reported that they want to work in ICT-related occupations, compared with 8% of boys who so reported, on average across OECD countries. In Bulgaria, Estonia, Lithuania, Poland, Serbia and Ukraine, more than 15% of boys reported that they expect to work in an ICT-related profession; but in no PISA-participating country or economy did more than 3% of girls so report. It seems even when they excel in mathematics or science in PISA, boys and girls have very different expectations for their future occupation. More than one in four boys reported than they expect to work as an engineer or science professional when they are 30 years old, but fewer than one in six girls so reported. Almost one in three high-performing girls, but only one in eight boys with the same proficiency reported that they expect to work as health professionals (OECD, 2019a).

PISA 2015 also found that boys spend more time playing video games and less time doing homework than girls. While excessive video gaming is shown to be a drag on student performance, a moderate amount of video gaming is related to boys' better performance in digital reading than in print reading (although boys still lag behind girls in both types of reading) (OECD, 2019b). Thus, the parents should know how to discuss with children to combine homework and playing video games, in order to offer more opportunity for learning-oriented and career strategies.

In fact, Moldova faces the same situation. Data shows some differences between girls' and boys' performance in PISA 2018 in the Republic of Moldova (table).

Table. Girls' and boys' performance in PISA 2009-2018 in the Republic of Moldova (points) (MECC/ANSA, 2019)

Discipline /year	**2009**		**2015**		**2018**	
	Boys	Girls	Boys	Girls	Boys	Girls
Reading	366	411	390	442	404	445
Mathematics	399	396	419	421	420	422
Sciences	406	420	425	431	423	434

Thus, it is attested that during the period 2009 - 2018 in the Republic of Moldova the differences in performances of girls and boys in mathematics have not changed significantly (3 points difference in favour of boys in PISA 2009; 2 points in favour of girls in PISA 2015 and in PISA 2018). Similarly, girls, on average, accumulate higher scores than boys in science.

PISA 2018 emphasize that girls perform better than boys in all three areas. The biggest difference between the performances of girls and boys is attested to reading / reading (41 points difference). On average across OECD countries in 2018, girls outperformed boys in science by two score points. In Albania, Bulgaria, Finland, Georgia, Greece, Israel, Malta, the Republic of Moldova, North Macedonia, Norway and Thailand, the gender gap in science performance, in favour of girls, ranged from 10 to 24 score points (OECD, 2019a).

On the other hand, boys and girls in Moldova record about the same performances (difference of 2 points in favour of girls) in mathematics, and in OECD countries boys accumulate 4 points more than girls.

A few initiatives in this respect would be mentioned: GirlsGoIT (a national program that provides access, education and promotion for girls in technology), Cariera IT, Generatia Z, events dedicated to start-ups and local innovation hubs, etc. As result of GirlsGoIT, during 2015-2018: from total trained 544 girls 132 (24,26%) pursuing STEM studies at Technical University (GirlsGoIT, 2018). All mentioned non-formal initiatives are great, but with limited possibility to cover the entire country.

In the last years, in the context of international commitments, Moldova adopted The National Strategy "Digital Moldova 2020", that includes strategic education directions, such as the Digital Education Program "Digital Skills for All". Also, Educational standards of digital skills and Methodology for assessing the digital competences of students in general education were elaborated. Several courses to improve teachers' digital skills were organised. Despite of positive measures in the ICT education field, an insufficiency of ICT skills and a low level of digital literacy are noticed (MEI, 2020).

One of the major problems in Moldova and at international level is the decline in the number of young people, especially women, who study science, engineering and technology. Within the female student population in higher education globally, only around 30% choose STEM (Science, Technologies, Engineering and Mathematics) related fields of study. Differences are observed by disciplines.

Female students' enrolment is particularly low in ICT (3%), natural science, mathematics and statistics (5%) and engineering, manufacturing and construction (8%); the highest is in health and welfare (15%) studies (UNESCO, 2017).

In Moldova, the probability that the graduating girls would choose a job in the field of science and engineering is 5 times smaller, and that they would choose a job in the field of IT - 10 times smaller. Women are more represented in higher education, but under-represented in the scientific and technical education. Women who graduate from higher

education are more numerous, but those who graduate from scientific and technical education are far fewer (NBS, 2019a).

Based on data mentioned above, we conclude many similar aspects regarding gender differences and similarities in the education system in Republic of Moldova and regional European context.

3 Interconnection between ICT and architecture education and gender

International documents and reports, researches clearly emphasized the enormous demand for the informatics people (P8_TA(2016)0204; Education 2030, 2016 etc.). As mentioned above, several publications analysed the impact of ICT on girls and boys education, gender differences in ICT use in the school, women's access in ICT sector etc.

However, most research explored the view that the girls are falling behind the boys, when it comes to ICT; in terms of perceptions/attitudes, self-attainment, ICTs' use models and so on. Thus, the gender differences support has been based on this claim.

The influence of peers, parents, teachers and the media, based on gender stereotypes, were noted as major factors affecting girls' confidence, self-efficacy and attitudes towards ICT in different countries, including Moldova (Becta, 2008; Ferreira, 2017; Cristei, 2017). Gender stereotypes begin at an early age with parents, based on cultural norms/traditions, and are reinforced by peers, the media/social media and, in some instances, by teachers at different education level. One of the strong idea refers to that ICT is the boys' domain due to the relation with games and programming. Thus, at school level there are visible differences between boys' and girls' ICT use and ICT perceptions.

In this regard, it is important to stress attention on the fact that gender should be analysed not as separate category but in combination with number of factors – socio-economic status, age, ethnicity, identity, family, education (including management) and labour market – which can influence how boys and girls use technology and the impact that use has on them. The mentioned factors can contribute to the perpetuation or reduction of gender stereotypes. For example, ideas such as technology is engaging and appealing to all boys affect girls' ICT use. Promoting successful female models in ICT-related business can encourage more girls to use ICT.

At the same time, in the context of social development digitalization, the problem lies not so much in the education of pure computer scientists, but especially of the people of various disciplines who are better educated in the field of informatics.

Thus, if schools through ICT education aim to provide children with tools for personal development and career guidance, universities through informatics education contribute to the professionalization of students. That's why the universities should pay special attention to the ICT education of students and teachers.

In this regard, this paper aims to present some of the recent focus groups discussions' findings on gender and ICT and education (based on architecture education).

We note some researches dedicated to role of ICT in Architecture Education (Sariyildiz and van der Veer, 2000; Gushchin & Divakova, 2016 etc.).

Some authors refer to gender issues in architecture education (Kurjenoja, 2013), to feminine paradigm (Niculae, 2012; Reisinger & Schalk, 2017 etc.). Specifically, referring to architectural practice or architectural education, women's lack of visibility is recognised as an important issue that reveals the fact that architecture is still defined by a masculine paradigm (Niculae, 2012).

In Moldova, despite of increased percentage of female graduates of higher architectural education for the last few years – to around 50%, is not yet equivalent to the number of women enrolled in the national Union of Architects. For example, in Moldova out of 227 members of the Union of Architects only 37 are women (16.29%).

According to Dubeissy (2020), the macho culture dominating architecture uproots from the architectural education, continues to practice and leadership. Education can contribute to diminishing male dominance by capitalizing of new learning strategies.

The above ideas were the landmarks for exploring the interlinkages between ICT and Architectural Education and Gender, based on Moldova case.

Taking into consideration the increasing number of women in architectural education, the perceptions of female and male students from the upper years of ICT in architectural education were analysed. Based on focus group discussions, we conclude the following results.

Today indisputable architectural practice is closely connecting with ICT. At the same time, gender perspective of ICT use in architectural education remains as important issue.

Due to multi-sectorial connection of architectural education, female and male students use computers as a tool mainly for following purposes such as: information processing tool, knowledge integration and knowledge transfer tool, communication tool, planning tool, architectural design process tool etc. The mentioned categories of computer use have the purpose of improving quality and efficiency of the students' competences as architects. From students' perspective the computers are not only a tool for the architects but more than that, computers and Internet are becoming a life style and medium of personal and professional development.

The findings of the study found that all students – female and male - use computers for their academic purposes. All students confirmed a positive attitude towards the use of ICT. Both women and men mentioned the significant impact of computers and Internet on their academic performance.

Female and male students use at large the different tools such AutoCAD, Revit, 3ds Max and other. Similar tasks by complexity, working in mixed teams together, girls and boys, can contribute to the development of career-related competences of both genders. We note that career-related competences refer to the knowledge and skills required to operate specialized hardware/software for a particular field (UNESCO, 2018), specifically in architecture. In this regards, there are no significant gender differences in ICT use for learning tasks focused on career-related competences.

At the same time, students' opinions were divided with reference to ICT skills. Thus, most boys, recognizing the good digital skills of girls, are in a position that men are better

at ICT. In fact, male students reproduced stereotypes of how women and men interact with technologies. Most girls consider that they have digital skills no weaker than boys, only that their interests are sometimes different. Thus, out of the courses, male students acknowledged that they more often download software related to cars, ICT equipment, various applications with games. Girls more often use ICT in terms of communication, training, health services, fashion, entertainment, etc.

Also, based on findings of others researches (Becta, 2008; Tømte, 2008) the interlinkage between the ICT use and self-confidence, quality of life was explored.

A few of students opined that the use of computers has improved their overall quality of life: more male students compared to female students. The answers were based on students' involvement in the workforce (part-time).

At the same time, a majority of female students and only some male students reported that the use of computers and Internet has made an impact in developing self-confidence.

The students also mentioned that the use of ICT has enhanced student-teacher interaction (a majority of female and few male students). It is interesting that boys come from school to university with skills to use ICT more developed compared to girls. Thus, they are sometimes more self-confident and underestimate the role of university teachers in training on the use of ICT in disciplines related to architecture. And girls need to work harder to fill the gaps in ICT work. Moreover, female students recognised that due to the persistence of gender stereotypes regarding girls and technology in the society, sometime the education environment press it – they need more efforts to demonstrate good skills in ICT use; the education environment the is not gender friendly.

In this respect, the role of teachers at the initial stage is crucial in motivating and mobilizing female and male students to study and use ICT on equal base. The accomplishment of the learning tasks in mixed groups of girls - boys, oriented towards the formation of the professional competences based on the use of the ICT from the 1st year of the faculty - is an important precondition of equal opportunities for professionalization of female and male students. Moreover, this methodology, leading to the narrowing of the gap between girls and boys regarding the use of ICT, must be extended to other educational fields. ICT can motivate both boys and girls to explore better knowledge and skills in architecture and not only. Thus, for long terms impact – this practice can contribute to women's better career opportunities and wellbeing. It is a real tool to contribute to gender transformative approach - approaching girls not as 'victims' of gender stereotypes but as active actors within educational system and the whole society.

We note that all students learned to use computers in architectural design process with the help of university teachers. This clearly indicates the role of university teachers on students' motivation to learn to use a computer and its specific applications. Thus, teachers can be mentioned as active agents for change. The success of using ICTs for educational purposes relies heavily on teachers' abilities to select, create and manage adequate digital resources in order to implement innovative and inclusive teaching

strategies in a specific context (Redecker, 2017). This idea was confirmed by strong necessity of online tools during the COVID-19 pandemic.

In the frame of focus groups, female and male students recognised the influence of a number of socio-economic, institutional, cultural, family, and last but not least, personal factors. With regard to the prioritization of factors, both female and male students highlighted the economic possibilities for purchasing computers and licensed programs, the impact of friends/peers and social networks, but especially employment/ career opportunities.

4 Conclusions

In the last years, the several documents and literature have largely stressed the importance of ICT in education of boys/men and girls/women. At the same time, the research area should be extended and cover the subject of ICT use through gender lens at different levels and types of education.

The current research found that there is a significant association between the levels of education and skills of use of computers and gender. If in the case of schools there are gender differences in the use of ICT, these differences become insignificant in the case of architectural education due to the involvement of female and male students on equal base in the career-related competences tasks. Thus, from gender transformative perspective female students in architecture can be as active agents for change.

At the same time, at individual level out of university tasks the differences are more visible. Despite of recognition of female students' skills to ICT use, male students often reproduced gender stereotypes. Research findings confirmed similarities and differences in female and male students' perceptions of ICT in architecture education, including impact on self-confidence, relation student-teacher and others.

The results confirmed the findings of some mentioned above studies on teachers' positive influence on the pupils' ICT behaviour. At the same time, the majority of training programs on ICT are focusing on school teachers. Therefore, university teachers should have access to different programs in order to strengthen skills on ICTs use in the frame of different disciplines. The relevance is high especially in the context of architectural education where men predominate, so women need more effort for professionalism.

The research' findings confirm that the experiences of using ICT through co-creation, collaboration on an equal basis between female and male students in accomplishing tasks related to career competencies, integration of ICT in all disciplines at school level ensuring connection and complexity at university level, can be beneficial for girls and boys, and in the long run - for the whole society.

At the same time, the emphasis must be on preventing and eliminating gender stereotypes in relation to ICT. Addressing the nexus between ITC and Education through gender equality perspective requires sufficient awareness and strong co-operation across stakeholders, promotion of best models of successful women in the Architecture, organisation of awareness-raising, training and gender-mainstreaming campaigns.

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Leveraging IoT in Experiential Learning to Develop Operational Knowledge in the Digital Era

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Abstract

The complexity brought by digitalization in operations is disrupting blue-collar and technical jobs, increasing levels of knowledge required to perform them. When workers such as electrical grid operators become "smart grid operators", the breadth of knowledge required to them increases. The shift from I-shaped to T-shaped profiles has been described by literature (e.g. Demirkan, 2015), and the need for a shift from T-shaped to Pi-shaped profiles, with a second "depth" of knowledge in data science, has been discussed for skilled jobs such as researchers (Faris et al., 2011). In this work we show how, with the advent of digitalization, also operational job profiles will need more depth in a second field of knowledge: not only domain knowledge, but also digital literacy. This study intends to explore the benefits of integrating IoT technologies in a Challenge-Based Learning approach to innovate Education and develop pieces of the new digital knowledge that will be required to operational jobs of the future. By means of an action research, we explored how the operational firm-specific knowledge needs of an electric distribution firm are evolving, and provided an off-the-job Challenge-Based training to two classes of students involved in its dual apprenticeship. Our findings show how such experiential learning activities based on IoT technologies can be fostered by concurrent dual apprenticeships, which act as the "concrete experience" phase of the experiential learning cycle (Kolb, 1984; Morris, 2019). Its two tacit phases, namely "experience" and "experimentation" (Raelin, 1998), were the two that benefited the most from complementing on-the-job and off-the-job training. Last, we disentangle the contributions of firm and the technical high school, and discuss how such structured collaboration can be effective in co-creating effective Challenge-Based activities. Further studies will be needed to explain in detail benefits and rationales of involving a university as off-the-job provider in such educational paradigm.

Keywords – Education in the Digital Age, Innovative Education, Experiential Learning, Challenge-Based Learning, Internet of Things.

Paper type – Academic Research Paper

1 Introduction

With a data-richer task environment enabled by technologies like the Internet of Things, drones, or database architectures for analytics and visualization, operational jobs are experiencing new needs in terms of knowledge. Blue-collars and other professional workers are in direct contact with such work environment, of which they accumulate on a daily basis domain and tacit knowledge through on-field experience, essential for a proper sense-making of data (Helper, 2018). Therefore, especially in high-involvement work environments, consulting them in any decision-making process related to maintenance and line management is becoming a common and needed practice. This is the case, for example, of electric grid workers, who have now to deal with the digitalization of the grid. With smart grids and remote control, their contribution will be vital to provide insights to engineers who control the grid from distance. Such change implies the need for an upskilling (Helper, 2009) and requires a new approach to education and new training models for these workers (Fuller, 2014). Experiential learning approaches such as Challenge-Based Learning (CBL), if based on emerging digital technologies such as the Internet of Things, represent a promising opportunity to train "off-the-job" the skills related to digitalization, and provide learners with the domain and digital knowledge required. However, notwithstanding such practices are diffused and wide adoption is reported among practitioners, scant literature has been published on them. In particular, to disentangle how such approaches can enable knowledge development, rigorous frameworks such as the experiential learning cycle of Kolb (1984) need to be used. Moreover, sound empirical evidences are needed to contribute to experiential learning theory. With this aim, the electrical sector – which is facing little automation but a heavy digital transformation through sensors – turns out to be the most convenient research setting to explore the use of IoT technologies as enablers of experiential learning.

This paper is structured as follows. In section 2, we provide a conceptual framework to introduce the new operational needs brought by digitalization and innovative teaching approaches which could help develop such knowledge. In section 3, the research setting and the action research phases which led to design an innovative education method, based on the exploitation of IoT technologies and a Challenge-Based Learning approach, are reported. Section 4 shows the findings related to the new operational needs and the four phases of the experiential learning cycle in the IoT-based CBL activity. In section 5, such findings are discussed: the importance of experiential learning in exploiting and generating knowledge, the contribution of each the actors involved, with a focus on the link between dual apprenticeships and Challenge-Based Learning activities. In the conclusion section we draw conclusions on the role of IoT and Challenge-Based Learning on developing new operational knowledge, whereas the disentanglement of the role of university in such off-the-job training is left to next steps for research.

2 Conceptual Framework

Drawing from labor, organization and education literatures, in this section we review the new needs of operational jobs in terms of knowledge, and the opportunities to develop it through technology-based innovative teaching methods.

2.1 The need for new operational knowledge in the digital era

The awareness of a greater need for knowledge and skills due to technology development and adoption has to do with the so-called "Skill-Biased Technological Change" theory, for which information technologies are believed to increase the demand for highly skilled workers (e.g. Violante, 2008). However – in contrast with this theory, more concerned about computerization and automation – with digitalization, all skill levels will be affected by such upskilling. Studies in Labor Relations and on high performance work organizations (e.g. Whitfield, 2000; Helper, 2009) show how the evolution towards high-involvement production systems is requiring a shift also for blue-collar workers and professionals. Therefore, in such organizations digital technologies are requiring an upskilling at all levels of educational attainment. Operational jobs will need basic knowledge on IoT architectures and databases, analytical and interpersonal skills, and an attitude towards long-life learning to deal with ever-evolving jobs.

However, "despite the emphasis on training, many organizations report a failure to effectively develop skills and anticipate future needs" (Grossman, 2011), and education struggles in keeping up with such increase in complexity (Cedefop, 2018). Training should produce "permanent cognitive and behavioral changes", and develop critical knowledge for job performance. Moreover, "the conditions of transfer include both the generalization of learned material to the job and the maintenance of trained skills over a period of time on the job" (Baldwin, 1988). This is why, in the current context of rapid change in digital technologies, companies are developing dual apprenticeship programs to better match their firm-specific needs while students are still acquiring general knowledge at school. This is achieved by parallelizing the generation of occupation-specific know-how and knowledge-based "know why" provided by schooling. However, this kind of occupation-specific training programs have been widely criticized. In Germany, for instance, they have been considered "unable to provide sufficient general knowledge to enable workers to adapt to technological progress" (Jacob, 2015).

2.2 Experiential Learning to leverage IoT in knowledge development

Such effect could be reduced by integrating on-the-job and off-the-job training, being the latter a way of providing a broader set of industry-specific competencies. The term "off-the-job training" dates back to 1950 (Fryer), referring to the development of a particular skill or piece of knowledge through a course, in a protected environment.

In this wake, two examples of trending off-the-job teaching methods, according to the need for process-oriented curricula and direct interaction with the real world of operational action (Gebhardt, 2015), are Problem-Based Learning and its evolution, namely Challenge-Based Learning. Problem-Based Learning (PBL) is a curricular active learning (Silberman, 1996) approach aimed at making learners face real-world problems on which apply and develop their competencies by integrating theory and practice to solve them (Savery, 1995). It promotes team work and collaboration (Duch, 2001), develops communication skills thanks to the final presentation of results (Hasanefendic, 2016), and enhance problem solving skills and interest in design and technology (Mettas and Constantinou, 2008). It allows to create interdisciplinary connection, and develop the attitude towards learning to learn (Allen, 1996). It also involves project-oriented research and interdisciplinary work, which makes it congenial to be carried out in a university environment. Trials of applications of Problem-Based Learning in the workplace proved to have potential in addressing long-standing firm problems (making it cost-effective), facilitating continuous learning and developing skills such as problem-solving and communication (O'Brien, 2019). Challenge-Based Learning (CBL) was ideated by Apple in 2008 to incorporate 21st-century skills into problem-based learning, with which it shares also all the above-mentioned effects. In CBL, students are required to "make something happen" through "solutions that are both credible and realistic in light of time and resources" (Johnson, 2009). Typically, they are asked to solve complex problems with technology finding concrete, real-world solutions, thus going beyond the "mere" critical thinking exercise proposed by PBL. Briefly, it consists of a process in which students identify a real-world problem, develop a set of activities to analyse it, and eventually propose an actionable solution, which is evaluated by the trainers (Nichols, 2008). In some cases, students are encouraged to publish their results.

Both of the described teaching methods use concrete experience and problem-solving as enablers of learning. Cohen and Levinthal (1990) argue that problem solving and learning capabilities are so similar that there is little reason to differentiate their modes of development, although exactly what is learned may differ: learning capabilities involve the development of the capacity to assimilate existing knowledge, while problem-solving skills represent a capacity to create new knowledge. According to them, the prior possession of relevant knowledge and skill is what gives rise to creativity, permitting the sorts of associations and linkages that may have never been considered before. Such constructive approach to absorptive capacity is related to prior studies of Piaget (1973), for which new knowledge has not just to be told to students, but rather has to be learned, rediscovered and placed by the students themselves into existing conceptual structures. Learning is not about behavioral outcomes, but a continuous process based on the experiences of the learner who resolves conflicts between opposing ways of dealing with the world (Kolb, 2005). These assumptions proceed from his experiential learning theory, first published by Kolb in 1984, for which learning occurs in a four-stages cycle: concrete experience, reflective observation, abstract conceptualization, and active experimentation.

Raelin (1998) goes further, synthetizing new findings on tacit knowledge to add a "work" dimension to Kolb's model. In his work-based model, the four phases of individual learning are categorized into theory vs practice and explicit vs tacit dimensions as follows: experience (practice, tacit), conceptualization (theory, explicit), experimentation (theory, tacit), and reflection (practice, explicit). Investigating what makes a "concrete experience", Morris (2019) recently proposed a revision to Kolb's experiential learning model, by adding an attribute to each phase: "contextually rich" concrete experience, "critical" reflective observation, "contextual-specific" abstract conceptualization, and "pragmatic" active experimentation. Being the IoT a relatively recent technology, its role in the experiential learning cycle to develop operational knowledge has still to be explored.

3 Research Methodology

The empirical setting of this study is a leading electric power distribution operator. With the advent of smart grids, the electricity sector is facing heavy digitalization; as a consequence, operational tasks like inspections, maintenance and use of the electrical grid can be conducted using IoT systems to monitor and control the grid. Such advances are posing the question for further upskilling and new operational knowledge. A pillar of this transformation is the use of dual apprenticeship schemes, where students in the last two years of vocational school are involved in workplace training with the firm. In 2018-2020, the dual apprenticeship to train its future smart grid operators is being carried out jointly with two vocational schools with a path in electronics and electrotechnics.

The selected methodology followed an action research cycle (Lewin, 1946), whose four main steps can be summarized in two macro-phases: phase 1 (reconnaissance stage) and phase 2 (planning, implementation and evaluation of the intervention). Phase 1 aimed at exploring the work-based knowledge needs of the firm. This involved delving into the current training practices by means of interviews and a focus group with operating unit managers and grid operators. Also the dual apprenticeship tutor on the school side was interviewed. Phase 2 involved the two classes participating in the dual program. Based on the findings of Phase 1, this phase involved planning, execution and evaluation of a one-week Challenge-Based IoT laboratory, co-designed with the contribution of the firm to complement "off-the-job" the ongoing workplace training. Apprentices were challenged to design IoT-based solutions to real problems of the grid on which they worked during their workplace training, and explore how IoT will change their task environment in relation to inspection and monitoring. Two separate interventions were carried out in the summer period between their fourth and fifth (last) year of high school, namely at halfway of their two-year dual apprenticeship. Class 1 was involved at the beginning of the summer, whereas Class 2 at the end, i.e. after six additional weeks of on-the-job training, which has been taken into consideration in the analyses. The evaluation phase consisted in the triangulation of direct observation and a survey issued at the end of each of the two weeks.

4 Findings

The interviews to the two dual apprenticeship tutors have been coded inductively into categories, and two second-order themes were identified: knowledge and skills currently provided (no gaps) and needed (gaps); limitations and opportunities of innovating teaching and training methods (Table 1).

Table 3. Findings from interviews to the dual apprenticeship tutors (both firm and school sides)

Knowledge and skills provided by dual apprenticeship and current needs	**No gaps:** • **Awareness that deep theoretical domain knowledge is needed to understand new phenomena of RES** • **Firm-specific skills are provided on the job through the dual apprenticeship scheme** • **Dual apprenticeship provided an approach towards continuous learning** **Gaps:** • **Operational knowledge about primary transformers, three-phase, technical English, proper Italian language for technical communication and interaction. Statistics are not taught. New, transversal knowledge ("breadth") is needed to acquire new knowledge on smart grids;** • **No coding skills are taught; problem solving skills have to be strengthened; lack of manual dexterity. Second-guessing and critical spirit on algorithm outcomes.**
Innovation of teaching and training methods: current limitations and opportunities	Limitations: • While training is customized, learning is generalized, not individual, though there are differences in learning capabilities • IT providers have a role in shaping curricula • Teaching gap: no use of innovative teaching tools. Opportunities: • Schools can freely act on curricula, and firms can have a voice on that • Companies need external laboratories and technologies

What emerges is that the dual apprenticeship is providing firm-specific skills and an approach towards continuous learning, whereas school is struggling in providing the necessary new knowledge. This is due to a lack of new technologies in the laboratories and the necessity to level all students. Opportunities are opened by the possibility to act on school curricula, as IT providers are already doing by providing their technologies and user manuals as text books. In the focus group, 13 electrical grid workers were asked to state their impressions on what becomes more important with the digitalization of the grid. Results are reported in Figure 1.

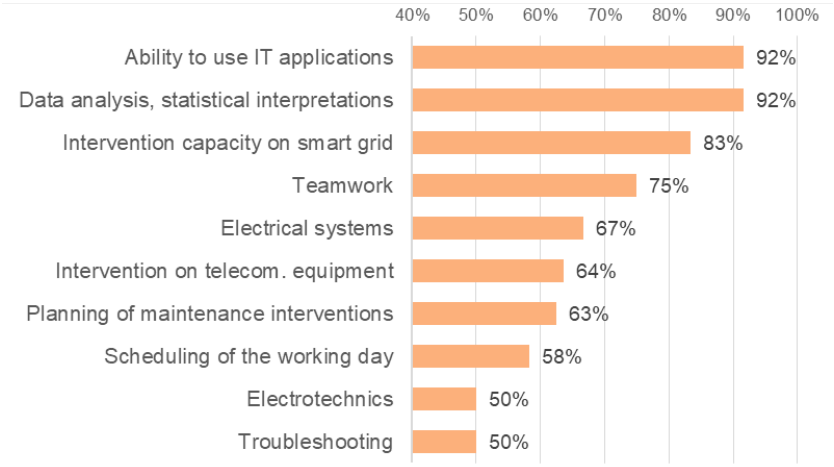

Figure 8. Aspects that are becoming more important due to grid digitalization (from focus group)

IT literacy and the ability to analyze and interpret data were considered the most important knowledge and skills to possess with the upcoming increase in complexity of the grid. Moreover, what emerged is that there will be more need of theoretical knowledge to make sense of data. The ability to interpret natural phenomena is crucial for second-guessing and critical spirit on algorithm outcome:

«If you know theory, it helps you.You already know where to look»

Another insight came from the operating team leader, who expressed the concern for being exclusively data-driven, without knowing theory, in troubleshooting:

«An installer told me: 'no, there is excessive tension, I have to make another cabin'. I replied: 'how is it possible? Looking at electrotechnics theory, there is no need of another cabin here' [...] In the end, I found out that there was a dummy load and his calculations were wrong, but he only looked at data»

Findings from Phase 1 were used as an input to design the Challenge-Based Learning activity for the two classes. Results of the IoT-based challenges were analyzed in turn. Table 2 reports the learning outcomes perceived by the apprentices at the end of each week, concerning domain knowledge and digital skills deployed in the challenges.

Table 4. Perceived impacts attributed by students to the IoT Challenge-Based activity

	Mean	St. Dev.	Mean class 1	Mean class 2	Difference
Management of data generated by sensors	4.12	0.69	4.1	4.14	.04
Secondary cabins' breakdowns causes	3.91	0.83	3.75	4.14	.39
Ability to manage and interpret data coming from measuring instruments	3.71	0.76	3.75	3.64	-.11

Secondary cabins' functioning and equipment	3.68	0.84	3.35	4.14	.79***
Ability to assembly IoT-based measurement tools	3.38	0.85	3.45	3.29	-.16
Ability to program IoT devices	3.03	1.17	2.8	3.36	.56

Overall, class 2 shows higher values, though difference between the two groups is statistically significant only for "feeling more knowledgeable about secondary cabins' functioning and equipment". Since developing IoT coding skills was not the focus, but rather an enabler for the challenges, the perception of having developed such skills registered the lower values. Last, questions aimed at assessing apprentices' perceptions on the four stages of the experiential learning cycle were computed by means of a principal component analysis. Table 3 reports totals and differences between the two classes.

Table 5. Apprentices' perception of learning from the four phases of the experiential learning cycle

	Mean	St. Dev.	Mean class 1	Mean class 2	Difference
Experience	3.35	.70	3.11	3.69	.59**
Conceptualization	3.54	.73	3.58	3.50	-.08
Experimentation	3.63	.69	3.43	3.93	.50**
Reflection	3.76	.77	3.65	3.93	.28

Values of "experience" phase are the lowest, due to the fact that such learning phase pertains to the dual apprenticeship rather than the CBL activities. Statistically significant differences for "experience" and "experimentation", however, suggest that having received more on-the-job training allowed Class 2 to learn more from the CBL activity on what Raelin (1998) considered to be the "tacit" part of learning. Figure 2 reports the box plots, in which it is possible to appreciate the variance by class.

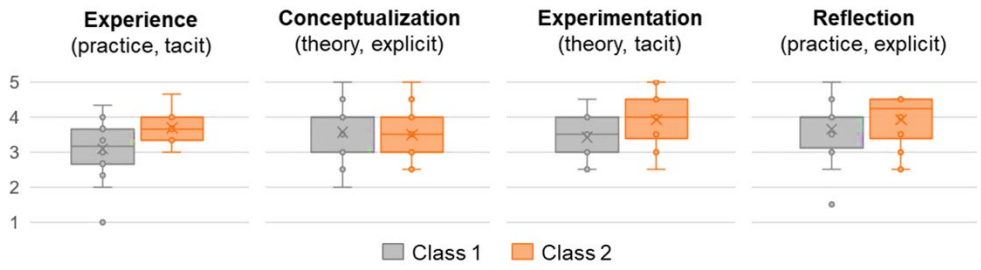

Figure 9. Differences in stepping on the four experiential learning cycle phases

5 Discussion

The increasing content of digital technologies and data-driven practices is making smart grid workers shifting from T-shaped to Pi-shaped profile of competencies. On the vertical axis of the greek pi is depth of knowledge, and on the horizontal axis is breadth with transversal knowledge (Faris et al., 2011). The second "leg", in this case, is digital literacy with knowledge on IoT architectures, data management, fundamental of statistics and interpretation of charts. However, depth in domain knowledge (in this case, electrotechnics) will remain vital for the sense-making of data. Therefore, experiential learning approaches to train off-the-job line workers and technicians will need to take this into consideration, and incorporate technologies which could enable a bridge between domain and digital knowledge. On this, IoT technologies showed to hold a huge potential. In a protected environment, producing very trivial demonstrators, based on sensors and on basic commercial processors, it was possible to emulate the whole data flow that will be experienced by operational roles on a daily basis with the advent of smart grids. From the natural phenomenon (temperature, humidity, electric field intensity), to the data collection through sensors, to its digitization in a computer, to data visualization and basics of statistics with averages, time series, charts. Given the fact that such Challenge-Based Learning needs to be based on brand-new digital technologies that have not been absorbed by vocational schools yet, and the benefits of CBL being carried out in post-secondary environments (Shuptrine, 2013), a technical university was needed along with the firm and the two classes.

When a new technology, calling for new knowledge, emerges in an industry, external providers need to be included, especially for companies that might be less experienced in training (Smith, 2002) or not have the necessary resources or competencies in terms of training transfer (Hill and Stewart, 1999). In uncertain transition phases like the ongoing digital transformation, a part of the training might therefore give better returns if outsourced. Integrating on-the-job (dual apprenticeship) and off-the-job (Challenge-Based Learning) training allows to provide both work-related skills (firm-specific, occupation-specific human capital) and attitude towards breadth of knowledge and continuous learning (general human capital). Such integration has proved to be a best practice to transfer knowledge since it offered "a great opportunity to understand the why of the process rather than just the how" (Sparkes, 2000) and helps develop intellectual skills, particularly in apprenticeships and traineeships (Smith, 2002). Challenge-Based Learning, motivated the apprentices by creating connections with real-work practices that were relevant to them (see also Shuptrine, 2013), engaging them in the training activities. According to Morris' (2019) expansion of the experiential learning cycle, the dual apprenticeship constituted the "contextually rich" concrete experience, enabling the CBL in which the apprentices had the opportunity to perform a "contextual-specific" abstract conceptualization, a "pragmatic" active experimentation and a "critical" reflective observation. Completing the cycle with a CBL training based on IoT technologies allowed to make explicit part of the tacit knowledge acquired during the dual

apprenticeship, especially through reflection and conceptualization phases (Raelin, 1998). As shown by findings, especially for those who carried out more on-the-job training, IoT sensors proved to be an effective tool to link the "know-why" and the "know-how", allowing a more "pragmatic" active experimentation (Morris, 2019) in a protected environment. Using a new technology – of which the apprentices did not know anything – to solve problems coming from the "real world" allowed them to focus on theory and successfully transform tacit knowledge into explicit knowledge (Raelin, 1998), through "critical" (Morris, 2019) reflective observation. Such transition from tacit to explicit is of paramount importance, and must be achieved in every effective training program aimed at fully developing the new, complex and multifaceted operational knowledge needed in the digital era.

6 Conclusions

With the advent of digitalization, including IoT technology in a Challenge-Based Learning approach can have a strong impact on developing (and exploiting, in a constructivist approach) the new operational knowledge needed by blue-collars and technicians. The challenges brought by a new technology, with which the learners are completely unfamiliar, proved to be functional to the development of new knowledge and skills to perform. Moreover, the concurrent dual apprenticeship in which the learners were involved was the perfect "concrete experience" setting which enabled a complete experiential learning cycle. Confirming this, apprentices who underwent more workplace training showed to benefit more from the Challenge-Based Learning, as the involvement in a dual apprenticeship provided the students with higher willingness to learn and a broader set of knowledge and skills, allowing them to build more new knowledge upon it (see Piaget, 1973; Cohen and Levinthal, 1990). Each of the two parts involved in the dual apprenticeship had its role. The school was fundamental in providing both domain (depth) and cross knowledge (breadth) on which to build new knowledge. The firm was fundamental in enabling informal learning (see Eraut, 2004), bringing challenges from real work situations, and transferring location-experiential knowledge to trainees during the laboratory. Further qualitative analyses, based on post-intervention interviews to tutors and apprentices, are needed to better disentangle the contributions of each of the actors involved, especially concerning the rationales for involving a university in the co-creation process of education and training of operational profiles, which we feel goes way beyond the "mere" expertise on IoT technologies.

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Cybersecurity Management: a Knowledge-Based Perspective

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Abstract

The continuously growing importance of cybersecurity is an unavoidable consequence of the rapid development of innovative technological solutions, including, e.g., ubiquitous networking, mobile computing, Internet of things, or various forms of cloud services. Every new solution, however, gradually threatens electronic data, accessible practically from anywhere. Such vulnerability is critical, particularly in the industrial domain, where single firms and institutions must remain competitive and cannot ignore business advantages if of modern platforms. Although strategic managers are generally aware of cybersecurity risks, they frequently have problems with the efficient implementation of efficient managerial solutions. Thorough characterisation and minimisation of this bottleneck, based on qualitative dynamic modelling, is the primary goal of this research. We see the main reason for this discrepancy in a mainly technical nature of cybersecurity and related tools and policies in comparison with qualitatively oriented frameworks and techniques of strategic management. The existence of such vertical inconsistence naturally reflects knowledge asymmetry between business, architectural and logical views of enterprise architecture on one side and explicit ways of network communication, configuration of related components and other physical aspects on the other.

Consequently, the cybersecurity planning power of strategic managers tends to be limited and unfocused. Such a lack of specific technical knowledge can result in the adoption of risky and possibly limiting strategies of cyber under- or overprotection. Beyond the internal vertical gap, there is also a horizontal gap, influencing company interoperability in external networks, like supply chains, critical infrastructures, keiretsu groups, or international partnerships.

We believe that both kinds of problems could be minimised with transparent and holistic integration and continuous bidirectional understanding and sharing of related business and technical

knowledge. That is why we conducted a literature review, reflecting typical structural and behavioural aspects, related to all investigated levels and directions of cybersecurity management in a business context. Collected results were visualised and analysed using the mind map and system diagram. Based on these findings, we formulated a set of typical dynamic hypotheses and validated it quantitatively through the corresponding causal loop diagram. Because of the adopted knowledge-based approach, we propose a generally transparent, but still reasonably comprehensive solution, addressing both strategic decision-makers and technicians.

Keywords – Cybersecurity, Business alignment, Qualitative modelling

Paper type – Academic Research Paper

1 Introduction

Cybersecurity is a pervasive phenomenon, attracting the increasing interest of authorities, industry, researches and end-users (Lezzi et al., 2018), (Pala & Zhuang, 2019), (Sánchez et al., 2019), (Fitzgerald, 2020) as a side effect of progressively escalating development of information and communication technologies (Leszczyna, 2018), (Habibzadeh et al., 2019), (Corallo et al., 2020). Importance of cybersecurity on all levels is widely reflected by international and national legislation, e.g., (Directive (EU) 2016/1148, 2016), (Commission Implementing Regulation (EU) 2018/151, 2018), (Council Regulation (EU) 2019/881, 2019) and industrial standards (International Organization for Standardization ISO/IEC 13335-1:2004, 2004), (ISO/IEC 27002:2005, 2005), (ISO/IEC 27002:2013, 2013), (ISO/IEC 30111:2019, 2019), supported by specialised institutions (ENISA, The European Union Agency for Cybersecurity, ECSO, The European Cyber Security Organisation) and implemented through wide range of different frameworks and up-to-date tools (Li et al., 2019), (Bland et al., 2020), (Williams et al., 2020).

Despite this effort, the number, intensity and impact of cyberattacks growth as a natural consequence of the increasing number of interconnected devices (Arumugam & Subramanian, 2019). Thus the contemporary orientation on smart spaces and people-centric approaches (Elmaghraby & Losavio, 2014), (Rawat & Ghafoor, 2019) considers the systematic embedding of security principles to any kind of interaction with information and communication (ICT) resources as an unavoidable must. The inherent complexity of this task, however, lies in its two-folded nature. Disregarding whether we deal with the private, industrial or public traffic, there is an evident gap between the technical and user level of computer applications, which our research strived to fill. To narrow the spectrum of the addressed target audience, we concentrated only on security aspects of enterprise information systems and on the qualitative level answer the following question:

Is it possible to present cybersecurity matters also to the non-technical strategic manager makers in a transparent, applicable and profitable form?

Such formulation anticipates the following assumptions:

- Transparency means that the structural and functional formalisation of the analysed phenomenon must be generally understandable, easy to interpret and discuss, as well as precise and concise. All these criteria can be met on the knowledge level of representation, which integrates and creatively summarises available data and information resources (Lai, 2007), (Brusoni et al., 2009), (Malhotra & Nair, 2015). If done correctly, significant characteristics remain preserved and selected specific details are omitted.
- Applicability and profitability are based on a seamless inclusion of proposed model into standardised performance management frameworks. These arrangements expect realistic definition and quantification of all involved variables.

To fulfil these goals, we adopted the balanced scorecard framework (BSC) and extended it with knowledge-based aspects of cybersecurity, including the threat intelligence, measures of cyber risks and security-supporting architectures, orchestrated in the following context:

- Value engineering as a transparent way of company value-creating processes requires systemic utilisation of standardised performance architectures (Kiran, 2017), (Egbuhuzor & Port, 2019), (Yihong et al., 2019). They must reflect its two-folded structure, incorporating effectiveness, i.e. measure of success in doing the right things and efficiency, quantifying the level of embedded quality. Because of cyclic, i.e. dynamic nature of management, related frameworks must use temporal indicators from all internal domains of business, because single time slice can hardly explain complex relations among its key leading (predictive, drivers-related) and lagging (output-oriented) indicators (KPIs) (Badawy et al., 2016), (Domínguez et al., 2019). This research used mainly strategic mapping and dynamic balanced scorecards techniques (Kaplan & Norton, 2005), extend with selected features of next generations of BSC (Sofiyabadi & Nasabb, 2012), (Nielsen & Nielsen, 2013) and inclusion of cybersecurity performance features into this framework.
- Cyber threat intelligence (Abu et al., 2018), (Wagner et al., 2019), (Shin & Lowry, 2020) can be considered as a complementary initiative to the researched topic. Generally, the threat intelligence is evidence-based, must deliver expected value and allow to formulate efficient counteractions. Its main goal to collect and distribute information about passed threats and their actors to strengthen the current level of cyber resilience. Its outputs can be in the form of technical recommendations, traditional and advanced data analyses or comprehensive knowledge-based representations, depending on the level of discovered behaviour. Final recommendations are composed of internally collected data and knowledge and extended with experience form external partners and security-related communities of practice. They include strategic suggestions for board members and C-type of managers, tactical hints for security architects,

operational information, characterising defenders' behaviour and finally also technical data, quantifying incident parameters.

- Cybersecurity/cyber risk indexes transform diverse and interlinked cybersecurity aspects into a single number, which is convenient for governance and strategic planning (Lewis et al., 2012), (Bunker, 2020), (Hoffmann et al., 2020). There are several recognised approaches, combining internal cybersecurity capabilities with the country and industrial sector-specific characteristics (Sammut-Bonnici & Galea, 2015). Typical final formulas consider data from the following areas:
  - Level of preparation, including cybersecurity-related business alignment, strategic context, governance and leadership, investments or resilience and response readiness,
  - Characteristics of historical security incidents,
  - Exposition of cybersecurity risks, given by actual ICT infrastructure, impacts of cyber threats, or portfolio of core businesses.
- Enterprise architecture: structural implementation of strategic management tools and techniques, gradually transforming business processes and organisational structures into particular services, provided by specific IT applications, and running on appropriate technical infrastructure (Moeller, 2013), (Mowbray & Shimonski, 2014), (Dhingra, 2017), (Bhattacharya, 2018). There are numerous applicable frameworks, addressing specific types of management. Because this research dealt mainly with the inclusion of cybersecurity into the governance, strategic planning and change management levels, the following frameworks were of our specific interest:
  - Control Objectives for Information and Related Technology (COBIT) is a direction-level framework, proposed by The Information Systems Audit and Control Association (ISACA) for ICT governance and management (Bartens et al., 2015), (Arief & Wahab, 2016), (Almeida et al., 2018), proposing tools and processes, minimising the gap between technical issues, business risk and process requirements and, consequently, reflecting and supporting business processes. Its mission is to get optimal value from enterprise ICT infrastructure by balancing related benefits, risks and resources. These goals are achieved through the following principles: (i) meeting stakeholder needs, (ii) covering the enterprise end to end, (iii) applying a single integrated framework, enabling a holistic approach and (iv) separating governance from management. Moreover, COBIT scalable structure supports straightforward inclusion of new business processes, including the cybersecurity. Although the main strength of COBIT insists in the direction level, it covers also change management (enterprise architecture) and partially touches also design and management of operations. Because for the business alignment of last two levels is frequently used Information Technology Infrastructure Library (ITIL),

companies usually combine both platforms to cover the whole range of business activities equally (Sauve et al., 2006), (Huang et al., 2009), (Hermanto et al., 2019).

- The Open Group Architecture Framework (TOGAF) is a framework and a set of supporting tools for developing enterprise ICT architecture and aligning it with business objectives (Winter & Fischer, 2006), (Hermawan & Sumitra, 2019), (*The TOGAF® Standard, Version 9.2*, 2020).
  It is based on the Architecture Development Method (ADM), which can also accommodate cybersecurity requirements. As an intermediate layer, TOGAF takes requirements from governance and strategic planning and transforms them into the design and implementation matters, convenient for operational, e.g. ITIL-based level.
- From the security architecture point of view, particularly interesting is also Sherwood Applied Business Security Architecture (SABSA) framework, suggesting an optimal methodology for the development of risk-driven enterprise information security architectures and for delivering security infrastructure solutions that support critical business initiatives (Coetzee, 2012), (Pleinevaux, 2016).

2 Methods

Although the routine utilisation of knowledge-driven solutions belongs among the most perspective performance drivers, there are still some open questions, related mainly to appropriate ways of their implementation. Beyond the already mentioned representational clarity, practical solutions must be holistic, user-friendly, scalable, intuitive or easily shareable in teams. Logically, also the set of applied tools and techniques must reflect these non-functional requirements. Based on such assumptions, we conducted initial qualitative research, discovering state of the art in knowledge-based inclusion of cybersecurity aspects into standardised strategic planning and management frameworks. Thus, we followed the general principles of system thinking and design, including holism, purposefulness, openness, multidimensionality, hierarchy, interdependence, equilibrium, counterintuitiveness, ambiguity or entropy, introduced and refined, e.g., by (Bertalanffy et al., 2015), (Forrester, 1961), (Sterman, 2014) or (Meadows & Wright, 2015). These aspects were employed in both main phases of the presented research, including knowledge elicitation (Diaper, 1989) and modelling (Firlej & Hellens, 1991). Resultant findings were considered in the context of organisational learning, divided in (Senge, 2006) into the following five disciplines: personal mastery, mental models, shared vision and team learning, integrated through the principles of systems thinking. Organisations with properly implemented learning principles can also profit from knowledge management (Massingham, 2019). As a result, related findings were summarised in the mind map (Buzan, 2018), providing a loosely structured graphical representation of analysed phenomenon. Due to its visual straightforwardness and clarity, this technique

represents an efficient way of representation, communication and sharing of comprehensive outputs of literature review. In parallel, the collected conceptual artefacts are further structured with the system diagram. In contrast to the linearly structured mind map, system diagram already uses feedback loops and more sharply distinguishes between parameters (connections) and state variables (boxes). I

Invented assumptions concerning internal dynamics were incorporated into dynamic hypotheses and modelled with the causal loop diagram. The behaviour of the resultant model was discussed for selected scenarios, the feasibility of which also proves model validity. Thus, the achieved qualitative results and recognised limitations can facilitate managerial decisions and modifying the existing reality. Although the presented outputs were simplified because of their readability in this document, full versions of all modelling diagrams are more comprehensive and serve as resources for currently developed computation model.

3 Results and discussion

3.1 Mind map

The mind map in figure 1 characterises the main pillars of our understanding of the business alignment of cybersecurity. In its left part, the risk related factors are structured into selected types of threats, which can spoil both company data and ICT infrastructure and affect its business processes in different ways with explicitly quantifiable impacts. To minimise their occurrence, duration and consequences, selected aspects of cybersecurity risks must be appropriately included into the existing system of company governance and management, summarised in the right part of the map. It covers the particular levels of governance, extended with related cybersecurity policy and high-level structure for strategic planning and management. Achieved cybersecurity performance, in our case integrated into BSC framework, can be evaluated with a selected metric from the left part.

Then the detailed CS strategy can be composed as a weighted mixture of listed components, to maximise the goals, listed in the underlying branch. It also shows the specific cycle of CS management, which differs from the generic plan, organise, staff, lead and control quintuplet. Finally, structural foundations of EU governance are shown as unavoidable external factors.

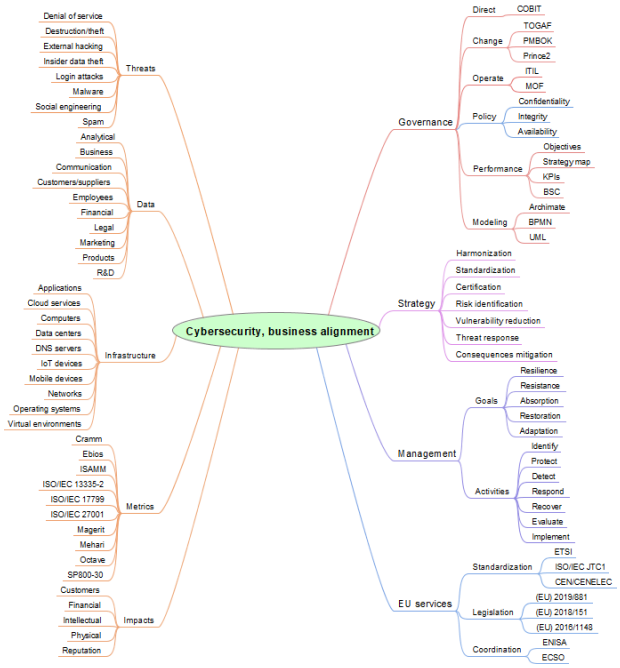

Figure 1 Mind map of analysed domain

3.2 System diagram

Following the adopted way of implementation, figure 2 presents the related system diagram is the system dynamics notation. We extended four BSC sectors with the cybersecurity one because it simultaneously and nontrivially influences segments of customers, operations and learning & growth, and indirectly also finances. The diagram is composed of the following elements:

- Rectangles, stocks or capacities are time-varying state variables, expressed with nouns. Mutually coordinated development of their levels is crucial for the final performance.
- Clouds are dummy external resources, which do not belong to the system.
- Annotated hourglasses are valves, filling or draining the stocks through the oriented double arrows (pipes). Because their turning represents an activity, are expressed with verbs.
- Regular variables without borders are stationary parameters, generally represented with linear or nonlinear functions (risk, utility, subjectivity).
- Oriented single arrows constitute a parametric setting of the system. Double-crossed ones denote considerably slower transfers from start to end.
- Phantom variables in angle brackets only increase the visual clarity of the diagram by removal of possibly intersected graphical elements.

System-level interpretation of BSC considers the main system variables of single sectors as stocks, filled or drained with parametrically controlled valves. Interconnection of subsystems is demonstrated with binding stock levels. Strategic decisions are realised through Finances, primarily collected from sold products or services, i.e. *Operations*.

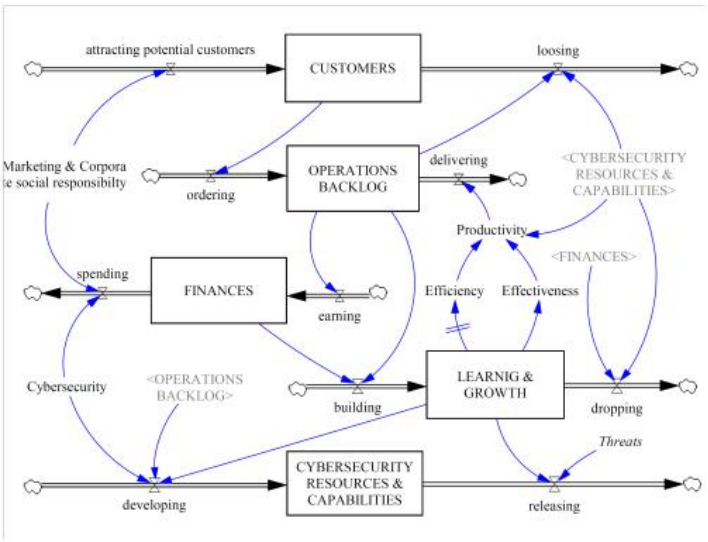

Figure 2 System diagram of cybersecurity in BSC-like performance framework

Thus, the constant level of *Operations* backlog is one of the desirable planning targets. Available level of *Finances* directly determines the most expensive *Learning and growth* subsystem, including both performance drivers (mostly human resources) and infrastructural performance enablers. This sector generates both components of productivity, efficiency and effectiveness, which, altogether with market-related activities, maintain the level of *Customers* and generate backlog. *Cybersecurity* was separated from *Learning and growth* sector, because of its broader impact, which is, moreover, oriented mainly in the opposite direction from the performance. Beyond productivity, cybersecurity incidents can discourage both customers and employees, as well as damage infrastructure or business data.

3.3 Dynamic hypotheses

For simplicity, let us expect that the performance is expressed with a normalised function of quantitative and qualitative indicators from all fours BSC sectors, i.e.,

Performance (Customers, Operations, Learning and growth, Finances) [%],

and its target value should be 100% at the end of the planning period. This situation represents the basal dynamics hypothesis H1 in figure 3. Let us also introduce an overall

normalised index of company cybersecurity level (CSI), structured in accordance with the left side of figure 1. This relative indicator can be used in the following ways:

- Independently from performance to provide decision-makers compound information concerning this matter.
- As a part of more or less independent risk management, where the risk is normalised function of threat probability or likelihood, level of vulnerability and impact of consequences, i.e.:

  Risk(exposed CSI).
- Fully integrated into existing performance management framework, which is approach, presented in this paper. In such case, CSI must be distributed into particular BSC sectors.

To illustrate this last option, we considered a scenario, when single cyberattack appeared at the end of the fourth month. With this situation, we interlinked the remaining four dynamic hypotheses, H2 – H5 as follows:

H2: If company does not systematically invest into own cybersecurity, an average security incident can negatively and irreversibly affect its performance. Although an immediate recovery is possible, the slope of performance graph remains negative until the further managerial event or threat occurrence.

H3: Even a low level of systematic inclusion of cybersecurity into a performance framework can eliminate performance decrease and preserve its steady level.

H4: Optimal level of systematic inclusion of cybersecurity into a performance framework can eliminate performance decrease and originate its next growth.

H5: Extensive level of systematic inclusion of cybersecurity into a performance framework can quickly eliminate performance decrease and originate its next growth. However, this level of security and fast adaptability is expensive, which, it turns, negatively influence the performance. That is why it is generally difficult to overcome a smaller growth slope, caused by extensive investments to cybersecurity.

Exact implementation strategy of particular hypotheses can be derived from the corresponding causal loop diagram, serving as a qualitative dynamic model of integration of cybersecurity into the business.

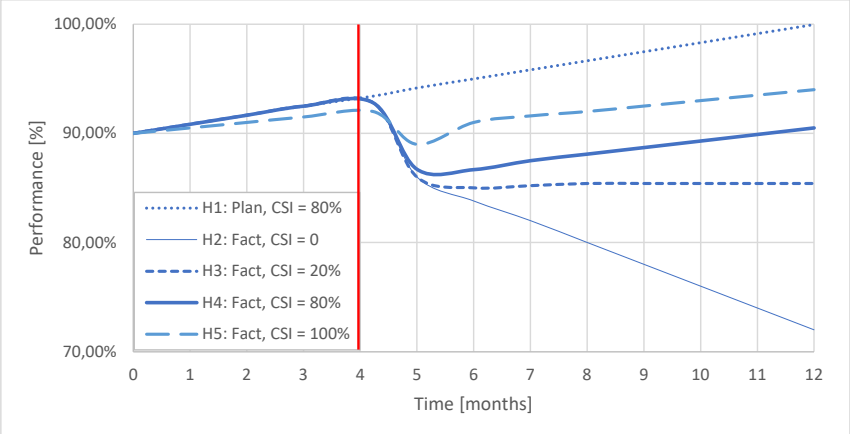

Figure 3 Dynamic hypotheses for sample scenarios and strategies

3.4 Causal loop diagram

The diagram of qualitative dynamics in figure 4 approximately refines the system diagram and suggests conditions, satisfying the above-outlined dynamic hypotheses. Sample resources for strategic decisions are shown in its lower part in the form of several stabilising loops with for clarity omitted settings of desired levels. The exact values of single parameters depend on adopted strategy and are limited mainly with available finances, generated by operations backlog, maintained with an appropriate combination of orders, technology and productivity. Productivity, i.e. input to output conversion ratio, is composed of the quantitative part, including staff and infrastructural changes and the qualitative one, achieving efficiency through organisational learning and development of teamwork and individual capabilities.

The upper right quadrant illustrates sample structure of the cybersecurity sector. It includes own quantitative and qualitative loops, establishing the desired level of resilience and decreasing vulnerability. Marketing focuses purely on the attraction of potential customers. Corporate social responsibility has, however, a broader scope and introduces external Political, Economic, Social, Technological, Environmental and Legal factors (PESTEL) to the model. They can be interpreted, e.g., as a competitive advantage, reputation, customers' satisfaction, interoperability or public awareness. From the dynamic point of view, cybersecurity is included in seven loops, chronologically ordered as follows:

Single balancing loop of strategic planning:

- L1: CS → Resources for strategic decisions → CS

Four reinforcing loops for building and using CS capabilities:

- L2: CS → General CS training → Resilience → Vulnerability → CS
- L3: CS → Specific CS training → Resilience → Vulnerability → CS
- L4: CS → CS staff → Resilience → Vulnerability → CS

- L5: CS → CS architecture, compliance, infrastructure → Resilience → Vulnerability → CS

Two balancing controlling loops:

- L6: CS → Effectiveness → Productivity → Operations backlog → Resources for strategic decisions → CS
- L7: CS → Quality of services Efficiency → Productivity → Operations backlog → Resources for strategic decisions→ CS

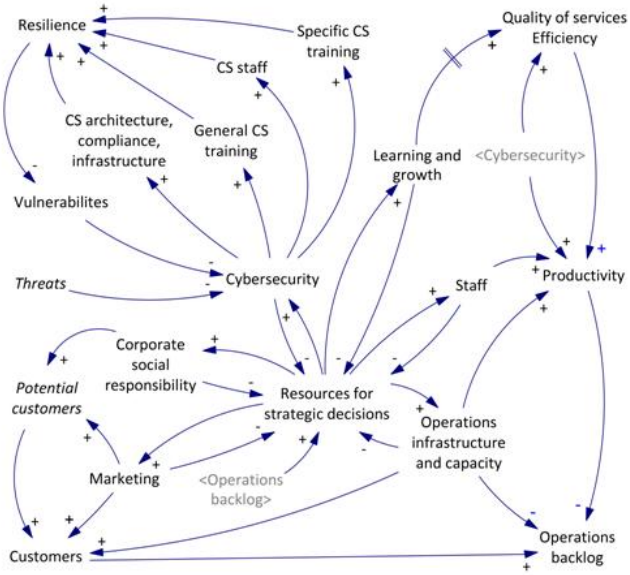

Figure 4 Causal loop diagram summarising dynamics of cybersecurity integration

These loops constitute behaviour, assumed by the specicic dynamic hypotheses:

H1 represents a sample output from the planning phase, and functionally corresponds with H4. Without external or internal threats, there is no need for any reactive actions, and the performace develops steadily during the whole period.

H2 does not expect any explicit cybersecurity infrastructure, which means, that loops L1 - L7 are missing. Such solution is cheaper and in a safe environment influences performance positively. However, when an accident happens, a vulnerable system is not prepared for a prompt recovery and loses performance gradually.

H3 assumes only development of mandatory cybersecurity quantities, represented with the loops L1, L2 and L6. These resources are enough for incident recovery, but cannot guarantee the recurring performance growth.

H4 benefits from the existence of all cybersecurity loops L1 – L7 and their optimal adjustment. Well-developed qualitative aspects of cybersecurity through loops L3 - L5 and L7 result at least in a renewal of original growth. Additional managerial decisions can this situation even improve.

H5 is the opposite extreme to H2. Excessive level of cybersecurity is a costly alternative, restricting performance growth because of budget limitations. On the other hand, minimisation of impacts and fast recovery are its evident advantages.

4 Conclusions

This research provides a qualitative dynamic analysis of an enterprise cybersecurity inclusion into a standardised performance framework. Its main goal was to propose a knowledge-based interconnection of technical and business aspects of the studied phenomenon. Practically it means that traffic data, outputs of network analysing tools as well as cybersecurity-related technical knowledge and threat intelligence are integrated into particular key performance indicators. In parallel, employees are educated in cybersecurity matters and trained to identify and mitigate cybersecurity risks early. Such a joint approach can result in a generally understood, systemically governed and safe growth of the business, capable to minimise consequences of incidents and efficiently reflect a continuous expansion of external and internal threats.

To establish such framework, we adopted the dynamic system approach and reviewed the latest related resources. Collected conceptual information was modelled and gradually structured using the mind map and system diagram. Then we proposed five dynamic hypotheses and justified them through the related causal loop diagram. The main findings were:

- Because of the fast dynamics of cybersecurity, caused by technological development, increasing diversity and frequency of cyberattacks, companies must be able to adopt systemic, scalable, transparent and well-justified, preferably knowledge-based solutions.
- From the governance point of view, cybersecurity represents a specific area of interest, directly or indirectly addressing all standard sectors of performance. That is why it cannot be merged with existing processes and requires specific structural arrangements.
- Strategic management of cybersecurity requires should be based on compound metrics, summarising its quantitative and qualitative aspects.
- Adequately unsecured organisations can face significant problems even after a single attack. On the other hand, massive cybersecurity investments slow down core business development. Optimal system of cybersecurity management has well-balanced its effectiveness and efficiency components.

Finally, the main advantage of knowledge-based modelling insists in its ability to find key behavioural features in the context of the whole system, identify counterintuitive patterns or simplify and visualise multidimensional nonlinear and delayed relations. Realistic transformation of real-world problems into a software form also establishes an intuitive platform for acquisition and sharing of knowledge among distributed research teams and supports professional education and training. Thus, the obtained qualitative model currently serves as a group decision-support tool, based entirely on domain knowledge and primarily validated with expert opinions. Its is intuitive and scalable architecture supports its continuous development. Our future research will concentrate mainly on the quantitative system dynamics implementation of the presented qualitative concept.

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Entrepreneurship and Fintech Development: Comparing Reward and Equity Crowdfunding

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Abstract

The spread of new Financial Technologies, better known as Fintech, offers many opportunities and challenges for entrepreneurs, however little is known on Fintech development. This study describes five areas in order to improve our knowledge on Fintech development: regulation, infrastructure, technologies, finance, innovations. Crowdfunding (CF) platforms are among the main players of the so-called Fintech revolution and many entrepreneurs use these platforms to get both funds and new knowledge for their ventures. The two main CF models are reward crowdfunding (RCF) and equity crowdfunding (ECF). Our study proposes four research propositions to compare these two models. In particular we focus on several campaigns characteristics: video, images, updates, comments. Hopefully this study sheds some lights on Fintech development and will have several implications for scholars and practitioners.

Keywords – Crowdfunding, Entrepreneurship, Fintech, Equity-model, Reward-model

Paper type – Academic Research Paper

1 Introduction

In the last few years, many entrepreneurs leveraged Open Innovation Platforms and in particular crowdfunding platforms (Troise et al., 2020a; Troise and Tani, 2020).

Crowdfunding (CF hereafter) is a new and popular financing mechanism that entrepreneurs use to fund their early stage businesses (Mollick, 2014; Schwienbacher and Larralde, 2010; Vulkan et al., 2016; Troise, 2019a; 2020). CF is one of the most promising initiatives in the so called "Fintech revolution" (Gomber et al., 2018). The term "Financial Technologies or Fintech" is used to describe a variety of emerging technologies and new innovative business models, including crowdfunding, that have the potential to transform the financial services industry (Huang et al., 2016; Carney, 2017; IOSCO, 2017).

The number of countries that pay attention to the development of Fintech has been growing lately. Many of them - e.g. Italy and United Kingdom - consider its potential role in fostering economic growth, which is currently weak (Chen, 2016). Two of the main areas of financial innovation that have great potential and have seen strong developments in recent years are reward crowdfunding (RCF hereafter) and equity crowdfunding (ECF hereafter) (Kirby and Worner, 2014). Financing platforms of these types are included in the innovative business models and emerging technologies that are transforming the financial services industry. The present study focuses on both RCF (Mollick, 2014; Courtney et al., 2017; Parhankangas and Renko, 2017) and ECF models (Ahlers et al., 2015; Troise, 2019b; Troise et al., 2020b), which show significant growths and several benefits (IOSCO, 2017).

According to Belleflamme et al. (2014: 588), crowdfunding mechanism "involves an open call, mostly through the Internet, for the provision of financial resources either in the form of donation or in exchange for the future product or some form of reward to support initiatives for specific purposes". Davis et al. (2017: 90) provided a specific definition for RCF and argued "Rewards-based crowdfunding enables entrepreneurs to garner funds in support of a specific purpose, which often centers on the development or distribution of a new, unfinished, or unproven product".

With regard to ECF, Ahlers et al. (2015: 958) highlighted that "Equity crowdfunding is a method of financing, whereby an entrepreneur sells a specified amount of equity or bond-like shares in a company to a group of (small) investors through an open call for funding on Internet-based platforms".

Entrepreneurs leverage the "wisdom" of the crowd (Belleflamme et al., 2014; Polzin et al., 2018; Troise and Tani, 2020) in order to have a faster product development process, increase their market knowledge, define a business growth strategy and expansion into new markets, improve the access to networks, and increase public awareness of their business (Di Pietro et al., 2018; Estrin et al., 2018; Wald et al., 2019).

In CF contexts, knowledge sharing is a critical driver of success that helps entrepreneurs to get a competitive advantage in a social economy (Wang and Noe 2010;

Hartono and Sheng 2016). One of the major challenge for entrepreneurs in this scenario based on the crowd inputs is manage knowledge.

Currently there is little knowledge on both the Fintech development and the main differences between CF models. The present study aims to fill these gaps. Firstly we describe the Fintech development in order to identify the main characteristics and areas. Second, we propose several research propositions to compare two well-known CF models, i.e. RCF and ECF (Troise et al., 2020c). These propositions will offer the opportunity to test hypotheses. Hence a next study will allow us to verify them and disclose the differences in terms of campaigns' characteristics.

2 Fintech Development

The Research Report on Financial Technology (Fintech), published by the International Organization of Securities Commissions (IOSCO) in February 2017, provided a definition of Fintech: "the term Financial Technologies or 'Fintech' is used to describe a variety of innovative business models and emerging technologies that have the potential to transform the financial services industry" (2017: 4).

Also a recent report (2017) by the Committee on the Global Financial System (CGFS) and the Financial Stability Board (FSB) focused on the new and innovative aspects of Fintech and reported that: "Fintech can be broadly defined as technologically enabled financial innovation that could result in new business models, applications, processes or products with an associated material effect on financial markets, financial institutions and the provision of financial services" (Carney, 2017).

While for Fintech there are specific notions, this is not the same for its development. In fact there is not a precise and univocal definition of "Fintech development", so this study considers several works on this theme and provides a summary description of the main aspects that characterize it. Among these contributions the most recent are considered, and in particular two of them: "The rise and development of fintech", a book edited by Teigland et al., and "On the Fintech Revolution: Interpreting the Forces of Innovation, Disruption, and Transformation in Financial Services", a paper authored by Gomber et al. (2018). The first, focused on Sweden, deals with many topics related to Fintech development (e.g. categories, regulations, process innovation developments, technologies, etc), with the Internet as key driver. The second analyses changes, transformations and new developments associated with the Fintech Revolution. The authors of this second work pay particular attention to three aspects of the Fintech Revolution, called "key forces": technology innovation, process disruption and services transformation.

Figure 1 reports the main elements of the Fintech development, while definitions of each factors are provided in Table I. Five areas of Fintech are highlighted in the present work: regulation, infrastructure, technologies, finance, innovations. Their development represents an opportunity for companies, especially for start ups and SMEs, and an important source for innovation in the industry. The Fintech ecosystem is quickly growing and is composed of many actors (e.g. firms, policy makers, consumers, financial

players) and some interrelated technologies. Each financial technology has a specific role which evolve to improve the transformation of products and processes. Also innovations spread in this context and they help the evolution of business models. According to Gomber et al. (2018: 228), Fintech innovations "*seem to fit into both categories of innovation - radical and disruptive*". These innovations are emerging in many facets of finance, for example financial market infrastructures, credit provision and equity capital raising (FinTech credit report by CGFS and FSB, 2017). The growth of the ecosystem and the development of Fintech are supported by specific regulations that vary by jurisdiction and by features of the Fintech model. The accelerating advancement in Fintech, in particular internet crowdfunding, is favored by policy packages (Chen, 2016). Considering the ECF model, for example, the stakes in companies acquired by investors have different legal forms and the financial law, which is based on "boxes" (such as financial instruments like MiFID II/MiFIR), varies by country (Zetzsche and Preiner, 2018). The number of countries that pay attention to the development of Fintech and consider its potential role in fostering economic growth - currently weak - has grown lately (Chen, 2016).

One of the main areas of financial innovation that has seen strong developments in recent years is CF. CF platforms are included in the innovative business models that are transforming the financial services industry. CF shows a significant growth and several benefits (IOSCO, 2017). This growth might support companies to close (or diminish) their capital needs, and it is driven by supply and demand factors including: reduced technology costs (e.g., internet interfaces used by founders and investors to show or view documentations and business scopes), previously underserved market segments (SMEs and start ups can attract capital more quickly through CF platforms) and low interest rates. The main benefits include: greater access to capital, cost advantages (funds and equity financing raised by entrepreneurs without the costs and procedures of an IPO; low cost of capital and high returns also for investors), market-driven system (platforms operate through an open system and a large number of people - including traditionally penalized segments - choose whether or not a company should receive funding), investor choice/diversification (a new asset in the early stage of innovative businesses that can interest both to crowd and to institutional investors for portfolio diversification), early validation (successful campaigns are positive for the company, its product, and its chances to attract further investments), network effect (exchanges between founders and investors that can support the company through contacts, experience, insight and information) and increase of competition (in a space traditionally dominated by a few providers). This latter aspects concerns the benefits for firms and in general for the economy. Companies access to financing in a timely manner and reducing transaction costs (typically there is only a platform fee applied on the funding amount collected), while traditional entities are incentivized to innovate, thus increasing efficiency.

The growth of CF is important since it might support entrepreneurs to close (or diminish) their capital needs and to receive several benefits. These benefits are additional

respect to those of government or traditional systems (e.g. banks, Venture Capitalists or Business Angels), and mainly are the support of informal networks and the opportunity of a marketing tool (Teigland et al., 2018).

CF platforms are a type of multisided platforms and can be interpreted as community-driven platforms, with entrepreneurs and investors on the two sides. Their value grows attracting more users (network effect) and the quantity or variety of agents on the sides (network externalities) (Rochet and Tirole, 2006). The development of CF platforms attract both projects and investors.

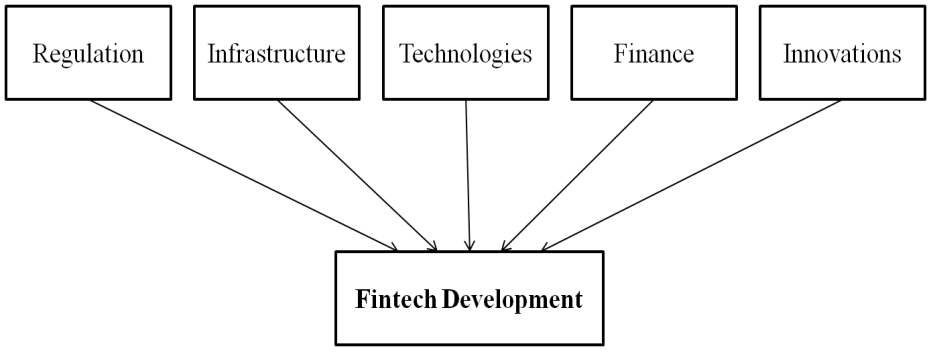

Figure. 1 Fintech Development

Table I. Fintech development: factors and descriptions

Factors	Descriptions
Regulation	Jurisdictions implement new regulatory regime tailored to the case. Regulatory changes influence companies (e.g. service processes and technology platforms). Regulators promote the formation of capital and supervise the risks for investors. Regulators increase their policy focus by issuing new regulations on specific Fintech areas.
Infrastructure	Development of a physical infrastructure for the Internet. Creation of new digital infrastructures which bring products and services to a wider public. Evolution of market infrastructure, connectivity, data infrastructures and integrated systems. Modernization and sharing of infrastructures (e.g. tech or business), platforms growth.
Technologies	Spread of emerging technologies (e.g. cognitive computing, machine learning, Regtech, DLT*) Application and synthesis of technological capabilities to reduce entry barriers. Speed of technological developments (artificial intelligence, big data analysis, cloud computing)

	The use of technology to automate processes, protect consumers, increase product breadth.
Finance	Dissemination of alternative finance models (e.g. crowdfunding). Democratization of finance, new support for entrepreneurship and collectively finance activities. Changes and new services for the finance industry and the global finance ecosystem (e.g. digital). Different actors in finance have been influenced by technologies and innovations in the sector.
Innovations	Development of innovations (e.g. technological and digital) which create value in the ecosystem. Innovations evolve in a market (industrial sectors) Fintech emphasizes how innovation empowers finance. Evolution of innovation strategy. Innovations transform finance and its infrastructure (e.g. services with mobile internet or big data)

*DLT = distributed ledger technologies; Regtech = regulatory technologies

3 Reward Crowdfunding and Equity Crowdfundings

Some studies compared the investment decision criteria of crowd investors, i.e. small and amateur investors, with other traditional investors such as Venture Capitalists (VCs) and Business Angels (BAs) (Lukkarinen et al., 2016; Vulkan et al., 2016).

Lukkarinen et al. (2016: 26) found that "the investment decision criteria traditionally used by VCs or business angels are not of prime importance for success in equity crowdfunding", the scholars in fact argued that ECF "success is related to pre-selected crowdfunding campaign characteristics and the utilization of private and public networks".

Vulkan et al. (2016) explored Seedrs, one of the most important ECF platform in Europe (UK), and leveraged the Mollick's results in the RCF context as a benchmark to ECF. The scholars compared the outcomes of ECF campaigns posted on Seeders with the outcomes of RCF campaigns posted on Kickstarter, a leading RCF platform (U.S.). Their study highlighted both similarities (such as the average number of backers and the campaigns' failure rates) and dissimilarities (such as average investment goal; the average pledge; success rates) when comparing the two models.

However, the scholars focused on campaigns' outcomes, while less investigated are the differences between RCF and ECF in terms of campaigns' characteristics. Hence, we focus on four main elements of the campaigns (Mollick, 2014; Bi et al., 2017; Davis et al., 2017): video, images, updates and comments. We propose the following propositions:

P1*: RCF campaigns differ from ECF campaigns in terms of video length.*

P2*: RCF campaigns differ from ECF campaigns in terms of number of images.*

P3*: RCF campaigns differ from ECF campaigns in terms of number of updates.*

***P4**: RCF campaigns differ from ECF campaigns in terms of number of comments.*

We focus on Italy, a country where CF is widely used and widespread, especially the ECF model (Troise and Tani, 2020). In fact, Italy was the first country in Europe to regulate ECF through the D.L.179/2012 or Decreto Crescita Bis.

At this stage of our study, we can only propose several propositions as we will perform the analyses after the end of data collection.

4 Conclusions

In the last years, CF models are spreading all over the world and many entrepreneurs leverage several types of CF to support their business.

Hopefully, this research could improve our understanding on entrepreneurship in a new field like the Fintech one, and contribute to increase our knowledge about the CF and Fintech development. In particular, Fintech development is an emerging topic and the studies that address this theme are still few and limited. Thus, this paper aims to provide insights in the nascent research stream that specifically focuses on entrepreneurship in Fintech.

Hopefully, this study will have interesting implications for several players of the entrepreneurial ecosystem, such as entrepreneurs, managers, policy makers, authorities, investors, Fintech operators and so on.

This study just represents a first attempt to compare two players of the Fintech landscape, i.e. RCF and ECF. However, at this stage, the study offers only several research propositions and this represents the main limitation. The most suitable research method could be a quantitative methodology leveraging quantitative data in order to test the hypotheses related to our research propositions. This will allow us to have objective findings and confirm or not our hypotheses.

This study will favor the development of a full investigation of Fintech development and shed some lights on RCF and ECF that are among the most representative models of the Fintech landscape..

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A Stakeholder Engagement Case for Rusting away the University-Territory Link: Engineering Local Sustainable Car Body Shops

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Abstract

Nothing could seem more at odds than to think of a connection between a prestigious university institution, what was once critically labelled as an ivory tower and a car body shop. What could have in common an institution of high culture, and, those places, which, according to the collective imagination are associated with rust, burnt oil, and perhaps, a little spreading level of ignorance?
This is undoubtedly the case of rethinking stakeholder engagement of a public university (Politecnico di Torino) at its margin through a project intensively tighten with the local territory. Conducted by the Research Group "Competitiveness and Business Value", the case herein explored involves a multi-stakeholder network of local actors operating in the business sector of car body shops. The exogenous variables affecting the local area are crucial, especially for the historical background of the local economy grounded in the automotive sector. In this research, the multi-stakeholder network is composed by ten local Car Body Shops, a few dozen of their suppliers as well as, two Regional Chapter of Italian associations of handcrafts and Small and Medium Enterprises. The research project aims to drive the sector of car body shops towards the adoption of a sustainable business model among a real competitive leap with new keys to accessing the competitive-strategic, social and environmental, and economic-financial balance. Recurring to a

case study (Yazan, 2015; Yin, 2003), the dialogue between the Politecnico and the car body shops is investigated using the lens of their sustainable business model.
Key performance indicators are identified. Therefore it allows to apply the most appropriate statistical analysis models and to identify the market trends, the areas of managerial tension, the structure of investments and loans, the level of professional skills, the employment dynamics, the best practices, etc. and to disseminate, also through managerial and technical-professional training courses, information and knowledge to the entire national system of car body shops.

Keywords – University, Shared value, Small Business Social Responsibility (SBSR), Stakeholder engagement, Sustainable Business Model

Paper type – Academic Research Paper

1 Introduction

The University has the chance, and also the duty, as a centre of natural integration and of knowledge innovation, to represent an extraordinary development way for the social and economic context in which it operates. The keystone consists of the will and ability in looking for and finding the synchronicity between institutions and enterprises, by creating, as a common factor, a bijective flow of energies, methods, experiences and passions, in a temporal continuity. This is the inner meaning and the goal that has been animating the Research Department of Entrepreneurial Competitiveness and Value, of Politecnico di Torino, since 2009, the year of its birth. The goal of identifying the most efficient solutions for measuring performances of the economic entrepreneurial activities, has found a suitable laboratory for the automotive aftermarket industry, with high focus on the so called 'Independent After Market' segment, whose economic role is to produce and provide spare parts as the alternative or the equivalent to those originals, sold by the Parent Companies of cars, trucks, motorbikes etc. with their own brand. A historical, technological discontinuity affects the car product, from the thermal engine to the electric/hybrid one and from the use of ADAS (advance drivers assistance systems) to autonomous driving. Besides, a powerful competitive acceleration is in progress, in terms of services provided, organisational structures, professional skills, investment intensity, business size, and regulatory changes, legislation on pollution, traffic, infrastructures, road safety, etc. A business sector often stigmatised, 14,000 operating companies are operating in Italy with an average of 4 direct and 16 indirect employees (service companies, manufacturing companies of equipment, paints, spare parts, etc.). The contribution of this industry to the Market, in terms of Gross Domestic Product (GDP) and Employment is really impressive: suffice it to say that the car fleet in Italy counts towards 40 million of cars, 4,5 million of trucks and furthermore all those enterprises that produces machines for the production of spare parts and tools for all the car body shops and their maintenance enterprises, all around the country (Osservatorio di Mercato IAM, n.d.).

2 Literature backbone and overview on method

As noticed by Spence (2014), when it comes to small business social responsibilities, the focus of the research mainstream is to leaving beside single entrepreneurs and micro-companies, to focus more on medium organisations that can scale up. This attitude of research has led to the ignoring of the needs of smaller companies, not only in terms of competitiveness and market presence but also in terms of social and environmental impacts. Nevertheless, concerning the data reported in the latest Eurobarometer research, small businesses have enormous development potential for adopting sustainable and green business models. As a backbone of the European economy, SMEs are undergone a smooth, but evident transformation on two important directions, their greening (in terms of becoming more circular economy-oriented) and their progressive digitalisation (European Commission, 2016, 2017).

The research conducted is particularly interesting, as it traces an unusual direction of creating a dialogue with the territory, moreover with a part that can be considered disadvantaged, stigmatised and ignored (Brown & Dillard, 2015; Dillard & Vinnari, 2018; Dillard, Yuthas, & Baudot, 2016). How has such a dialogue between the university and the territory undergone? Pivotal on the notion of Creation of Shared Value (M. E. Porter & Kramer, 2011; Michael E. Porter & Kramer, 2019), car body shops will benefit from the synergies created with Politecnico unlocking a new level of competitiveness for the local economy.

With the word sustainable business model, we incorporate a triple bottom line approach and consider a wide range of stakeholder interests, including environment and society (Bocken, Short, Rana, & Evans, 2014). An adaptation of the definition of the sustainable business model for car body shops has been co-created during the research, capitalising on the knowledge shared by actors and defining guidelines on organisational / management quality, competitive-strategic and economic-financial balance, ethical, social and environmental criteria. A sort of integrated performance is then determined, and the knowledge created has been concretised into a disciplinary, that identifies the standard requirements for being certified as an Excellent Car Body Shop.

Social and practical applications are impacting the national state of the art of the such marginalised sectors, but also the case sheds light on a peculiar and unconventional channel of dialogue between higher education institutions and their territory that broaden the concept of an entrepreneurial university (Pugh, Lamine, Jack, & Hamilton, 2018).

In such a sector and in the deep aim of the entrepreneurial university (D'Este & Perkmann, 2011; Elia, Secundo, & Passiante, 2017; Gibb, Haskins, & Robertson, 2013), a case study will be presented the one of the above-mentioned Research Department and the Spin Off of the Politecnico di Torino Standard & Testing (Yazan, 2015; Yin, 2003). Born in 2019, it have identified the market segment of the Car Body Shops as an additional object of analysis for both the performances of the same and the improvement of their management path to follow, in order to react against competition.

3 The Assertion Process for the Sustainability of the Business Model of the Car Body Shops

The goal of the Assertion Project of the Car Body Shops is to certify, through an integrated system made of several KPIs (Key Performance Indicators), the sustainability, over time, of the business model of the enterprise. The Car Body Shop that has been asserted as sustainable is a warranty of an economic-financial equilibrium and of wealthy economical relationships with and for all the people involved (stakeholders), from the suppliers to the users, from the collaborators to the institutions. Moreover, asserted Car Body Shops mean higher guarantees in professional car body repair, decrease of death level on the streets, greater respect of operational safety standards, greater respect of social security and tax regulations, thus, higher resources for the community, higher attention to the environmental regulations which means the quality of life rised up, better organization and more awareness about professional competences, loyal selection for those supplier who respect the standards, etc. Asserted Car Body Shops mean be aware about the right professional behaviour with the belief that if the source of the matter is virtuous, there are no other ways that the shared activity is virtuous too.

3.1 Innovation and competitiveness

The reasons why excellent Car Body Shops might support and participate in this Project are countless, but it is possible to distinguish among the followings:

1. technological innovation of the car product (but also of the truck): nowadays there is a real technological discontinuity that can be described through three main sections: a) the engine evolution from the thermal one of hydrocarbon combustion, to the other electrically propelled and/or hydrogen-powered; b) the transition from context in which the driver must pay attention to everything without electrical support, the so called zero-level, to the other where the vehicle is completely autonomous and for which the human intervention is no longer needed, the so called fifth-level; c) the introduction in the market of a vehicle with more and more interconnected functions both within the machine and with the external environment;
2. a common up-growing environmental sensibility strengthened by more and more restrictive standards about pollutant emissions into the environment and circulation in metropolitan areas;
3. the progressive expansion of the principle of the possession instead of the one of the property, thus the possibility to make car rental also for private users, for both short and long terms, for both used and new cars, will make the rental companies the most important client for the Car Body Shops, which, at the same time, must be ready and well organized to efficiently process higher and higher volumes;

4. the direction of Car Body Shops market segment towards the multi-service approach, that means satisfy nearly all types of requirements of the client with respect to their cars, starting from the traditional activities about car body repair, to the mechatronic, from the classic inspection to tyres substitution, from the pose of glass parts to the selling of insurance policies etc.;
5. the dual necessity, with respect to above mentioned considerations, for the Car Body Shops of investing more and more money in tools (think to the calibration of ADAS, advanced driver assistance systems), spaces, business management, professional competences (training courses etc.), business intelligence systems, managerial programming and control culture etc. on the one side; to dispose of a financial structure well balanced between financial debts and equity on the other;
6. the need to make visible the communication to the end users about the professional quality of the Car Body Shops, in terms of technical competences, of service, high quality of materials and components used, in order to give them the possibility to appreciate a different value proposition related to the price/quality relationship.

All those aspects lead the Car Body Shop Market segment following an evaluative path, starting from an handmade dimension, about which it is surely fundamental to preserve the professional quality, to a real business setting through which it is possible to acquire specific competences and coded process dispositions, expressed through standardized performances of efficiency and strength, that would be recognized as the reference for the excellent Car Body Shop and thus, shared to the public as such. One of the most reliable effects will be at the same time, totally for the advantage of the clients, the growth of the performance quality of these enterprises and a greater competitiveness that will lead to a scenario composed by less Car Body Shops in the Market, numerically speaking, but of bigger dimensions. All the models and the analytic algorithm for the market dynamics underline, for the next ten years, a decrease of the Caro Body Shops all over the country of nearly 4% per year, and a doubling increase in dimensions and spaces for the remaining: numerically speaking, over the time window 2020-2028 the decrease of the enterprises in Italy will be towards -33,52%, lowering the number of businesses all over the country to “just” 9.970 units. In parallel the earnings will increase for nearly +165,93%, at a Compound Average Growth Rate (CAGR) of +10,28%.

3.2 The methodological directives

About the methods adopted for the Assertion Project under analysis, the process is focussed on three main conditions that are considered fundamental and qualifying, not negotiable, and other two guidelines to satisfy based on precise performance indicators created ad hoc. With respect to the first point, to declare a Car Body Shop as ‘assertable’, it must respect the following three qualifying conditions:

1. respect of the laws, being those environmental, about security and hygiene on the job, equity of genders, social, fiscal etc. and linked compliances such as DURC (Documento Unico di regolarità contributiva), SCIA (segnalazione certificata d'inizio attività), GDPR (general data protection regulation), visura camerale, MUD (modello unico dichiarazione ambientale: denuncia annuale rifiuti), DVR (documento di valutazione dei rischi), CPI (certificato protezione incendi), dichiarazione di conformità di impianti elettrici, di messa a terra e dispositivi di protezione contro le scariche atmosferiche, note informative e verbale di consegna dei dispositivi di protezione individuale (DPI), l'Autorizzazione emissioni in atmosfera, etc.;
2. the possession of the basic qualifying tools to perform: there have been identified at least twelve different tools such as painting and drying booths; preparation plants, templates benches, dust extraction plants, lifting bridges, tintometric areas, welding fumes vacuum cleaners, rotoorbital for preparation and polishing, spotters, complete kits aerographs for painting, software estimators, etc. These tools are considered essential for a Car Body Shop to perform as such, otherwise the activity cannot be considered compelling;
3. The last point is a little bit more sensitive than the previous ones, because it is related to the amount of external work that a Car Body Shop makes: this percentage must not override the threshold of 40% about the total amount of goods and direct services purchased. By this way are not considered as assertable all those businesses based on a high level of externalized performances.

Concerning to the three guidelines above mentioned, it is possible to identify two main sections:

1. the first related to the organizational quality in terms of physical spaces, distinction among areas dedicated to the production, investment innovation, programming and control activities of the process flows, service level, types of estimates, turnover of the spare parts and components, productivity level of the human resources, kinds of tools a part from the ones prior mentioned as essential, level of competences, professional training activities, customer relationship management models, key-to-key time (time span between the moment the client leaves his car in the Car Body Shop, and the moment when he picks it up), etc.;
2. the second point is related to the economic-financial equilibrium expressed in terms of strategy, profitability, financial sustainability, development rate, economic elasticity of the structure, patrimonial level and relative financial independence strength of the business, days sales outstanding coherent with the days purchasing outstanding, operating and recurring financial dynamics, value added created by resources on work, value creation for the stakeholders etc.

For each one of the two guidelines just now described, there have been created appropriate performance indicators: more precisely 31 KPIs for each guideline. These

indicators must have three main characteristics to be considered reliable: the must be measurable, impartial, and verifiable. Furthermore, for each of them a coherent scale of values have been created (starting from 0- worst performance, to 10 – best performance), with the aim to confer to the value of each KPI the relative score pointed on the scale. When the positivity value of a KPI among two consecutive years is confirmed or even improved, there have been considered some point bonus, to award this performance; as well as some point as malus are subtracted in case the outcome crosses from positive into negative or if e bad score is confirmed among two consecutive years. The formulas of the 62 KPIs, the scale of values connected to them and all the variables involved for their calculation are part of the so called 'Disciplinary of the Assertion Process'. other two methods are taken into considerations: the former consists of pointing out, for each KPI whose scores would be lower than the minimum admitted for the assertion, which variables are better off to intervene on and the time horizon in which operate to rise u the value of the KPI involved. The latter is to compare, always for each KPI, the performances of the Car Body Shop under analysis with respect both to a sample of comparable enterprises and to the best performer of that sample. In more details, there have been identified three criteria to build up the comparable samples: the distinction is made upon the number of employees of the Car Body Shop, its geographical location (distinguishing among metropolitan areas, extra metropolitan areas and rural areas) and the kind of activity performed (car repair only, multiservice etc.) with the availability or not of the tow truck.

4 Operating process

The operating process of the Assertion project is composed by six different phases: of which four are useful to obtain the certificate and the other two for the maintenance over time of the same assertion. More precisely:

1. the first phase consists of the verification of the three qualifying conditions with linked documents acquisition to let the validation process to be made;
2. the second phase, so called 'Competitive Equilibrium' is a certificate that can be obtained once the car Body Shop under analysis get a compounded average score not lower than 62,5% of the maximum, and is referred to a group of 31 KPIs, of which 15 are related to the organizational quality and 16 to the economic-financial equilibrium of the business: important to specify that these indicators are measured and evaluated for the last three years since the year for the Assertion. Furthermore the improvement or the worsening of these KPIs, together with the possible volatility of each of them may contribute to the scores got by each indicator;
3. during the third phase, named 'Competitive Strength', the KPIs involved in the evaluation amount to 62 and the compounded average score might not be lower than 72,5% of the maximum;

4. the forth phase is characterized by the formal and physical validation of the previous two phases, by a certifying agent, in the car body Shop and with the authorization by the last one for the access to the informatics system, where there are all the data useful for the calculation of the KPIs for Assertion;
5. the last two phases are useful for the monitoring of the business in one and two years respectively for the assertion obtained, in order to evaluate again the 62 KPIs as a maintenance of the certificate.

Each one of these phases, as well as each one of the 62 KPIs have been deeply discussed and shared, at the end of a six-months work, with a group of work made by ten Car Body Shops located in Piedmont, two category organizers and the contribution of some of the greatest supplier of goods and tools for Car Body Shops of the market, in terms of competences and experience in the sector. Such group of work has rised the analytical operating organization of each one of the these ten enterprises involved, starting from the check-in to the delivery of the fixed car to the client, with the aim of underlying the points of strength and weaknesses and identifying the consequent improving paths to follow, also in order to react to the competitiveness' pressure.

4.1 Next steps

Next steps of the Assertion Process for the Sustainability of the Business Model of the Car Body Shop would be made by following four different directions:

1. to collect a total of at least 200 Car Body Shops asserted and then create a cooperation with Accredia (the national unique Entity designated to certify all those activities that would certify at their own pace other businesses, for example Standard & Testing, Spin Off of the Politecnico di Torino, under the control of the Economic and Development Ministry of the Italian Government, and following the European Rule 765/2008, for certify the competence, the independence and the impartiality of all those organizations that would certify, verify and inspect laboratories), with the goal of making the 62 KPIs a public standard of reference;
2. to communicate to all the interlocutors of the Car Body Shops the list of those who have achieved the Assertion after having completed all the cycle, underlying their scores performances and those variables subject to improvement;
3. to update time after time the models of analysis of performances of Car Body Shops referring to both organizational quality and to economic-financial equilibrium;
4. to plan national conferences focussed on Car Body Shops market segment with the aim of exposing the results of all the analysis made by the Research Centre and By the Spin Off of the Politecnico di Torino, with reference to the

economic-financial trend of the Car Body Shops and to the evolution of the supply chain itself.

5 Conclusion and Future aim

In the end, the goal of the Research Centre for competitiveness and Enterprise's Value together with the Spin Off of Politecnico di Torino Standard & Testing, is to build a strong connection between university didactic world with the one social and economic of the workers, paying particular attention to the Car Body Shops' Market segment. The background of automotive competitiveness will cross, in very short term, from the production to the selling and to the repairing, a real change in paradigm; due to this fact all the operators of the chain will have to react promptly to these changes , adapting their own business model on the new organizational set-up, performance parameters, minimal competences' level, investment innovation etc. This might represent an epochal turning point for one of the most relevant pieces of the Italian economic system, when us, as scientific researchers, have the challenge to assure an award for all those main characters of this sector who respect the law and are able to create and share economic value for and with the community.

Different discourses and dialogues emerge from this case:

- An interinstitutional dialogue between the university (Politecnico) and its multi-stakeholder networks of agents
- An endogenous dialogue between local actors in determining the essential features to be monitored, also with competing interests and different point of views
- A micro-foundational dialogue between the Politecnico and each small company involved in the project, especially on the feedback effect on business performances.

As a future development of this research, we will contextualise and better triangulate data collected from the user, developing a more sophisticated interventionist research protocol with reflective analysis**.**

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How Design-Based Learning Approach Serves for Nurturing of Entrepreneurs in the Digital Age

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Abstract

Design-based learning is an educational approach grounded in the inquiry and reasoning processes towards generating innovative solutions. The approach is known and proven to be effective in the context of learning natural sciences and engineering education. Thake into account that design cognition is also close to entrepreneurs to create opportunities and innovation, we adapt the design-based learning for entrepreneurship education in co-creation project-based learning. In this paper, we illustrate how we train nascent innovative entrepreneurs using co-design approach to foster innovative thinking (creativity, analyticity, intuition, flexibility of thinking) in the project-based learning format. Our exploratory research has revealed key characteristics of co-design project-based learning approach for nurturing of entrepreneurs in the digital age.

Keywords – design-based learning, digital, prototyping, innovative thinking

Paper type – Academic Research Paper

1 Introduction

Entrepreneurship education (EE) can be taught in different ways by a wide range of approaches (Pittaway and Edwards, 2012; Kuratko, 2005; Hjorth and Johannisson, 2007; Wang and Chugh, 2014). Still we have a lot of discussion about the scope, objectives and methodologies that should be addressed in EE (Fayolle, 2013; Fayolle and Gailly, 2015; Kuckertz, 2013) as well as about its actual impact. EE has evolved over the years due to influence of dynamic business environment and uncertainty, rapid development of technologies and ubiquitous digitalization. Today's entrepreneurs have more resources at their fingertips than ever before. The internet, social media, big data made many tools available to innovative entrepreneurs. It also opened up an entirely new place to do new

products and business. EE moves away from approaches of “about” and “for” to the character of “through”. Entrepreneurial learning needs to reflect the process that entrepreneurs go through by focusing on action, experiences, reflection and generation in an unknown future (Kassean et al. 2015; Neck and Greene, 2011).

Exploratory learning (also experimental learning) often results from the internal transformation through developing new knowledge (Kreiser 2011; Zhao et al. 2011) and deviance-error learning (Bingham and Davis 2012).

Action-based entrepreneurial pedagogy involves getting out of a classroom to get hands-on experience talking to users/customers and regularly present lessons learned (Ries, 2011; Blank, 2013). Over the last decade, innovative entrepreneurs use hypothesis-driven approach for opportunity creation called lean startup (Eisenmann, et al. 2011). Key features of this approach are willingness for experimentation, ability and skills to learn from experiments (Alvarez, 2010). Such learning requires "innovative thinking" competence (creativity, intuition, analyticity, flexibility of thinking), ability to be collaborative, open to feedback, willingness to fail and learn from experience. Analytical reasoning taught in business schools, equips managers with cognitive skills and methods. Innovative entrepreneurs deal with high degrees of uncertainty are still equipped not enough in terms of managerial methods and tools. There is a gap in EE when it comes to addressing complex, ill-defined problems with poorly formalized, scarce or ambiguous facts.

Effectuation suggests that instead of predefining goals in highly uncertain environments, innovative entrepreneurs rely on the means that are available at hand and co-create opportunities (Sarasvathy, 2001). The effectuation logic is based on many features that align with design (Stovang and Nielsen 2015). Design cognition addresses these gaps by identifying specific cognitive acts and structures associated with productive outcomes to open-ended and unstructured cases (Garbuio, et al. 2018). Creativity is an intersection between entrepreneurship and design (Li, 2008; Ko and Butler, 2007). Uncertainty is a major force that drives behaviour in both domains (Sarasvathy, 2009; Buchanan, 1992). Empathy allows entrepreneurs and designers to address explicit or latent needs (Brown, 2009; Chiles et al., 2010). There are many similarities between the front-end of the innovation product design process and the front-end of the entrepreneurial process (Barringer and Gresock, 2014; Mata García et al., 2017). Logically EE calls for user-centered approach (Glen et al., 2014; Fixson and Rao, 2014).

The objective of this paper is to adapt the design-based learning approach for entrepreneurship education with the aim to improve innovative thinking competence of nascent entrepreneurs, operating at fuzzy front end of innovation, and identify key characteristics of co-design project-based learning approach for nurturing of entrepreneurs in the digital age.

This exploratory research is based on qualitative and quantitative analysis. To evaluate the progress in improvement of innovative thinking the pre- and post-codesign workshop surveys of the 54 nascent entrepreneurs were administered with 92,5% response rate. The

data was analyses using statistical method, i.e. calculation of the mean, standard deviation, mean difference and a paired t-test. The research was held in 2019/20 and took 4 months.

The paper is structured as follows. In the coming section, we discuss the background and the underlying principles of design thinking as a user-centered design approach, introduce design-based learning as an educational approach grounded in the processes of inquiry and reasoning towards generating innovative solutions. Next, we introduce CoDesign-based learning approach and its key characteristics to foster innovative thinking as a specific entrepreneurial competence, present specially developed co-creation training workshops for nascent innovative entrepreneurs and the results of statistical analysis of innovative skills development. In conclusion, the results and the direction of further research are formulated.

2 Design approach in entrepreneurial learning

2.1 Design thinking a human-centered, iterative and collaborative process

Over the past two decades, the importance of design and the value of design thinking as a tool for innovation have been recognized by business, entrepreneurial community and government (Gruber, et al. 2015). The concept of Design Thinking (DTh) as a "way of thinking" and a "method of creative action" in the sciences can be traced back to the mid-90s (Simon, 1996) and then has been extended on creation of innovation and organizational change by Tim Brown and Roger Martin (Brown, 2009; Martin, 2009). By DTh we refer to a human-centered approach to problem solving and creation of innovation that puts the observation and discovery of often highly nuanced, even tacit/latent, human "pains"/problem/needs right at the forefront of the innovation process. It considers not just the technological system constraints but also the sociocultural context.

DTh approach starts with an observation of the users/customers/clients and of the system's context and constraints, so-called the discovery phase. Discovery phase involves ethnography, visual anthropology, and the use of design probes and workshops with key stakeholders. The next define phase involves finding and framing the problems/needs and insights. The ideation phase involves brainstorming sessions and exploration, through prototypes and visualizations, alternative potential solutions and how different types of users and stakeholders might interact with those solution concepts. In the final delivery phase, the solution concepts are tested not only in terms of their robustness and effectiveness, but also of their fit with users' needs and the broader context of their lives. The DTh process is highly iterative, as it moves backwards and forwards through the phases. It is highly collaborative, involving users/customers/clients in the framing of the problem, as well as in scoping the new opportunity for design. The DTh process is as well

cross-disciplinary, involving technical, design and business disciplines in each of the phases (Brown, 2009; Gruber, et al. 2015).

Design is the synthesis of creativity, as the ability to imagine a new thing, and innovation, as the ability to bring those new things together (Li, 2008). In entrepreneurship, creativity is required to create opportunity that leads to a new product, business model and ventures (Ko and Butler, 2007). An innovative mindset or thinking is central for designers and innovative entrepreneurs (Koh et al. 2015; Laptev, et al. 2014). Following the logic of common characteristics and similarity, there is a reason to use design cognition (methods and tools) in entrepreneurship, in particular to create new product, opportunities and business model. In addition, universities and business schools acknowledge the design approach as an effective learning approach (Kolodner, 2002; Gómez, et al. 2013; (Dunne and Martin, 2006).

2.2 Design-based learning

Design-based learning (DBL) is an educational approach grounded in the processes of inquiry and reasoning towards generating innovative artefacts and solutions (Gómez, et al. 2013). DBL can be taken as an instructional method, which engages students in solving real-life problems. DBL emphasizes planning and design of activities in which students make decisions in the design cognitive thinking processes. In teams, they go iterating through problems and insights identification, generate ideas, create and test solutions (Doppelt et al. 2008; Doppelt, 2009). As an educational approach DBL is akin to and in part stems from pedagogical principles of problem-alike reasoning and problem-based project-based learning (De Graaff and Kolmos 2003). DBL is a promising instructional method to enhance the learning of the natural sciences and engineering (Kolodner, 2002; Gómez, et al. 2013).

DTh, as the combination of tools, processes, and mindsets that designers utilize to solve problems, has increasingly been added to course curricula in business schools for managers (Dunne and Martin, 2006; Liedtka, 2022; Glen, et al., 2014) and nascent entrepreneurs (Garbuio et al., 2018; Huber, 2016; Sarooghi, et al., 2019; Linton and Klinton, 2019). However, the characteristics of DBL needed to enhance the learning of competencies of entrepreneurs haven't been explored systematically.

During the last decade, we have been developing the laboratory infrastructure and using DBL to improve the competencies of nascent technology entrepreneurs in innovative product development and business models in collaboration with colleagues from European universities in a framework of EC Tempus/Erasmus+ projects. In the last couple of years, we experimented with the co-design approach in DBL workshops to improve the specific competence of nascent innovative entrepreneurs and studied key dimensions relevant to DBL (the project features, the facilities for project activities, the role of the teacher/instructor, the social context and assessment methods). In the next section, we present details of DBL co-creation activity, research methods and results.

3 CoDesign-based learning for innovative entrepreneurs

3.1 CoDesign-based learning in fostering specific entrepreneurial competence

Innovative entrepreneurs can benefit from design approach when looking for new challenges, creating opportunities and process of problem solving. This paper focuses on fostering innovative thinking – the ability to find radically new, innovative ways to solve problems by:

- Creativity – *the ability to generate a large number of ideas and striving for high variability of decisions.*
- Analyticity – *the ability to organize information, identify key inconsistencies, errors or problem areas, identifying cause-and-effect relationships and trends.*
- Intuition – *the ability to instant catching of prospective opportunities.*
- Flexibility of thinking – *the ability to rebuild quickly integrating newly arrived information in their proposals, the ability to offer different solutions to the same task, susceptibility and tolerance for different ideas.*

Co-design with users/customers/clients and entrepreneurial team is a highly collaborative and iterative process that discovers "pains"/problems, frames the key insights, and then rapidly prototypes and trials potential solutions with key stakeholders before moving into the delivery phase (Gruber, et al., 2015; *Frow, et al, 2015; Sandersa and Stappersb, 2008, 2014;* Ali and Liem, 2015). At the heart of co-creation is the primacy of human experience, and that the products and business model should be designed to enable that compelling experience, rather than the other way around.

In the 2019/20 academic year, 57 nascent entrepreneurs with different background (science, engineering and business) were selected to foster innovative thinking competence by CoDesign-based learning (CoDBL) workshops organized by MSU Innovation Business & Entrepreneurship Lab. During each of 4-week CoDBL workshops, three cross-disciplinary entrepreneurial teams of five-six members were immersed into co-design activities with users/customers/clients. They gained experience in our rapid prototyping lab equipped with digital facilities (3D printers, milling and laser machines, scanners, VR/AR, etc.), materials for modelling, and creative spaces in "d.school style" for co-creation team work. CoDBL workshop can be described as a combination of “hard” (a set of equipment for design, rapid prototyping and creative space for team/project work) and “soft” (entrepreneurial management, user-centered and participatory design approaches, customer development, lead product development) components for creating successful innovative products. CoDBL workshop instructors and entrepreneurial team supervisors are both university staff and industry representatives from design, engineering and management. CoDBL workshop teams had to carry their projects through all the steps of the creative problem-solving product co-design process within fuzzy front end (Kim and Wilemon, 2002), i.e identification of customer/market/technology opportunities, co-development product ideas to meet

user/customer demand and co-development of a product concept. The goal of CoDBL workshop teams was to co-develop and validate product concepts, i.e. MVPs- minimum viable products (Ries, 2011; Blank, 2013; *Frow, et al, 2015;* Ali and Liem, 2015).

Carrying out the CoDBL workshops we also studied the improvement of innovative thinking competence of nascent entrepreneurs. To clarify the impact of co-design-based learning and project based learning approaches the statistical analysis was carried out in order to determine the effects of the CoDBL workshop. Two surveys in the form of questionnaire were administered to workshop participants: one at the beginning of CoDBL workshops and another after the completion of the product design project. We asked participants of three CoDBL workshops (54 nascent innovative entrepreneurs) to rate their innovative thinking (creativity, intuition, analyticity, flexibility of thinking) on a scale of 1 to 5 where 1 = poor, 2 = basic, 3 = medium, 4 = advanced and 5 = expert level (see Table 1). The response rate was 92,5%. Tables 1-3 show how the skills/abilities of the CoDBL workshop's participants changed.

Table 1, The results from the pre- and post- CoDBL for participants of the CoDBL workshop#1.

Skills/Abilities	**Pre- CoDBL**		**Post- CoDBL**		**Mean**	**Paired t-test***	
	Mean	SD	Mean	SD	**difference**	**t-value**	**p-value**
Creativity	2,24	0,44	3,59	0,51	1,35	9,20	< ,00001
Analyticity	2,53	0,51	3,71	0,47	1,18	7,63	< ,00001
Intuition	2,18	0,53	3,18	0,39	1,00	6,73	< ,00001
Flexibility of thinking	2,29	0,59	3,47	0,51	1,18	9,18	< ,00001

Source: author's elaboration, Number of observation is 17 for both pre- and post- CoDBL.
* significance value = 0.05

Table 2, The results from the pre- and post- CoDBL for participants of the CoDBL workshop#2.

Skills/Abilities	**Pre- CoDBL**		**Post- CoDBL**		**Mean**	**Paired t-test***	
	Mean	SD	Mean	SD	**difference**	**t-value**	**p-value**
Creativity	2,31	0,48	3,56	0,51	1,25	7,32	< ,00001
Analyticity	2,38	0,50	3,88	0,34	1,50	9,49	< ,00001
Intuition	2,19	0,40	3,13	0,34	0,94	8,47	< ,00001
Flexibility of thinking	2,25	0,58	3,50	0,52	1,25	8,66	< ,00001

Source: author's elaboration, Number of observation is 16 for both pre- and post- CoDBL.
* significance value = 0.05

Table 3, The results from the pre- and post- CoDBL for participants of the CoDBL workshop#3.

Skills/Abilities	Pre- CoDBL		Post- CoDBL		Mean	Paired t-test*	
	Mean	SD	Mean	SD	difference	t-value	p-value
Creativity	2,35	0,49	3,76	0,44	1,41	8,17	< ,00001
Analyticity	2,41	0,51	3,65	0,49	1,24	9,06	< ,00001
Intuition	2,29	0,59	3,29	0,47	1,00	5,22	< ,00001
Flexibility of thinking	2,35	0,49	3,65	0,49	1,29	6,91	< ,00001

Source: author's elaboration, Number of observation is 17 for both pre- and post- CoDBL.
* significance value = 0.05

Based on the participants' rates for each components of innovative thinking competence before and after the CoDBL workshops, we calculated statistics and the paired sample t-test. Tables 1 – 3 show the results of the experiment data. The results of the paired t-test show that the p-value for each of the category is less the 0.0001, which indicates that there is the difference between pre- and post- values for each category. We observe that the results of the three CoDBL workshops activities are rather successful. The results of the statistical analysis demonstrate an increase in the mean values for all components of innovative thinking competence of the CoDBL workshops participants (nascent innovative entrepreneurs). Based on the change in the standard deviation (SD) we conclude that the group of participants becomes more homogeneous after going through the CoDBL. Following each of the three 4-week CoDBL workshops, one participant from each team was selected and interviewed. The purpose of the interview was to determine perceptions regarding effects of the co-design workshops, accepted value and further personal development this way.

3.2 Characteristic of CoDBL in entrepreneurship

The result of CoDBL workshops revealed, that co-design approach in teaching entrepreneurship enhances innovative thinking, ability to work in team, establish new connections, network and create opportunity by exploring the social, cultural, technological and economic landscape, and also improve the ability to tolerate ambiguity and uncertain situations, make sound decisions in such situations and being able to control own emotions.

Based on these results, we continued the empirical research and devoted it to identification of the key characteristics of CoDBL in entrepreneurship education. As a first step, we administered the surveys in the form of questionnaire to CoDBL workshop graduates. In addition, we selected and interviewed 18 CoDBL workshop graduates, two from each team. To gain additional expertise, in-depth interviews were conducted with 5 professional product designers and organizers of the co-creation sessions.

As a result, we identified key dimensions relevant to CoDBL in entrepreneurial learning: project features, facilities for project activities, role of the teacher/instructor,

social context of learning and result assessment) and found following characteristics (see Tables 4-7).

Table 4. Characteristics of CoDBL pertaining to project features.

Project feature	Examples
Entrepreneurial project	Competitive combination of innovative product/service and/or business model. Competitive value proposition by innovative product/service or/and business/revenue model. Business/sale perspective.
Cross-disciplinary	Project participants are from science, engineering, design, business, etc. Cross-disciplinary team.
Open-ended	No unique solution is given. No specification, questioning help to arrive to a fully developed specification. Incomplete information is provided in beginning of project activities. Case reasoning approach to solve problems.
Management	Project participants in collaboration with stakeholders define the "pain"/problem/need, the goals and design task. Project participants search solutions based on iteration "hypothesis-build-measure-learn-new hypothesis…" feedback loop. Project participants use design (human-centered) approach and methodology. Project participants can use lean and agile approach. Rapid/exploratory prototyping. Prototype is MVP - minimum viable product. Project participants are requested to determine own procedures and solution testing plan. Real life scenario for solution testing. Final business solution is usually a combination of product/service and business/revenue model.
Experience & experimentation	Project participants apply theory in practical schemes. Hands-on experiences. Project participants conduct experiments and learn from iterations and interaction inside and outside the team. Reflection based on experimentation and experiencing.

Table 5. Characteristics of CoDBL pertaining to facilities for project activities.

Facilities for project activities	Examples
Digital equipment for design & rapid prototyping	Digital equipment for collaborative and distant product concept design. Digital equipment for rapid prototyping. Lab equipment for rapid prototyping (3D printers, milling and laser machines, scanners, VR/AR, etc.) always kept clean, smart and within easy reach. Creative spaces in "d.school style" for co-creation team work with vidio-conference connection.
Creative spaces	Creative spaces in "d.school style" for co-creation team work with vidio-conference connection. Creative spaces for individual work and DIY with Wi-Fi.

Table 6. Characteristics of CoDBL pertaining to the teacher's/instructor's role.

Teacher's/Instructor's role	Examples
Coaching	Coaching on task, process and team. Discussions to reflect on process to technical design and business case. Use hands-outs, worksheets, and other forms of representation. Stimulation of evaluation of process and self-reflection Regular online communication to clarify project issues.
Industrial, venture business & academic expertise/consultation	Faculty (teachers) and instructors act as consultants/expert. Industrial representatives act as consultants/expert. Venture business/capital act as consultants/expert. Formative feedback; project plan, progress reports, mock-up/prototype, etc. Regular online communication to clarify project issues.

Table 7. Characteristics of CoDBL pertaining to the social context and result assessment.

Social context and assessment of the results	Examples
Collaborative/open innovation approach for learning	Identification and communication with key stakeholders ("customer discovery & validation" approach). Co-creation/co-design with key stakeholders/lead users. Building and managing cross-disciplinary project teams. Peer-to-peer communication and peer-to-peer feedback. Peer learning processes within and across project teams. Motivation through competitions. Openness to communicate in social networks and professional communities.
Summative assessment	User/customer validated prototype (MVP - minimum viable product) and business model.

4 Conclusions

This paper supports a new look at design that can be effectively applied to entrepreneurship education. We moved from user-centred design to co-designing and thereby involved users/customers and other stakeholder in the educational process. CoDesign-based learning, as a collaborative learning method, allowed significantly expand the social context and embed nascent entrepreneurs in critical thinking peer-to-peer activities and learning. For further research, we plan to provide recommendations on introducing CoDesign-based learning in project based learning of nascent innovative entrepreneurs and discuss the environment, the role of practitioners and external support from design and innovation business community. At next stage of our research, we will have focus on the study of collaborative project features and digital facilities for project activities.

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The Relevance of Relationship in Crowdfunding Operation: a Woman Startup Case Study

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Abstract

The current research is a part of ongoing work aimed to shed light on relationship' value for woman startup in the crowdfunding context. This paper analyses how intangible resources, as relational capital, can contribute to fundraising during the early stage and, especially, which types of these relations female entrepreneurs must or must not growing to fundraise resources from the crowd.
Based on the qualitative approach of the single-case study, the paper, through the CAOS ('characteristics, ambiance, organization, start-up') observe all the relevant relationships (cardinal links in first, second, and third types) that can lead the success of the financial operation.
The findings show that at least for the early-stage, in the crowdfunding operation, the informal configuration of the relationship established by woman start-up can produce a negative effect on fundraising process.
Several implications have been reached. Firstly, for the academic community, this study can contribute to expanding the literature on gender study especially which that focusing its studies on the start-up phase of female company. Secondly for practitioners, because ever more companies, especially in the actual context of the digital age, are oriented toward alternative ways of finance, particularly via internet as crowdfunding. In this way, efficient use of relational capital' resources could be a value driver to overcome the hard stage of the start-up. Also, again concerning managerial aspects, the model applied (CAOS) allows to observe that the misdistribution of the role can involve the failure of the female startup.
The limitation of the research concerns the SMEs (startup) dimension. Analysis of data has been available only through direct interviews with female entrepreneurship. Regard to future perspectives, the present paper represents the second step of "RC and Woman start-up" research mainstream. In the future, the authors will replicate the analysis, by the acquisition of additional data, will investigate which RC factors can promote the success of fundraising operations.

Keywords – Female entrepreneurship, Woman startup, Crowdfunding, Relational capital

Paper type – Academic Research Paper

1 Introduction

The advent of the Digital Age is allowing the startup firms to overcome traditional patterns of SME's typical function. The real change is related to the use by companies of the new channel of finance introduced by a new phenomenon called FinTech Revolution (Blakstad and Allen, 2018). In this landscape, small and medium companies, in accordance with their needs, can choose if utilize new financial instrument oriented by debt channel, as mini-bond, or by equity-channel, as crowdfunding (Paoloni, et al., 2020a; Paoloni, et al. 2019a; Caratelli and Fattobene, 2018).

Crowdfunding, allows small entrepreneurs to raise funds from a large crowd via Internet. It has the potential to help fill the funding gap because it allows nonqualified individuals to also invest in innovative start-ups. (Belleflamme, et al., 2014; Hornuf and Schwienbacher, 2017). This innovative financial tool has significant scope to facilitate investment in emerging economies (Zheng, et al., 2016; Liao et al.,2015),

The main actors involved in a typical crowdfunding operation are (i) project initiator who presents it credit request or idea/project to be funded; (ii) individuals or groups (i.e., the crowd) who support the funding request; and (iii) a moderating organization (i.e., the platform) that brings the parties together to launch the idea or support the borrowing request (Pellizzon, et al.,2016).

However, regarding gender studies, female entrepreneurs still meet barriers to access credit. The main difficulties still discussed in literature about the barriers to financing related to gender factors accessing credit and of their preference to use personal loan more than man (Cesaroni and Sentuti, 2014; Constantinidis et al., 2006), has been found also in the stream of the innovative financial instrument (Coleman and Robb, 2009; Kanze, et al, 2018).

Recent research about crowdfunding and woman start-ups' (Paoloni et al., 2019b) has confirmed a gap in the literature concerning their use of crowdfunding.

Based on previous mainstream on the importance of intangible assets to fundraise (Ahlers, et al., 2015; Vismara, 2016; Brown, et al., 2019), the present research investigated how relational capital (RC) could help the crowdfunding operations of WSUs. To answer this research question, a qualitative research methodology using a multiple case study (Yin, 2014) was utilized, and the CAOS model of micro-entrepreneurship by Paoloni (2011) was also applied.

This paper is organized as follows. Section 2 develops the literature review and highlights some gaps in the literature. Section 3 presents the methodology. Section 4 tackles the case study and findings. The last section summarizes the conclusion, implication for practitioners, limitation and future perspective.

2 Literature Review

The interest for alternative finance channel' topic, as crowdfunding, has grown up into the SMEs dimension in the last decades. Crowdfunding is one of the main actors of the Fintech revolution phenomenon (Arner, et al., 2016; Chen, et al., 2017; Gabor, et al., 2017). Across this new financing tool, the company can give financial resources directly from the "crowd" (Belleflamme, et al., 2014; Fatoki, 2015; Maier, 2016; Block et al., 2018).

During the time, despite the mechanism to give resources from the crowd is still unchanged, crowdfunding has taken various forms. What differentiates each type from the other is the return reserved to the subject that has contributed to the campaign. Actually, the main 4 forms known are donation-based, reward-based, lending-based and equity-based (Cholakova and Clarysse 2015). In the donation-based the donors financing the companies' project without expecting anything in return. In the reward-based, after received funds, the company reserved to backers a specific reward inherent in the project development. This form of financial gathering is the most commonly used in art' projects. (Kuppuswamy and Bayus, 2018)

The lending-based is the crowdfunding form closest to the traditional loan channel. In fact, by the lending model, the company, before that, the crowdfunding campaign was declared open, establishes inter alia the loan repayment condition reserved to the lenders (Bottiglia, 2016). Finally, in the equity model, the investor contributes directly to the number of equity shares of the company. Once that investor subscribes the equity, it shares the risks related to the economic activity of the company (Ahlers, et al., 2015).

This particular form of crowdfunding has been introduced in 2012 in the legal regulation of several countries. Referring to the Italian context, equity crowdfunding has been introduced by Decrees-Law no. 83/2012 and 145/2013.

Focusing on economic data have confirmed that this innovative tool is popular with SMEs. Starteed (2019) reported that, in Italy, the volume of crowdfunding resources has grown from 66 million in 2015 to 442.68 million in 2019 (up 85% in four years). Also, only the equity-model in 2019 generates 128.5 million with 408 campaigns.

However, regarding gender studies, recent research about crowdfunding and woman start-ups' (Paoloni et al., 2019b) has confirmed a gap in the literature concerning WSUs' use of crowdfunding. The main difficulties still discussed for traditional enterprises conducted by woman have also been observed for crowdfunding operations, as the topics of accessing credit (Cesaroni and Sentuti, 2014), the barriers to financing related to gender factors (Constantinidis et al., 2006) or their preference to use personal loan more than man (Coleman and Robb, 2009). For instance, in the crowdfunding context, female entrepreneurs raise significantly less funding than males (Cumming, et al., 2019; Kanze, et al, 2018).

Geiger and Oranburg, (2018) evidence that crowdfunding campaigns that have a female primary signatory (i.e. key founder, president, or CEO of the company) receive less funding. This research also underlines a relation between the offering amount and

funding raised. Female companies receive increasingly less funding than male and their likelihood to give all the resource requests depends on offers amount: the higher the maximum offering, the lower their probability of success.

The reasons for gender differences within business financing remain unclear. Several scholars perceive these inequalities to the different contributions of intangible assets, as human, social and intellectual capital, during crowdfunding operations.

Zheng et al. (2014), through the multidimensional approach, the integration of structural, relational, and cognitive dimensions provides an inseparable view of social capital in an entrepreneur's fundraising efforts. Ahlers, et al., (2015) examine the impact of venture quality (human, social and intellectual capital) and uncertainty on fundraising success. Drawing on signaling theory, the authors show that the main factor that contributes to the success of fundraising operation is human capital, measured by the percentage of board members with MBA degrees. While intellectual capital (as measured by patents) and social capital (as measured by alliance) had little or no significant impact on funding success.

Vismara (2016) shows that the entrepreneurs' social connections help investors to reduce information asymmetries and influence venture finance decisions. Also, this study highlighted that project proponents can effectively rely on their personal connections in the initial stages of campaigns to attract larger numbers of contributions.

Brown, et al., (2019) examine the role of entrepreneurial networks in the equity crowdfunding process. Through a quantitative approach, the authors highlighted a different contribution of the network concerning the different stages of the crowdfunding campaign. In the first stage (pre-crowdfunding), the study demonstrates strong ties between the entrepreneurs and their personal networks. Family, friends and personal colleagues of entrepreneurs encourage it to look into the crowdfunding instrument. Even in the first stage, the second type of network activated by the entrepreneur is that with the crowdfunding' platform. This contact has a crucial role in the success of operations. The platform can promote the campaign with its personal contact, like other firms, bank or investors community. Once the campaign is launched, the second phase can start. In this stage, the company establishes two different types of relationships. The first one with the small investors (i.e. the "crowd") which contributes to share capital with a small contribution, the second one with the professional investors, as venture capital and business angel. The last stage "post-crowdfunding" shows that crowdfunding confers multiple benefits (pecuniary and non-pecuniary) on firms who successfully go through the process. It helps cement weak ties with new business networks such as business angel investors whilst simultaneously strengthening weak ties to small investors in the "crowd", similar to the "fanvestors" noted by others (Brown et al., 2018). The post-crow- funding phase also sees the start-ups become engaged in a form of "network orchestration" which has both positive and negative elements.

The most recent studies investigated how entrepreneurs can build social capital. Larsson Y. et al. (2019), through social capital theory in a mixed-methods case study,

show that entrepreneurs strategically select their limited resources to build their social capital. The development of RC contributes to the community's giving collective resources for ventures.

Eiteneyer et al. (2019) investigated social capital and the digital crowd. The study suggested that reward-based crowdfunding could provide a digital opportunity for the involvement of customers in entrepreneurial ventures and business-to-consumer (B2C) relationships. Through quantitative analysis, the study underscored crowdfunding as a digital platform for market-oriented innovation.

However, no directed treatment related to relational capital and crowdfunding by the qualitative approach was conducted in the above literature. In this stream, this ongoing research (see also Paoloni, et al., 2020b) aim to analyze, through a single case study, what kind of relationship between the two would promote WSUs' successfully fundraising operations.

3 Methodology

To analyze the proposed topic, we will use the case study method with a descriptive single-case design. Case study methodology that includes both quantitative and qualitative data helps explain both the process and the outcome of a phenomenon through thorough observation, reconstruction, and analysis of the case under investigation (Lyons, 2005; Tellis, 1997; Stouffetr, 1941). The case study method allows a close examination of the data within a specific context. Case studies explore and investigate contemporary real-life phenomena through detailed contextual analysis of a limited number of events or conditions, and their relationships (Yin, 2014). To gather information about the case study in accordance with Yin (1981), data collection procedures were followed by face-to-face interviews with key informants and illustrative materials (e.g., presentation and conference materials).

The information required is in regard to specific aspects of the company, its organization, and the environment in which it is inserted. Moreover, to understand the complexity of this case study, it is very important to understand the reason that led the company to conclude the financial operation.

To answer our research question, we will use the CAOS model (Paoloni, 2011). The CAOS (an Italian acronym for 'caratteristiche personali, ambiente, organizzazione, and start-ups') model refers to the personal characteristics of the entrepreneur (C), the environment in which the micro-enterprise operates (A), organizational and managerial aspects (O), and finally, the motivations for starting a new business and the particular stage in which the SME is observed (S).

The determinants of the model are:

Personal characteristics of the entrepreneur (C): Defines distinctive factors of each entrepreneur, how they may affect the role played by the entrepreneur within the firm, and the capability to build networks and take advantage of them. Elements composing these dimensions are the following:

- anagraphic information of the entrepreneur or company (name, age, education, professional experience);
- micro-enterprise information (denomination, legal form, size, location);
- motivation supporting the business;
- business vision;
- management form;
- entrepreneur's role in the firm;
- decision-making process activation.

The environment in which the micro-enterprise operates (A): Describes the socio-economic-cultural context in which the enterprise is positioned. The environment can influence connections that a company creates while interacting with subjects in this context. Thus, the environment also impacts on the relationships deriving from the Italian economic system.

Organizational and managerial aspects (O): Identifies the factors connected to the entrepreneur's objectives, tasks, and responsibilities within the organization to understand how the agri-food system is situated in the Italian economic system and its financial characteristics. These are the elements to consider:

- assignment of roles;
- identification of responsibility;
- operational and management procedures that define how roles and business actions are executed.

The motivations for starting a new business (S): Describes the relevant phase in which the entrepreneur is focused on each of the following actions:

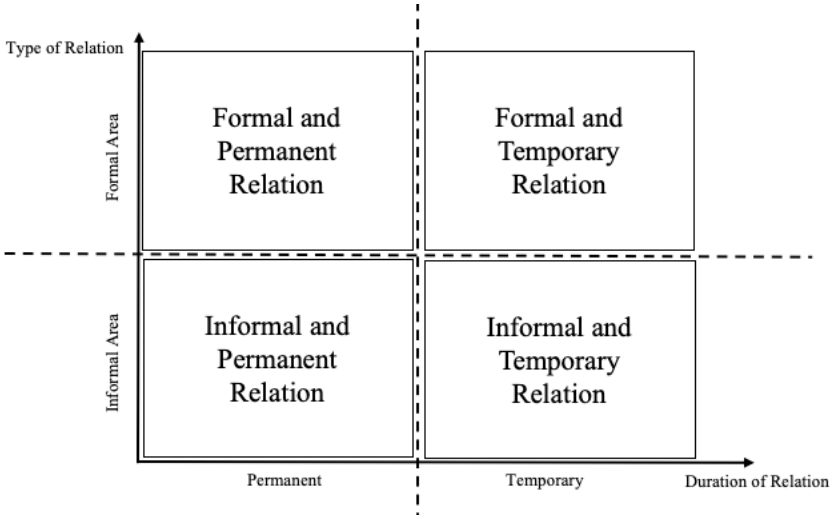
- study of the environment;
- writing a business plan;
- finding financial funds;
- choosing the legal form;
- building up the organizational structure;
- launching the business.

The CAOS model is useful for the aim of this paper, because it facilitates describing all topics that involve the company in a certain context. To this point, this model is also used for evaluation of capital relations.

3.1 The model for analyzing the case study

The model we use to analyze the relations of SMEs in this single-case study is found in the following Paoloni matrix (Paoloni, 2011), based on four types of network relations. The matrix is composed of the intensity of the relations variable—permanent or temporary—and the type of relation variable—formal or informal.

The model identifies four network relations, as shown in Figure 1.



Source: Authors

Figure 1. Relations matrix.

The relations are important in order to understand how the networks support the enterprise in developing a business.

The process identified in the CAOS model (Paoloni, 2011) requires a careful analysis of the four elements. We will call the connections linking Point S with Points C, O, and A the cardinal links, because they represent the cornerstone of all business relationships. Within these connections, there will be different kinds of relationships: formal, informal, temporary, and permanent. The cardinal links are:

- first (S–C/C–S),
- second (S–O/O–S),
- and third (S–A/A–S).

The first cardinal links identify all contacts that the SME activates to start the business; they depend on their characteristics, their needs, and their motivations. The formal relationships present in the start-up stage are, for example, all the contacts that connect the enterprise to the lenders, customers, suppliers, or financial administration and other stakeholders.

The second cardinal links are those relationships that the micro-entrepreneur activates to organize the enterprise and to define roles, tasks, and responsibilities associated with it, as well as the relationships among the various governing bodies (lines of influence).

The third cardinal links during the start-up phase concern the micro-enterprise and the environment into which it is set. These relationships come from outside the micro-enterprise. In these relationships, the environment is the driver of the relational circuit. Often, the use of a certain type of network is not the conclusive solution for the fulfilment of a need, but is necessary at a particular point in time of the business's life. An example in this case study is the need to raise funds in the start-up phase.

4 Case study: Bike ‘n’ Bike

The case study of Bike ‘n’ Bike, an Italian WSU, was analysed through the application of Paoloni’s CAOS framework.

4.1 Personal characteristics of the female entrepreneur (C)

Matilde is 37 years old and lives in Rome (IT). She has a degree in art restoration, but her passion is bike travel. Finding people with which travel by bike is one of the troubles that she faced with her hobby. To fill these difficulties, in 2016 Matilde founded Bike ‘n’ Bike, a start-up with the aim to connect people who organize bike tours with those looking for such an opportunity. Bike ‘n’ Bike portal, thanks to Matilde’s background and her goal of improving the customers’ experience, allows the users to choose many different travel options and bike-tour around the Italy.

Concerning the company’ governance Matilde shares the leadership of the company with her co-founder and marketing manager. Also, Bike ‘n’ Bike employed two other persons with complementary skills. However, the decision-making process is centralized on Matilde, rarely her partners are involved in this crucial role.

4.2 The environment of the micro-enterprise (A)

Bike ‘n’ Bike is an online and multilanguage (Italian and English) platform that connects many people from all over the world. For these reasons, like the most common start-up, Bike ‘n’ Bike has no need for a physical location, in fact, it users can communicate directly on the platform to organize bike travel. Two types of users the platform accepted: the host and the traveler-guests. The host is usually Italian only one is international; currently, there are 32 hosts. The international host, from Croatia, is the result of Matilde’s network.

Traveler-guests, instead, come from all over the world. For the future, Matilde hopes that Bike ‘n’ Bike became an international platform able to organize bike-tour in all Italian territory.

4.3 Organizational and managerial aspects (O)

Bike ‘n’ Bike is an online portal with a light structure. The activities on the Bike ‘n’ Bike portal are coordinated by Matilde, who leads the decision-making process. As mentioned, she only occasionally asks for suggestions from her other partners for relevant questions. Corporate planning is oriented only for the short term; the weakness of financial resources does not allow Matilde to formulate a plan oriented for a long period.

Monitoring activities are performed on the users’ activities on the platform. The business model is constant; the hosts give a percentage fee for all tours organized through the Bike ‘n’ Bike portal. Matilde is aware that the business model does not allow for the

sustainability of the business for a long time, but this is only to attract users. During the interview, she said, "Bike 'n' Bike does not live on its earnings but always needs liquidity injections by owners." This liquidity gap does not allow the company to develop its business.

4.4 The motivations for starting a new business (S)

Bike 'n' Bike born from Matilde's passion for bike travel. The market segment where Bike 'n' Bike is located is highly selective and limited; for these reasons, Bike 'n' Bike could become a relevant operator in the bike economy sector. However, to develop this positive effect will require a significant financial effort, including cost of internationalization, cost of the agreement with international hosts and guests, cost of insurance, cost of bike transport and taxes. In order to starting this expansion process, Matilde has tried to candidate a crowdfunding campaign but with no positive results. Moreover, she has never taken part in a start-up program organized by business incubators, where she could develop a Bike 'n' Bike fundraising project. Thus, the company has a level of undercapitalization that does not allow business development as Matilde hoped.

4.5 The analysis of RC in the start-up phase

Based on the CAOS model, the relationships of Bike 'n' Bike are as follows:

- Cardinal links of the first type (S-C). This phase is characterized by informal and permanent relationships. The Bike 'n' Bike owners are a group of friends with a passion for bike travel. In this phase, there is a lack of relationship between the variables S and C.
- Cardinal links of the second type (S-O). This phase is characterized by informal and permanent relationships. The informality of the relationship is highlighted by the decision-making process; Matilde asks for suggestions from her partners only for relevant questions.
- Cardinal links of the third type (S-A). This phase is characterized by informal and permanent relationships. Many hosts and guests that use the Bike 'n' Bike portal are Matilde's friends who have the same passion.

5 Discussion and Conclusion

In the digital era crowdfunding phenomenon has become international allowing small-medium enterprises to raise funds from a large crowd via internet . (Belleflamme, et al., 2014; Arner, et al., 2016; Chen, et al., 2017). However, female start-ups seem to no have easy access to the operations. In literature, several scholars assert that, in the crowdfunding context, the female entrepreneurship meet the same difficulties to access credit still occurring in the traditional financing channels (Cesaroni and Sentuti, 2014;

Constantinidis et al., 2006; Coleman and Robb, 2009; Cumming, et al., 2019; Kanze, et al, 2018)

A relevant contribution is provided by Brown, et al., (2019). It examines the role of entrepreneurial networks in the equity crowdfunding process, highlighting a different contribution related to the different stages of the operation: pre-crowdfunding, when the campaign is opened and the stage post-crowdfunding.

Starting from these pieces of evidence, our study, structured by the qualitative approach, analyzed through the CAOS model (Paoloni, 2011) the relations that entrepreneurs Matilde has established during the start-up phase of her company.

The evidence highlight a lack of relationship with investors prevented the start-up from finding the financial resources needed to develop the business. The relationships observed with the CAOS model showed an informal and permanent link among all the variables. This relationship involves many relevant aspects of the start-up lifecycle: the relationship with start-up partners, decision-making process, and relationship with the users (guests and hosts) of the online portal.

In this light, it is possible to conclude that this type of relations activated by the entrepreneurs doesn't allow the company to overcome even the first stage of "pre-crowdfunding" described in Brown, et al., (2019).

This research is a prosecution of the qualitative study on crowdfunding and female start-ups. It also contributed to the expansion of gender studies and the role of RC in innovative financial tools.

Regarding managerial implication, the results of the present research, compared to our previous contribution (see Paoloni, et al., 2020b) can give an initial contribution in order to start new activities run by a woman. Especially we refer to the efficient use of relational capital' resources as a driver to overcome the difficulties meet during the start-up phase. Also, again concerning managerial aspects, the model applied (CAOS) allows asserting that the misdistribution of the role, described in the cardinal links (especially into S-O and S-C), involves the failure of the female startup.

Limitations concerned the dimension of the firms. The analysis of data was available only through direct interviews with female entrepreneurs. Concerning future perspectives, the present paper represents the second step of "RC and Woman start-up" research mainstream. In the future, the authors will replicate the analysis, by the acquisition of additional data, will investigate which RC factors can promote the success of fundraising operations.

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Islamic Microfinance: New Approaches and Key Implications for Female Entrepreneurship

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Abstract

In recent years, several routes have been entered to face the scarcity of financial market liquidity, with the aim of increase access to credit for individuals and micro and medium enterprises (MMEs). In this framework, the application of Islamic banking finance instruments has progressively assumed relevant dimensions, showing to be compatible with the needs of micro entrepreneurs. Moreover, the increasing concentration of wealth of Islamic market is leading western realities to look at the potential arising from collaboration between conventional and alternative markets to decrease inequalities within gender entrepreneurship. Within this context, globalization and digitalization have enlarged market opportunities to empower women financially. Authors examine the socio-economic status of women Shariah compliant financial products to investigate the impact that Islamic micro finance instruments could have to upward mobility of worldwide female entrepreneurship. The objective of this paper is thus to explore viable means for both middle east and western women to manage their wealth from an Islamic perspective.
The applied methodology is grounded in academic publications and reports published by authoritative bodies, also relying on cross-sectional data. It is organized in different steps: first, a proper analysis of Islamic finance instruments is in-depth; then, the comparison between traditional and non-conventional financial instruments is shown; and the assessment of women Islamic-backed status is tackled; moreover, the proficiency of microfinance is analysed; finally, succeeding the finance models evaluation trough the application of a balance scorecard system, a SWOT Analysis is mentioned.
The approach undertaken appears to be innovative in consideration that Islamic Microfinance is still considered a new market. Thus, a concerted action to expand existing knowledge on the possible advantages coming from the study and complementarity of different financial systems is needed.

Indeed, the research represents a deepening in order to assess system potentials. In addition, the high feasibility of such application in different contextual realities would result important for the possible fulfilment of worldwide both Muslim and no-Muslim statused women needs and objectives.
The attractiveness of the application is going to be crucial in order to tackle gender gap in financial inclusion. The possibility to overcome the restrictions related to inadequate collateral, insufficient legal status, high transaction costs and the sensitivity of entrepreneurs, proper of Islamic microfinance would possibly allow to overcome interest-based financing products thus permitting women and MMEs to contribute to the re-launch of economies and financial policies.

Keywords – Microfinance, Alternative Islamic finance, Female entrepreneurship, Emerging countries, Gender and Women's Empowerment Sustainable development.

Paper type – Practical Paper.

1 Introduction

This research practical paper essentially deals with the access to Islamic microcredit for Muslim and no-Muslim statused women. In a broad sense, it concerns a systemic analysis of critical finance different and more inclusive from below than the current and prevailing one. A sort of new "ethics of reciprocity", based on the assumption of the possible opportunities for Muslim women to contribute to developing, in their own territorial realities, and to the increase in the wealth of the community. Ultimately, it represents a positive influence in the economic field with a significant leap beyond the wall of requests for guarantees and commitments by banks. The current credit system, as is known, very often contributes to reinforce social injustice, because it generally offers money to those who already have it. Moreover, the current crisis, even more dramatically widened by the spread of the pandemic worldwide, must be seen as an opportunity to regenerate an unfair and unjust system, to ensure equal dignity of access to credit for all.

In this scenario the role of Islamic finance appears fundamental to ensure the autonomy of Muslim and no-Muslim women, through the microcredit that appears to offers tools and methods of interventions able to fight and get out of poverty, to favour the achievement of the necessary autonomy, to face complicated life situations, both personal that of the family, with greater security to believe in their own abilities and resources, to nurture self-confidence and the possibility of choosing their own future.

The crux of microcredit in Islamic finance, precisely in relation to the evolution of the precepts and constraints imposed, not only of a religious nature, but also political and social, is to verify how much women can contribute, and with what tools, to the growth of the communities to which they belong with the application of Islamic microfinance instruments. In this regard, it should be considered that despite the different interpretations of Qur'anic assumptions, the development of female entrepreneurship for access to microcredit, which may appear negative as a starting point, could instead prefigure and insert itself in the occidens culture, through the recognition and the

strengthening of the undoubted potential of ethical finance. This in consideration of the different modulation of loan conditions, where a capillary network of capital investments, albeit in the short term and without recalculation of interest, could however determine a virtuous circuit of more widespread liquidity, such as to make up for the effects of the lack of the interest rate for credit institutions. This would lead to a significant increase in physiological inputs to the market, such as to ensure potential growth in the most disparate sectors of intervention. These different circumstances of microfinance policy, based on the diffusion of fiduciary credits, may determine new economic and social support policies, involving the main actors (banks) to take up an epochal challenge, which, starting from the bottom, would allow a diffusion of wealth, in economically weaker social strata and for millions of women, otherwise excluded from the credit world and markets.

The paper is divided into three sections. First a theoretical framework and a proper analysis of Islamic finance instruments and tools is in-depth; then, the comparison between conventional and non-conventional financial instruments is shown; and the assessment of women Islamic-backed status is tackled; moreover, the proficiency of microfinance as development financial instruments for local entrepreneurship is analysed; finally, succeeding the first identification of finance models based on the combination of correct Islamic banking tools within microfinance and the following evaluation trough the application of a balance scorecard system, the advantages of the application to female entrepreneurship are assessed and a SWOT Analysis is mentioned.

2 Theoretical framework

In the near future, the implementation of financial and economic cooperation models able to overcome women entrepreneurs existing obstacles, such as gender gap, limited business experience and access to credit is becoming increasingly fundamental for the development of Countries. According to Schumpeter (1934) entrepreneurship stands at the basis of business cycles and of economic development. Similarly, Barretto (1989) stated that economic development is the results of entrepreneurial efforts expressed within new markets and organizations. Successively, Haque (2007) defined the concept of entrepreneurship as “A process of identification and development of innovative ideas and opportunities into business”. Indeed, promoting new business brings employment generation, innovation, high welfare and improvement in living standards. Brush Candida et al., (2007) and similarly, Green, Kirkpatrick, and Murinde (2006), assessed the existence of a causal relationship between the development of enterprises, poverty mitigation and management of the financial policy. Within these assessments and despite the definition of Millennium Development goals (MDGs), economic development still faces challenge to increase employment opportunities for women manly due to international crisis and to difficult living and social conditions. However, it is strongly believed in literature that economic integration and globalization is progressively spreading the idea of women entrepreneurship stream into developing countries

contributing to enrich society and to support local development. Over time, the innovation of new modalities of access to credit increasingly permits to women to acquire a role in societies as a substantial parte of different productivity systems (Ellahi, Awais and Raza., 2018). As pointed by Ghani et al. (2011) and Kalim (2012), women constitute one of major driver to globally overcome economic challenges leading to a modern high tech world with the ability to diversify production services. Stevenson, Onge (2005) and Iaona (2007) conducted the analysis of female entrepreneurship within different countries and region assessing as differences were mainly based on their cultural and ethical beliefs, their access to natural resources and policies pursued at the national level to promote female entrepreneurship. Indeed, the encouragement of female entrepreneurs requires a detailed analysis of environmental and social factors affecting them, accompanied by economic and financial policies pursued by the government aimed at promoting gender equality. Within this scenario, the exploitation of financial market and microfinance institutions, as a source of funding to mitigate poverty and increase gender equality, helping poor and needy people to run their business, can be seen as an eligible field to prevent gender gap and to help women, indeed creating job and life opportunities. Among the different typologies of alternative and non-conventional finance, literature agreed to consider the application of Islamic Finance instruments a possible cure for the ailing of global financial markets and of different living standards (Iqbal., 2008) as evidence exists that it performed much better than their conventional counterparts, even during crises (Farooq et al., 2015). Islamic Finance is defined as a collaborative promising approach capable of establish long term relationship based on trust, responsible participative principles, cost of capital decrease, lower interest rates and easier access to loans (Van Benthem, 2016; Allen, 2013; Zgheib, 2017; Bakar et al., 2011). Similarly, Islamic microfinance can play an important role in the development of the economy, by providing financial services without interest (*riba*), representing a common ground of collaboration between conventional and non-conventional models. The fiduciary and no-speculative element of Islamic microfinance encourages long-term, partnership based, profit and loss-sharing investments at a zero interest rate demonstrating indeed to have substantial potential for supporting local economies and women entrepreneurship. Those existing few studied that have been conducted in order to assess the relationship between women entrepreneurship and microcredit programs have mainly focused on a social service perspective (Akter et al., 2018), showing that utilization of microcredit could help to improve the overall development of regions: lack of credit and less access to financing shows in fact to be the main critical factor affecting the existence of gender gap.

Therefore, the present paper aims at improve existing knowledge on the exploration of the benefits coming from the application of Islamic micro-financing tools for worldwide developing female entrepreneurship.

3 Islamic Microfinance tools and existing models

At the Microcredit Summit in 1997 microfinance was defined as a "program, which extends small loans to very poor people for self employment projects which generate income in allowing them to take care of themselves and their families". However, those poor who are practicing Muslims, and are thus unable to take advantage of traditional microfinance contracts, which involves the payment of interest (ElKommi and Croson., 2012). Islamic microfinance represents in fact the meeting of two rapidly growing industries: microfinance and Islamic finance. Islamic Finance activities, as much as microfinance instruments, have to be compatible with Islamic law that is based on the respect of specific precepts and religious behavioural standards of the Qur'an: prohibition to realize interest on loans (Riba); obligation to make socially responsible/legitimate investments (Halal), injunction to arrange contracts involving unreasonable uncertainties and ambiguities (Gharar); restrictions on speculation (Maysir), prohibition to invest in prohibited activities (alcohol, gambling, weapons etc.) (Haram), and charity obligation for each adult Muslim (Zakat).

Islamic Microfinance has been progressively growing in the world, particularly in poor countries, as credible alternative to traditional financial models with the aim to allow poor populations having access to basic financial services at low cost (Ahmed., 2002). Islamic microfinance products are actually concentrated in a few countries; the top three are Indonesia, Bangladesh, and Afghanistan where the demand is very strong, accounting for 80 per cent of global outreach (Karim, Tarazi, Reille., 2008).

Given the moral and ethical attributes of Islamic financing schemes, while conventional microfinance institutions have expanded their operations in the last two decades, poverty-focused microfinance based on Islamic principles is also growing rapidly showing a feasible application also within no-Islamic contexts. This is due to the inner values of Islamic microfinance were the absence of interests and speculation leads to the promotion of a major ethical finance based on mutual cooperation able to promote socio-economic development (Abdul Rahman., 2007). Islamic banking, that, as investors, are characterized by risk-sharing and provision of loans without collateral, proves to be a good solution for micro-entrepreneurs (Dhumale and Sapcanin., 1999) which are motivated to succeed while feeling supported and empowered by a major trust relationship with credit institutions.

Different tools of Islamic banking prove to be feasible and applicable to develop Islamic microfinance.

The Mudarbah: three parties are involved: rabulMaal (zakat, waqf, or government), mudaarib (Islamic banking institution) and final mudaarib (i.e. women entrepreneur). According to pre-decided ratio, profits are distributed and entrepreneurs have full control over the business, with a monitoring duty from the bank which own all risk;

The Musharkah: the Islamic bank becomes a partner of women entrepreneurs and losses are distributed according to capital contributions and profits according to

predetermined ratios. In this case a third-party guarantee can prove a good solution for risk mitigation;

In the case of Murabaha, Islamic banks purchase and then sell goods and services to entrepreneurs, earning a mark-up. It is most suitable for purchasing business equipment. This method of financing includes continuous monitoring by banks and loans are further initiated to the entrepreneurs with good repute and loans usually given to a group of micro-entrepreneurs to reduce the chances of default;

Within the Ijarah Muntahia Bitamleek, Islamic banks purchases required assets and rent it to entrepreneurs. Entrepreneurs, further pay this rent back after regular intervals and will be responsible for taking care of assets and banks monitors its performance;

Qardhul Hasan or interest-free loans is useful for promoting new entrepreneurs start-up capital. Regular instalments for repayment are settled according to an agreed contract. However, Credit risk is involved in this case (Ellahi, Awais, Raza., 2018).

Those above described main Islamic financial instruments can easily been combined and applied to microfinance trough four different models.

The first one is the Composite model that works as follows: donor (IsMIFI) create zakah fund and waqf fund based in physical and cash is build; the poorest who are economically inactive will get zakah fund as safety net and skills training are delivered for the necessitous utilizing community-held physical assets under waqf; skills improvement will therefore encourage the poorest to graduate from poverty and become economically active; beneficiaries are formed in self help groups with mutual guarantee; allocated fund based on combination for profit debt based and equity based modes; loan repayment, with possibilities of higher loan in the future; zakah fund is used to guarantee against default; saving is encouraged under micro-savings; takaful fund (as insurance) is encouraged to protect against risks and uncertainties (Obaidullah., 2008b: 53-55).

The second one is the Wakalah Agency Model that utilises fund from zakah and NGO donor, distributed to the poor in qardhul hasan, hence, zakah is promoted as self sustaining development tool for the needy, and educate them to be independent (Wilson., 2007-210). The management company act as agency and assesses the eligible credit application. For this duty, a fixed fee, is set up as reward of conducting the operation. The participants could get fund disbursement, but with rationing mechanism and prioritization to prevent mass of capital be taken out. In this case, it is similar to credit union, but with qualified financial administration and protection for clients (Riwajanti., 2013).

The third model is the Mudarabah model that is based on profit and loss sharing contract (Wilson., 2007: 211). In this model, company acts as financier (Rabb al mal), invest the fund to client (mudharib) and get pre-determined ratio of profit share as return, in which similar to joint venture. Hence, due to the fluctuation of actual profit, the amount of share will fluctuate. If there is loss, the bank will liable for not getting the fund back and clients has risk of not obtaining rewards for the works done in running the business. Zakah fund could not be used in this method because the nature is more commercial rather than social (Riwajanti., 2013).

The forth SPV Model is proposed by Dusuki as an alternative, which have the following features: a variety of fund sources with specific microfinance intention are mobilised by Islamic Banks; a bankruptcyremote SPV is created; certain amounts of funds are allocated and forwarded to SPV; the funds are distributed to based on clients' demand (Dusuki., 2008: 61).

From the assessment of the above models it is possible to conclude that Islamic microfinance maintains the basic format of conventional microfinance in terms of weekly/monthly repayments and social development programmes. However, Islamic microfinance presents much more opportunities to use other external funds which based its existence and effectiveness from charities (zakah, waqfs), the mode of financing is more varied to accommodate the different needs of the impoverished, and the approach in dealing with default is softer.

4 Comparison between traditional and non-conventional financial instruments

According to the recent studies, the overall supply of Islamic products is still quite small relative to the conventional microfinance sector ones and customers using Sharia-compliant products still represent less than 1 per cent of total microfinance outreach. However, with the rapid growth of the market, literature has increasingly investigated the performance of Islamic banks (Bashir., 2001), comparing it to conventional banks (Abdul-Majid et al., 2008; Beck et al., 2013) and assessing the existence of a persisting gap in empirical studies deemed to analyse the performance of Islamic MFIs. In general, there are several characteristics that distinguish conventional microfinance from Islamic Microfinance (Ahmed., 2002). While, both of them mobilize external funds and savings as their source of fund, Islamic charity such as *zakat* and *waqf* are major source for funding Islamic microfinance, which instead are not present in traditional microfinance. The second specificity of Islamic microfinance concerns modes of financing that should eliminate interest in their operation whereas conventional microfinance can adapt interest-based financing. The third feature concerns funds transfer by microfinance institutions. In conventional microfinance, the institution can directly give cash to their client as the financing. While Islamic financial services providers are not allowed to give cash to their clients as loan is prohibited in Islam and it is therefore base on good transferred. Moreover, Islamic microfinance may use similar technique of conventional institutions (group lending as a way to alleviate risk in their operation) and they also developed Islamic ethical principles to ensure their clients paying regularly. Within the contract in the conventional micro finance a part of funds is deducted as inception on the contrary within Islamic finance no deduction at inception is foreseen. While conventional microfinance institutions focused mainly in women as their client, advocates of Islamic microfinance argue that Islamic MFI should be extended to the whole family as well (Abdelkader, I. B., and Salem, A. B., 2013).

5 Assessment of women Islamic-backed status

Accordingly to Islamic religion there is nothing against Muslims running out business (Kayed., 2010). The only condition that must be preserved is the realization that every business undertaking is intended firstly to please *The Almighty Allah* (Kayed., 2010). Entrepreneurs (both women and men) embrace positive values in promoting productivity through entrepreneurship (Nayeam., 2006) and positive correlation of women and earnings appear to be a message of the Holy Qur'an which quoted: « *Men shall have a benefit from what they earn, and women shall have a benefit from what they earn*. » (Surah An-Nisa: Ayat 32). Furthermore, the status of women seems to be assessed in the Qur'an as it declares the *creation of opposite genders as a part of divine scheme, a matter of reflection* (51:49, 36:36) and *good deeds of all humans will be rewarded irrespective of their gender* (16:97). To cite some religious sources that corroborate these theses, non-exhaustive passages are indicated: *« O mankind! reverence your Guardian-Lord, who created you from a single person, created, of like nature, His mate, and from them twain scattered (like seeds) countless men and women;- reverence Allah, through whom ye demand your mutual (rights), and (reverence) the wombs (That bore you)* » (4:1). In other verses, the Qur'an says: « *Women have rights similar to the rights against them" (2:228). Women and men possess equal rights for work and compensation*. » and « *Never will I suffer to be lost the work of any of you, be he/she male or female: you are members, one of another* » (3:195) (al-Hibri., 1997).

As a confirmation, Islamic law and jurisprudence does not deprive a woman from the right to work within the limits that protect her honour and dignity, permitting them to conduct financial transactions. Indeed a correct implementation of principles and rules of Islam appears to offer women real possibilities of enhancing various types of businesses, encouraging their participation in socio economic activities, within the respect of the following guidelines: first, Women must take consent, if married, from her guardian or husband, as her actions will may influence the functioning of the family and it is her role ensuring, while running a business, that her home and children are properly cared for. Husband then may contribute to the correct implementation of the business. Secondly, care must be taken to choose the business that cannot deal with forbidden activities, services, or products and has to be appropriate and fits with women skills. Each activity that can prevent women from fulfilling any of her Islamic obligations is not allowed. Thirdly, women has to respect the Women's Dress in Islam as *Allah* has stated in the Qur'an that *women must guard their modesty* (Qur'an : 24.31).

To conclude despite to different interpretation, it is not correct to affirm that Islamic culture does discriminate women economically or socially as often portrayed (Ridley., 2016). The real challenge is to intervene on a social basis to increase recognition of women's capabilities within and across Islamic societies (Ali, 2013; Barlas, 2001; Hassan, 1994).

Therefore it is precisely with the aim of encouraging female participation and exploitation of Islamic microfinance participatory instruments that it was considered

appropriate to develop the following balanced scored card accompanied by a swot analysis of the microfinance scenario with the attempt to enrich present knowledge on the effectiveness of such assessments for the development of women entrepreneurship.

6 The SWOT Analysis of Islamic Microfinance and the Balanced Scorecard Model for Islamic Microfinance Institutions

On the basis of the above authors have deemed it appropriate to conduct a proper analysis of Islamic microfinance through the definition of a swot analysis in order to identify its Strengths-Weaknesses-Opportunities-Threats. The aims is to identify advantages and dominant inhibitors for the development of Islamic Microfinance for women. In particular, the analysis of existing literature shows as strengths of the application of microfinance models are:

1) the high initiative of local community. The existence of microfinance shows to be a major ethical and moral financing method, to whom women get more entrusted and motivated by the absence of interest and by the lack of speculation and moral hazard, as it prevents community from the pressure of return that is very burdensome to them;
2) Islamic finance initiatives do not require large capital showing to be compatible with poorest needs leading to inclusive growth and poverty alleviation;
3) Islamic finance shows to be keener for small and medium micro enterprises segment, which represents the majority of businesses in development countries.
4) Islamic banking has become very popular across the world in a short span of time as it shows to be more stable than conventional banks differently based on debt and on high rates of inflation.
5) Islamic banks are more immune to instability as evidenced during the global financial crisis as the level of sophistication of the technology used is low and does not require high skills to request and obtain access to credit.

Meanwhile, the weaknesses are:

1) Cost of obtaining legal permits and of definition of regulations from governments; Lack of unified benchmarks and standards;
2) Cost of monitoring and communication to reach needed person and general insufficient knowledge, perception and awareness of its potential.
3) Lack of dedicated institutions: Islamic MFIs should adopt the role of such an institution.

On the other hand, factors that regarded as opportunities are:

1) Public interest toward Islamic micro-finance transaction is getting bigger also as a consequence of economic and recent pandemic crisis, as Government needs both for developed and underdeveloped countries to find way to increase access to credit;
2) Finance sector is very flexible – there is no limit of minimum financing;

3) Shifting from a product orientated approach to a client orientated approach.
4) Islamic MFIs should promote and establish community owned and controlled endowment funds to strengthen local capital accumulation while IMFIs itself should adopt a role of observer and regulator so to address any loopholes in the system.
5) Huge market size especially the high concentration of Islamic practicing is big opportunity for Islamic Banks.
6) Growing developing economy has huge potential to attract investments from cash surplus Islamic countries.
7) Large number of Muslims practicing avoids participating in the conventional banking system and as a result large credit is not utilized.
8) The spreading of new technologies and production processes in the field of information and communication technology (ICT) that can really support dynamic business activities, including supporting the ability to access the market quickly

While the threats are:

1) Gap between the ability to save and utilize credit because of first inexperience that need the definition of training and educational procedures;
2) Weak regulation and legality of Islamic microfinance institutions – The absence of sufficient law;
3) Introduction of Islamic banking could be seen as threat to secularism and may result in political turmoil; two parallel banking stream may give rise to communalism.

   Indeed, what emerges from the swot analysis is that the application and development of the Islamic microfinance presents far more strengths and opportunities than threats and weaknesses. The greatest is the lack of institutions made up of those that act as benchmarks for the definition and dissemination of best practices, which is the reason why authors decided to hypothesize a Balanced Scorecard (BSC) of these institutions.

According to the Balanced Scorecard Model (BSC), the different dimensions to be considered in order to improve and emphasize Micro Finance Institutions (MFIs) performance for women entrepreneurs are the following: Financial, Customer, Internal business process and learning, growth & innovation. In learning, growth & innovations perspective, the performance measures to use are:

- *Training* - Defined in terms of the proportion of staff receiving training on different status of worldwide women conditions.

- *Innovations* - Measures the capability of the organisation to develop new products, processes, and services to define new markets for women entrepreneurs.

- *Knowledge sharing* - Accurate and timely information shared among women.

In the internal business processes, the performance measures to use are:

- *Per unit costs* – Define a general framework to which all banks and institutions can refers to apply microfinance instruments to their realities and measure of the resources

used in producing a unit of service. For example, cost per loan issued, and cost per member served by the MFI.

- *Cycle time* – Optimization of the time taken for a project to be completed. This can be a key measure of women satisfaction. This may include; time to get service, time to process a loan application etc.

- *Response time* – Measure of the amount of time taken to respond to a request for service.

- *Backlog* - Measures the amount of work in queue, waiting to be processed. For example, the number of loan applications waiting for processing

In the customer perspective, the performance metrics used were:

Coverage – Measure of the female population served by the MFI, which also included the number of men & women getting the financial services from the MFI.

Accomplishment – Overall outcome or achievement of a program, including poverty reduction or improvement on household income or increased awareness of the services.

Quality - The proportion of services provided without error or complaints.

Satisfaction - Women satisfaction is measured by a pre-defined survey, based on customers' comments on their satisfaction levels and the benefits they have attained.

In the financial perspective, the performance to use are:

Profitability ratio – Measures the net income in relation to its balance sheet.

Financial viability – The ability of an MFI to cover its costs with earned revenue, and not relying on donor funding to subsidize its operations.

Portfolio quality ratios - Provide information on the percentage of non-earning assets, which in turn decrease the revenue and liquidity position of an MFI. For example, repayment rates, portfolio quality ratios and loan loss ratios.

Leverage & capital adequacy – Leverage refers to the extent to which an MFI borrows money relative to its amount of equity. Capital adequacy refers to the amount of capital an MFI has relative to its assets. Capital adequacy relates to leverage in terms of the adequacy of the MFIs funding structure.

Indeed, the proposed Balanced Scorecard Model (BSC) shows as it is possible to contribute to the definition of a comprehensive set of performance measures able to provide a valid framework for strategic recommendations.

7 Conclusions

Microfinance has been identified as an important and increasing potential policy instrument that allows greater financial and social independence even for the weakest by facilitating access to financial services. In order to incentivize such a trend urge the need, with the support of advanced technologies, of providing business education, training, and skills to women entrepreneurs in order to decrease the performance gap between male-owned and female-owned entrepreneurs. Analysis shows as possible resolutions consists in increasing bank participation in microfinance and diversifying their portfolios, provision of education and training program, better coordination and networking and

technical assistance. Moreover, female enterprises result less in number than men mainly because of existing gap in governmental policies for encouraging women and because of the lack of communication that today is very difficult because of poor infrastructural facilities, instabilities in the socio-cultural and political environment and high production cost which are major factors that act as a hindrance to the development of female entrepreneurs. Because of this reason technology and innovation can find a fertile ground to support this development assuring to women of being able to spread encouraging attitude, combine family commitments with business running. The SWOT analysis and the Balanced Scorecard Model (BSC) also reveals that Government in order to open to women business should open its doors to Islamic banking as the strengths and opportunities far out-weigh the weaknesses and threats, along with the definition of correct performance measures for dedicated Institutions. To conclude the present research is hopefully going to lead governments to formulate policies for the implementation and the spreading of Islamic microfinance identifying gaps in policies and social set up with the aim to explore these issues seriously, especially in the context of developing countries.

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Towards National Learning Assessment System

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Abstract

Improving education quality is crucial for raising human capital. Raising the quality of education system and particularly learning outcomes is useful to know and understanding where we are in terms of learning achievement and what are the action that we need take to improve.
Some questions – who, what, when, how, and why – become of central importance for planning National Learning Assessment System. To answer each question and all of them in a coherent way for the multiple contexts we suggest a knowledge governance approach. Clarifying concepts, understanding the links between data, information and knowledge and making them available to different segments of stakeholders requires this holistic approach.

Keywords – Smart Public Administration, Quality education, Assessment systems, Knowledge Management, Knowledge Governance.

Paper type – Academic Research Paper

1 Introduction

The emergence of an evidence based approach in education are related to the educational effectiveness movement.

Implementation of Evidence-Based Practices in Learning Assessment can brings some barriers. To overcome or minimize these barriers, it is necessary to consider the local characteristics of its main actors: students and teachers.

Planning National Learning Assessment System is a crucial step for the effectiveness of this system. Ask the right questions and reflect and answer those questions, taking into account not only the results you want to achieve but also the characteristics of the population of each country.

To deal with this complexity, we can take a knowledge governance approach in order to build robust and flexible assessment and reporting systems. This is an important tool for discussion, political decision, and educational evaluation policy implementation, for improvement of teaching and learning and evaluation of the educational policy itself.

Linking research, policy, practice, teaching and learning and the diverse stakeholders in data and information is a challenge that will only be successful if everyone participates in an informed way and with increasing literacy on assessment.

2 The role of Evidence

The relevance of information and knowledge has been widely recognised as a resource to capture evidence in education OECD (2007). The use of evidence is more and more the base of an informed decision process at Educational Policymaking (Giebels et al., 2015; Wiseman, 2010). Complex knowledge processes of acquiring, creating, interpreting, sharing and using research evidence can provide solid knowledge and practical steps also for educational research, practice and policy implementation (Finnigan e Daly, 2014; Pinho et al., 2012; Rego et al., 2009).

The role of research for understanding education policy and its implementation is relevant; this role of research is also linked with teaching and learning practice (Fensham, 2009; Scheeler et al., 2016). Information on student context and outcomes can support decisions about strategies and approaches on robust evidence generated by research (Hollands et al., 2019).

Some research-based procedures associated with the implementation of policy reforms and the change of practices must overcome barriers to their implementation. Sometimes there is language difficulties and clear communication between research and practice; other barriers are linked to resistance to change at both the individual and institutional level. Gaps in specific training in assessment may also create problems as well as the fear of sanctions in case of not reaching the goals can cause distrust. Some recommendations for facilitating the implementation can help educational researchers, leaders, and policymakers, such as: (a) utilize local data, (b) incorporate practitioner narratives in the dissemination (c) use scaling-up strategies to reach an institutional tipping point for EBP implementation, and (d) conduct and disseminate use-inspired research that integrally involves practitioners and their perspectives. See Table 1 for an overview of these recommendations Cook et al. (2012).

Table 1 – Recommendations for Facilitating the Implementation of Evidence-Based Practices in Education

Use local data	
	Administrators can present findings showing the positive impact that an evidence-based practice has had for students whose educational needs are similar to those of children in their teachers ' classes; in other classrooms in teachers ' own schools; or in nearby, similar schools and classrooms.
Use practitioner narratives	
	Testimonial accounts from colleagues are important sources of evidence for many practitioners. Careful and conscientious use of teachers' narrative accounts of the implementation and effects of an evidence-based practice can be used as a powerful complement to summaries of research findings
Attain institutional tipping points	
	Initially, considerable effort and resources will be needed to initiate and extend the use of a new evidence-based practice in schools and school systems (e.g., providing extensive training to a small group of carefully selected teachers). However, once implementation of practice is scaled up to approximately 60% of teachers, it will become part of the school culture.
Conduct use-inspired research	

	Researchers should strive to conduct rigorous research that provides practice-based evidence regarding evidence-based practice. That is, in addition to determining the efficacy of an intervention, it is important that research examine whether an intervention has broad reach, can be broadly and readily implemented and adopted, and can be maintained over time.

Source: Cook et al. (2012)

3 Data, information and information systems in education

Education need to use information systems to take change and to monitor the results and the impact (González-Sancho e Vincent-Lancrin, 2016). At schools level we also need to implement Knowledge management to increase the link between tacit and explicit knowledge (Petrides e Guiney, 2002).

There is no "one best way" to do evaluation but we can identify many practices shown by research and bridge the research–practice gap by identifying, promoting, and implementing evidence-based practices (Wrigley e McCusker, 2019).

Knowledge governance can facilitate a flow of multiple services based on data and information (Diagnosis, Review, Dialogue and Implementation), which can be provided separately or in combination.

We also need to link linking administrative data for research and for decision. This have some implications, such as: (i) the data linkage environment and privacy preservation; (ii) the linkage process itself (including data preparation, and deterministic and probabilistic linkage methods) and (iii) linkage quality and potential bias in linked data (Harron et al., 2017).

4 The key questions

Learning Assessment is a complex issue. The debates about the role of evaluation and the classification evaluation types, inside the spectrum formative and summative evaluation, define a field of study with a strong link between theory and practice (Dixson e Worrell, 2016; Leite e Nunes, 2009; Morosini *et al.*, 2016; Pastore *et al.*, 2019; Pedrosa *et al.*, 2019; Wiliam, 2010).

For planning learning assessment system we need clearly answered some key questions:

The first question is: What to evaluate? In the present case the specific question will be: what is learning assessment? By defining the focus of the evaluation we direct and limit the choice data and indicators, such inputs (infrastructures, students and teachers' socio-demographic characteristics), processes (teaching and learning, school leadership, school administration) and of the results.

The second question is: Why evaluate? In answering this question, the objective (s) that may have a greater bias for accountability or improved learning are identified.

The third question is: Who to evaluate? The unit of analysis must be clearly defined. In the present case the focus is the assessment of student learning.

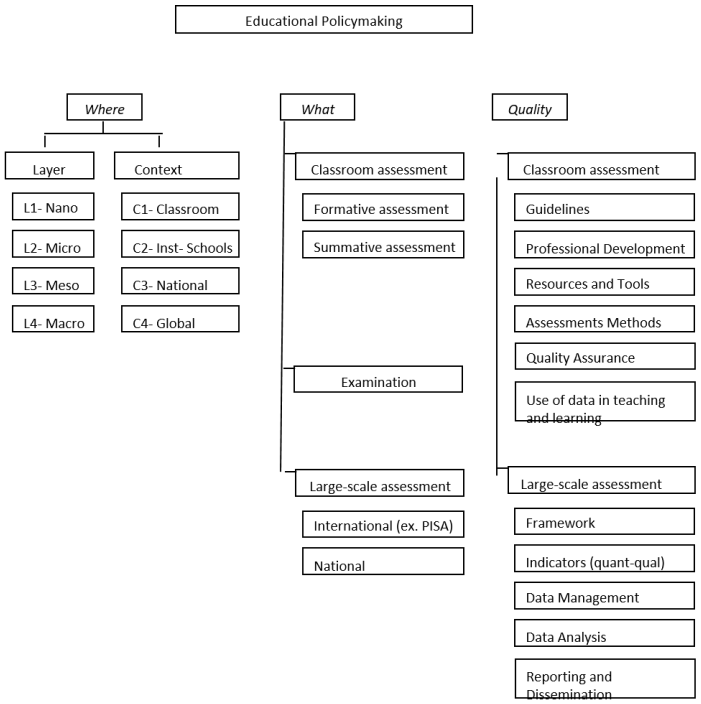
The fourth question is: How to evaluate? The so-called "evaluation technology" includes the evaluation criteria and standards as well as the instruments, indicators and metrics.

The fourth question is: Who evaluates? In addition to the general aspects of evaluators and evaluation agencies, it is important to identify and promote training on the skills and competences needed to evaluate.

The fifth question is: How are evaluation results used? It is interesting to identify who are the users of the results and to what extent this feedback is used.

5 Learning Assessment Knowledge Governance

To provide adequate answers to previous questions in an integrated manner, a knowledge governance approach is useful (see Figure 1). Knowledge governance refers to choosing the structures and mechanisms that can influence the processes of knowledge looking the interrelation between micro, meso and macro levels, with a strategic focus (Foss, 2009; Foss, 2007; Pinho *et al.*, 2019; Pinho e Pinho, 2016).



Source: author

Figure 1 - Learning Assessment Knowledge Governance

We need information of the context because “what works” in education are necessarily local and policymakers must use evidence with critical thinking, without forgetting the context (Goldman, 1976). Each information layer (Nano, Micro, Meso and Macro) and each context (Classroom, Institutional-Schools, National and Global) must be identified to definite the scope of Learning assessment exercise.

This classification is useful for operationalizing learning assessment at each level. We also need to clear identify what kind of Learning Assessment; there are two main types of assessment: formative and summative.

6 National Learning Assessment System

Each country or state have its Education System that can be analysed across some areas such as: accountability, school curriculum, teacher qualifications, early childhood education and care, achievement in basic skills, early leaving from education and training higher education, graduate employability and learning mobility (Clarke, 2017; Eurydice, 2019a, 2019b).

It is not enough to have data, it is necessary to know how to use the data by the various educational stakeholders. At micro level, as Matthew Militello said ” the road to improve teacher pedagogy and equitable student learning may indeed be paved with data” (2013, p. 113). Assessment data is also used at macro national level, such as for evidence-based policy and decision making (Best *et al.*, 2013).

Teachers, school administrators and leadership, educational researchers, and others stakeholders need training and support on data and information, not only by technological data procedures but also on ethical issues to use this soft resource. Classroom assessment (formative and summative), examination and large-scale assessment are different categories of assessment, but there is a need of an effort of integration and coherence to reach the common objective: improving learning

To build a coherent National Learning Assessment system it can be useful to have a knowledge governance approach in order to integrate the different levels of action, the different assessments, the different stakeholders, the different objectives, the different data and the diverse information that are blocks of this “building” of multiservice.

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Suggestions to Bridge the Digital Skills Gap and Overcome the Italian 'Digital Emergency'

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Abstract
This paper focuses on the Italian public administration that, with its more than 10,000 inefficient data centers, employs at least 30,000 people who are tasked with the maintenance and technological updating of these obsolete infrastructure and with the upkeeping applications (often outdated and on which much more people work) that run on these infrastructures. Yet, there is no measure to empower or even hire Chief Information Officers, Chief Technology Officers, Chief Information Security Officers, Cloud Computing Architects, Data Scientists and so on.
In the specific case of the Italian public sector, despite Information and Communication Technology (ICT) is rapidly changing our planet, there is a significant ICT specialists' shortage; the situation is common to other countries but in Italy it is particularly severe due, not only, to the lack of skills but also to the abundance of useless and wrong ones.
The purpose of this paper is to highlight the 'Italian digital emergency' with a specific focus on the public sector and suggest a way to improve the situation in Italy but also in other similar countries through innovative ways of recruiting and training, and with structural reforms, for instance, in the system of education.

Keywords – IT, digital competences, e-competences, public sector

Paper type – Practical Paper

1 Introduction

In Italy we live in a constant state of emergency. Society as a whole is aware of a vast array of emergencies: employment, immigration and emigration (brain drain), healthcare, justice, social security, tax evasion, organized crime, corruption (Dècina, 2016). Yet, there are many others the majority of citizens is totally unaware of, and among these there is the 'digital emergency' (Attias, 2019; Attias and Cerofolini, 2019). At the beginning of 2020, the dramatic consequences of the COVID-19 epidemic, which was unforeseeable when we set to write this paper, have further emphasized the added value of digital technologies as they are proving to be critically important to manage and mitigate one of the world worst health emergencies, in the last 100 years or so.

The 'digital emergency' is pervasive and intersects (Borgonovi and Buccoliero, 2000; Eggers, 2005; Contini and Lanzara, 2009; Barone, 2015; Quintarelli, 2016) all the other emergencies affecting Italy. Therefore, if the problem is not dealt with comprehensively, all the other emergencies could not be effectively addressed and would remain unsolved (De Maio, 2005; Palozzi et al., 2018).

In particular, our analysis is focused on a specific segment of the digital emergency, that is the public sector employees (including those ones of private IT companies that work for public administration) and their digital competences (Ala-Mutka, 2011; Ilomäki et al., 2011; Murawski and Bick, 2017).

Although the IT skills shortage in the public sector is a worldwide phenomenon, we will focus on the Italian public sector not only to underline the critical deficiency of digital competences but also to provide a list – to be regularly updated – of the most significant IT competences that are missing. Such analysis will help to assess the level of digital skills in the public sector, identify priorities, and is conducive to develop a strategy for a stable improvement cycle of digital competences (Attias, 2016).

This paper is organized as follows. Section 2 focuses on the definition of digital competences and digital divide. Section 3 expounds on the IT skills shortage in Italy, with a special attention to the public sector digital emergency. In Section 4 we propose possible solutions to bridge the gap and in Section 5 we will wrap up our main conclusions.

2 e-Competences and digital divide

Digitalization is pervasive: whether we like it or not, sooner or later, we will all be impacted by its effects; it is dynamic/agile: we cannot deal with it occasionally, but with continuity; it is young and society, as a whole, has not yet developed a full awareness of the actual impacts of digital technologies; thus, analysing the implications (as a philosopher) of digitization is still necessary.

Digital technologies are a primary enabling factor, represent a propulsive push towards a process of democratization of our planet and a means against inequalities (Avila et al.,

2014). Actually, the level of civilization of a country is also measured by its degree of digitalization (Attias and Ruggiero, 2017).

Digitalization can make a difference and has already allowed many countries, which have already exploited its full potential properly and knowingly, not only to reach a higher economic growth and higher level of social and civil maturity, but to progress more quickly towards the welfare of all their citizens.

Within this framework, we wish to examine and propose some definitions.

The European "e-Competence Framework" (e-CF) (EN 16234-1, 2019) was developed to answer the need *of supporting mutual understanding and provide transparency of language through the articulation of competences required and deployed by ICT […] practitioners and managers* (Fernández-Sanz et al., 2017); it proposes the following definitions:

- competence: "a demonstrated ability to apply knowledge, skills and attitudes for achieving observable results";
- knowledge: "set of know-what";
- skill: "ability to carry out managerial or technical tasks"; attitude: "cognitive and relational capacity".

In this paper, we focus on e-competence such as the ability to develop and use ICT resources in order to take part in a conscious and critical way in social and economic activities increasingly transformed by digital technologies.

In our opinion, indeed, 'e-competence' plays a fundamental role for the development of a critically conscious and empowered society, a creative and innovative workforce, a dynamic system of higher education that can seize the new opportunities and respond adequately to the changing needs of society and economy.

Attias et al. (2017) recognize three main and different meanings of 'e-competence' which have infinite nuances in continuous and constant evolution:

1. e-competence of those who are ICT professionals and specialists;
2. e-competence of those who use digital technologies in their job;
3. e-competence of those who use digital technologies in their everyday life, unknowingly and without any specific expertise.

This division entails very different forms of digital divide. Today, the 'digitally excluded' is no longer or not only, the one who does not have access to the network, or does not have the technologies to access it, but the one who does not know how to exploit the network and technologies. The 'digitally excluded' is the one who does not have the cultural competence or critical skills to fully enjoy digital citizenship and participate - we use the word with a political undertone - to social life. The 'digitally excluded' is therefore unable to understand the opportunities at hand (Solimine, 2014).

Paradoxically, if in the past an ICT specialist could not be considered at risk of digital divide, this assumption is no longer entirely true.

Accordingly, Attias *et al*. (2017) define the digital divide as *a multidimensional, multidisciplinary and constantly evolving concept, the definition of which must be*

dynamic and flexible, since it should adapt to and absorb the continuous changes and numerous innovative opportunities which are offered by the enabling technologies for the digitisation.

The term "digital divide" refers chiefly to the gap between individuals, social groups, businesses and countries in accessing and having the capability to use digital technologies. Yet, the "digital divide" is a multifaceted concept as it encompasses different inequalities and elements such as lack of access and connection, affordability, retrieval and usability of information, possession of adequate computers and/or other devices, technology adoption and experience i.e. technology-literate end-users, upgrading of working professionals' skills to stay on the cutting edge of innovative technologies, responsible interaction with and use of social networks and social media, ability to retrieve and use the information available on the internet, adaptation of the social, cultural and political context, transformation of the economic and working conditions.

By access, retrieval and usability of information we refer to the availability of network connections, both fixed and mobile, and usage opportunities. The latter includes not only the population's widespread, adequate and satisfactory digital skills - at least in the Internet use- but also the availability of online services. The public sector has a unique role not only in providing access and affordable connectivity but also in promoting the digital literacy among the citizens; on the one hand, useful and easy-to-use public services, support and increase the penetration and citizens' adoption and, on the other hand, spur the digital transformation of the public sector, in a sort of virtuous cycle. Better public digital services lead to a stronger demand for them.

Today, the civilization of a country is also measured in terms of digital civilisation: the country's level of digitalisation and digital awareness.

Everywhere in the world, any "digital divide" inevitably generates geo-historical and geopolitical inequalities and differences, in other words, "digital exclusion", both on an individual and collective level, with negative, more often than not, repercussions on social organization, cultural evolution and the overall progress.

The above definition replaces the most common ones, which are strictly related to the access to the Internet and World Wide Web (w.w.w.) (Anderson et al., 1995; DiMaggio et al., 2001). Unquestionably, this definition takes into account a wider interpretation of the digital divide as a cultural issue that affects more broadly even those who have full and constant access to the net and new technologies (Fuggetta, 2018).

3 Where Italy stands

3.1 Ranking

Numerous studies rank Italy in the last positions in terms of digital skills and recommend to take effective policy measures to improve citizens' digital skills.

The “OECD Skills Strategy - A Diagnostic Report: Italy” (OECD, 2017) shows how Italians lack basic digital skills.

The Digital Scoreboard (European Commission, 2020) points out that Italians (all individuals) between 16 and 74 years old who regularly (at least once a week) use Internet are 73.9%, compared to a European average of 85.3%. The lowest percentage refers to Bulgaria (66.8%) while in Scandinavia, Luxembourg, the Netherlands, the United Kingdom and Germany at least nine out of ten citizens are regular internet users.

If we consider the indicator “individuals aged 16-74 with at least basic digital skills”: Italian males represent 44.9% against a European average of 60.5%, Italian females represent 38.2% against a European average of 56.2% (European Commission, 2020a). The figures are worse for “above basic level of digital skills”: Italians aged 16-74 represents only the 22% against the 61.6% of Icelanders and a European average of 33.3% (European Commission, 2020b).

Finally and sadly, the 2019 data (European Commission, 2020c) reveal that only 23.4% of Italian citizens (all individuals aged 16-74) uses the internet for interaction with public authorities (individuals interacting online with public authorities, last 12 months), against a European average of 54.6%. Only Romania (11.7%) performs worse than Italy.

The Digital Economy and Society Index (DESI) is a composite index, conceived in 2014, that summarises 30 relevant indicators on Europe’s digital performance and tracks the evolution of EU Member States in digital competitiveness, across five main dimensions: “1. Connectivity”, “2. Human Capital/Digital skills”, “3. Use of Internet Services by citizens”, “4. Integration of Digital Technology by businesses”, “5. Digital Public Services”. Figure 1 reports DESI ranking of 2019.

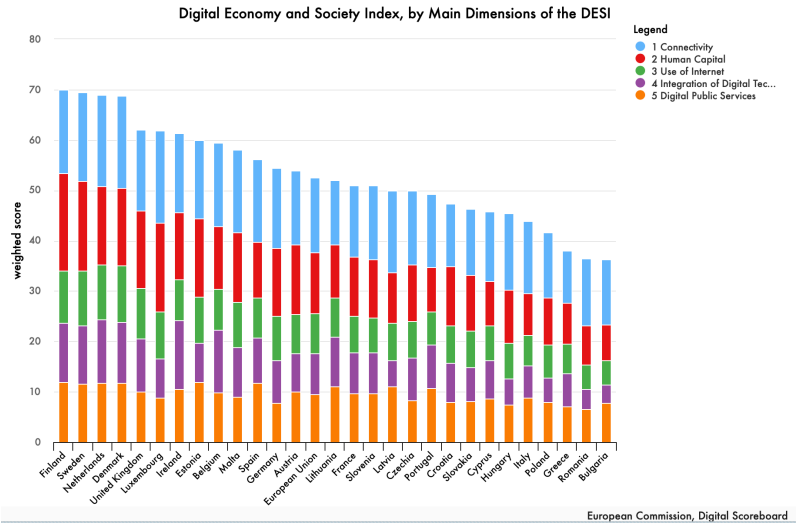

Figure 1 - DESI 2019 Ranking

Since 2014, Italy has always ranked in the last positions in company with other countries such as Bulgaria, Romania and Greece. Italy performs very poorly in spite of the investments in ICT which, historically, have always been significantly higher than in the above-mentioned countries. This proof that the quality of the investments matters more than the absolute value.

Although over the years the European Commission has refined DESI methodology, one of the indicators in which Italy's placement has remained dramatically constant is digital skills. This latter has two sub-dimensions: "internet user skills" and "advanced skills and development" (which we consider one of the most relevant dimension of DESI). The former draws on the European Commission's Digital Skills Indicator, which is computed based on the number and complexity of activities involving the use of digital devices and/or the internet. The second includes indicators on ICT specialist employment and ICT graduates where Italy has major deficiencies as shown in Figure 2 (DESI, 2019).

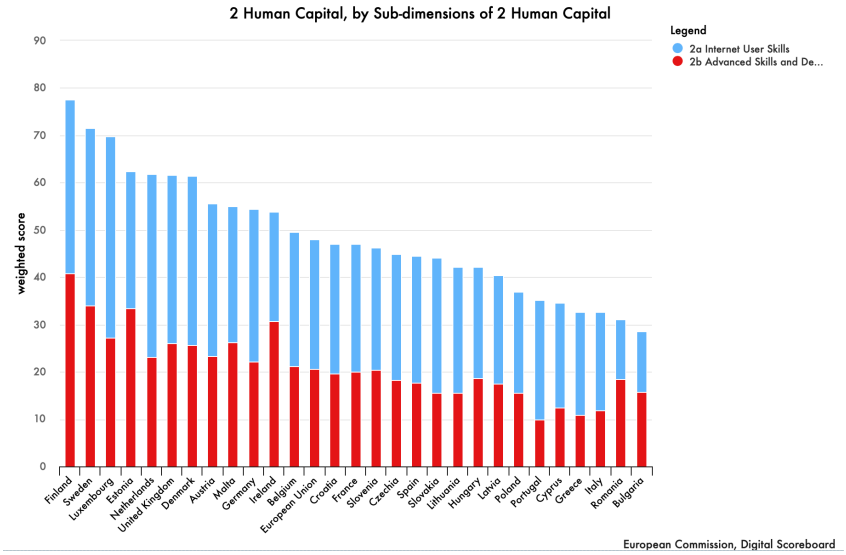

Figure 2 - DESI 2019 Human Capital

Obviously, these poor results, concerning both basic digital skills and those of the ICT specialists, refer also to the hybrid professions, which are currently, and increasingly will be, positively impacted or 'cross-contaminated' by the pervasiveness of ICT.

In our scenario, almost every profession (e.g. lawyers, doctors, accountants, teachers), even if not digital native, will be 'cross-contaminated' by ICT (Rubino et al., 2019). Hence, all workers will have to acquire 'digital proficiency' in a short time, while very few will remain strictly speaking ICT professionals (Butera, 2019). Information Technology is rapidly changing our planet; we cannot afford ignoring the future that is rapidly becoming present (Davenport and Prusak, 1998).

Of course, we do not maintain that everybody should become a digital expert, competent in all the new digital technologies (e.g. cloud computing, blockchain, cybersecurity, artificial intelligence, machine learning) but we cannot ignore that as they spread on a planetary level, these technologies are becoming more and more pervasive and are more and more impacting our daily life.

It will not be an easy cultural change. Currently, many geographical areas and/or social classes are already affected by the digital divide (Norris, 2001; Attias et al., 2017; Longo, 2018). However, we firmly believe that the change should be addressed (Xhaët, 2017).

In Italy, the current state is serious and the country lives in a persistent 'digital emergency'.

3.2 The public sector: a failed story of IT infrastructures and applications

At present, in the Italian public administration, there are about 11,000 data centers (data processing centers) (Meta, 2019), providing services to over 22,000 central and local administrations (de Rosa et al., 2020); approximately, there is a data center for every two public sector entities.

Almost every Italian municipality manages its own server autonomously, sometimes in precarious conditions, without adequate security, without any concern for energy efficiency. The number is definitely out of control and has no equivalent in the rest of Europe. This situation causes significant inefficiencies and diseconomies. Moreover, many data centers are not counted in the official surveys, such as the one that the Agency for Digital Italy (AgID) carried out in 2019 to inventory the "ICT asset of the public administration with the aim of detecting the state of the IT infrastructure and acquire useful information in order to rationalize data centers and adopt the cloud model".

The Italian public sector employs at least 30,000 people (default estimation) who perform maintenance tasks (backup & logging) and technological updating (patching & updating) of these obsolete infrastructures; even more workers are involved in the execution chores relating to the applications that run on these infrastructures.

According to AgID, the applications are more than 200,000 (but the real number, which no one knows, is perhaps more than one million). Over the decades, the public sector has developed a huge number of applications that are not interoperable but perform very similar tasks in slightly different manners and run on at least 160,000 databases – most likely many more. To run these applications, the public sector employs thousands of protocol systems experts, custom document management systems experts, legal treatment management systems experts, management control systems experts, custom HR system experts, custom collaboration system experts etc., instead of improving the hiring number of or reinforcing the role of Chief Information Officers (Lawry et al. 2007), Chief Technology Officers (Adler and Ferdows, 1990; Smith, 2003), Chief Information Security Officers (Whitten, 2016), Cloud Computing Architects (Rhubart, 2012), Data Scientists (Davenport and Patil, 2012) and so on.

Thus, we can easily assert that we have about 11,000 "absolute digital monarchies" both from an infrastructural and applicative point of view (procurement included); the sovereigns are the public sector high-ranking officials who claim ownership of them and strenuously defend their survival.

This difficult situation has negative impacts on the public sector employees (and even more on IT companies employees that work for public sector) who are losing their skills and cross sectoral competences that they have acquired in years of specialist studies, and whose expertise is not easily replaceable. As a result, there is an enormous quantity of pointless and 'damaging' (OECD 2019).

The fragmentation of obsolete IT infrastructures and applications and the 'waste' of human resources could be solved only through an in-depth reorganization that could potentially save at least two billion euros per year (de Rosa et al., 2020) and, thus, free resources for more proficuous investments in innovative areas.

The Italian Government is implementing a strategy to reduce those dreadful numbers, 'shifting' the public sector services from the current obsolete and/or inadequate data centers to safer solutions and/or cloud computing technologies, where applications are delivered (unique by type) in SaaS mode[1], in compliance with regulations and technical guidelines for the benefit of all central and local public administrations (OECD 2018).

4 What the Italian Public Administration needs

4.1 New jobs opportunities

After this review, we wish to focus on the e-competencies that could positively impact the public sector. With this scope, we listed below some of the new jobs' opportunities in the field of ICT: Chief Information Officer, Chief Digital Officer, Chief Technology Officer, Chief Security Information Officer, Chief Data Officer, Digital Architect, Cloud Computing Architect, Cloud Computing Integrator, Data Driven Decision, Business Intelligence, Data Scientist, Open Data Expert, Internet of Things, Big Data Expert, Mobile App Development, e-Commerce Specialist, e-Public Procurement, Digital Marketing Manager, Web Marketing Manager, Online Store Manager, User Experience Manager, Analytics Director, Web Analytics Manager, Digital Copywriter, Digital Designer, Search Engine Optimization, Search Engine Marketing, Community Manager, e-Reputation Manager, Social Media Manager, Artificial Intelligence, Machine Learning, Blockchain, Cyber Security, Industry 4.0.

[1] *Software as a service (SaaS) is a software licensing and delivery model in which software is licensed on a subscription basis and is centrally hosted.*
SaaS applications are also known as web-based software, on-demand software and hosted software. The term SaaS is considered to be part of the nomenclature of cloud computing, along with infrastructure as a service (IaaS) and platform as a service (PaaS).
SaaS apps are typically accessed by users using a thin client, e.g. via a web browser. SaaS has become a common delivery model for many business applications.

In the following sessions, we analyse some of these jobs, highlighting concerning required skills.

4.1.1 C-suite

As known C-suite refers to a cluster of some of the most important corporations' senior executives able to set the company's strategy, make higher-stakes decisions and ensure the day-to-day operations align with fulfilling the company's strategic goals (Rouse and Pratt, 2019). It is obvious that in order to efficiently and effectively pursuit results, C-level managers need to have adequate expertise in order to improve performance through critical organizational outcomes (quality, innovation, profit, and ethics), adopting systems and technical processes required for high performance (Dawson et al., 2015). With particular regard to ICT, C-level management must have a specific and significant technical expertise in their field but also a deep understanding of the business (Curran, 2009), and a business strategic view (Smith, 2003).

In the following paragraph, we want to provide a short description regarding the most common IT C-level roles that, according to us, could help the Italian public sector.

- Chief Information Officers (CIO) guide the evolution of IT resources, adapting the internal infrastructure to the achievement of the strategic objectives. They contribute both to the definition of business and change management process, defining key performance indicators and service level agreement. Furthermore, they manage the IT department budget and resources in order to assure the daily operation of information systems and satisfy the needs of users. CIOs do not only provide the right technology but they also lead the evolution of IT departments with strategic perspective, helping their chief executive officer colleagues to steer companies (Smaczny, 2001); As Babin and Grant (2019) point out, CIOs are increasingly becoming leaders who actively participate in strategic business decisions to develop a business-focused set of skills, in addition to technical ones.
- Chief Digital Officers have the responsibility of implementing and accompanying the digital transformation (Engesmo and Panteli, 2019). They focus on the re-engineering of traditional analogue processes across different types of organisations and industries. The digital transformation of an organization affects both the industrial, productive and administrative areas and the organizational and management areas. Although this process has already been underway for several years, it is not be completed, yet. There are still many challenges, in terms of deploying a common and shared strategy within the company, and implementing organizational models allowing the different departments to communicate effectively and make consistent use of IT resources throughout the company.
- Chief Technology Officers occupy the highest position associated with technology responsibilities (Lohmuller and Petrikhin, 2018); they monitor technological advances (Adler and Ferdows 1990), assess technological aspects of major strategic initiatives (Roberts 2001; Medcof 2007) and select profitable new

technologies to apply within the organization to improve productivity and competitiveness.

- Chief Information Security Officers (CISO) have the responsibility to identify and implement the best organizational model to ensure adequate data and technology security (Karanja, 2017). CISOs are focused on risk minimization and on introducing appropriate controls and standards in compliance with the security regulations. They are responsible for cybersecurity, disaster recovery and business continuity management, identity and access management, privacy, risk management, design of security architectures etc. (Digital4HR, 2017).
- Chief Data Officers (CDO) have the responsibility for data management strategy; through data analysis, they identify new business opportunity (Xu et al., 2016) and help the decision-making process in order to improve the competitiveness (Noh, 2016); as Gellweiler (2020) states: *the CDO is placed between IT and marketing*. Their work is based on two pillars: data science and data analytics.

At this point, it is appropriate to point out that the public sector produces and control an enormous amount of data with an extraordinary added value.

Unfortunately, these data are often stored in vertical silos that are not interoperable with other public sector entities and their potential is not maximized. Government organisations should be able to collect, analyse, process and interpret these data for analytical, predictive and strategic purposes. The information extracted would generate new knowledge useful to citizens, also in terms of the services offered to them. Accordingly, another important role is the Open Data expert that reports to CDO.

4.1.2 Other useful roles

In addition to the above-mentioned C-level roles, the Italian public sector could benefit from the use of the following professional profiles:

- Digital Architects; they make effective decisions and enable rapid solution development by employing modular services and components (Korhonen and Halén, 2017); they would translate the requirements of the public managers into solutions that are sustainable, effective and innovative. Due to their professional background, most of the public sector top management do not have specific knowledge in technologies. Digital Architects can help public managers to better understand the short, medium- and long-term implications. In other words, Digital Architects are one of the technical cornerstones of the digital transformation of the Italian public sector. In particular, it would be beneficial hiring:
  - Enterprise Architects who define processes, information and data to adapt to a very high-level strategy (for example, a national planning for central government);
  - Solutions Architects who define the design and implementation of a single IT system for central and local administrations;

    - Data Architects who deal with information architecture (how to acquire data, where to store them and how to use them) through the existing data and information mapping;
    - Cloud Computing Architects who are expert in cloud technology that will be increasingly adopted by the Italian public sector in compliance with the National Strategic Plan[1];
    - User Experience Architects who help the public sector to design citizen-oriented services that are inclusive and respond to the real needs of people.
- e-Public Procurement Managers who manage a vast and delicate area. Nowadays, managing an administrative procedure could be considered only a good start. The Italian public sector should be the driving force of a dynamic society and should be able to understand the market ruled by global dynamics. The synergic and interdisciplinary skills such as IT, legal and managerial (organizational, strategic, analytical, etc.) should complement the management skills.
- Artificial Intelligence, Machine Learning, Internet of Things;
- Social Media Managers who take care of improving the relationship between PA, private companies and citizens through the communication channels. The effectiveness of the communication model presently adopted in the public institutions could be enhanced by fostering a more inclusive participation of citizens who can express their needs and share their ideas.

4.2 Room for improvement: few suggestions

At the end of this review, we wish to put forward some recommendations that may help the public sector to successfully complete its digital transformation.

The digitalization process has already started; a new governance has been put in place[2]. Much remains to be done. The process is not an easy one and requires a strategic and whole-of-government approach. The actions taken so far are only the necessary prerequisites, but they are not enough to guarantee an effective digital transformation of the Italian public sector and, more generally, of the entire country.

We believe that the major resistance to the digital revolution is a cultural one.

Ask me my three main priorities for government and I will tell you: education, education and education (Tony Blair, 1996[3]).

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[1] *It is a strategic and economic policy document for all public administrations that oversees the Italian digital transformation. The Plan defines: the operational course of action in the development of public information technology; the strategic model of the evolution of the PA information system; ICT investments in the public sector according to the European and Governmental guidelines.*

[2] *The Digital Transformation Team (established by 2016); the appointment of the minister for technological innovation and digitalization (September 2019); the establishment of the Department for Digital Transformation (September 2019); PagoPA, a state-owned company with the purpose of supporting the use of digital services in Italy.*

[3] *Speech at the Labour Party Conference, 1st October 1996.*

In every country, the system of education is the pivot of the digital transformation. Digital citizenship should part of the school curriculum. Students should understand their digital rights and duties in the digital society, should be taught to acquire a critical approach to the Internet, media, social networks, and should learn how to protect themselves from the dark side of the World Wide Web (cyberbullying, predators, scams, etc.).

Digital literacy should help youth not to be passive users of technology but should help them grow into true digital citizens with the right digital skills and a clear understanding of rights and duties, of do's and don'ts.

Only the school systems digital revolution can assure the creative and innovative workforce of the future. Unfortunately, the Italian school system has not even addressed this topic. Changing the education system is a long-term endeavour. Yet, there is not much time left.

Digital citizenship should be introduced in the school curriculum and should be taught by specialised teachers, properly trained for different age groups. This is the first step to foster the right e-competences.

As for the higher education, the academia should support and facilitate the entry of new IT graduates into the workforce and put in place specific measures to align the number of graduates from particular programs to the market needs.

Another crucial component of the digital transformation is central or regional digital infrastructures - the so-called enabling platforms - that should be supported by substantial investments, right skills, proper organization and state-of-art technology. These infrastructures - some are already in place - would be able to provide advanced digital services not only to the public sector but also to private companies and citizens.

Last but not least, digital literary should remain high in the Italian government political agenda. Consequently, even the media, not only the specialized ones, but also the major ones, those that today deal little and badly with issues related to Information Technology, should assume specific skills to be up to face these new challenges.

5 Conclusions

There is robust evidence that show the dramatic situation of digitalization in Italy. This 'emergency' has manifold implications on the entire population and its impact on the daily life has been emphasized during the lockdown period due to COVID-19. Indeed, digitalization impacts the educational system, work in the public and private sector, civil society.

Its complexity does not make easy finding proper solutions; it takes time to bridge the gap. In this paper, we tried to raise awareness, providing a broad framework, although not exhaustive, of the Italian 'digital emergency'; we focused, in particular, on the inadequate level of competences of the public sector employees who work in the IT. Also, we highlighted the potential usefulness of some job profiles.

Then, we put forward some consistent proposals for improving the current situation in the medium-long run; our suggestions focus on: the introduction of compulsory ICT course starting from the primary school; a better labour market alignment between the number of graduates from particular programs with the demand for workers with these qualifications; a targeted investments to centralize the ICT infrastructures and more efficient management of the public sector workforce with the appropriate skills; last but not least, a renewed and continuous attention to digital skills and culture in the political agenda.

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Digitalization at Local Government Level: Managing Smart Data or a Bulky Compliance Effort?

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Abstract

The digitalization of the public sector has been implemented through smart technologies, that is digital processes and tools. At local government level, this allows not only to communicate with citizens and provide digital services, but also to collect information generating new knowledge. Smart data and analytics can improve services, foster transparency, promote accountability, as well as improve decision-making, management, and control.
The study focuses on the digital transformation of municipalities in Italy. It highlights opportunities as well as critical issues and obstacles for local government digitalization within a knowledge management context. In particular, the timeliness, relevance, and selectivity features of information and control systems seem to be overlooked: digitalization has often induced mere bureaucratic obligations, often made even more ineffective by the digital divide.
The paper benefits from national data and the experiences and opinions of managers who generate, manage, and could use digital information at local level. The issues raised by digitalization at local level highlight the need to refine competences about information systems and knowledge management, but also to listen to local requests to avoid fuelling new gaps instead of favouring a homogeneous development at the lower tier of government.

Keywords – control systems, information systems, ITC, knowledge management, public sector

Paper type – Academic Research Paper

1 Introduction

Digitalization has fostered radical changes in government and governance (Dawes, 2009). It is not yet a standard across public administration (Gil-Garcia et al., 2019), even though it is a fundamental knowledge management tool and strategic lever (Criado and Gil-Garcia, 2019; Sandoval-Almazán et al., 2017) as the Covid-19 pandemic has shown. The digital transformation allows not only to benefit from new ways of communicating with citizens through a single access point and the provision of online services, but also to better master administrative processes (Asgarkhani, 2005), by on the one hand simplifying and homogenising them and, on the other, ensuring transparency and improving information systems (Criado and Gil-Garcia, 2019; Velsberg et al., 2020).

This paper explores the role of digital solutions in the public sector by focusing on whether and how smart technologies are influencing local governments in Italy, a mixed bag in Europe for digitalisation. Despite the adoption of the Digital Administration Code since 2005, Italy is in the fifth last place of DESI (Digital Economic Strategy Index - European Commission, 2019) with which the European Union classifies the digitalization process underway in its member states. Italian public administration is suffering from a delay in the adoption of smart technologies due to the slow adoption of ICT (Information and Communications Technology) (Court of Auditors, 2019).

After a brief review of the literature, this contribution focuses on the empirical data collected at national level by the Italian Statistical Office (ISTAT) and at local level through interviews with key respondents. The opinions of a sample of town clerks, financial managers and auditors from local governments will help contextualise results.

2 Theoretical background

The digitalization of the public sector has been implemented through smart technologies, that imply the combination of technology, people and organisations (Velsberg et al., 2020). “E-government” is understood as using advanced technologies to achieve better services as well as improved administration and management (Dawes, 2009). As far as local government is concerned, digitalization is associated in the relevant literature with five key aspects:

- the online delivery of services to citizens and businesses through a single access point (Yildiz, 2007);
- the rationalization of internal operations with the simplification and standardization of processes and procedures using online software and platforms (Asgarkhani, 2005);
- the improvement of management and control information systems (Anthony, 1965; Amigoni, 1978) through the automated and timely collection of accurate data (Bertot et al., 2012; Lourenço, 2015; Cinquini, 2019) which increases knowledge, transparency and accountability;

- the introduction of smart working and remote work practices (Garson, 2003);
- the promotion of citizen participation, the so-called e-democracy through platforms and web-based applications with innovative ways of engaging citizens and of tapping into their knowledge and inputs (Ingrams et al., 2018; Mergel 2018), which not only improves outcomes but contributes to transparency and accountability.

Therefore, at local government level internal and external stakeholders benefit from a greater exchange of information and improved trust and communication (Desouza and Bhagwatwar, 2012). The production and consumption of knowledge has experienced tremendous changes in the last decades in line with technological advancements to collect and share it (Secundo et al., 2017), yet it needs to be managed efficiently and effectively as a key resource of local government. "Smartness in public sector innovation" (Velsber et al., 2020) requires sufficient management capabilities and robust strategies, along with a willingness to explore and adopt new work practices rather than simply implement emerging technologies. Hence, knowledge management can become "a powerful enabler" (McAdam and Reid, 2000, p.328) since the "effective functioning of government rests on effective acquisition and dissemination of knowledge" (Moffett & Walker, 2015, p.68).

Overall digitalization can thus create public value by developing from a facilitation tool into a strategic lever for knowledge management (Criado and Gil-Garcia, 2019). Indeed, it affects the intellectual capital of local authorities in its three components (Dumay et al., 2015), i.e. its human capital with the new skills to be acquired by local government employees, its structural capital with the digitalization of procedures and the development of tools for the collection and sharing of data with a view to transparency, reuse and interoperability, and its relational capital with new ways of dealing and engaging citizens and other stakeholders.

However, the literature reveals that results of public sector reforms, such as digitalization, are often influenced not so much by new tools, but rather by contextual factors (Castelnovo & Sorrentino, 2018). In general, environmental dynamics and system-inherent barriers, such as a high degree of compliance, red-tape and complexity, can hinder achievements (Mergel, 2018). The main challenge is how to overcome these barriers (Massaro et al., 2015).

Furthermore, considering the barriers to the implementation of smart technologies and the failure rates of many digitalization projects (Anthopoulos et al., 2016), e-government channels are often added instead of replacing or being integrated into traditional ones, resulting in additional costs for public sector organizations at the expense of efficiency (Budding et al., 2018; Nam, 2019).

On the other hand, in order to satisfy internal and external knowledge needs in an efficient and effective way, for strategic planning, directional control as well as operational control (Anthony, 1965), information systems must be selective, relevant, timely, reliable, verifiable, flexible and acceptable (Amigoni, 1978), but technology does not always allow it (Lavertu, 2016). While digitalization increases the amount of

information available, its diffusion, flexibility, versatility and timeliness, helping encourage the involvement of internal and external stakeholders and promoting transparency and accountability, it can also cause an excess of information, with a loss of relevance and accuracy, as well as security issues (Mancini et al., 2017). As highlighted earlier, smart technologies can improve public services, internal procedures, information systems, working practices and citizen engagement, yet they need to be managed so as to account for the risks of their misappropriation (Desouza and Bhagwatwar, 2012) and the amplification of real-world biases and discriminatory practices such as the digital divide (Lember, 2018).

Therefore, this paper aims to investigate the impact of digitalization on local government, and in particular on its knowledge management practices and its intellectual capital, considering both positive impacts and liabilities.

3 Methodology

In order to explore the research questions, a case study was analysed through quantitative and qualitative evidence. As mentioned before, Italy provides an extreme case study (Seawright and Gerring, 2008), as it is so far behind with respect to most of Europe in its digitalization process. The Italian public sector is traditionally characterized by a level of organizational inertia favoured by elements of self-regulation that favour stability, which may involve an orientation towards immobility, apathy and slow change (Sancino et al., 2018).

The issues related to the digitalization of Italian local authorities were first framed through a review of the literature and an analysis of the legislation. Secondly, the empirical evidence provided by national statistics and insights from key informants were analysed. Specifically, the data provided by the ISTAT survey "Survey on information and communication technologies in local public administrations - Year 2018" conducted in the summer of 2019, were used to verify the level of local government digitalization and the degree of accomplishment of regulatory requirements. The survey can be considered representative of the universe of Italian local authorities given that 6,117 Municipalities participated out of a total of 7,954, or 77% (ISTAT, 2020).

The national statistics produced by ISTAT were complemented, explained and contextualised through qualitative information collected via unstructured interviews carried out with a selection of town clerks, financial managers and auditors in November 2019 (Table 1). This allowed exploring how smart technologies are perceived on the ground and what impact they are having on the operations, knowledge management practices and intellectual capital of Italian local authorities with different dimensional characteristics.

Table 1. Interviews

	Respondents
Small municipalities with less than 5.000 people	12
Medium municipalities with 5.000 to 9.999 people	8
Large municipalities with 10.000 to 49.999 people	5
Towns and cities with 50.000 people or more	5
Total	30

A qualitative analysis was then performed through "open coding", segmenting the answers to the interviews into meaningful expressions (Kim and Andersen, 2012) to identify more precisely key concepts and their interconnections starting from the raw data.

4 Results

In Italy the informatization of public administration activities began already in the last century (Natalini and Stolfi, 2011) in some fundamental areas, such as the establishment of the tax registry, the integrated public accounting information system and the centres for the payment of public employee salaries. Over time, smart technologies have assumed an increasingly important role shifting gradually from a simple facilitation tool for institutional activities to a strategic lever for change and development (Criado and Gil Garcia, 2019).

In the wake of the initiatives at European level, the fundamental regulatory steps with respect to the digitalization of Italian local authorities have been:

- the adoption of the Digital Administration Code (CAD) in 2005, which was then revised in 2016;
- the approval in 2012 of the Italian Digital Agenda (ADI), which identifies the strategy to achieve the objectives set by the European Digital Agenda in 2010;
- the establishment in 2012 of the Agency for Digital Italy (AgID), which develops three-year plans for public administration informatization, and supports and coordinates digitalization efforts;
- the establishment of the Digital Transformation Team, which between 2016 and 2019 managed all digital transformation projects which were subsequently transferred to the Ministry of Innovation, Technology, and Digitalization and the Department for Digital Transformation which were both established in September 2019.

According to the 2019-2021 three-year plan (AgID, 2019), a digital transformation is to be understood not only as a technological innovation, but also as a simplification and facilitation of administrative processes and of the relationship with citizens and businesses by promoting efficiency and effectiveness at government level. The plan is based on four core principles:

- digital by default: conceiving, designing and implementing digital services as the primary (and, if possible, the only one) delivery method;
- once only: avoiding asking citizens for information the administration already has in its possession in one form or another;
- digital identity only: grounding citizen recognition processes on digital elements;
- cloud first: gradually abandoning proprietary IT infrastructures to convert to cloud technology.

Hence, it is necessary to review processes, procedures, practices, responsibilities and skills to digitalize local government activities. To this end, article 17 of the CAD establishes that local authorities should establish a digital transition office and appoint a Digital Transition Manager (RTD) to coordinate and facilitate such developments.

And yet, the evidence collected for this research reveals that the situation on the ground is far from ideal. The report by ISTAT (2020) finds that the level of digitalization reached by Italian municipalities by the end of 2018 was not that sought by legislators, neither with respect to regulatory requirements nor with respect to improving administrative functionality. The interviews with municipal clerks, financial managers and auditors offer interesting insights into the results of the ISTAT survey, which are explored in the following sections.

4.1 What influences digitalization

The ISTAT report (2020) highlights that the factors that mostly favoured the process of digitalization of local authorities were legal obligations (84.0% of municipalities), directives from central and regional governments (79.6 %) and the need to keep costs down (61.5%). Therefore, mainly coercive isomorphism and efficiency issues. Less than half of the municipalities considered as important reasons to digitalise the need to adapt and improve their processes (39.4%), and user satisfaction (38.5%), which thus seem to remain at the bottom of the list of priorities for local authorities.

All respondents to the qualitative investigation agree that too many innovations make it difficult to keep up with the regulations and directives from the central administration. In particular, obligations are becoming ever more, so much so that functionality improvements and users' requests are perceived not so much as stimuli and objectives, but rather as additional issues to be dealt with.

4.2 Digital equipment

ISTAT data show that almost all municipalities now have desktop PCs (99.6%) available to almost all employees (94.5%), even though 13.5% of employees do not have access to the Internet. Portable PCs are present in 62% of municipalities and are used by 6.6% of employees. Contrary to what one might think, although the percentage of employees who have access to portable systems is higher among larger municipalities

(51.8% among small municipalities versus 85.6% for larger municipalities), the proportion of employees using them is highest in small municipalities at 7.9% versus 6.3% in larger municipalities. Interviews confirmed that in smaller municipalities, laptops are used to guarantee flexibility for employees who work at more than one institution. Despite this, smart working solutions, which facilitate shared access to data, information and documents, and tools for remote participation in meetings and gatherings, are not very widespread, especially among small municipalities. According to ISTAT, only 59.0% of municipalities (58.7% among small municipalities) have an Intranet network, 34.3% (27.9% among small municipalities) make use of cloud computing services and 17.8% (13.6% among small municipalities) have videoconferencing tools.

4.3 Internal structures and processes

According to the national survey, local governments have adopted smart technologies for managing official records (83.3%), for accounting purposes (81.0%), for the population registrar (80.8%), and for managing payslips (78.9%), taxes (75.7%) and administrative documents (74.9%). Very few even large municipalities use artificial intelligence tools (2.4%) and analyse the data collected through IT systems to improve internal processes or services (2.9%), let alone to generate useful information for decision-making.

Furthermore, most municipalities have not implemented many CAD directives: only 26.0% have an IT office (15.1% among small municipalities) and only 21.8% have an RTD (17.2% among small municipalities).

Among technologies aimed at reducing costs, 50.9% of municipalities use open source software, 34.8% use VoIP solutions and 6.7% use software from other local administrations. With respect to the rationalization of purchases, 80.9% of municipalities used e-procurement in 2018. But, 88.1% still use tools such as stamps and signatures on formal paper registrars and 45.2% collect as paper records more than half of their documentation, which often originated in digital form.

The Court of Auditors (2019) found that local authorities have difficulties in modifying their information systems and reorganizing their office working modes. On the other hand, qualitative interviews revealed how often the digital applications proposed by the national and regional governments are not suitable to local situations, because they are too complex or are not compatible with the internal procedures of local authorities and, therefore, are abandoned or not really implemented.

4.4 Staff training

IT training also did not meet the CAD requirements in 2018. Only 16.2% of municipalities took part in ICT training courses, involving 7.3% of employees on average.

The interviewees confirmed deficient technological skills at local authority level and how important it is instead to have employees who understand ICT.

At the same time, however, in 2018 the staff of most municipalities participated in general e-government courses: 58.5% municipalities had staff take part in courses on electronic invoicing, 48.2% on e-procurement, 44.2% on telematic payments, 37.0% on internal process digitalization, 25.6% on digital identity, 20.2% on web, multimedia and social media services, 12.7% on open data and 7.4% on cloud computing.

Nonetheless, according to a survey carried out by AgID on a sample of 60 RTDs, the task perceived as most urgent for public administration training remains the development and dissemination of digital skills, both in terms of basic IT knowledge as well as specific digital processes for the public sector (AgID and CRUI, 2019).

4.5 Citizen and business services

Although the last decade has seen the implementation of various digital initiatives such as the Public Digital Identity System (SPID), the National Register of Resident Population (ANPR), the National Service Card (CNS), the Electronic Identity Card (CIE) , the platform for payments of public services (PagoPA), the electronic health record for each citizen, their adoption has been limited.

The survey by ISTAT shows that, despite the fact that almost all municipalities (98.7%) offer online information about their services, only 69% offer the submission of online forms and 48.3% allow carrying out online the entire procedure relating to at least one of their services. Business related practices can be managed entirely online in a third of municipalities (36.9%), while the percentage of those that have fully digitalised citizen services is much lower: paying for parking 2.0%, processing identity cards 2.4%, registry certificates 3.2%, calculating and paying waste taxes 3.3%, paying fines 4.5%, paying municipal property taxes 5.1%. In the period between 2016 and 2018 only 21.5% of municipalities monitored the use of online services and 10.9% monitored the level of user satisfaction. 38.5% have improved their online services, that is they have reduced waiting times (17.7%), increased the proportion of requests received online (22.9%) or increased the proportion of online procedures (18.1%).

Some respondents to the qualitative investigation call for a simplification and rationalization of digital tools. For example, there could be a single and unique digital identity for citizens and businesses by harmonizing existing individual databases. Similarly, digital recognition systems such as SPID, CNS and CIE could be rationalized into a single solution.

4.6 Information systems

Digitalization allows collecting valuable data in information systems for management control purposes (Anthony, 1965; Amigoni, 1978) and for monitoring the impact of

digitalization on service improvements, simplification and cost reduction (Asgarkhani, 2005). In 2019, at least four initiatives were undertaken in this respect: the ISTAT survey "Survey on information and communication technologies in local public administrations - Year 2018", whose results are used in this research; the "Questionnaire for the assessment of the implementation of the three-year IT plan for public administration" carried out by the Court of Auditors; the "Survey on the training needs of the RTD and its office" conducted by AgID; and the investigation on "Common indicators for public administration support functions" promoted by the Department of Public Administration

Although all surveys could be completed online and had partially different purposes, all respondents noted that they implied additional efforts with detailed requests and no direct benefits. Interviewees complained, on the one hand, about the lack of coordination among central government institutions to run a single investigation, and, on the other, that data collection should be automated as far as possible by exploiting the information that municipalities regularly submit to the central administration, without weighing on local government staff and other resources. Some respondents described how in many cases the answers were copied and pasted from one survey to another at the expense of data accuracy and quality.

4.7 Citizen engagement

This aspect of e-government was not explicitly included in the ISTAT survey. However, the investigation revealed that only that 40.3% of municipalities make open data available regarding different aspects of public life: 30.8% of municipalities share information related to economics and finance, 30.7% to government and public sector, 23.1 % to education, culture and sport, 18.7% to the environment, etc.

Respondents to the qualitative investigation reported sporadic citizen involvement initiatives through online platforms and social media: some municipalities have collected comments and suggestions for updating tools such as the Master Zoning Plan, others engage them in activities such as participatory budgeting or surveys to verify the population sentiment with respect to particular initiatives such as square and street naming, scheduling local cultural activities, and so on. However, these are often improvised solutions, mostly entrusted to social networks and therefore unreliable because they guarantee neither data validity nor participation fairness, representativeness and quality.

5 Discussion

Referring to the five areas identified by the literature, the ISTAT report highlights how e-government is spreading both across services and internal processes within local authorities, less so as far as citizen participation is concerned, as confirmed by the interviews with town clerks, financial managers and auditors. Future surveys carried out regularly could allow monitoring progress and compliance rates. The quantitative survey

has shown how smart technologies are often introduced progressively and in addition rather than to replace traditional systems, against the "digital by default" principle and at additional costs. Further, a more organic approach to the interoperability and management of information across databases is needed so that citizens and businesses have a unique digital identity and need to provide their data only once to public authorities, according to the "once only" principle. Until an effective transition to digital systems takes place and has demonstrated by the Covid-19 emergency, smart working at local government level remains of limited implementation, because the necessary equipment is not widely available, and processes and databases are not yet fully dematerialized.

As far as information systems are concerned, digitalization has often induced mere bureaucratic obligations, often made even more ineffective by the digital divide. The interviews revealed a growing gap between data collection initiatives and databases on the one hand, and the ability of local managers to use such information for management purposes, almost as if data collection was an end in itself, resulting in a huge IT compliance effort to little, if any, avail. Considering information and control systems, the several surveys proposed by central administration units appear to neglect the criteria of relevance, selectivity and timeliness of information (Amigoni, 1978; Mancini et al., 2017). In addition to the excess of information requested several times from local authorities, survey results are published the year following data collection, which already refers to the year preceding the survey and resulting in two-year time delay, effectively hindering any prompt action by both central government institutions and local authorities.

6 Conclusions

The study highlights opportunities as well as critical issues and obstacles for local government digitalization within a knowledge management context, although it does not delve on the strategies adopted by local administrations in pursuing digitalization and overcoming these obstacles. This could be a topic for future research as well as the efforts undertaken during the Covid-19 emergency which exacerbated the need for greater digitalization.

So far evidence from Italian municipalities highlights the need to develop, on the one hand, a unified approach to stakeholder information needs, and on the other, IT systems that can transform in activities performed automatically and autonomously in real time those tasks perceived by local administrations as mere compliance and which take resources away from daily functions. This would allow creating a dynamic sharing system with the development of structural and functional synergies which would curb the exclusion and alienation especially of smaller and less structured local authorities, which are often characterized by widespread shortcomings of digital skills.

Therefore, the difficulties that local authorities are facing with digitalisation risk feeding new divides instead of favouring a homogeneous development both between organisations with different dimensional characteristics, endowments and resources, and between central government and local administrations. On the contrary, digital systems

and data collected through smart technologies could not only allow more and better services, transparency and accountability, but could also provide legislators, local decision-makers and managers with more evidence and knowledge to guide their work on the principle of data based decision making.

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Stays Abroad and Student's Intercultural Competences

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Abstract

Aims: This study examines the relationship between the time students spent abroad, personality traits, behavioural patterns as well as the circumstances during this time and the student's intercultural competence. The study uses a correlative cross-sectional design. *Design and sample*: A total of 202 academic subjects were surveyed in a cross-sectional design. The study was conducted between the 01.05. – 01.07.2018 via an online survey tool. The average age was 22 years. *Measurements*: The survey characteristics of stays abroad such as type and length of the longest stay or the integration into the target culture, further, intercultural competence, social competence and work-related attitudes as patterns of behaviour and experience using the "Work-related Behaviour and Experiencing Pattern 44". This scale assesses work related personality traits and sorts participants to one of four patterns, describing their health behaviour at work. *Results*: The motivational competence increased after one to five month, the cognitive and behavioral competence was significantly higher after minimum five month. The personality patterns influenced the motivational and metacognitive competences. Having a pattern A or B lead to a lower motivational competence through occupational stays abroad. Further, a S pattern was connected to lower metacognitive competence after a occupational stay abroad or an Au-pair. The results show that for different types of stays abroad and different characters specific support measures are required from companies or universities.

Keywords – intercultural competence, personality, stay abroad, acculturation, stress

Paper type – Academic Research Paper

1 Introduction

To be long-term successful in today's modern, globalized world, a high level of social competence is needed, both in dealing with one's own culture, as well as with individuals with a different cultural background (Kanning, 2003; Genkova, 2019). Competence can be defined as the handling of interaction that leads to more appropriate or effective results in any context (Spitzberg & Changnon, 2009; Yeke & Semerciöz, 2016).

To prepare students adequately for the demands of working life, universities focus on semesters abroad as "the best way" to train intercultural competence (Brohm, 2009). As a result, the number of semesters abroad rises strongly (Wolff, 2017). Thereby universities often take a limited approach to intercultural competence and assume that the longer a student is sent abroad, the more competent a person is (Brohm, 2009).

This point of view neglects individual characteristics of the students and the contextual factors of the stays abroad. Lasauskiene and Bagdonaviciute (2018) assume that the quality of the contacts abroad influences the gain of competences. This also applies to the way individuals deal with intercultural stress (Berry, 2003). Wolff (2017) showed that competence can be gained in the course of time, but these results are little differentiated. Similarly, it has already been shown that a semester abroad leads to the greatest increase in competence (Watson et al., 2013), but these results do not include the personality dimension either.

The aim of this study is therefore to examine empirically a differentiated approach of stays abroad and their impact on intercultural competence. Personality variables and characteristics of the stays abroad were examined. Furthermore, the focus is on the predictors of intercultural competence and action implications are derived.

2 Theoretical Background

Thomas (2003) describes culture as an orientation-system that defines the affiliation of its members through influencing perception, thinking and acting.

Culture therefore also represents a part of social identity (Brewer & Yuki, 2007). In this way, individuals can identify with different cultures without contradictions (Rosenthal et al., 2015). In intercultural exchange situations, however, the learned orientation system may no longer function as expected. The failure of one's own orientation can cause considerable stress for those involved (Thomas, 2003).

Only through the mutual approach to each other it is possible to overcome problems and to enrich each other's experiences through the different perspectives (Sam & Berry, 2010). This process of adaption is called acculturation (Redfield, Linton, & Herskovits, 1936). It means that cognitive and cultural learning and internalization processes must take place among the interaction partners, which are necessary to participate in social life (Heckmann, 2015).

In research it is still very important to differentiate acculturation from intercultural competence. According to Ng et al. (2017) the acculturation process is a predictor for a successful adaptation, the process of adaptation also leads to more competence.

To date, no generally accepted, theoretically sound and empirically proven overall model for intercultural competence exists in literature (Genkova, 2019). Van Dyne, Ang and Koh (2008) designed a differentiated compositional model of intercultural competence. Intercultural competence was divided into the subdimensions metacognitive, motivational, cognitive and behavioural competences. Metacognitive refers to the process of thinking and reflection and describes the interpretation of behaviour of people from other cultures. People with high metacognitive intercultural competence are more aware of potential misunderstandings in intercultural situations because they observe and try to understand. This enables them to react more appropriately. The cognitive component describes the aspect of learning the rules of a new culture. Individuals are aware of these rules and themselves and can act accordingly. The motivational level refers to the urge to understand new cultures, to adapt or to solve intercultural situations successfully. Behavioural intercultural competence refers to the actual skills, such as adapting language, to successfully deal with individuals from other cultures (Racicot & Ferry, 2016). Racicot and Ferry (2016) considered the four aspects of intercultural competence (based on Ang et al. 2007) as four separate constructs that interact with each other but have different predictors and different effects.

The model of van Dyne et al. (2008) suggests no temporal sequence or hierarchy of the individual components, as is the case with other authors (Deardorff, 2006; Spitzberg & Changnon, 2009) who suggested it but this could not be proven. Nevertheless, a temporal component must exist if competence can be increased in the course of an acculturation process.

According to Berry (2003) adaption takes place as a reaction to more or less drastic experiences that an individual has. Those experiences lead to stress that reduces the well-being, especially if the usual coping mechanisms are not working and there is a lack of social support. The core problem that leads to acculturative stress is that individuals are sometimes unable to change their behaviour or standards so that they can behave appropriately in certain situations. According to Berry, Phinney, Sam, und Vedder (2006), there are several moderation and mediation effects on the experience and handling of acculturation stress, both before and during adaptation. Decisive factors are primarily age, gender, and social support.

Van der Zee and Oudenhoven (2013) describe that especially the way how stress in intercultural situations is perceived is crucial. They showed relations with the personality. People who had low values for emotional stability and flexibility experienced uncontrollable intercultural situations as more frightening compared to people who had high values in these dimensions. Similarly, individuals who showed low levels of cultural empathy and openness experienced the situation as more stressful than those with high values.

There seems to be a connection between the handling of stress and intercultural competence. Concerning intercultural competence, the cognitive intercultural competence and social competence, Wang, Chen, Liu, Barkley and Wu (2020) found out that those competences predict the job satisfaction of Chinese expatriates moderated by the psychological well-being. However, the psychological well-being is strongly conditioned by health-promoting behaviour (Schaarschmidt & Fischer, 2008). This study therefore takes on the concept of work-related behaviour and experience patterns by Schaarschmidt and Fischer (2008). The scale is explained in more detail in the Methods section. The present study postulates that people who deal unhealthily with stress have a lower intercultural competence than people who have a healthy relationship with work.

Watson et al. (2013) showed that semesters abroad offer good conditions for the acquisition of intercultural competence due to the high level of contact and the need to interact with different people. Hanada (2019) examined the intercultural competence of Japanese students with a pre-post-design. The intercultural competence was influenced here by the type of stay abroad and in advance by the intention to go abroad and language skills.

The results of Lasauskiene and Bagdonaviciute (2018), as well as the empirical analysis of Hanada (2019) suggest that this kind of a stay abroad creates specific framework conditions. Furthermore, Wang et al. (2020) suggest that work-related health behaviour is related to intercultural competence. According to Gullahorn and Gullahorn (1963) it is crucial in the course of a stay aboard to overcome a culture shock to develop a positive attitude towards the other culture. Today it is assumed that overcoming so-called "daily hassles" is the acculturation stress that needs to be mastered (Genkova, 2019). These differ according to Watson et al. (2013) between two kinds of stays abroad. It is therefore assumed that there is an interaction effect between the types of stay abroad and job-related personality patterns.

Social competence is regarded as a condition for successful interaction with other individuals, which is necessary for a learning process (Rathje, 2007). However, interpersonal differences should not be attributed to culture-bound social competence (Genkova, 2019), but to the variables of the model, which is why social competence is included as a covariate. Furthermore, the duration abroad was already considered a predictor of intercultural competence. Lasauskiene, and Bagdonaviciute (2018) describe that the subjectively perceived quality of contacts with locals also seems to have had an influence on the students' competence. It is therefore assumed that the quality of contacts also has a linear relationship with intercultural competence.

3 Research Question, Method and Sample Description

The present study therefore assumes that people who have been abroad in the past have a higher intercultural competence and those who have been abroad for a longer period have a higher competence than those who have been abroad for a shorter period of time. Since Wolff's study (2007) only allowed a comparison of the conditions before and after

three months and not beyond that, a less specified hypothesis was chosen here to make differences visible after longer periods of time.

Hypothesis 1: The duration has a positive correlation with intercultural competence

Hypothesis 2: The personality is related to intercultural competence.

Hypothesis 3: The type of stay abroad is related to intercultural competence.

Hypothesis 4: Personality influences the effect of the type of stay abroad on intercultural competence.

3.2 Measurement instruments

The acquisition took place via the social network Facebook. An incentive (20€-Amazon voucher) was raffled. The participation lasted about 30 minutes. At the beginning the participants were instructed to answer spontaneously and honestly. Furthermore, the anonymity of the data processing and the exclusively scientific purpose of the study were also pointed out.

The Work-related Behaviour and Experience Patterns Scale (AVEM-44), the Cultural Intelligence Scale (CQS) and the Bochum Inventory for Job-related Personality Description (BIP-6F) were used. Questions about the conditions of the stay were based on the Socio-Cultural Adaptation Scale (SCAS). The duration of the stays abroad was asked as the duration of the longest stay abroad. The type of stay was queried as predefined categories, with an option for "other". The categories were semester abroad, school stay, professional stay, vacation and work and travel. In addition, it was asked how well one had mastered the language of the host country at the time (none - very good knowledge), how often one had contact with locals (Daily - Never) and how good these contacts were (No contacts - Large circle of local friends).

The AVEM-44 records 11 dimensions of job-related personality which are assigned to the 4 patterns via different clusters. Pattern G (German: Gesundheit = health): high but not extreme values for commitment, resilience, satisfaction and well-being without losing distance, low resignation tendency. A healthy attitude towards work. Pattern S (German: Schonung = Gentle): Low values for commitment, importance of work, ambition and willingness to spend, without losing distance, low resignation tendency. In addition, a high level of inner peace and life satisfaction, which, however, does not derive from work. Pattern A (German: Anstrengung = effort): Very high importance of work, willingness to work hard and strive for perfection, but a low ability to distance oneself from work. High commitment, but low resilience, life satisfaction and experience of social support. Pattern A is characterized by a high level of commitment to work without emotional compensation. Pattern B (burn-out): is characterised by low work commitment combined with a low ability to distance oneself from work. The tendency to resignation is high, and there is no satisfaction or experience of social support (Schaarschmidt & Fischer, 2008).

The Cultural Intelligence Scale (CQS) by Van Dyne et al. (2008) is a self-assessment questionnaire covering the four factors of intercultural competence. Metacognitive (questions 1 - 4; example: "I am aware of the cultural knowledge I use when interacting with people from other cultural backgrounds"), cognitive (questions 5 - 11; example: "I know the legal and economic systems of other cultures"), motivational (questions 12 - 15; example: "I enjoy interacting with people from other cultures") and behavioural (questions 16 - 20; example: "I change my language behaviour (e.g. I have to speak a different language") e.g. accent, tone) when an intercultural action requires it") intercultural competence on a Likert scale from 1 = "I don't agree at all" to 7 = "I fully agree" information about their self-assessment. In this study, the German version of the scale by Zimmermann and Neyer (2013) was used.

Social competence was assessed via the fitting part of the Bochum Business focussed Inventory of personality – 6 factors (BIP-6F) (Hossiep & Krüger, 2012) by an 8 items with Likert-scale. The reliability was $\alpha = .72$.

3.3 Sample

106 of the 202 participants were female, 57 were male. 39 gave no indication. The average age was 22.43 years (17-46 years). 83 % of the participants either had a high school diploma or already had a university degree. The largest proportion of respondents (16 %) came from the field of economics, the second largest from psychology (5.4 %). The patterns of the AVEM-44 test could be calculated for 152 data sets. 40% had the dominant pattern G, 27% had S, 20% had risk pattern A and 12% had risk pattern B.

58 % of the participants stayed abroad in the past. 32% had completed a semester abroad, 6% had been an au pair, 13% had worked and travelled, 11% had spent a school year abroad, 11% had been abroad for work and 28% had simply travelled. 64% of the respondents with a stay abroad stated that they had a good or very good command of the national language. 25 % said that they did not speak the language at all. 80 % of the participants stated that they had daily contact with locals. 11 % stated that they had had a large circle of friends. 25 % had some deeper contacts and some very good acquaintances. 31 % said they had had several superficial contacts. The quality of the contacts and their frequency correlated negatively ($r = -.380$, $p < .001$).

4. Results

Hypothesis 1: The duration of stay has a positive correlation with intercultural competence.

This hypothesis was evaluated based on an analysis of variance with subsequent consideration of the contrasts. None of the dimensions showed a linear relationship in the graphical evaluation of competence as a function of time.

Rather, the data appeared to be tending to accumulate, although the variance in the data means that it is not possible to speak of a sharp increase without further analysis. Wolff

(2017) describes that in a study with a post-hoc design that a competence gain was measured after 3 months. Analogously, a grouping after 5 months was observed here and therefore a grouping was made that distinguished between people without experience abroad, those with up to 5 months and those with more experience. Variance homogeneity was only given for the cognitive CQ. Therefore, the robust Welch-test was carried out for the other dimensions. It was shown that the mean values of the dimensions differed significantly, except for the metacognitive CQ. The results of the Welch test are presented in Table 1, the contrasts calculated afterwards in Table 2. Contrasts were calculated for the differences between the first two levels (Contrast 1) and the second and third levels (Contrast 2). The examination of the contrasts showed that the cognitive CQ differed among the participants who had been abroad for longer than 5 months and for shorter periods. The motivational competence increased across all three levels of the duration factor and the behavioural CQ differed between people who had not been abroad at all and those who had been abroad.

Table 1. *Welch-Test. Dependent variable: Dimensions of the CQS, independent variable: Duration ((0, < 5, > 5 months)*

		Statistics	df1	df2	p
Metacognitive_CQ	Welch-Test	2.60	2	82.36	.080
Cognitive_CQ	Welch-Test	5.69	2	97.91	.005
Motivational_CQ	Welch-Test	6.85	2	83.84	.002
Behavioral CQ	Welch-Test	11.44	2	73.99	.000

Table 2. Contrasts of the three levels of duration

		Contrast	Value of contrast	Std.-error		t	df	p
K_CQ	Equal variances	1	-0.56	0.98	0.57	150	.567	
		2	-2.50	1.01	2.45	150	.015	
Mot_CQ	No equal variances	1	-2.03	0.99	2.03	70.08	.045	
		2	-1.74	0.79	2.19	91.26	.031	
V_CQ	No equal variances	1	-5.45	1.18	4.59	52.76	.000	
		2	-0.11	0.79	0.14	82.05	.884	

Contrasts: 1. Level 1and 2; 2. Level 2 and 3

Hypothesis 2: The personality is related to intercultural competence.

The results show that only the influence on motivational competence is significant. Table 3 shows the results of the analysis of variance. Patterns S (M=5.01, SD=.76) and B (M=4.82, SD=.80) show high levels of motivational CQ, pattern G medium (M=3.50, SD=.99) and pattern A low (M=3.19, SD=.90). The analysis of the contrasts shows that

the patterns S (t(125) = 3.11, p = .002), G (t(125) = 2.11, p = .037) and B (t(125) = -2.06, p = .042) differ significantly from pattern A, but not among themselves.

Table 3.Single-factor ANOVA for AVEM patterns and motivational CQ

		QS	df	MQ	F	p
Mot_CQ	Between groups	8.52	3	2.84	3.36	.021
	Within groups	106.44	126	0.84		
	Total	114.97	129			

Hypothesis 3: The type of stay abroad is related to intercultural competence.
Hypothesis 4: Personality influences the effect of the type of stay abroad on intercultural competence.

To test hypothesis 3 and 4, a two-factor multiple covariance analysis was calculated. Equality of variance matrices and variance homogeneity were given. The dependent variables correlated moderately, but not highly.

The factors were type of stay abroad (6 levels) and AVEM (4 levels). The influence of the quality of contact with locals, social skills and duration, which were expected to be related based on theoretical considerations, were excluded. Table 4 shows the influence of the type of stay abroad and the AVEM, excluding the covariates. The AVEM patterns are significant even when the covariates are excluded. The types of stay abroad differ for metacognitive and motivational CQ. People who have spent a semester, school (half) year or au pair abroad have higher overall competences than those who have travelled, worked and travelled or worked abroad. Furthermore, an interaction effect of the type and AVEM on the motivational CQ can be observed. This model showed a goodness for the metacognitive CQ of $R^2 = .538$, for the cognitive CQ $R^2 = .433$ and for the motivational CQ $R^2 = .658$. The model for the behavioural CQ was not significant.

Table 4. Results of the covariance analysis. Relationship between the AVEM and the type of stay abroad and intercultural competence.

	AV	QS	df	MQ	F	p
AVEM	Met_CQ	1.01	3	0.33	0.61	.613
	K_CQ	.70	3	0.23	0.41	.745
	Mot_CQ	3.28	3	1.09	3.43	.024
	V_CQ	.32	3	0.10	0.19	.904
Type	Met_CQ	12.47	5	2.49	4.48	.002
	K_CQ	7.35	5	1.46	2.57	.039
	Mot_CQ	15.82	5	3.16	9.91	.000
	V_CQ	2.27	5	0.45	0.79	.558
AVEM x Type	Met_CQ	14.05	12	1.17	2.10	.035
	K_CQ	6.45	12	0.53	0.94	.517
	Mot_CQ	7.82	12	0.65	2.04	.041
	V_CQ	11.69	12	0.97	1.70	.096
Error	Met_CQ	26.17	47	0.55		
	K_CQ	26.89	47	0.57		
	Mot_CQ	14.99	47	0.31		
	V_CQ	26.85	47	0.57		

Figure 1 Illustrates the interaction effect on Motivational CQ. It becomes clear that the significant effect results from the differences in professional stays abroad, as well as in work-and-travel and only travel.

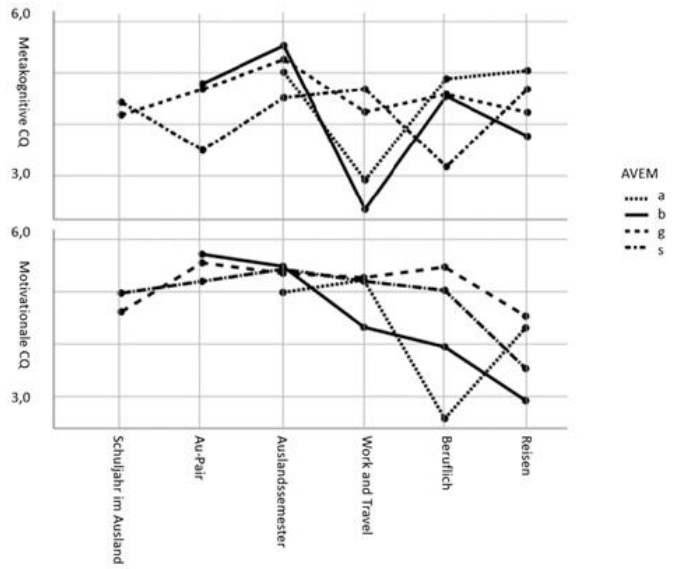

Figure 1. Interaction effects of type of stay abroad and AVEM on metacognitive and motivational CQ

Besides the analysis of the interaction effects, the parameter estimation of the covariates was also considered. Of the variables examined, only the quality of the contacts showed a significant linear influence on the dependent variables. It influenced metacognitive (ß = 0.37, p = .001), cognitive (ß = 0.32, p = .005) and motivational (ß = 0.19, p = .022) competence.

5 Discussion and Summary

Duration affects cognitive, motivational and behavioural CQ. However, significant differences for cognitive and behavioural competence are only observed after more than 5 months. The motivational CQ increases significantly between all three factor levels. The metacognitive CQ does not differ across the three groups.

Significant differences of the cognitive and behavioural competence could be identified after only 5 months contradicts previous theoretical assumptions regarding the gain in competence. In studies that research exclusively from a competence-oriented perspective (cf. Genkova and Ringeisen, 2017), a linear course is predominantly assumed. Rather, it appears that the development of certain competencies only takes place after a certain time. The results do not directly rule out a hierarchical relationship between the

subdimensions of intercultural competence (see Van Dyne et al., 2008). The motivational competence increases earlier in the course of time, however, the sub-dimensions correlate moderately with each other. But, apart from the theoretical assumptions of Van Dyne et al. (2008) and the time sequence, no evidence for this theory could be found. Moreover, metacognitive competence does not appear to be related to time at all, but is rather predisposed by personality. Considering the ambivalent connection between acculturation and intercultural competence that Lee and Sukoco (2010) found, concepts of cultural adaptation should also be included in the discussion.

Gullahorn and Gullahorn (1963) described the psycho-emotional aspects of cultural adaptation as a double U and W curve respectively. Accordingly, at the beginning of the stay abroad, a first honeymoon phase is followed by a culture shock, when the awareness grows that the learned behaviours and standards do not work as usual. As a result, an individual may or may not be able to cope with these problems, as well as daily-hassles (Ward, Bochner and Furnham, 2001). Since the second U-curve of the course refers to the home culture, it can be neglected for this consideration.

A possible culture shock was not shown in the available data. A negative attitude towards the host culture might be revealed by a low level of motivational competence. However, the motivational competence was increased after 1-5 months and even higher after more than 5 months. This suggests that the presumed correlation with duration is exactly the opposite, i.e. a person who is more motivated to interact with other cultures stays abroad longer. Linder (2019) describes that motivation to go abroad is an important factor for exchange students and expatriates. Overall, people who are externally motivated to go abroad (due to pressure, financial incentives, career aspirations) appear to adapt less well and to be less successful.

Regarding the respondents' handling of stress, it was found that subjects with an A pattern had significantly lower motivational competence than the other patterns. Remarkably, respondents with a B pattern differed only slightly from the non-risk patterns. Risk and non-risk patterns differed primarily in satisfaction, resilience and the ability to distance oneself from others (Schaarschmidt & Fischer, 2008). Sam and Berry (2010) describe that affective acculturation is above all also related to psychological well-being. Obviously, the satisfaction that individuals feel in their work or studies also influences the life they lead outside. According to Schaarschmidt and Fischer (2008), dissatisfaction and aversion to others increase from pattern G to pattern B. Lower life satisfaction could result in lower motivational intercultural competence. However, the results at this point do not provide clear evidence of this, as it appears that even people with low satisfaction with a pattern B do not differ significantly from the non-risk patterns. It is therefore concluded that, although satisfaction may result from a progressive acculturation process (Berry, 2013), it is not related to intercultural competence.

Van der Zee and Van Oudenhoven (2013) stress the importance of resilience in dealing with the stress of acculturation. Originally it was assumed that this is a central aspect of

the AVEM patterns for dealing with acculturation stress. However, patterns G and S are not significantly different from pattern B. It can therefore be assumed that resilience cannot be the decisive factor that predicts motivational competence. The difference between patterns A and B should be considered here. The subjects with pattern B had significantly higher levels of motivational intercultural competence than the subjects with pattern A. Both patterns are characterised by low resilience, distance, absence of social support and satisfaction and a high tendency to resignation. The differences are mainly because pattern A is characterised by high work commitment, striving for perfection and importance of the work, whereas these characteristics are low in pattern B (Schaarschmidt & Fischer, 2008). Sample A subjects also had a lower value for the quality of contacts in comparison.

It can be assumed that the sample A respondents did not value the intercultural contact because of their focus on work/study and the intercultural contacts they were able to make. This would correspond to the acculturation strategy isolation according to Berry (1980), which leads to little acculturation success. At the same time there are no significant direct effects on the other competence dimensions. It can be concluded that even people who focus less on their environment and more on work are still able to learn other competence dimensions.

The results for the AVEM samples did not change even when the covariates were excluded. For the type of stay abroad it was shown that metacognitive, cognitive and behavioural competence differed across the types. In this context, persons who have completed a work-and-travel, a professional stay abroad or have travelled have a lower competence than those who have spent an au-pair, a school year or a semester abroad. This confirms hypothesis 3 based on Watson et al. (2013). Furthermore, the assumed interaction effect on metacognitive and motivational competence was confirmed. People with patterns A and B had particularly poor motivational competence after occupational stays, and particularly low metacognitive CQ after work-and-travel. Persons with an S pattern after an au-pair and a work-related stay had particularly low metacognitive competence and low motivational competence after travel. Apparently, certain types can acquire competence to varying degrees under the conditions of the types of stay abroad. Although it was not possible to generate data for every point, it is possible to derive conclusions for the practical organisation of stays abroad. Persons with an S pattern were less metacognitively competent after stays that required a high level of work commitment. If the motivation to interact with others is seen as a basic prerequisite for adaptation and competence acquisition (Sam & Berry, 2010), it could be that less engaged persons are not prepared to achieve the high degree of adaptation under the demanding conditions of working in another culture. Risk patterns A and B had a particularly low motivational CQ after work stays. This specifies the result of hypothesis 2, which shows that resilience and aversion towards others influence the motivational competence when it comes to a professional stay. It can be assumed that under these particularly demanding conditions any risk of burnout is particularly pronounced.

It was shown that semesters abroad are the best way to develop intercultural competence. There is a strong correlation with the quality of contacts with locals. Berry (2003) explains that social support is particularly important in the first period in a new culture. Niehaus, Reading, Nelson, Wegener and Arthur (2018) describe that mentoring programmes for exchange students are particularly well suited to help students make the transition. At the same time, Bolten (2016) showed that intercultural training led to improved competence gains. Regarding higher education and semesters abroad, a mixture of preparation by the home university and support through mentoring seems obvious in order to simplify the acquisition of competencies as much as possible and to prevent negative experiences. Based on theoretical considerations, Genkova (2019) also proposes a mix of methods for preparing and accompanying expatriates.

There are some limitations to this study. The post-hoc view makes it difficult to conclude on interrelationships in the development of intercultural competence. Future studies should take a more differentiated view of students and professionals. Likewise, a possible migration background of the interviewees was not taken into consideration. It must also be noted that the CQS as a self-assessment questionnaire cannot have the same validity as a performance measurement. However, corresponding economic measurement instruments have not yet been developed.

The present study was able to show that the duration of a stay abroad influenced cognitive, motivational and behavioural competence. The motivational competence was already significantly higher after one to five months, the motivational and behavioural competence only after at least five months. The AVEM patterns differed in terms of motivational intercultural competence. During stays at work, A and B patterns led to particularly low motivational competence. In addition, an S pattern had negative effects on metacognitive competence after stays at work and au pairs. The analysis allowed a differentiated examination of individual elements of stays abroad. For future studies, special attention should be paid to the motivation to go abroad, since the motivation to interact was shown to be a central aspect in this study. Also, the importance of intercultural preparatory and accompanying measures is emphasized, especially for professional assignments abroad. Future studies should evaluate these methods under consideration of the job-related personality.

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Tensions in Iinter-Organisational Knowledge Transfer from a Quadruple Helix Perspective: the FinTech Ecosystem in Bahrain

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Abstract

The study aims to explore tensions in an inter-organisational knowledge transfer involving key "Quadruple Helix" actors: academia, regulators, industry, and public or civil society, in the emerging FinTech sector of Bahrain. The collaborative initiatives under a Quadruple Helix configuration bring together a group of actors with dissimilar agendas, to work together and solve complex problems despite their differences. The contrasting nature of the various actors, however, makes these collaborations more vulnerable to tension and conflict. This study provides an understanding of the nature of these tensions, of the reasons why they arise, and of some of the strategies deployed by different organisational actors to address them.

In line with the study's exploratory purpose, a qualitative methodological approach was used employing the principles of Grounded Theory. Semi-structured interviews were conducted with key participants.

Initial findings identified a number of collaborative tensions. These involve tensions associated with conflicting interests, incongruent collaboration motives, and the divergent values sought from the collaborative engagements by different stakeholders. While most participants held an espoused discourse of collaboration and collegiality, their descriptions of de facto instances exposed tensions that were in practice recognised by them. The study contributes to the field by further exploring the micro aspects of the collaborative tensions within a Quadruple Helix configuration.

Keywords – Quadruple Helix Innovation Model, FinTech ecosystem, Inter-organisational micro dynamics, Collaborative tensions.

Paper type – Academic Research Paper

1 Introduction

This paper aims to explore the collaborative tensions between key "Quadruple Helix" actors: academia, regulators, industry, and public or civil society, in the FinTech sector of Bahrain.

Few studies attempt to provide an understanding of the dynamic nature of the roles and interactions involved in the helix configurations from a micro perspective. These include an individual actor or stakeholder's level (Alexander et al., 2017; Cunningham & O'Reilly, 2018; Kriz, Bankins, & Molloy, 2018; McAdam et al., 2018), on the level of the relationships (Hasche, Höglund, & Linton, 2019) and joint activities (Höglund & Linton, 2018). The Quadruple Helix framework was found to offer interesting insights into the collaborative tensions that arise between key actors. Studying these tensions further helps understand what shape the interactions take in practice, how the specific collaborations unfold, and what drives the heterogeneous relationships.

The next section presents the theoretical framework, followed by the research methodology, and the analytical framework used to understand the collaborative interactions. Next follows an analysis of interactions. This involves the three tensions associated with conflicting interests, incongruent collaboration motives and the divergent values sought from the collaborative engagements. In the final section of the paper findings are discussed and concluded, exploring the theoretical possibilities for understanding the complex nature of interactions in a Quadruple Helix configuration.

2 Inter-organisational knowledge transfer in a Quadruple Helix ecosystem

In recent years, innovation has been one of the typical features of the financial services sector (Fáykiss, Papp, Sajtos, & Tőrös, 2018), that has been transformed by the wave of financial innovation (Castilla-Rubio, Robins, & Zadek, 2016; Jenik & Lauer, 2017), particularly with the introduction of open banking, robo advisory, and cryptoassets (Laldin & Furqani, 2019). Platforms like FinTech were created to support the financial services industry and cover all aspects of applying technological advancement in delivering, facilitating, or enabling financial services (Laldin & Furqani, 2019). This has given the opportunity to new players, not necessarily financial institutions, to enter the industry and develop innovative solutions (Karagiannaki, Vergados, & Fouskas, 2017). The collaborators come together either in interorganisational knowledge creation networks, according to Holmqvist (1999), or open innovation teams, according to Chesbrough & Schwartz (2007), to develop new products and services using each other's know-how. In the context of the Quadruple Helix, (figure 1), open innovation was seen as "a new and novel strategy, policy-making, and governance approach" (Carayannis & Campbell, 2011, p.328). In fact, one of the core patterns of "Open Innovation 2.0" (OI2) was using the Quadruple Helix, where "government, industry, academia and civil participants work together to co create the future and drive structural changes far beyond the scope of what any one organisation or person could do alone" (Curley, 2015, p.12).

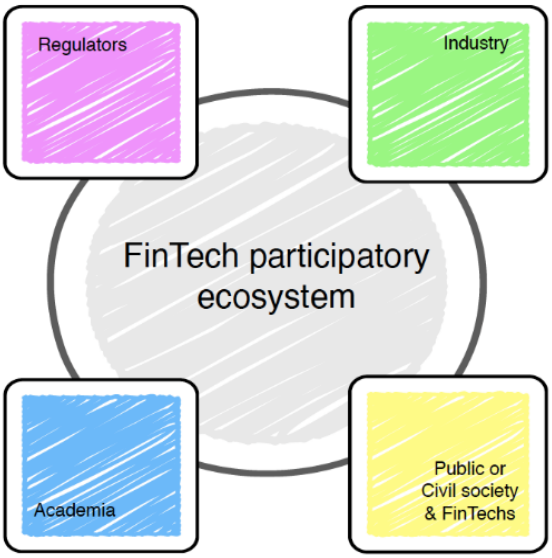

Figure 1 The Quadruple Helix Model. Adapted from: Fitzpatrick & Malmborg (2018).

Theoretically, the Quadruple Helix ecosystem refers to configurations where diverse actors - academia, industry, regulator and public or civil society - are organised into "fluid and heterogeneous innovation networks" (Carayannis & Campbell, 2011, p. 342) where innovation is "driven by increasingly complex, non-linear and dynamic processes of knowledge creation" (Carayannis & Campbell, 2009, p.202). Until recently, theoretical models of the Quadruple Helix innovation model have mostly taken a macro regional point of view (Caetano, 2017; Cavallini, Soldi, Friedl, & Volpe, 2016; Ivanova, 2014; MacGregor, Marques-Gou, & Simon-Villar, 2010). Schoonmaker & Carayannis (2013) and Manniche & Testa (2018) for example have focused on the context of the regional innovation networks, territories and aggregates of actors.

Few studies however attempt to provide an understanding of the Quadruple Helix configurations, the roles and interactions from a micro perspective (McAdam, Miller, & McAdam, 2018). According to Kriz, Bankins & Molloy (2018), it is essential to explore the micro aspects of these relationships to better understand the dynamics within the helix. Research however varied in how the micro aspects of the Quadruple Helix relationships are addressed, and often focused on a variety of levels. These involved individual actor or stakeholder's level (Alexander, Miller, & Fielding, 2017; Cunningham & O'Reilly, 2018; Kriz et al., 2018; McAdam et al., 2018), intra- and inter-organisational relationships levels (Manniche & Testa, 2018), the level of interdependencies (Hasche et al., 2019), joint activities (Höglund & Linton, 2018; McAdam et al., 2018), boundary work (Cunningham, Menter, & O'Kane, 2018), motivations (Cunningham & O'Reilly, 2018) and communications (Plewa et al., 2013). According to McAdam & Debackere (2018) and Kriz, Bankins & Molloy (2018), studying these micro processes further help understand what drives the heterogeneous relationships across the helix spheres.

Because FinTech is an emerging ecosystem and not fully articulated (Still, Huhtala, & Saraniemi, 2016), the Quadruple Helix framework was found to offer interesting insights into the micro aspects of the relationships and the collaborative tensions that arise between key actors (Fitzpatrick & Malmborg, 2018). Tensions were found to be both inherited and unavoidable (Fitzpatrick & Malmborg, 2018), creating a "challenge of balancing the needs of the different actors to achieve societal, economic and environmental value" (Van Horne & Dutot, 2017, p.290). Tensions in the Quadruple Helix literature however were limited to those existing between basic research and commercialisation (Bozeman, 2000; McAdam et al., 2018; Miller, Mcadam, & Mcadam, 2016). On the other hand, tensions that arise from the complexity of the interactions have not been fully investigated (Carayannis & Rakhmatullin, 2014; Hasche, Höglund, & Linton, 2019; McAdam et al., 2018). Exploring these tensions helps better understand what shape the interactions take in practice, how the specific collaborations unfold, and when do specific tensions arise.

3 Methodological approach

A qualitative research strategy was followed to collect and analyse data, adopting the "Glaserian" Grounded Theory principles (Glaser & Strauss, 1967). The methodological approach, depicted in Figure 2 below, is influenced by the three key principles of theoretical sampling, inductively deriving key findings through constant comparison of interview data.

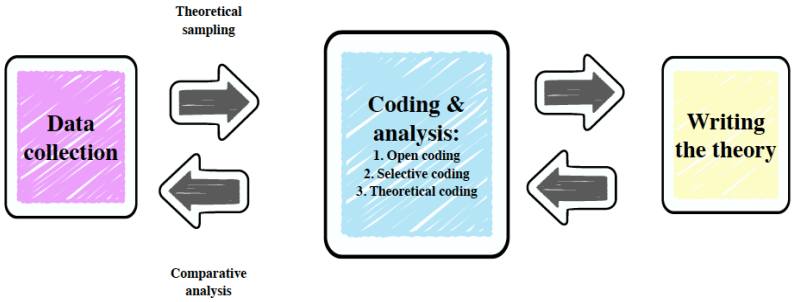

Figure 3 Grounded Theory methodological process.

The principal method for data collection was semi-structured interviews, backed by analysing some internal documentation. Interviews were conducted over a period of around one year with participant actors from all the four helices in the FinTech Ecosystem. The selection of the participants was influenced by an initial exploratory study and the analytical framework that developed with it. They included a Higher Education Institution which was specifically established to cater to the training needs of the financial services sector, representatives from FinTechs, academic regulators; the financial services sector regulator, public/civil society (learners and end users), in

addition to intermediaries. The role of intermediaries has been undertaken by two public entities. The first was a public agency that facilitates the interactions between the government and the other actors above and identify where collaboration and investment opportunities exist. The second intermediary role was undertaken by a public authority, offering consulting, financing, training and entrepreneurship support services to the various actors. Table 1 below displays the codes used through-out this paper to represent participants.

Table 1 Participants' verbatim coding.

Helix dimension	Code
Academia	A1, A2, A3, A4, A5, A6, A7, A8, A9, A10
Intermediary	INT1, INT2, INT3
Industry	IND1, IND2
Regulator	R1, R2, R3, R4
Public/civil society	P1, P2, P3, P4

Constant comparison was the method of analysis following three general guidelines of: (1) open coding, (2) selective coding, and lastly (3) theoretical coding (Glaser & Holton, 2004). Categories and inter-relationships were then developed from the findings which are then delimited, using theoretical saturation to form the basis for the emerging framework (B. G. Glaser & Strauss, 1967). It is important to note that the coding stages used to analyse data, illustrated in figure 2 above, encompass several repetitive cycles, and "are not intended to be distinct and linear" (Heath & Cowley, 2004, 146).

Constant comparison and the iterative process of analysis has enabled developing the characteristics of key categories in the findings as well as to readdressing the relationships between them. Relationships between the categories were established, after observing certain patterns in the data, resulting in one main core category in this study – *Collaborative tensions*. The process involved:

I. Exploring Quadruple Helix context, key actors, the network dynamics and the forms of knowledge transferred.
II. Explaining the impact of sector-specific interests, incongruent motives and values sought from the collaborative engagements on the knowledge transfer process.

4 Collaborative tensions: Conflicting interests, incongruent collaboration motives and divergent perceptions of collaborative value

The study identified three distinct collaborative tensions articulated around the conflicting interests of different stakeholders, their incongruent collaboration motives, and the divergent perceptions developed of the collaboration value.

In what concerns the first tension, *conflicting interests*, one main source of tension was often attributed to the diverse and heterogeneous group of actors involved, with their own interests coming with different objectives, priorities, and foci, as put by this intermediary:

> *"But nobody will have the same interest because the industry has a different focus, a different objective" (INT1, 8:40).*

Tension appeared when partners placed an emphasis on expectations related to their distinct needs. As such, this increased the probability of partners not cooperating. To ensure commitment to the collaboration, participants suggested that stakeholders should be equally engaged and involved in defining common objectives and tasks right from the initial phase of the project. Participants found this helpful in decreasing the likelihood of any misunderstandings, and in helping to avoid divergent expectations and friction as the collaboration progressed. As put by a regulator partner below:

> *"We normally involve our team, our training and development team […] and if they have any concerns they have to raise in the very beginning of the process, to react quickly to bridge the gap" (R1, 12:42).*

The tensions that arise from the conflicting interests however were found entrenched in the collaborators' diverse worlds and mindsets. According to an industry and a public partner, respectively below:

> *"Yes, we are in a different world thinking" (IND2, 5:03).*
>
> *"we see it a different angle and a different perspective" (P2, 8:16).*

Boundaries appeared as a result of the differences in interests between collaborators. Partners may still disagree about a particular solution, no matter how much they appreciate each other's' perspective, because they do not want to change their own practice. Most often partners hold on into their old ways of doing work. As recognised by this public partner:

> *"Just because their legacy structures they have always thought about doing business in a certain way" (P4, 33:11).*

Because the collaborative process usually required accommodating multiple voices, tensions arose as the collaborators tried to envisage and balance the collaboration's internal dynamics with the external demands of the stakeholders regarding the outcomes. Partners were therefore found to either place too much interest to the extent of ignoring their obligations to their broader sphere, or struggle committing to maintaining the collaborative relationship. As a result, some simply avoided the meetings and withdrew from the entire engagement. As put by this intermediary:

> *"One manager in particular said she's been here every year she deliberately didn't go this year and she said to me because I have made extensive contribution, I've seen it as important, first of all my colleagues don't see it as important, and second of all [academia] doesn't listen anyway, why should I come" (INT2, 6:50).*

With so many participants coming from various sectors, responsibility for particular tasks were often found unclear; thus, there was a struggle with those responsible for

taking action. According to the intermediary participant below, many of the ideas discussed were not actually acted upon:

> *"Because nobody wants to own it. It's more talk than solution, so, I think its lack of ownership. Occasionally you'll see someone who says I'll take that, and then you sort of think did anything come out of this, […] it just feels like the action element to these forums, you know agreement might happen, but no action comes from it" (INT2, 9:18).*

Quite often, as the same intermediary continues, partners tended to speak different technical and professional languages inhibiting the ability of the stakeholders to provide substantial input or communicate their needs in a clear manner. Very often, what was actually sought was far from what was actually needed:

> *"You've got lots of people from lots of different industries with different perspectives […] very often what they actually want is quite looks different to what actually they said they wanted […] So, it happened many times there are certain conversations where the academic person uses a whole lot of jargon that the other person doesn't understand or vice versa" (INT2, 18:50).*

To overcome this, participants suggested allocating trainers, experts and specialists from the start, to capture the tacit knowledge that these conversations often involve and make it explicit to others. A participant from the industry suggested involving mediators to translate technical terminology and bridge the gap between the partners' diverse expectations:

> *"So, if there could be someone to translate the technical terms that we use. So, that could be an opportunity for the mediator that we are speaking about" (IND1, 13:07).*

A mediator is thus expected to understand the professional languages spoken by the various partners, be engaged in great deal of inter-institutional negotiation, relationship building and industry research and feedback. This also involves listening to the various partners, translating their needs, and matching the requirements to construct a set of proposals that satisfy the diverse interests. As described by this intermediary:

> *"It is a big gap just between academia and industry, but a lot of my work has been relationship building with people […] scope out needs and flesh them out, that can go around in circles for quite a long time. I need to translate what I'm hearing and try match the two and write the proposal" (INT2, 16:55).*

In terms of the second collaborative tension, *incongruent collaboration motives*, the conflicting interests of the various actors, who eventually prioritised their own interest over their partners, were seen to compel incongruent motives. Partners tended to work together if they perceived their cooperation brought benefits and value for all stakeholders. The motivations driving commitment and interactions were divided between commercialisation or personal gain, and knowledge sharing or altruistic motives. The majority of participants for example, disclosed clear instances of maximising individual utility and self-interests, such as gaining professional recognition or become noteworthy

among peers. The intermediary below mentions that most of the relationships were driven by commercial exchange rather than for knowledge sharing or exchange:

> *"The purpose of the exchange is more for sales than it is for knowledge sharing" (INT2, 16:55).*

While some partners were driven by the well-established names of certain partners according to this academic partner, others felt it was politically good and appealing to collaborate. As put by this intermediary:

> *"A lot of people work with us because its politically good to work with us, because our chairman is on your board or something like that" (INT2, 12:00).*

Few partners, however, were driven by altruistic reasons to the common effort of sharing a quality experience. As shared by this intermediary:

> *"The relationships with the industry were more because of altruistic reasons, the industry was often more genuine about wanting to mentor young people" (INT2, 11:00).*

The intermediary states that quite often the motivations of partners were difficult to align with the realities of the industry, especially with timeline gap between academia and industry:

> *"You have to understand the needs in timelines of industry, there's a really big gap specially the timelines, academia tends to move a lot slower than industry" (INT2, 23:33).*

Therefore, there was an endless need to sustain the motivations of the different partners, teaming them up and ensuring their full engagement which was seen to be quite impossible. According to this academic participant, this was attributed to partners lack of interest which mostly impeded commitment to collaborate:

> *"It's impossible to have a 100% involvement of everybody and sometimes it could be lack of interest" (A6, 39:33).*

This lack of interest was recognised by another intermediary participant, who further recognised the challenge of bringing the different stakeholders together, and ensuring they share the same knowledge to contribute:

> *"Obviously bringing people together has its challenges, and maybe making sure that they are all on the same page" (INT3, 11:27).*

This has further resulted in team members being excluded from the knowledge that the majority of partners withheld. A public participant mentioned that partners have sometimes expressed a lack of understanding of what the project is about and what it constitutes:

> *"People working on that project don't necessarily get what open banking is, or what it has to do" (P4, 24:33).*

In what concerns the third theme of tensions, *the divergent perceptions of collaborative value*, tensions appeared as a result of the incongruent motives that underpinned the interactions. Actors, therefore, according to this intermediary, were not quite persuaded with the benefits of the collaboration, and some felt undervalued, as they were not

listened to. Though aware that their input might not be characterised as technical, partners sought to see their thoughts addressed, welcomed, and positively desired by the rest of partners. the various actors thus expected changes made in response to their extensive contributions. They regarded clear details of the ways their feedback will be integrated as one major reason to join the collaboration meetings. There was an apparent struggle with those responsible for taking action, as many of the ideas discussed were not actually acted upon:

> *"There has been no changes […] because we didn't give or send them a summary of the meeting we didn't send them an action list, we didn't send them any outcome from the meeting, so there is also a communication gap there between us and them" (INT2, 6:50).*

In general, the value sought in these collaborative engagements constituted substantial contribution, in terms of providing the strategic insight and a holistic perspective. Partners however lacked the interest to join the collaborative engagements and the contributions made were described as superficial, fragmented, generic and insufficient to create the expected outcome. This has further impacted the ability of teaming up the different stakeholders, and sustaining their full and equal engagement:

> *"Obviously bringing people together has its challenges, and maybe making sure that they are all on the same page" (INT3, 11:27).*

As the tension associated with divergent values will remain, a public partner suggested engaging in more knowledge transfer activities, and establishing multi-disciplinary teams, instead of departments working in silos:

> *"So, I think there needs to be more transfer of knowledge, and having multi-disciplinary teams, not departments working in silos and not knowing what the other person is doing and they end up having really fragmented strategies" (P4, 24:33).*

To ensure meaningful interactions, participants suggested aligning aims and developing mutual interests by engaging in more dialogic activities. Matching and aligning offerings entirely to the market however were described as a difficult mission. As one public partner puts it, there will always be a gap and mismatch of needs, and as a result, collaboration outcomes may not be satisfactorily to all partners:

> *"We do have gaps and that's normal, we don't sell ice cream, so they might not be always happy with what we provide […] again, to match and speak the language of the market, we can't reach that 100% of course but we are trying to be as close as possible" (P3, 19:18).*

Participants attributed this mainly to the absence of a structured mechanism to assess alignment in the most systematic manner possible and the lack of consensus that the various partners had to establish regarding the changes and improvements to be introduced. The consensus here concerns the direction of the collaboration, and with aligning the collaboration and individual partners with some set of mutual goals:

"The consensus is always yeah we need to change this, but anything beyond that becomes quite difficult" (INT2, 9:18).

To summarise, tensions appeared when partners placed an emphasis on certain expectations related to their distinct needs, and in trying to manage their responsibilities in protecting their interests. Because partners prioritised their own interest over their partners a second theme of tensions appeared, mainly associated with the actors' incongruent collaboration motives and their divergent value perceptions. Participation in the different forms of interaction was underpinned by partners' varying motives, and partners tended to work together if they perceived their cooperation brought benefits and value. Aligning the diverse interests and values in addition to sustaining the various motives for collaboration, however, were found challenging.

5 Discussion and conclusions

Conceptual models of the Quadruple Helix have mostly adopted a macro perspective, focusing on the context of the regional innovation networks, territories, and aggregates of actors (Caetano, 2017; Cavallini et al., 2016; Ivanova, 2014; MacGregor et al., 2010; Manniche & Testa, 2018; Schoonmaker & Carayannis, 2013). Not many studies accounted for understanding the interactions and activities or their complexity on a micro level (McAdam et al., 2018). Research on Quadruple Helix that took a micro perspective, often focused on various levels. These involved the individual actors and stakeholder's levels, the levels of the activities, relationships and their interdependencies, boundary work levels, motivations, and communications (Alexander et al., 2017; Cunningham et al., 2018; Cunningham & O'Reilly, 2018; Hasche et al., 2019; Höglund & Linton, 2018; Kriz et al., 2018; Manniche & Testa, 2018; McAdam et al., 2018; Plewa et al., 2013). Studying the micro aspects of these collaborative tensions were found to help understand what shape the interactions take in practice, how the specific collaborations unfold and what drives the heterogeneous relationships (Kriz et al., 2018; McAdam et al., 2018).

The paper contributes to the emerging body of literature on the Quadruple Helix model in two ways. First, by adopting a micro perspective (Miller, Mcadam, Moffett, Alexander, & Puthusserry, 2016), it uncovers the collaborative tensions that underpin interactions in the helix and shows their interrelations; the study explores the nature of these tensions, the reasons why they arise, and the strategies employed by the various actors to address them. Secondly, this study extends previous research which found tensions were both inherited and unavoidable in helix contexts (Fitzpatrick & Malmborg, 2018; Van Horne & Dutot, 2017), by demonstrating that, beyond that, tensions are constitutive of the Quadruple Helix environment and shaping of its interactions.

Regarding the first area of contribution, initial findings identified three interrelated collaborative tensions as a result of developing a micro perspective. These involve; (1) tensions associated with conflicting interests, (2) incongruent collaboration motives, and (3) divergent perceptions of collaborative value. The first tension, conflicting interests appeared as a result of the diversity and the heterogeneity of the actors involved

(Carayannis & Campbell, 2011), and the boundaries constructed around their diverse worlds, that often focus on their incompatible mind-sets and thus expectations (Muscio & Vallanti, 2014; Van Horne & Dutot, 2017). The conflicting interests further compelled a second type of tension with partners holding and promoting incongruent motives for collaboration (Nielsen & Mengiste, 2014). Examining partners' interests therefore provided an early indication of their motivations according to Austin & Seitanidi (2012) and Seitanidi & Lindgreen (2010). Motivations varied between extrinsic - commercial exchange, advancing career, gaining professional recognition (Battistella & Nonino, 2013; Brabham, 2012)- and intrinsic motivations to contribute to the collaborative effort driven by the opportunity to access complementary knowledge. Iincompatible motives for collaboration further gave rise to a third tension, divergent perceptions of collaborative value. This was found in line with Austin (2010), in how the various motivations that propel partners to collaborate across sectors can generate incompatible values and objectives to collaborate. Moreover, Quadruple Helix participatory projects were often characterised by the presence of diverse values among the individual actors (Arnkil, Järvensivu, Koski, & Piirainen, 2010), and thus participants varied in defining the value of the collaboration (Perkmann et al., 2013), and often espoused different perspectives and expectations of what value is (Hardy, Lawrence, & Phillips, 2006; Seitanidi & Lindgreen, 2010). Individual actors therefore had to confront the tension between balancing their own contribution in comparison to others' fulfilment of responsibilities. According Arnkil et al. (2010), in complex settings such as those of a Quadruple Helix, there is a continuous need for negotiating values among the various participants. Values in this study were viewed in terms of interdependencies partners developed among themselves. This is in line with how perceptions of value increase when the partners appreciate the extent of their interdependence on each other (Clarysse, Wright, Bruneel, & Mahajan, 2014; Gray, 1985). A primary indication of perceived value was thus taking action in response to the individual helix contributions and the ability to influence the agreed action plans. However, tension remained due to the lack of mechanisms that ensure stakeholders are fully informed of the ways their feedback is integrated. Instead actors engaged in internal coordination to partly resolve these tensions (Hansen, 1999).

In what concerns the second area of contribution, the experiences of Quadruple Helix partners demonstrate that the tensions which were identified are constitutive of the Quadruple Helix and shape its interactions. These tensions stem from the collaboration as a forum and the dual position of the actors where they try to pursue the interests of their individual spheres, manage their obligations, and at the same time meet the demands of the collaboration network (Hardy et al., 2006; Kolehmainen et al., 2016; Lawrence & Hardy, 1999). Actors were found to react to this tension in two different ways; however, both reactions impacted the collaboration negatively. The first way partners reacted was by placing an emphasis on the expectations related to their distinct spheres in favour of developing joint collaborative outcomes. Partners were therefore found to be involved only in a superficial manner, showing lack of interest and contribution and ran the risk of

no collaboration (Hardy et al., 2006). The second way was when some partners, specifically academia, eliminated the tension by primarily serving the collaboration purpose, and ignoring their responsibilities to their wider sphere, running again the risk of not drawing on the diverse interests of the various actors (Hardy et al., 2006). With so many potentially diverse participants, and the ambiguity in early stages of the collaboration, individual responsibility and ownership for specific tasks were unclear (Aranguren & Larrea, 2011). Participants expressed the need to structure the initiative and guide actors' individual pursuits (Susman, Gray, Perry, & Blair, 2003).

Intermediaries were therefore introduced to manage tensions arising from conflicting interests, the misalignment between the varied motivations and the realities and timelines of the various actors, and balance the individual helix motives with the collective motives (Cunningham et al., 2018).

To participate in collaborative conversations is therefore to participate in an endless struggle between two roles. The participant is both a collaborator and a sphere representative, and consequently, collaborations are inseparable from these two competing tensions. Further research is needed to investigate how the various actors manage the identified tensions more effectively, helping future Quadruple Helix participants be better aligned and balanced.

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Ecosystem Dynamics and Strategic Alliances: an Integrated Study Perspective

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Abstract

This paper seeks to open a new avenue in terms of study perspective and investigation methodology to explain the effects that strategic alliances may have on the evolutionary dynamics of an ecosystem. More specifically, we aim to shed light on the importance of developing a new systemic metric and a computational model to predict ecosystems' network dynamics based on the agents' behavior towards cooperation or acquisition practices. Despite existing literature on ecosystems has largely coped with issues related to the structure (closed networks or structural hole theory), the benefit of a network, or actors' behavior, it does not provide contributions or methodological frameworks to investigate ecosystem dynamics trigged by collaboration or merger and acquisition strategies. Nevertheless, the topic is particularly relevant to understand for instance present and future dynamics of modern ecosystems (characterized by a high competitive context) or of nascent ecosystems (such as those in less developed countries), that evolve driven by strategic alliances employed between certain actors (i.e. incumbents and startups or incumbents and service providers). Insofar, authors introduce three new issues in the ecosystems management literature to address this topic: i) the relevance of strategic alliances in the ecosystem evolution; ii) the introduction of a new measure of proximity to evaluate the structure and the characterization of the network - the value chain distance -; iii) an integrated methodology to capture ecosystem evolutions - the agent-based simulation combined with the social network analysis - . Authors propose as the

unit of analysis the industrial ecosystem, an embryonal ecosystem useful to derive general assumptions on the ecosystem configurations and its evolutionary dynamics.
The paper is purely conceptual, its originality concerns the perspective of study and represents the first attempt to propose some direction to better study the evolution of ecosystems as a result of actors' strategic alliances.

Keywords – ecosystem, structure of network, M&A, collaboration, strategic alliance

Paper type – Academic Research Paper

1 Introduction

During the last two decades, academics have gone in-depth by accurately analyzing the realm of alliance strategies and carrying out the uttermost theoretical and practical frameworks. A bit at a time the big picture of the single company features and its context in terms of stakeholders, dynamics or know-how providers became more and more understandable. Therefore, the attention gradually was moving towards the interconnection among actors and resources, and their capacity of jointly generating a greater value-added than a single actor may unleash. This is fundamental at the base of the ecosystem concept. The need to understand the ecosystem as a unique body instead of a sum of different actors is rooted in the possibility of installing a new pattern of relationships in terms of structural configuration. At this point, the strategy of alliances is not only a matter of single actor performance rather seems to be pivotal for the evaluation of the effects on the entire system. In fact, configurations assumed recently by the banking or the healthcare ecosystems are evidence of how is relevant interpret M&A operation in a systemic way. In these high competitive contexts or also in ecosystem nascent in less developed countries, strategic alliances between firms as well as incumbents and new firms (i.e startups) or incumbents and service providers inevitably break the existing balance and create new ecosystem configuration.

The re-modularization of the lens of analysis at the level of the entire system is not full of novelty, although addressing the theme of simultaneous evolution of alliances strategy and structural configuration is a further step towards a fuller understanding ecosystem dynamics. Nevertheless, the existing literature does not provide adequate contributions or methodological tools to investigated some aspect of the phenomenon, focusing on the desirable structure of networks - closed networks or structural hole theory (Burt, 1992; Coleman, 1988, 1990); on the knowledge transfer (Ahuja, 2000); on the speed of innovation and organizational learning (Ahuja 2000; Gulati et al. 2000) for networked firms; despite showing the ecosystem network as the simplest effective organizational form to improve company performance (Fritsch and Kauffeld-Monz, 2010; Ahuja 2000; Gulati et al., 2000). Therefore, issues to address before to carry out an empirical analysis of effects of strategic alliances on the ecosystem evolution are as follows. Firstly, the issue of systemic metrics. In other words, shedding light on which parameters are more useful than others, is necessary for capturing and assessing the impact strategic alliances

may have on the structure and evolution of a network. Authors starting their observation analyzing industrial ecosystems (IE) have identified a new useful parameter, the "value chain distance", a sort of industrial proximity, to measure the distance between the actors – evaluated on the sequential flow of the product or service created in the cluster. The roots of this parameter are tied with the quantification of the structural changes when an actor has re-modulated its strategy. Furthermore, another interesting issue, partially unexplored, concerns the complexity, the heterogeneity, and the dynamism of ecosystems, when they are exposed to the alliances' reconfiguration. In a nutshell, the social network analysis approach (used until now) lacks the predictive ability and it does not deal with the dynamism of an ecosystem. Therefore, for disentangling the complexity of industrial system structure and providing a method for experimentation, we propose a multi-integrated methodology that combines the strictness, the precision and the descriptive capacity of social network analysis along with the forecast ability and complexity suitability of agent-based simulation.

Our research question is stimulated by the above-cited problems, and it is focused on understanding whether some new metrics and new methodologies may be developed starting from the need of clarifying how the ecosystem will evolve along the time in response to the strategic alliances implemented by key actors of an ecosystem. Before experiment and validate our assumptions we start our reflection analyzing dynamic of the industrial ecosystem, an embryonal ecosystem characterized by the M&A alliances led by dominant actors. The originality of this paper concerns the perspective of the study. In other words, we have tried to open a new strain of research by mixing different approaches coming from the innovation ecosystem, the M&A studies and agent-based simulation experimentations. We have proposed a mix between a typical empirical method as the social network analysis with a computational and laboratory method as the agent-based model.

2 Literature background

2.1 Industrial ecosystem and the role of dominant actors

The concept of an industrial ecosystem (IE) arises from the reflections of Frosch and Gallopoulos (1989) regarding the negative effects of industrialization in the late 1980s. Scholars wrote of a necessary change in the traditional industrial paradigm, proposing more integrated models of industrialization that give consideration to industrial effects produced on the natural ecosystem. In fact, their attention focused on aspects related to the environment and on the possibility of reducing the damage produced by industries through an attitude of cooperation between businesses and between businesses and customers. Specifically, the authors considered the IE an analog of the biological one, and therefore it, albeit ideally, should have tended for the infinite recycling of the materials used. Adopting such a policy would have reduced the negative impact of companies on

the environment, encouraging them to develop their economy in harmony with the surrounding ecosystem. This would have been possible through a change of habits of the individual parties, but also through concerted participation by all producers and consumers of a supply chain. Korhonen et al. (2001) re-proposed the concept of industrial ecosystem intended as a system pursuing environmental sustainability, i.e. an ecosystem with the aim of extending the principle of sustainability to all industrial operations. However, their studies were interesting because, in addition to stressing the "cooperation" component, fundamental for the success of an industrial ecosystem, they also stressed that of "diversity". The survival of the ecosystem was based precisely on the diversity in the species, which connotes the system of characteristics such as high flexibility and adaptability. These principles, adapted to the concept of industrial ecosystem intended in the strictest sense of business ecosystem and leaving out the more ecological aspects of the ecosystem, take on a different but more feasible meaning, inviting companies, even if of different nature, to cooperate not only to survive but also to innovate.

In fact, the most recent definitions of IE, inspired by Moore's business ecosystem definitions, introduce a further aspect of the ecosystem which is the capacity for innovation. The industrial ecosystem (IE) is defined by Feng, Wu and He (2018) as a new paradigm for the development of the innovation ecosystem. It refers to "companies that connect through the industrial agglomeration and influence each other to build a network system, sharing information between different participants, disseminating resources and promoting the sustainable development of IE" (Feng, Wu and He, 2018, p.3). Unlike Moore's definition (1996, p.9) on business ecosystems - an economic community supported by a foundation of organizations and individuals interacting in the business world - Feng et al. (2018) maintain the industry meaning of the ecosystem. This meaning refers mainly to an ecosystem based on the supply of products and materials (Tsvetkova and Gustafsson, 2012) or well-defined geography (Boon and Baas, 1997). Although its characteristic may appear as a limit and seems to be overcome by the most modern concepts of networks or of the business ecosystem itself (Iansiti and Levien, 2004), it is very useful for i) the analysis of emerging ecosystems in late-developed countries and for ii) the analysis of very complex ecosystems. Feng, Wu and He (2018) believe that in late-developing countries, the drive for growth and innovation of other businesses can start from an industrial ecosystem led by the leader of an industrial chain. The reconstruction of the bonds and relationships established in the ecosystem help to better manage the levers of development and innovation. Tsvetkova and Gustafsson (2012) use IE to analyze the complexity of some ecosystems. An IE is, in fact, modular and decomposable. Starting from it to analyze ecosystems allows you to isolate the key components and then extend the analysis to the whole. The IE encompasses many of the basic relationships of the ecosystem, which give rise to new flows of relationships over time.

For this reason, it is also crucial to understand the role played by some companies in the ecosystem, in particular, that of the leader companies (Moore, 1996), around which very often the main events of the ecosystem revolve. One thinks of the role of keystones

of Google or Apple in their industrial ecosystem (Yang, Nam and Kim, 2018). Their actions are able of influencing other ecosystem companies in the short or long term and therefore changing the characteristics and configuration of the starting ecosystem.

An ecosystem is in fact made up of groups of companies or sometimes a single company which plays a functional role within the ecosystem. Iansiti and Levien (2004) focus on these aspects and recognize three types of ecosystem roles: the rulers, keystones and niches.

- Dominators tend to dominate a large part of the ecosystem enterprises, especially the smaller ones; they adopt integration strategies, control multiple network nodes to acquire value only to their advantage.
- Keystones are more extended to collaboration and sharing: they redistribute the value within the ecosystem producing benefits for all its members; they control a few nodes, not the whole network.
- Niches are small actors within the ecosystem who try to specialize to differentiate themselves from others, however, they need support to be able to capture more value, they are willing to share in order to grow; they represent a large part of the enterprises of the ecosystem determining their number and variety.

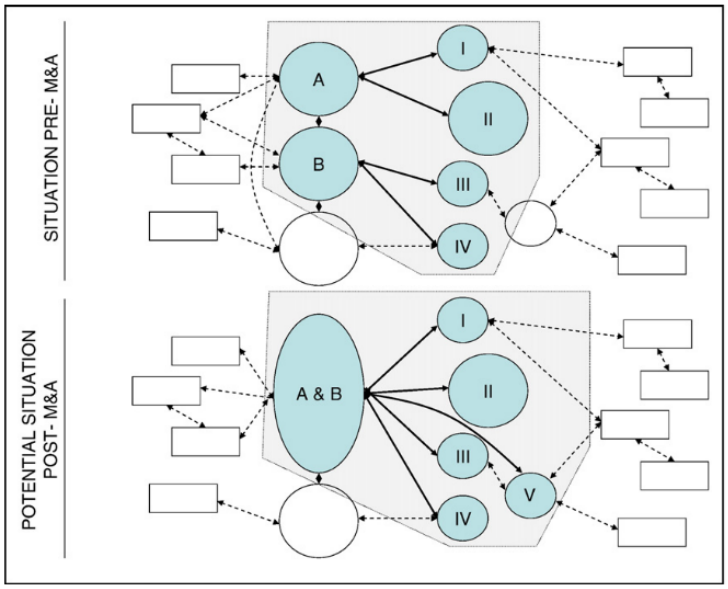
The strategies implemented by some components of the ecosystem inevitably condition it (Iansiti and Levien, 2004), sometimes in the short, sometimes in the long run. Meanwhile, the industrial ecosystem turns out to be a unit of analysis necessary to reconstruct ecosystem dynamics.

2.2 Strategic alliance and ecosystem structure

The behavior of a system emerges from its own structure (Sterman, 2000, p. 107), which in turn is the product of the links between the actors. Analyzing structure and relationships is fundamental to understanding the characteristics and evolution of the ecosystem.

Scholars Yang, Nam and Kim (2018) argue that strategic alliances and collaborations between groups of actors inevitably strengthen or weaken the competitiveness of an ecosystem, consequently also changing its structure (Yang, Nam and Kim, 2018). However, the analysis of the effects of these operations on the structural configuration of the ecosystem is hardly addressed. Yet inevitably mergers, acquisitions and collaboration that result in the consolidation of two companies into a single economic unit respectively (Weston and Weaver, 2001); control of ownership over another company (Hagedoorn and Duysters, 2002); collaborative relationships without compromising the economic unit; they influence the ecosystem in terms of density, number, diversity and therefore flexibility or rigidity. Through these strategic alliances, strong or weak ties are established between the parts that condition survival and innovativeness not only of the single actors. Therefore, although these operations usually concern two or some of the ecosystem companies, the effects produced can also affect other ecosystem companies not directly

involved (Figure 1), transmitting and generating a change indirectly (Hertz, 1998; Havila and Salmi, 2000). Much depends on the strength and character of the relationships through which knowledge, financial resources and the relationships themselves are transferred. For example, very weak links between the parties are indicative of strong independence of the actors but also of reduced flexibility of the ecosystem, which will become more exposed to changes (Simon, 1962; Tsvetkova and Gustafsson, 2012).



Source: Öberg et al.,2007

Figure 1.

The literature analyzes the effects of M&A or even collaborations focusing only on the parties participating in the alliance; few were interested in wider effects. Some such as Havila and Salmi, (2000) discuss the changes brought about by a dyad of businesses that merges or acquires by questioning the radical change that this behavior would cause on the entire network. In fact, through mergers and acquisitions, new relationships appear or old ones disappear, also influencing relatively distant actors in the network. Others, such as Anderson, Havila, and Salmi, (2001) and Öberg and Holtström (2006) analyze the effects of M&A on business relationships and end customers, arguing however that many companies do not act as part of a network, but think in a selfish logic. Öberg and Holtström (2006) became interested in the effects on the network by limiting themselves to the focal network (companies and their customers), but felt the need to invite researchers in an analysis that included a wider network horizon and including in the analysis indirect interactions that can be transferred following an M&A or a collaboration.

3 The value chain distance to investigate industrial ecosystem

This study attempts to extend the management literature by exploring a new measure of industrial proximity to interpret the distance between the actors – evaluated on the sequential flow of the product or service created in the cluster - and to understand links and the centrality of their role within the industrial ecosystem (Frosch and Gallopoulos, 1989; Ehrenfeld, 2000; Basu and van Zyl, 2006).

Porter's study (1991) offers a strategic perspective based on the positioning of the company and its capabilities to provide the best defense against the competitive forces. On the other hand, he also introduces the concept of value-generating activities (or strategically relevant areas) beyond the functional approach, to explore the value chain of a company which represents the building blocks of competitive advantage. The effects of environmental evolution affect the functional areas of the individual company, forcing it to reconsider its structure, the duties and roles of the different actors involved in ecosystem companies. Nowadays, the analysis of the structure of a company's value chain would lead to configure a different subdivision compared to that provided by Porter. Indeed, with the development of outsourcing phenomenon most of the activities that do not belong to the core business are brought outside and most companies close or far from their value chain position, collaborate, or are acquired.

Drawing on the network picture change developed by Öberg et al., (2007), we can develop some theoretical speculation about how a new measure of industrial proximity as the value chain distance may be useful to evaluate the structure and the characterization of the network due to strategic alliances lead by key actors. These considerations on the network open to broad reflections regarding the typology of information, knowledge and resources exchanged between nearby or far off actors from the value chain, which may be conditioning at actors level the intensity of the relationships, at the systemic level the structure (in term of flexibility or rigidity) and the specialization of the ecosystem (i.e. product, service, customer or technology oriented).

We decided to adopt Öberg et al., (2007) study because it is one of the most conceptual frameworks in industrial studies regarding the merger or acquisition causing changes in a business network, especially about the concepts of ‘network pictures’ and ‘networking’. Thus, we validate this model trying to extent adopting a new measure of industrial proximity as value chain distance.

For these reasons, the structural effects on the network based on the concept of value chain distance can be reassumed in two directions. First, it helps to identify the key actors of the networks and their capability to forge the ecosystem. Second, it can improve the external growth process that allows to connect the value chains of different companies and therefore to take advantage of their strengths in carrying out the business. From this perspective, the value chain can be intended as a system of interdependent activities, connected internally and potentially connected to external value chains. Links between actors and the external value chain may affect the structure, the characteristics, and the evolution of the ecosystem.

The links to analyze range from a traditional vertical collaboration between the company's value chain and those of suppliers or channels, to those between firm and buyer, to a horizontal relationship between competing firms, characterized by possible links such as M&A or collaboration.

Therefore, the strategic orientation can change because it passes from the management of the resources controlled by the structure and the internal skills accumulated, to the search for external opportunities (collaboration) and to the possibility of using resources greater than those directly controlled (M&A). These opportunity-driven strategies are based on a specific ability to access common information within the entire ecosystem and effectively use external resources-skills to pursue the best opportunities and long-term competitive advantage. As affirmed by Gummesson and Mele (2010), interaction in the ecosystem strives to enhance services through a better connection between resources, processes, and outcomes.

Thus, the interchange of value among relatively distant actors would be fruitful for the effect of the structure and competencies of the network. Our aim is to simulate an analysis that includes a wider network horizon and including in the analysis of indirect interactions that can be transferred following an M&A or a collaboration.

4 An integrated methodology: social network analysis and simulation model

This paper seeks to open a new avenue in terms of investigation methodology. The aim is enlarging the researcher's toolkit in order to provide a new multi-perspective method in favour of industrial ecosystem scholars. The body of thesis is the outpacing of difficulties related to two main methodology: the static nature of network analysis, and the lack of strictness of the agent-based model. Indeed, the most common structural network analyses, depicting the network in a very thorough way (Wasserman & Faust, 1994). Although this realm of research instruments is not able to provide a forecast or a future projection. At the opposite the agent-based model has its points of strength in the capacity of managing the complexity by running a large spectrum of changes and simulating the evolution of scenario (Macy & Willer, 2002). Although it is common that the agent-based simulation might be affected by a great generalization, by ending to provide just the trajectory of evolution but no more practical and applicable implications.

The expression "computer simulation" is referred to the exploitation of a computational model aimed at enlarging as much as possible the understanding of complex systems (Epstein & Axtell, 1996). The Agent based model is particularly useful when the system complexity is generated by the tally of each individual strategy within a broader body. The matter of fact is tied with the size of the phenomenon and the difficulty of realizing direct observations. In the light of this scenario the possibility to realize " in-machina" experiments, opens the route to in depth examination of complex system (Sallach, 2003). An agent based model fits very well when: the experimentation concerns a representative

and typical agent; the set of agent's strategies is depicted by a finite domain; the numbers of dependent variables is finite; the domain of each dependent variable might be infinite; the choice of a strategy influences the entire set of variables that are interconnected among them. Therefore, the ABM has a great level of suitability in order to shed light on very interconnected and fuzzy mechanisms at the base of industrial ecosystem. Indeed, for the sake of clarity the model may be run by adopting a reasonable degree of generalizability for the agent. The set of agent's strategies might be potentially unlimited, although, we decide to investigate strategies that may impact on the structural configuration of the ecosystem, therefore, for simplicity we restrict the spectrum of analysis to three main strategy: mergers, acquisitions and collaboration. The novelty of an integrated multi-perspective agent-based simulation concerns the set of dependent variables, that our model draws by the network analysis. In other terms we evaluate the impact of agent's strategy choices on the structural configuration of network, more specifically, we have selected as dependent variables the following network measures: density, diversity, flexibility and rigidity.

5 Discussion

Our conceptual remarks represent a first attempt in forecasting the evolution of ecosystems' dynamics, whereas the majority of studies in the field tend to provide a snapshot analysis of the current ecosystem's performance or investigate the determinants of their evolution state. While the study of networks within the ecosystems, especially through quantitative methods, contribute to show the important role of connectivity among the ecosystems' actors, the emphasis on the agent-based theory, allows for more comprehensive modeling of interdependence dynamics. Indeed, by foreseeing the agent's reactions following other agents' behaviours (i.e dominant actors) , the model allows to capture the dynamic evolution of the ecosystem by zooming in on its inner dynamics, instead of generally considering their evolution as the result of external factors at the macrolevel. More specifically, such a model would contribute to measure the ecosystems performance based on indicators that go beyond the conventional measures of economic and innovation performance, including ecosystem's flexibility to respond and adapt to external changes thanks to the observation of actors' behaviour. The possibility to predict the level of ecosystems' flexibility or adaptation would carry relevant implications for policy-making, which could therefore redesign and rethink programs, policies and interventions from an antifragile perspective to build robustness in the concerned ecosystems. However, it has been argued that the ecosystem's flexibility could be constrained by the strong independence of actors. However, the flexibility of the ecosystem should not compromise the independence of each individual actor, as it would make them too vulnerable to change. This is why some scholars still believe it is essential that the ecosystem is made up of a solid core, while surrounding itself with transversal ties that allow it sustainability and flexibility (Simon, 1962; Tsvetkova e Gustafsson, 2012).

Moreover, including the concept of value chain distance as an explanatory variable for agent's behavior would allow integrating a further form of proximity in addition to the well-known ones, i.e. geographical, social, cognitive, organizational, institutional and sectoral (Boshma, 2005). Indeed, while a great body of studies has investigated the implications for collaboration deriving from the above-mentioned types of proximities, none of them has so far contributed to understanding how affiliation to a similar or different value chain can inhibit or stimulate practices of cooperation or M&A. Understanding whereas actors within the same ecosystem would be more or less prone to acquire or collaborate with actors with a short value chain distance would carry interesting implications for the policymaking. In particular, in those cases where the relationship between the value chain distance and cooperation is negative, the government may be encouraged to stimulate the establishment of micro industrial districts within the ecosystem where incentivizing practices of collaboration driven by innovation.

6 Conclusion

This paper seeks to open a new avenue in terms of study perspective and investigation methodology. More specifically, we aim to shed light on the importance of developing a new systemic metric and a computational model to predict ecosystems' network dynamics based on agent's behavior towards cooperation practices. By integrating insights from Social Network Theory and Agent-Based Theory, we suggest that the development of this predictive model would contribute to a greater understanding of the complex nature of ecosystems. Furthermore, by including the concept of value chain distance as a further explanatory variable of agent's behavior would contribute to improving the clarity of the fuzzy mechanisms at the base of the industrial ecosystem, as well as proposing assumption related to the structure (in term of flexibility or rigidity) and the specialization of the ecosystems (i.e. product, service, customer or technology-oriented.

Particularly, the mixed model and the value chain parameter may contribute to better explain the effects that collaboration or merger and acquisition (M&A) strategies may have on the evolutionary and innovative dynamics of an ecosystem. On these bases, we suggest that further advances should be made in this direction.

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Process of Digitalization and Sustainability. Evidence from Utility Industry in Europe and USA

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Abstract

In recent years, the business models of companies have undergone significant changes. These transformations are fueled by the increasingly domineering advent of technological innovation.
New technologies affect most sectors of the economy with significant impacts on industrial processes. The development of devices capable of transmitting and processing huge amounts of data in a timely manner promotes the efficiency of production processes and greater precision. In line with these considerations, the implementation of Industry 4.0 technologies could be considered the tool capable of promoting the sustainability of business processes. The protection of the ecosystem, the satisfaction of the present and future needs of the community, as well as the continuous evolution of the production and industrial process have led to a radical transformation of the competitive business environment.
The issue of pollution and climate change is radically transforming the relationship between businesses and the environment, pushing them towards the implementation of strategies that affect the social, economic and social environmental problems in which they operate. Furthermore, in support of the adoption of sustainable behaviours, there are also new European regulations that increasingly encourage the integration of environmentally friendly policies.
Since environmental sustainability is one of the main drivers of competitiveness and innovation to date, this work aims to study the relationship between technological innovation and sustainability.

In order to achieve our goal, a regression model for the panel data will be estimated considering a time horizon of 5 years. The analysis will be conducted with reference to a sample of listed companies operating in the public services sector in Europe and the United States.
In our document we will use a multiple regression analysis to test the relationship between sustainability and digitalization of processes.
Since there is a productive synergy between Industry 4.0 and environmentally sustainable production, we expect to find greater sustainability in companies that use the digitalization of their industrial processes.
Today many studies focus on sustainability, while there is still little research explaining the relationship between digital innovation and sustainability. This study aims to fill this gap by offering an empirical analysis of the national and international context. The contribution has practical implications, as it provides market operators with information on how environmental sustainability issues will be affected by the adoption of new digital technologies.

Keywords – sustainability, environmental, innovation, digital technologies, business processes

Paper type – Academic Research Paper

1 Introduction

The growing interest in new digital technologies is fuelled by the ability to achieve significant benefits for the business. The implementation of new technologies affects most fields of the economy with significant impacts on industrial processes. The development of devices capable of transmitting and processing huge amounts of data in a timely manner promotes the efficiency of production processes as well as greater accuracy (Rajput and Singh 2019). The data available for companies and the way they use them can help to consolidate a valuable competitive advantage (Pappas et al. 2018). This is essential to survive in a constantly changing market. In this regard the company's ability to identify, assimilate and use the information most useful to the development of its business (Cohen and Levinthal 1990) is crucial and then transforms it into product or process innovations. The implementation of Industry 4.0 technologies is also the tool that can promote the sustainability of business processes. The issue of sustainability, which is extremely topical, is leading the prevalence, if not all of the organizations, to pay more and more attention to the environment (Kotze et al. 2010) and its preservation. In particular companies are increasingly oriented towards the development of a sustainable corporate culture, which is encouraging the optimization of business operations (A. Nowak et al. 2011). In fact the growing focus of companies and their stakeholders on the issues of environmental sustainability and corporate social responsibility has emphasized the adoption of policies and the pursuit of increasingly sustainable goals. The protection of the ecosystem, the satisfaction of the present and future needs of the community (Brundtland 1987), as well as the continuous evolution of the production and industrial process (Savastano et al. 2019) has led to a radical transformation of the competitive business environmental.

For this purpose, Business Process Management (BPM), understood in terms of overseeing the work done in order to achieve consistent results and take advantage of opportunities for improvement (Dumas et al. 2013), needs a transformation. More precisely the conventional view of BPM needs to be extended towards a dimension of environmental sustainability (A. Nowak and Leymann 2013; Reijers and Liman Mansar 2005; Seidel et al. 2011). This new configuration of the BPM, defined as BPM green (Maciel 2017; Seidel et al. 2011; Carl Stolze et al. 2012), is aimed at reducing the environmental impact of business processes, through the use of alternative raw materials, the reduction of electricity consumption (Cappiello et al. 2013), carbon emissions (Recker et al. 2012) or, more generally, through the efficient use of resources (A. Nowak et al. 2011). In this regard in contrast to traditional Key Performance Indicators (KPIs), Nowak (2010) and other authors have identified Key Ecological Indicators (KEIs) as tools useful for assessing environmental performance.

Since environmental sustainability is one of the major drivers of competitiveness and innovation to date, this work aims to investigate the relationship between technological innovation and sustainability. In particular, we intend to investigate the relationship between the digitalization of business processes and sustainability.

The paper is structured as follows: section 2 presents the literature review; section 3 describes the research methodology; section 4 presents the results; section 5 discusses the results and finally section 6 presents the conclusions, the implications and the future research lines.

2 Literature review

2.1 Sustainability and business process management

Sustainability is usually defined as the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development (WCED), 1987). Business process management can be defined as the subject field that provides appropriate concepts, methods, and tools to model, implement, operate, and monitor business processes (Reiter et al. 2014). The importance of implementing environmentally-aware business processes can be observed in several industries. Various organizations have taken in the first steps towards improving the environmental impact of their processes by defining and realizing corresponding business strategies and process adaptations. The execution of a business process has always a certain impact on the environment (Alexander Nowak et al. 2011). Business processes play thus an important role in contributing to the carbon footprint of an organization (Lan 2012). As a business process transforms inputs into outputs, the renewable and non-renewable inputs as well as the type and environmental quality of the outputs determine the sustainability of a business process (Seidel et al. 2011). In this line of thought, the extent of renewable inputs as well

as the extent of emissions (outputs) that can be kept within the assimilative capacity of the environment should be maximized, while the extent of non-renewable inputs and the extent of emissions (outputs) that exceed the assimilative capacity of the environment should be minimized (Seidel et al. 2011). Therefore, a green business process is an environmentally conscious business process that is necessary, efficient, effective, agile, and measured in the context of an organization (Lan 2012) and delivers organizational value with a minimal impact on the natural environment (Seidel et al.,2012, January). Additionally, from a more technological perspective, an energy-aware business process is a service-based business process that considers functional and non-functional requirements, as well as specific annotations for guiding energy assessment (Cappiello et al., 2011).

Different yet similar definitions of Green BPM can be found. They commonly build on the business process lifecycle from "classical" BPM, and add the ecological factor. Examples are the "dedicated consideration paid to the environmental consequences of these business processes" (Seidel et al. 2011), the optimization of business processes considering the ecological dimension (Alexander Nowak et al. 2011), and the aim to support environmental objectives (Lubbecke et al. 2015). Hence, one can understand Green BPM as the discipline that provides appropriate concepts, methods, and tools support business process modeling, implementation, execution, monitoring, and continuous change with dedicated consideration of the environmental impact of these business processes.

Green BPM is not an entirely new way in optimizing organizations' business processes. In fact, existing BPM methodologies and techniques such as discussed in (Hammer and Champy 1994) are leveraged, extended, or refined in order to support the new requirements emerging from environmental concerns. Green BPM deals with the optimization of business processes based on the four common dimensions cost, quality, time, flexibility, and in particular also considers a fifth dimension: the ecological dimension. This dimension covers a variety of aspects like energy consumption, water consumption, or production waste incurring during performance of business processes and activities contained therein, respectively. Although Green BPM is still in an early stage, more and more organizations try to find different ways for improving the environmental impact of their business processes. The motivations for this development are manifold: increasing costs for raw-materials and energy, legislative regulations to reduce emission of carbon, or the public image of an organization, to name some examples. Many institutions and researchers focus on Digitalization and innovation program into utilities firm according to its attributions and responsibilities in society, contributing to growth and delivering goods and services (European Commission 2019a, 2019b).

The main difficulty organizations are faced with is finding a proper solution for green business process improvement considering (a) the particular business process structure,

(b) if and how the process may be changed, and (c) how the process interacts with business partners (A. Nowak and Leymann 2013).

An early approach to capturing green BPM was proposed in (Ghose et al. 2009) and has later been extended and detailed in (Hoesch-Klohe et al. 2010; Hoesch-Klohe and Ghose 2010a, 2010b). The authors provided a first overture for the computation of carbon emissions when modeling business processes. They identified environmental properties, which describe water or energy expenditure, or the impact to the flora and fauna, and resource types that can be annotated to the process model in order to calculate the total environmental impact of a process. They addressed these aspects by proposing a mechanism to aggregate heterogeneous environmental properties of activities (Hoesch-Klohe and Ghose 2010a) as well as a methodology on how to capture and use the relationship between resources and process activities (Hoesch-Klohe et al. 2010). To boot, they introduced an approach to ecologically improve business p0rocesses by redesigning business process models using so-called process fragments. These fragments, usually incorporating a specific functionality, can be exchanged based on their environmental impact. The approaches are mainly focusing on the Design and Analysis phase of the life cycle. Process models are annotated during the modeling time, which allows determining the aggregated resource consumption. This data can also be used as decision support for process model adaptation (Ghose et al. 2009). The information on emissions is taken as granted. Notwithstanding, the approaches support the annotation of this information to the process model and also consider the aggregation of heterogeneous green performance indicators.

Another approach is provided in (Ardagna et al. 2008). The authors developed mechanisms for energy-aware resource allocation and policies for SOA- and process-based applications while ensuring certain QoS requirements. The proposed approach identifies three layers: process layer, infrastructure layer, and control layer, which provide an integrated plan of attack to decrease energy consumption in ICT. The approach comprises both, design time and runtime. Operations are designed considering ecological and economic requirements. The optimization of web service selection is performed within the process layer. The infrastructure layer deals with the trade-off between performance and energy expenditure. So, it uses current runtime information and adapts services if possible, i.e. decrease the energy consumption while not worsen the performance. Additionally, the control layer performs server provisioning and virtual machine placement decisions. The approach focuses entirely on energy consumption and how it can be reduced. Nevertheless, the focus here is on business processes and sensor data as well as the analysis of this data and corresponding adaptation mechanisms. The approach partly considers business related aspects. A basic assumption is to always fulfil customers' requirements and to address the trade-off between performance and energy consumption. This requires proper engineering and services used in the operation. Hence, this approach deals (at least partially) with ecologically optimized Operation, Marketing and Sales, Procurement and Technology Development parts of the Value Chain. The

approach has been further refined in (Cappiello et al. 2013), which focus on models and methods for the analysis and reduction of energy consumption associated with applications which are made energy-aware through annotations and Green Performance Indicators (GPI) in applications. The approach sets a green lifestyle for the development of adaptive, self-healing, and self-managing application systems able to reduce energy consumption. The approach also uses so-called GPIs in order to determine the energy consumption of an application. They are thought to describe the green properties of an application. Hence, this approach deals (at least partially) with ecologically optimized Operation, Marketing and Sales, Procurement and Technology Development parts of the Value Chain.

To sum up, one can understand that an environmentally sustainable (green) business process is a business process that generates business value with minimal impact on the environment, thus without compromising the environmental resource availability for future generations (Maciel 2017).

2. 2 Digitalization of business processes

Companies have always operated in continuously disturbed environments. Not only the presence of competitors, but also and above all the continuous changes affecting the market, generate the need to implement flexible company management policies capable of promptly modifying the products and production processes implemented.

Companies are currently facing a new challenge represented by the fourth industrial revolution. Artificial intelligence, Big Data, Internet of Things are the engine of this revolution (Schwab 2016) and are radically changing every aspect of business life (Jovanović et al. 2018).

In particular, changes are observed at the level of operating processes (Maresova et al. 2018), in the way in which the activities are conducted within the industrial value chains (Parida et al. 2019) and in the promotion and marketing of products. So, the way of doing business is literally changing.

By digital transformation we mean "the application of digital capabilities to processes, products and resources" (Schmarzo 2017) in order to make business processes more efficient, increase value for customers and minimize the risks associated with business.

Furthermore, there are benefits in terms of automation and optimization of processes and the consequent saving of time, costs as well as a reduction of errors and risks (Grubic and Jennions 2018). Through the IoT it is possible to promote the reduction of errors as well as improve their usefulness thanks to information from customers who have already used similar products (Tao et al. 2017).

In fact, the advantages deriving from the use of digital technologies can be different.

Some authors (Neumeier et al. 2017), based on the classification by Frank and Winter and Fischer of an organization in four different intra-organizational layers (Business Model, Business Processes, Application Systems & Services and Infrastructure.), have

identified for each layers some specific benefits deriving from the application of digital technologies.

With reference to the Business Processes, they identified advantages in terms of increased productivity, process flexibility, reduction of product time-to-market, proposal of service speed, operational excellence, process automation, intelligent workflow integration, process improvement, obtaining external network synergies. Such advantages could be obtained, for example, through "using the Internet to conduct marketing or sales activities, to do competitive benchmarking or gather information, to communicate within and outside the organization, or to conduct or support administrative tasks such as purchasing or distribution" (BarNir et al. 2003).

The transition from a traditional business process management system to a digital one requires, however, the development of high skills to correct the processing of the enormous quantities of data and information available to companies. Indeed, it is precisely the way in which these data are provided that can favour the consolidation of a solid competitive advantage (Pappas et al. 2018).

Some authors (BarNir et al. 2003) have shown that the digitalization of business processes depends on the age and size of the company: in the longer-lived and larger companies there is a greater digitalization of the processes.

Many companies, therefore, are changing the objectives of business management, moving towards the development of a digital business strategy (Bharadwaj et al. 2013). However, this is not enough to be competitive on the market.

The digital strategy must be accompanied by the company's ability to be flexible and to adapt continuously to changes in the context in which it operates (Keen and Williams 2013).

The adoption of highly developed strategies by large industrial companies often determines not only an improvement in production processes but also the use of new resources and new business models compared to companies without a digitization strategy (Neligan 2018).

The business model represents the architecture to be implemented to generate a profitable business, both from the point of view of producers and customers (Osterwalder et al. 2005).

In particular, to benefit from the advantages deriving from the use of new technologies, the business model must be built around digital technologies such as artificial intelligence, digital platforms and big data analysis (Parida et al. 2019).

Business models, therefore, are influenced by new digital technologies, determining a new form of communication along the supply chains (Glova et al. 2014).

Furthermore, digitalization also plays a key role in the development of sustainable business models, which make the company more profitable (Maffei et al. 2019).

In fact, we are observing the transition from a traditional business model (BM) to an innovative business model (BMI), which represents the desired business model (Foss and Saebi 2017), focused on digitalization as a tool that promotes sustainability of business

(Maffei et al. 2019). Digital technologies are therefore instrumental to sustainable development (van der Velden 2018).

Digital transformation can create different opportunities to reduce material dependence, improve productivity, increase, the use of renewable energies and synergies between companies (Demartini et al. 2019).

In addition, through digitalization, companies obtain information on energy consumption in real time, promptly viewing the improvements deriving from energy efficiency and thus helping companies better understand the benefits of energy saving (Ringenson et al. 2018).

2.3 Sustainability and digital transformation

It took most parts of the business community some time to recognize the issues and challenges in full. Recently, studies found that managers' started to incorporate sustainability into their core strategic thinking rather than seeing it as being of minor importance (Accenture 2011; Lacy et al. 2010). This is especially true for the generally innovation friendly IS/IT community: the trend of Green IT made sustainability a premiere subject for its decision makers. Although IT consumes resources, its intelligent use offers the major opportunity to transform organisations and societies towards more sustainable and energy-saving behaviour (Boehm et al. 2011; Ozturk et al. 2011; Carl Stolze et al. 2012). Nonetheless, it took IS researchers some time to follow their counterparts from other disciplines. Even these days the IS perspective is still not reflected as it should be within the research activities regarding sustainability (Melville 2010). Having in mind that the quality of the environment is not immediately affected by technological artifacts per-se but by human behaviour (Elliot 2011), technology is a means to an end that can facilitate and support changed behaviour. It should go hand in hand with on-the-job training towards sustainability (Stolze et al. 2011) and the thoughtful design of the chained activities performed by humans and machines (Ozturk et al. 2011) – also known as BPM. Thereby, BPM could be a tool to help managers around the globe to tackle questions of sustainability by changing the way activities are performed. Therefore, researchers should not only solve (theoretical) knowledge problems but offer innovative, relevant solutions to those practical problems (Wieringa 2010) at the intersection of BPM and sustainability.

BPM is a holistic management practice for making out and transforming organizational operations (Hammer 2010). In their efforts to oversee and improve business processes to enable business benefits in terms of costs, flexibility, time savings, quality, or, indeed, sustainable practices, BPM also involves the use of IT and IT-based systems. Past years have discovered the emergence of holistic enterprise resource planning systems (Davenport 2000), automated workflow systems (van der Aalst and ter Hofstede 2005; van der Velden 2018), CASE and other process design systems (Orlikowski 1993), expert systems (Markus et al. 2002), and business rules systems (von Halle 2001) as IT enabled

systems that enable process change management and thereby lead to business value generation.

It is at this intersection of IT-system enablement and process change that we believe the potential for sustainability initiatives lies. Our key premise is that business and IT managers need to engage in a process-focused discussion to enable a common, comprehensive understanding of process, and the process-centered opportunities for making these processes, and ultimately the organization as a process-centric entity, 'green.' It is impossible today to think of undertaking a major sustainability change initiative (involving the re-design of major business processes) without considering what IT can do to that effect. Still, it is equally impossible to think about any major redesign that does not call for major changes in how employees perform their jobs (Kotter 1996). Employees and the management of employees are just as important as IT in the transformation to sustainable practices and solutions, and BPM provides just the perspective that enables an integrated, holistic approach to the management of sustainability change (Seidel et al. 2011).

In line with the previous literature, the following hypothesis is suggested:

H1) Is there a positive relationship between the digitalization of business processes and sustainability?

3 Research methodology

3.1 Sample selection

The analysis focuses on the 575 listed firms operated in the utilities sector in Europe and the USA, for which data on digitalization and innovation was available on the date of analysis (final sample: 118 firms). We constructed a five-year panel dataset (from 2014 to 2018, the last year available in our data sources). These longitudinal data have "observations on the same units in several different time periods" (Kennedy, 2008). A panel data set has multiple entities, each of which has repeated measurements at different time periods. Panel data may have individual (group) effect, time effect, or both, which are analyzed by fixed effect and/or random effect models. Among the reasons for selecting these firms is, above all, the importance of this sector.

In fact, many institutions and researchers focus on Digitalization and innovation program into utilities firm according to its attributions and responsibilities in society, contributing to growth and delivering goods and services (European Commission 2019a, 2019b).

Data on the relationship between digitization and sustainability come from the Refinitiv database (previously called Thomson Reuters Asset4).

3.2 Model and variables

The next section will test the hypotheses regarding the effect of digitalization on sustainability, using panel data analysis to control for omitted/unobserved variable bias.

The significance of our analysis can be tested using panel data technique. In this way, we can control for some omitted variables without observing them by observing changes in the dependent variable over time. This controls for omitted variables that differ between cases but which are constant over time (fixed effects). We can also control for omitted variables that may be constant over time but which vary between cases, and others may be fixed between cases but can vary over time (random effects). More specifically, estimation model is the follow:

$$Y_{i,t} = \beta_0 + \beta_1 X_{i,t} + \alpha_i + u_{i,t}$$

In the model, the subscripts i and t represent ID company and period (year), respectively. The dependent variable ($Y_{i,t}$) is the *ESG Score*; β_0 is the constant and $X_{i,t}$ refers to a vector of independent variables.

Dependent Variable

In order to test our hypotheses, we used data on ESG performance (ESG SCORE) from Refinitiv. ESG score considers three dimensions: environmental, social and corporate governance.

Environmental performance measures a company's ability to minimize environmental emissions and efficiently utilise natural resources in their processes. In addition, environmental performance also considers a company's ability to support the research and development of eco-efficient products and services.

The second area (social performance) measures a company's ability to promote ethical values and generate confidence in its workforce, respect human rights, respect business ethics, and create value-added products and services.

The third area concerns corporate governance performance. It refers to company's ability to act in the interests of its shareholders through business management systems and processes (structure, functions, roles and responsibilities of the board and firm's committees, compensation policy, CSR policies etc...)

The overall ESG SCORE is expressed as he arithmetic mean of the three scores: social, environmental and corporate governance. It is a percentage ranging from 0 to 100 percent.

Independent Variables

To test our hypotheses, we used data on Environmental Innovation performance (Environmental Innovation SCORE) from Asset4 (Explanatory Variable). Environmental innovation category score reflects a company's capacity to reduce the environmental costs and burdens for its customers, and thereby creating new market opportunities through new environmental technologies and processes or eco-designed products. Environmental performance measures a company’s capacity to reduce environmental emissions, to

efficiently use natural resources in the production processes and to support the research and development of eco-efficient products and services.

The independent variables included in our econometric models are the Environmental Innovation score, CSR strategy and GRI report guidelines.

To avoid model misspecification, we control for additional variables that could influence ESG SCORE. In line with existing literature, we used Size as a control variable.

Table 1 shows a summary of the measurement of all variables.

Table 1- Variable description

Independent variable	**Variable code**	**Variable description**
Environmental Innovation Score	Env_Inn_Sco	Environmental innovation category score reflects a company's capacity to reduce the environmental costs and burdens for its customers, and thereby creating new market opportunities through new environmental technologies and processes or eco-designed products.
CSR Strategy Score	CSR_Strategy	CSR Strategy Score reflects a company's practices to communicate that it incorporates the economic (financial), social and environmental dimensions in its day-to-day decision-making processes.
GRI Report Guidelines	GRI_Guid	Is the company's CSR report published in accordance with the GRI guidelines?
Control variable	**Variable code**	**Variable description**
Total Assets	TA	Total Assets represent the sum of total current assets, long term receivables, investment in unconsolidated subsidiaries, other investments, net property plant and equipment and other assets.

4 Results

The following table shows descriptive statistics for dependent and independent variables. The descriptive statistics table includes the minimum, maximum, average and standard deviation.

The average level of ESG performance (ESG SCORE) of the companies analyzed is 57.67%, with a maximum of 92.76%. This reveals that the sustainability performance of companies for the 2014-2018 period has been very satisfactory by the standards of the definition of the score.

Similarly, the level of the environmental innovation score reaches an average value (52.63%) and the maximum value is 99.4%, suggesting that many companies analyzed use technologies to increase their level of sustainability.

In addition, the CSR strategy also has an average value of 70%, just as the orientation of the GRI ratios has an average value of 0.99% (on a maximum score of 1).

Table 2 - Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Id	590	59.5	34,09	1	118
N_of_year	590	5	0	5	5
CSR_Strategy	488	70,279	24,2704	0,5	99,76
ESG	488	57,67424	17,85806	14,01	92,76
Env_Inn_Sco	488	52,63314	27,44755	0,26	99,44
GRI_Guid	261	0,9961686	0,0618984	0	1
LnTA	586	16,38456	1,749009	11,64702	21,64297

The correlation matrix (Table 3) highlights very important relationships between the main variables of the study. More specifically, firm's sustainability performance (ESG SCORE) is found to be positively associated with Environmental Innovation Score, CSR strategy, GRI Report Guidelines and firm's size. These relationships show that more sustainable firms tend to implement digitalization into their business processes and more frequently adopt CSR strategies and/or GRI guidelines. Interestingly, the ESG score is negatively associated with firm's size which suggests that the business dimension doesn't influence corporate sustainability decisions.

Table 3 - Correlation matrix

	ESG	Env_Inn_Score	GRI_Guid	CSR_Strategy	LnTA
ESG	1.0000				
Env_Inn_Score	0.3093	1.0000			
GRI_Guid	0.0981	-0.0645	1.0000		
CSR_Strategy	0.3420	-0.1313	-0.0028	1.0000	
LnTA	-0.1260	-0.2353	0.1200	0.0085	1.0000

The comments that will follow the estimates reported in tabular form will only concern the model identified by the Hausman test. Pooled, fixed and random regressions were initially launched, considering the independent variables present in the dataset and entering robustness for both heteroskedasticity and correlation. To choose between fixed effects and random effects, we run the Housman test, which checks a more efficient model against a less efficient but consistent model, and indeed we need to know that the more efficient model also gives consistent results.

Subsequently, to perform the Hausman test and the Breusch-Pagan test, the same regressions were launched without robustness. First the Hausman test was launched to understand whether the fixed effects model or the random effects model should be used of

specification 2; the test, presenting a p-value of the chi-square greater than 10%, tells us to use the random effects model. Subsequently, the Breusch-Pagan test was carried out which, also presenting a p-value lower than 10%, confirms that it must use the second specification (if the p-value had been greater than 10%, then the specification would have been used 1, i.e. the pooled model). Ultimately, from the results obtained from the Breusch-Pagan test, the second specification must be used and, given that the p-value of the Hausman test is greater than 10%, the random effects model must be used.

Unlike the fixed effects model, the random effects model assumes that the variation between entities is random and unrelated to the predictor or independent variables included in the model (Green, 2008, p.183).

To test the joint statistical significance of the temporal effects, for each regression performed the test $ yeardum was launched from which, in relation to the resulting p-values (prob> F), it is possible to affirm that the null hypothesis cannot be accepted and therefore the temporal effects are always, in the regressions performed, jointly statistically significant at 1%, 5% or 10% as appropriate.

Table 4 - Regression results

Model	**(A) Pooled OLS**	**(B) Fixed Effects**	**(C) Random Effects**
	Coefficient (Robust SE)	**Coefficient (Robust SE)**	**Coefficient (Robust SE)**
Env_Inn_Sco	0.185*** (0.043)	0.124*** (0.024)	0.135*** (0.022)
CSR_Strategy	0.299*** (0.073)	0.185*** (0.042)	0.212*** (0.034)
GRI_Guid	27.950*** (3.637)	7.11*** (1.599)	9.372*** (1.428)
LnTA	- 0.051*** (0.014)	0.99* (1.514)	0.562* (1.010)
Hausman test	6.39 (p-value = 0.1721)		
Breusch and Pagan test	347.62 (p-value = 0.000)		
Years	2014 - 2018	2014 - 2018	2014 - 2018
Temporal effects	Yes	Yes	Yes
Standard errors - grouped data	Yes	Yes	Yes
R-square	26,70%	20,47%	23,53%
F test for temporal effects		Chi-sq 4.97***	17.64***
*** = significant at 1% ** = significant at 5% * = significant at 10%			

Using the random effects model, all the coefficients are statistically significant at 1%, with the exception of the natural logarithm of the total assets which is significant at 10%.

Consequently, it can be said that all the variables considered affect the dependent variable (Y) which, in our case, represents the ESG score.

In line with other studies (van der Velden 2018), there is a positive impact of the environmental Innovation Score on the ESG scores. In fact, one percentage point more than the environmental innovation score causes an increase of 0.135% in the ESG score. Reading the data, we can positively find the theory that, as the adoption of CSR policies increases, the sensitivity of the company to sustainability issues increases by 0.212%.

The GRI Report Guidelines regressor is a dummy variable and therefore, if it assumes value one it is assumed that the company adopts the GRI guidelines, vice versa if it assumes value 0.

In line with this consideration, it is possible to affirm that the adoption of the GRI guidelines positively affects the ESG score, resulting in an increase of the same by 9.37%. The chi-square in our model has a p-value of 0.000 and consequently it is possible to say that the regressors are all jointly significant at 1% and therefore have an effect on the ESG score.

In order for a regression model to be satisfactory, the theory reminds us that R-sq must assume values greater than 50%. Using the random effect model, although the regressors are all statistically significant, both individually and jointly, the R-sq overall, i.e. the average between the R-sq in the groups and the R-sq in the groups, is equal to 23.53%. Finally, analyzing the temporal effects, they were jointly statistically significant at 1% (p-value: 0.0014) and consequently it is possible to affirm that they also affect the dependent variable.

5 Conclusion

This work, starting from the limited number of contributions that explain the relationship between digital innovation and sustainability, tries to partially fill this gap. The issue of pollution and climate change has radically transformed the relationship between businesses and the environment, favouring the adoption of more sustainable production policies (Kotze et al. 2010). At the same time, new technologies have also influenced business processes. In fact, today many companies are transforming their policies, moving towards the development of a digital business strategy (Bharadwaj et al. 2013), aware of their importance to compete in an ever dynamic market (Keen and Williams 2013). Digital technologies are also instrumental to sustainable development (van der Velden 2018). In this regard, the new configuration of Business Process Management (BPM), called BPM green (Maciel 2017; Seidel et al. 2011; Carl Stolze et al. 2012) is very relevant, proposing the reduction of the environmental impact of business processes through the efficient use of resources (Cappiello et al. 2013; Recker et al. 2012).

Based on prior literature demonstrating that innovation play a key role in firm's sustainability performance, this study investigates the relationship between sustainability (ESG Score) and innovation in a large sample of 118 European and U.S. listed firms for

the period 2014–2018. The main results reveal that innovation and digitalization of business processes positively affect a company's ESG performance. For this reason, the hypothesis that a company that is more innovative and open to the challenges of digitalization is also an ethically sustainable and environmentally friendly company is considered likely.

The relationship between ESG performance and company size is negative. This underlines that the adoption of sustainable policies and green business models does not depend on the size of the company, but on other variables, such as decisions of the board of directors or group policies.

The contribution has practical implications, as it provides market operators with information on how environmental sustainability issues will be affected by the adoption of new digital technologies. From a management perspective, our work suggests that managers and CEOs should pay more attention to digitization and innovation. To improve performance in terms of sustainability, it is important to digitize processes, reducing the use of renewable resources and producing eco-sustainable products.

Furthermore, our study suggests the importance of adopting CSR and / or GRI guidelines policies, which are very strategic tools that demonstrate the company's strong commitment to sustainability.

Our study has not studied the managerial and technological aspect (in terms of potentially adoptable new technologies), but future research could go in this direction. In addition, it would be interesting to use a larger sample of companies (expanding the sectors of analysis) and a longer time window.

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From the Information Units to the Collective Intelligence: a Viable Systems Perspective for Managing Knowledge in the Digital Era

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Abstract

Nowadays, the development of data management technologies has deeply contributed to make immediate and effective the activity of gathering and processing large amounts of data with reference to specific process or performance indicators. The Big Data phenomenon along with Artificial Intelligence (AI) techniques represent a new era in information exploration and utilization, by offering new perspectives in the decision-making processes, especially in complex and fragmented situation. In this way, the emerging knowledge derived pushes toward new models of collective intelligence which can help to face the challenges that are affecting the current social context. In this direction, the paper, by adopting the interpretative lens offered by the Viable Systems Approach (vSa), proposes a conceptual model for managing collective knowledge based on big data and AI and for supporting decision-makers in complex contexts. The work is organized in four main sections. First of all, it opens with the analysis of the theoretical background of reference, highlighting the scientific evidence emerging from the literature dedicated to big data, artificial and the collective knowledge approaches. By adopting the concepts provided by the vSa, a new possible interpretative path is defined concerning managing knowledge in the digital era. In this regard, the Chinese case in facing up the COVID-19 pandemic thanks to collective intelligence approaches is presented. Finally, the potential implications of the work, both from a theoretical-scientific and a practical-managerial point of view, are highlighted.

Keywords - Big Data; Artificial Intelligence; Collective Intelligence; Viable Systems Approach; COVID-19

1 Introduction

The last decade has seen increasing attention to the digital revolution, which has opened the doors for many opportunities and has changed organizations boundaries. Interconnection, smartness and information value are progressively and deeply affecting the world and offering new solutions during always more complex challenges (French and Shim, 2016). For instance, the approaches based on Big Data (Zikopoulos and Eaton, 2011) and Artificial Intelligence (AI) (Nilsson, 2014) techniques can support human beings in the shift from a lower level of the rationality to "objective rationality" (Simon, 1955), by increasing the available information in a very short time. In this way, the emerging knowledge which enables the shift from individual to *collective intelligence* can help to face the challenges that are influencing the worldwide social development (Lévy and Bononno, 1997).

However, from a systems perspective, smart and data-driven approaches require to extend the

viewpoint to the (potential) relationships among different actors that can favour fruitful learning interactions. Consequently, since very few organizations can internally develop a wide range of knowledge, the focus is moved on their ability in formalizing frameworks which aim to build relationships which potentially can provide a new and broader knowledge-based source thanks to innovative information technology (Tsai and Ghoshal, 1998).

Therefore, the paper, by adopting the interpretative lens offered by the Viable Systems Approach (vSa) (Golinelli, 2000; 2010; Barile, 2008; 2009), proposes a conceptual model for managing collective knowledge based on big data and AI and for supporting decision-makers in complex contexts.

The work is organized in four main sections. First of all, it opens with the analysis of the theoretical background of reference, highlighting the scientific evidence emerging from the literature dedicated to big data, artificial and the collective knowledge approaches for managing knowledge and supporting the decision-making process. Continuing, the research path adopts the concepts provided by the vSa, for defining a new possible interpretative path concerning managing knowledge in the digital era. In this regard, the Chinese case in facing up the COVID-19 pandemic thanks to collective intelligence approaches is presented. Finally, the potential implications of the work, both from a theoretical-scientific and a practical-managerial point of view, are highlighted and the limitations are commented.

2 Literature review

2.1 Big data and artificial intelligence for extracting knowledge and supporting the decision-making process

Nowadays, innovative technologies made cheaper and faster the gathering and processing of large amounts of data, concerning specific processes and performance indicators. This new phenomenon, called Big Data, is blowing up, representing a new era in data exploration and utilization (Chen et al., 2012). The "*mass digitization*" (Coyle, 2006) along with "Internet of Things" interconnection (Ashton, 2009) have led to a rapid expansion of large amounts of data, characterized by three dimensions: *volume*, *speed* and *variety*, as reported by the "3Vs" model of Laney (Zikopoulos and Eaton, 2011; Beyer and Laney, 2012; Zaslavsky et al., 2013). Furthermore, additional concepts like *veracity* and *value* have been attributed to this model, to highlight respectively the quality across datasets and the capacity to generate useful output for industry challenges and issues (Uddin & Gupta, 2014).

Big data analytics follow an approach based on Artificial Intelligence (AI), which can be defined as the way of training computers to mimic thinking patterns and can even be done to simulate human behaviours (Nilsson, 2014). The subfields of AI include several techniques of machine learning (Qiu et al., 2016; Zhou et al., 2017), a set of algorithms able to build a computer system that improves automatically through experience; these can be applied to a large data set for identifying non-obvious and hidden patterns of information and building predictive models.

In this direction, big data, thanks to smart analytics, can be considered as an additional valuable knowledge asset (Erickson and Rothberg, 2015): the huge volumes of data are processed for extracting valuable knowledge, which can be used for enhancing the performance of many different processes in organizations. Thus, the adoption of these innovative information technologies determines the capacity to absorb untapped knowledge in big data and combine them with the existing knowledge for improve performance. The combination of tacit knowledge of experienced employees (Ball and Gotsill, 2011) with the knowledge obtained from big data (Feblowitz, 2013) can be a valuable resource for the organizations. In this way, it is possible to analyse the information from different perspectives for valuable decision-making (Lamont, 2012). Moreover, the data, consistent and integrated, make easier to extract knowledge from themself (LaValle et al., 2011). Especially, this new knowledge for organizations can be evaluated to generate new predictive knowledge (Bose, 2009; Pauleen and Wang, 2017).

Therefore, the decision-making process can be improved by data' transmission, capture, storage, analysis, visualization, and interpretation (LaValle et al., 2010; Chen and Zhang, 2014). The algorithms approach permit to extract useful information from large datasets or streams of data (Fan and Bifet, 2013) and can reveal valuable insights:

decisions will be increasingly based on data and sophisticated analysis, rather than on experience and intuition (McAfee et al., 2012).

In the following paragraph, frameworks and approaches for managing knowledge in the digital era are discussed.

2.2 Towards the collective intelligence: the collective knowledge approaches

Organizations should invest in frameworks able to conceptually and operationally integrate smart technologies with knowledge management for a better decision-making process and organizational value creation.

Starting from web 2.0 era, characterized by blogs, Twitter, wikis, photo sharing, collaborative tagging and social networking sites, which enable the creation and dissemination of content in a relatively simple way, Gruber (2008) proposes the Collective Knowledge System (CSK). This framework aims to reveal the potential of the Social Web thanks to the Semantic Web. The first one is intended as the web sites in which user participation is the primary driver of value, for instance, Facebook and YouTube. On the other hand, the Semantic Web can be considered as an ecosystem of structured data, where value is created by data integration from many sources. These systems can provide answers to small-groups of people by elaborating the user-generated contents in the websites, through knowledge extraction approaches. The information obtained, which cannot be found explicitly in web sites, represents emerging knowledge which enables the shift from individual intelligence to *collective intelligence*; this last concept can be defined as the enhancement of the collective pool of social knowledge thanks to networked ICTs (Information communication technologies) which simultaneously and constantly expand the extent of human interactions (Lèvy and Bononno, 1997).

The CKS consists of three subsystems:

1. A *social system* which generates problem-solving discussions (questions and answers) on the web sites;
2. A *search engine* which is capable to find questions and answers in the contents generated by the social system;
3. *Users in a complex situation* which, through a search engine, generate queries for scoring the online question/answer contents. Besides, users can provide feedback about which query/document pairs were effective at addressing their problems.

In such human-machine interactions, both humans and machines actively contribute to the resulting intelligence and can solve user problems thanks to ICT tools (analytics and research engine, etc.) (Gaeta et al., 2019).

Especially, in the field of emergency response, a framework based on the collective intelligence approach can aggregate body of knowledge at an accelerated rate and improve the process of decision-making. Vivacqua and Borges (2012) define a framework which underlines the interaction between environmental information (the

context of the emergency) and the multiple individuals who perceive it (the population and the respondents). The aim is to enable the participation of the population and emergency respondents to support the decision-making process of the latter. The framework is composed of two modules:

I. *CI module* consists of other submodules:
   - the *interface* (for instance web and mobile interfaces) which permits the population to provide data on its perception of the environment;
   - *data collection* which receives and stores the raw data sent in by the population for processing;
   - *data processing* through different algorithms for aggregation, organization, classification, consolidation and verification of the data provided.

II. *Decision Support module* receives CI data, processes it, adds it with data from external sources and provides it to emergency respondents to support their decision-making process.

Also, the metaphor of the black swan proposed by Taleb (2007), which refers to events not expected and with an extreme impact, draws attention to the challenge of creating a link between relevant information from different individuals and groups to face up an unforeseen scenario. A collective knowledge framework can provide a useful way to conceptualize knowledge management for prevention of black swans, and encourages us to think differently about how we view existing practices. However, there is still an open question regarding how to configure a conscious managerial action regarding the collective knowledge frameworks (Hecker, 2012): this pushes to adopt a systemic approach for modelling the problem.

3 A viable systems perspective for managing knowledge in the digital era

The theoretical approach adopted in this paper is the Viable Systems Approach (vSa), based on systems theories (Beer, 1984; Capra, 1997, 2002; Checkland, 1981; Laszlo, 1996; Meadows, 2008; Von Bertalanffy, 1968; Weinberg, 1975), which could be particularly useful for the analysis and interpretation of systems and social organizations. In particular, according to vSa (Golinelli, 2000; 2010; Barile, 2008; 2009), each entity can be described as a viable system, whose ultimate purpose is to survive within its specific context of reference. Focusing on the relationship between environment and system (Ashby, 1968), vSa concludes that a system can remain in balance - with the possibility of self-regulation and research of the homeostasis- and therefore to survive if it can understand and respond to the complexity and turbulence of the external environment. Furthermore, each viable system is seen always from the perspective of its governing body, which is defined as the top decision-making entity (e.g. the leader or the board), composed by one or more individuals (Golinelli 2010). It comes out that the destiny (i.e. system's survival) of every viable system depends on the decisions made by the

governing body. Therefore, the concept of decision is strictly connected with that of survival (Barile and Canfora, 2008).

From the above and as also reported in the previous paragraph, derives that the decision-maker has to face several problem areas that require different resolution paths and various levels of knowledge. Since the decision-making is a cognitive course of action, the maintenance of viability implies a continuous decisional process that can be represented as a knowledge itinerary (the 4Cs), as shown in Table 1.

Table 1. The knowledge itinerary (4Cs)

Chaos	A situation in which the viable system has an unconscious fastidious sensation but it is no aware of the origin/cause, the effect, and the solution. Both problem and resolution scheme are incognita.
Complexity	A problematical area characterized by the viable system's consciousness about the problem Although the problem is known the viable system is convinced that there is no way how t solve it.
Complication	A context in which the viable system increases the optimistic percentage thinking that th problem has a solution, but the formula (i.e. interpretation scheme) is not yet in its hands; it i just a matter of time.
Certainty	It is the last area characterized by the type of problems that seems to be very easy to solv (99% certain) to because a method already exists. These are repeated problems, such a organizational routines.

Source: Authors' elaboration from Barile (2009)

As noticed previously, each informational stage can be associated with a different type of reasoning that decision-maker should implement to foster the transition from chaos to certainty.

In particular, in the transition from chaos to complexity, there is a moment when the decision-maker isn't endowed with adequate knowledge to face the problem and carry out a conscious decision-making process. Therefore, it is necessary to stop the confusional growth, upon the entry of new information, triggering a process that could lead to a resolving hypothesis.

Furthermore, the key notion of *information variety* should be necessarily introduced introduce to explore how the theory can provide to the governing body the strategic drivers for proper utilization of data to acquire knowledge. In particular, the information variety is a representation of knowledge that a viable system possesses in a specific time point and is defined through three dimensions, that can be expressed as follows:

- The *information units* consist of the number of single units of data detained by a system (the structural knowledge of the system). Specifically, the information unit is an incoming signal from the external context or/and from the internal brain's memory centre, subjectively perceived and interpreted by the observer. In the digital era, the information units can be assimilated to the large amount of data generated online and by sensors;

- The *interpretative schemes* permit to assembled and understood the information units (the knowledge "shape" of the system). Indeed, it is precisely the interpretative schemes that determine the transformation of non-specific data into information relating to a given context. They serve as filters acting on information units through particular elaborations. These are organizational patterns because have the primary task to rationally organize the information. In the new technological and informative context, Artificial Intelligence (AI) and, in particular, machine learning techniques allow to interpret data sets and to identify precious information and predictive models;
- The third factor concerns the *value categories*, which are the basic values and strong beliefs of the system (the resistance to change) that influence how the interpretative schemes are used. The value categories characterize the context ethics for the generic moral, inspire and allow the activation of the criteria through which it is possible to express an opinion on events and facts and orientate and derive interpretative schemes. Therefore, the value categories are connected to the emotional sphere of the decision-maker and are independent of the computational capabilities of the new technologies.

In this direction, the paper proposes a framework that supports the decision-maker in the transition from the area of chaos to that of complexity, expanding his information variety thanks to the use of new technologies.

4 A viable framework based on collective knowledge in complex contexts

Based on the previous considerations, the proposed framework, as reported in Figure 1, aims to manage the collective knowledge thanks to big data and AI approaches and to support decision-makers during the transition from chaos to complexity.

The model, shaped by human-machine interactions which actively contribute to the resulting intelligence, is composed of two sections (Gruber, 2008):

1. "*Humans users*" which includes the reference context and focuses on human-human interactions;
2. "*Machine processes*", concerning the automated activities carried out by software and hardware components for enabling the smart technologies processes. This section, in turn, is composed by the *Collective Intelligence (CI) module*, which aims to collect and process the user-generated data, and the *Decision Support module*, that elaborates through AI algorithms the information units gathered.

An open and dynamic view of the context pushes to consider the environmental dynamism as a source of opportunity to improve the decision-makers' awareness of the context. In this direction, the aim of the framework is to interpret effectively the multiple entities which compose the context, by exploiting new forms of interaction (Saviano and Caputo, 2013).

Thus, the framework is based on the following fundamental steps:

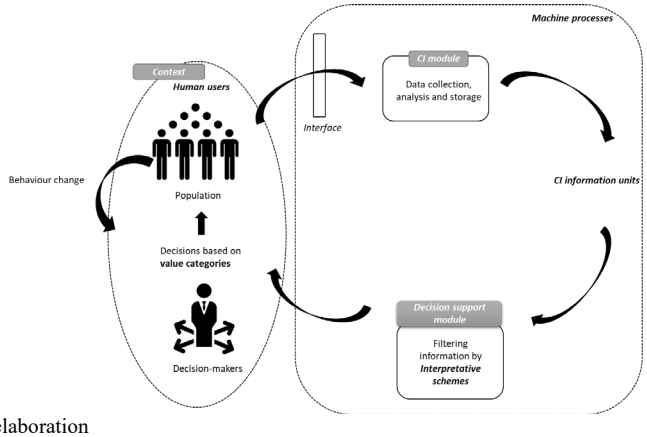
i. Firstly, the population, by interacting on the internet with activities of blogging, tagging and discussion through web and mobile interfaces, produces data (Lastowka, 2007); user-generated data concern their perception on the context and personal content.

ii. Subsequently, the *CI module* allows to receive and stores the raw data originated by the population; after the processing and the clustering, the data collected compose semi-structured data which can be managed in a repository (Vivacqua and Borges, 2012; Fan and Bifet, 2013). Therefore, this module outputs *information units* which should be interpreted in the next step.

iii. Next, the *Decision Support module* receives the CI information units and processes these by AI algorithms which provide *interpretative schemes*. Furthermore, this module adds external sources and selects relevant information to support the decision-making process. In particular, a search engine can find data of interest (Gruber, 2008) according to the decision-makers request. The machine learning algorithms, following an AI approach, can identify non-obvious and hidden patterns of information in data for creating knowledge.

iv. Then, the decision-makers, by evaluating the knowledge acquired, carry out the definitive choices. This knowledge of experienced people is tacit (Nonaka and Takeuchi, 1995) and it is strongly connected to their categorical values (Barile, 2009). Thus, this existing concept of tacit knowledge is combined with the new concept of predictive knowledge (Pauleen and Wang, 2017). Therefore, human insights are fundamental to understand, revise and confirm or reject the relationships emerged from the data (Hair, 2007).

v. Finally, the implemented decisions that depend on the decision maker's cognitive processes carry out a behaviour change in the population. This means that, in pursuing survival, each decision-maker can lead to different behaviours, that vary according to the information variety of himself (Carrubbo et al., 2017).



Source: Authors' elaboration

Figure 1. A viable framework based on collective knowledge in complex contexts

4.1. Computational collective intelligence against the COVID-19: the Chinese case

What has been said so far is reflected in the latest events involving the Chinese government in dealing with the pandemic caused by the COVID-19.

During the annual Lunar New Year holiday, the infectious disease COVID-19 has started to spread in China. In this period, the people returned to their family homes and several billion people have travelled on crowded planes, trains, and buses. Knowing this meant each infected person could have numerous close contacts over a protracted time and across long distances, the government needed to quickly act: China focused on traditional public health outbreak response tactics—isolation, quarantine, social distancing, and community containment (Wu and McGoogan, 2020). However, other approaches based on sophisticated computational methods have been applied by the Chinese government.

China government used data from hundreds of millions of smartphones to contain the spread of Covid-19. All smartphones with enabled GPS offered to telecom providers a precise record of the user's itinerary. Furthermore, Chinese government algorithms can estimate the probability that a given neighbourhood or even an individual has exposure to Covid-19 by matching the location of smartphones to known locations of infected individuals or groups. The authorities used this information to manage limited medical resources more efficiently by, for example, directing tests for the virus to high-risk subjects identified by the artificial intelligence algorithm. China, also, used electronic records of medicine purchases to identify sick individuals who may have attempted to flee quarantine (Goldman, 2020).

In this regard, the Chinese culture, with particular reference to their categorical values, has enabled this approach: in fact, China has no such privacy constraints, and telecom providers have used locational data for years for advertising. Instead, smartphone users in the United States and Europe can access their data, but privacy laws prevent the government from collecting this data.

Therefore, big data and AI analytics helped Chinese authorities to establish the chain of transmission of the virus. On the 2nd March, China reported only 126 new cases, compared to 851 in South Korea and 835 in Iran, out of a total of 1,969 new cases worldwide (Goldman, 2020).

Furthermore, Hu et al. (2020) developed a modified stacked auto-encoder for modelling the transmission dynamics of the epidemics. They used the latent variables in the auto-encoder and clustering algorithms to group the provinces/cities for investigating the transmission structure.

The work aimed to model the real-time forecasting the confirmed cases of Covid-19 across China. The data were collected from January 11 to February 27, 2020, by WHO. They predicted that the epidemics of Covid-19 will be over by the middle of April. If the data are reliable and there are no second transmissions, this model can forecast the transmission dynamics of the Covid-19 across the provinces/cities in China. The AI-

inspired methods are a powerful tool for helping public health planning and policymaking.

By concluding, the accuracy of the AI-based methods for forecasting the trajectory of Covid-19 was high (Hu et al., 2020). In this direction, there is the need to increase the data sharing in the event of outbreaks or disasters, leading to better global understanding and management of the same (Allam and Jones, 2020).

5 Managerial implications, limitations and future research

Nowadays, the digital tools along with big data and AI-oriented approaches can help to achieve the viability of the social system by pointing out a plurality of information that cannot be found such rapidly in other ways. In this direction, the proposed approach highlights the relevance of user-generated content which, through knowledge extraction approaches, enables the shift from individual to collective intelligence. Accordingly, the paper shows that effective management of the external knowledge in a social organization requires a holistic perspective, able also to clarify the role and the contributions of smart technologies, especially in complex contexts.

Reflecting upon these research streams, some implications can be discussed both from theoretical and practical points of view. From a theoretical point of view, the paper merges the collective knowledge approaches with vSa concepts, to combine the perspectives related to new trends in information technology with an interpretative lens of reality. In this way, a holistic approach can provide a clear picture to systemically consider the external information and the social organizations' characteristics by integrating a plurality of contributions into a unique identity of collective knowledge. On the other hand, from the managerial point of view, the work shows a model which aims to manage collective knowledge to support the decision-makers during the transition from chaos to complexity, by leveraging on big data and AI approaches. In particular, it emerges that the tacit knowledge is combined with the new concept of predictive knowledge (Pauleen and Wang, 2017) and the human insights are fundamental to understand, revise and confirm or reject the relationships emerged from the data (Hair, 2007).

Recognising the validity of the proposed concept, some possible future lines of research can be tracked to enrich the framework proposed and deepen it through a possible quantitative approach. Therefore, the reflections herein are only directed towards outlining a possible conceptual path which requires a better definition because of the multiple connections that can be traced among the identified concepts. Furthermore, more studies should be developed to effectively understand collective knowledge approaches correlated to the concept of resilience and how this connection can affect the viability of social systems.

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Knowledge Management and Digital Transformation in Swiss and Northern Italian Organizations

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Abstract

Nowadays, all organizations face increased global competition in a knowledge-based economy. Consequently, they need to continually learn and convert their project-derived knowledge into enhanced and innovative products and services in order to remain competitive in an increasingly aggressive market. Knowledge is not merely widely regarded as a key asset in companies, but it is becoming the most critical strategic determinant of economic growth.
This study investigates possible correlations between the adoption of knowledge management systems, complexity of the working environment and digitalization. It investigates any correlation between complex working environments and systems of knowledge management, between specific organizational context and level of digitalization.
The study has been developed with the start of a structured online survey sent via e-mail to a selected target working in companies located in Switzerland and Northern Italy and operating in different sectors, whose size range from small, to mid-size to large, including both local and global organizations. It consisted of 19 closed questions grouped in 4 main KPI (Complexity, Digitalisation, KMS, Organisational Context) aimed to gain a relevant insight on knowledge management practices and digital transformation topics.
The overall picture that emerged shows that organizations with high KPI for digitalization, knowledge management systems and organizational context are tendentially young, small, from tertiary sector and with national customer base. Moreover, the survey demonstrates a strong interconnection between the 3 KPIs organisational context, digitalisation and adoption of knowledge management systems.
Organizations should therefore encourage the creation of knowledge and endeavour to invest in tools and technologies necessary to support processes involved in knowledge management

Keywords – Knowledge Integration, Technological change, Project Knowledge, Digital Transformation

Paper type – Academic Research Paper

1 Introduction

1.1 Purpose / Value

The accelerating technological change imposes organizations an extra effort to become digitally proficient in order to improve attractiveness and efficiency. This is reflected by the effective management of project knowledge using information technology tools, which improve overall organizational performance and contribute to the achievement of business benefits: the ability to integrate the appropriate knowledge for the management of new technologies and, consequently manage the intellectual capital of qualified employees plays therefore a crucial role.

Project knowledge management may be widely applied, also through a lesson learned register, where "any lessons learned that will improve performance for current or future projects is recorded as it is learned (PMBOK, 2017 – p. 97), however the tools used and the levels of digitalization vary a lot.

While there exists a rich literature strand on knowledge management itself, this study, started in March 2020 by the faculty of Project Management of the University of Applied Science and Arts of Southern Switzerland (SUPSI), aims to investigate possible correlations between the adoption of knowledge management systems, complexity of the working environment and digitalization. Following the lacks of a globally recognized practices, the study focuses on the following objectives, evaluated between Switzerland, Northern and Central Italy:

- Correlation between complex working environments and systems of knowledge management.
- Correlation between specific organizational context and level of digitalization.

1.2 Knowledge Management and Digital Transformation

It is widely recognized that knowledge management is a key factor that ensures the success of the organizations and the continuity of their businesses.

As reported by PMBOK, 2017 (p. 100), "it is a common misconception that managing knowledge involves just documenting it so it can be shared".

Actually, knowledge management is meant to be not just the ability to manage (capture, share and re-use) the knowledge gained during the projects, in the way that the "knowledge is shared using a mixture of knowledge management tools and techniques (interaction between people)" (PMBOK, 2017). It also involves the aptitude to change and adapt behaviour according to new assumptions/expertise as well as the competence to arise awareness about the importance of this activity.

With the help of innovation, it enables the organizations to perform business processes in more creative ways, which improves effectiveness, efficiency and at least

marketability. The organizations are able to solve the problems through innovative solutions, which rely on knowledge shared among individuals. It is therefore important to understand how knowledge is created and shared and not only referred to as a standard business operation.

However, there is no one-size-fits-all solution and organizations are being creative looking for different combinations of practices and methods for knowledge management. We expect this study to investigate further if the different approaches adopted by organizations do have an impact on level of digitalization.

There are many activities, which are formed to carry out key elements of an organization's KM strategy and operations. For instance, an organization must first identify and capture knowledge, and then organize it in order to bring knowledge within the organizational boundaries. Knowledge is also transferred and shared throughout the members of the organization using both human and technological means.

The fundamental objective of organizing knowledge is to allow for its retrieval. The consequences of not organizing knowledge in a manner that leads to retrieval and use can be severe. It is therefore important for organizations to spend resources and efforts in managing and organizing the knowledge that exists within the boundaries of the organization. However, literature shows that "processes and technology alone are not enough to drive an organization, but its people (staff) and the knowledge that reside in the people are a very integral pivot in organization's success" (cfr Omotayo, F. O. (2015), Knowledge management as an important tool in organizational management).

Therefore, in order for an organization to be successful, attention must be paid, not only on the processes and technology, but on knowledge and its workforce which are people who are the sources of knowledge.

With this study, we expect to identify a correlation between specific skills of the workforce, organizational context and implementation of successful knowledge management systems.

1.3 Definition of Complex Working Environment

The concept of complexity is related to variety and to the number of entities operating in an organization. However, there does not seem to be a unique definition of complexity.

According to J.R. SanCristóbal (Complexity in Project Management, Procedia Computer Science, Volume 121, 2017, Pages 762-766), as well as a general lack of consensus when defining complexity, complexity models do not take into account critical aspects of complexity. Requirements of a good project complexity model must consider not only the number of elements and their interdependencies, but also the social and political context, and project manager's skills such as shared leadership, emotional intelligence, vision, values and beliefs, etc.

McElroy (Integrating Complexity Theory, Knowledge Management, and Organizational Learning, Journal of Knowledge Management. 4, Pages 195-203) claims

that complexity is strictly related to the concepts of knowledge management and organizational learning: "Complex systems are, by any other definition, learning organizations." Complexity Theory, KM, and OL are all complementary and co-dependent. “KM and OL each lack a theory of how cognition happens in human social systems – complexity theory offers this missing piece.

All the above definitions suggest that the word "complexity" is not necessarily a characteristic of large and mature companies, but can also identify younger companies. We expect our study to confirm this assumption.

A study carried out by Kenney and Gudergan (Knowledge integration in organizations: An empirical assessment. J. Knowledge Management. 10, Pages 43-58) suggests that combinative capabilities and organizational forms affect the efficiency, scope and flexibility of knowledge integration simultaneously; given the above framework our study aims to investigate further if a complex working environment necessary involves a higher level of digitalization and if a firm knowledge integration capacity is determined by the employment of particular organizational forms.

2 Methodology

The study has been developed with the start of a survey in two versions in Italian and English languages, with specific questions aimed to gain a relevant insight on knowledge management practices and digital transformation topics.

The survey was developed through the free tool “Google Forms” and it was submitted by email to a pool of 500 organizations operating in the three sectors (primary, secondary and tertiary) and employing a varying number of employees.

The survey consisted of 19 closed questions grouped in 5 main KPI (see table 1).

- 3 questions on General Information

These questions aim to collect general information like foundation date or location of the organization.

- 4 questions on Complexity

These questions aim to investigate the complexity of the organization by evaluating some criteria like number of employees, customers location or self-evaluation on their experience in managing projects.

- 4 question on Digitalization

These questions aim to understand the use of digital tools for managing projects, sharing and communicating information between employees. They also investigate if cross-functional projects are well connected to each other via digital platform.

- 3 Questions on Knowledge Management Systems

These questions aim to gather insights on the usage of knowledge management systems by asking information on the specific tools, if the knowledge acquired during project management is correctly integrated into business and if it is properly shared through digital tools.

- 5 questions on Organizational Framework

These last questions aim to collect information on the organizational framework, the respondent is asked if the organization encourages new ideas or if it allows experimentation of new tool for managing project knowledge.

Before analysis the gathered data have been exported from Google Forms as .csv file and arranged into a MS Excel spreadsheet. Answers to parameters belonging to the organizational complexity KPI, i.e. “number of employees” and “customer location”, were numerically converted to a 1 - 5 scale as follows:

Number of employees

1-50 = 1;

50-250 = 2;

250-500 = 3;

500+ = 5

Customer location

Regional = 1;

National = 3;

International = 5;

All other answers were either used as their numerical value on a “strongly agree” (= 5) to “strongly disagree” scale (= 1).

All the data collected have been classified following the KPI’s Table, the data were then analysed for KPI’s by two-way ANOVA with Geisser-Greenhouse correction, correcting for multiple comparison using statistical hypothesis testing (Tukey).

The standard error of the mean was calculated for each mean KPI value and correlation analysis was performed calculating Pearson’s correlation coefficient for each pair of KPI’s, with two-tailed 95% confidence interval.

Table 1: Parameters (i.e. answers) were allocated to KPI categories

KPI	Organization Information	Complexity	Digitalization	KMS	Organizational context
Questions	Foundation year	How many employees are currently employed at your organization?	Your organization uses digital tools to gather data on operational activities	Please select the main tools used in your organization to grant an efficient system for managing project knowledge (Paper, digital, KNS)	Your corporate strategy implements practices of knowledge management and provides a guiding framework
	Head Quarter	Self-assessed complexity degree	Employees communicate and share information on digital platforms	The knowledge acquired during project management is integrated into business processes (e.g. lesson learned, return of experience)	Your organization allows for experimentation of new tools
	Sector	How do you evaluate your organization's experience in managing projects?	Employees are fully supported with efficient training in digital technologies	Your organization project knowledge is adequately shared through specific digital tools	Your organization encourages new ideas for managing project knowledge
		Where are your customers located?	Cross-functional project teams are well connected to each other via digital platforms		Your team trusts the source of project knowledge and sees the benefits of using it
					Your team is motivated to share their project knowledge with other team members
Amount of parameters	3	4	4	3	5

KPI values were calculated as average mean value of the corresponding parameters (i.e. answers), where these were converted into numerical values.

3 Results

3.1 Statistical Distribution of participants to the survey

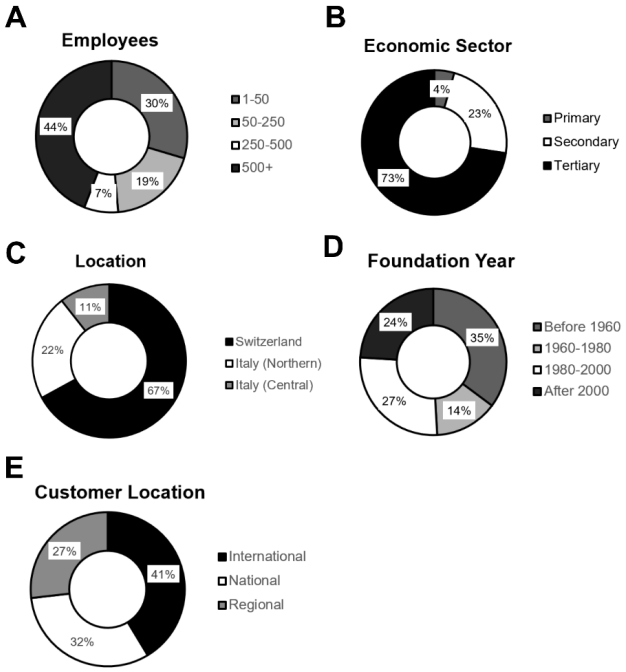

Figure 4 Statistical distribution of survey participants. Percentage distribution for organization's employees (A), economic sector (B), head quarter location (C). foundation year (D), and customer's portfolio network (E) for all invited participants to the survey that provided a feedback. Pie charts show percentage distribution among all category parameters. N=179.

Participation to the survey was relatively low: 179 organizations out of 500 survey invitees answered to the survey (6% of invited participants).

Almost half of the organizations (44%) have more than 500 employees, while one third (30%) have less than 50 employees; the remaining was divided into a range of 50 to 500 employees (Figure 1A).

With regards to the economic sector, the majority belongs to the tertiary sector (73%), while just 4% of the participants belong to the primary sector (Figure 1B).

As a result for the majority of invites to the survey being sent to Swiss organizations, two thirds of the answers came from organizations located in Switzerland (67%), while 22% came from North-Italian and 11% from Central-Italian participants (Figure 1C).

Out of all organizations, one third was relatively old, being founded before 1960 (35%), while young companies founded after 2000 are 24%. The remaining was either founded between 1960 and 1980 (4%) or between 1980 and 2000 (27%) (Figure 1D).

Customer location of the participants was equally distributed between regional (27%), national (32%) and international (41%) (Figure 1E).

3.2 KPI Analysis

The influence of each organizational parameter not related to organization's complexity (i.e. foundation year, economic sector, location) over each study's KPI - created based on the survey questions - was investigated by statistical analysis using Tukey's 2-way ANOVA multiple comparison test. Aim of this analysis was to investigate for statistically significant influences of each parameters over the KPI's.

In detail, KPIs are: complexity, digitization level, maturity of KMS, organizational context with regards to knowledge management and digitalization, including both organization's and employees' attitude.

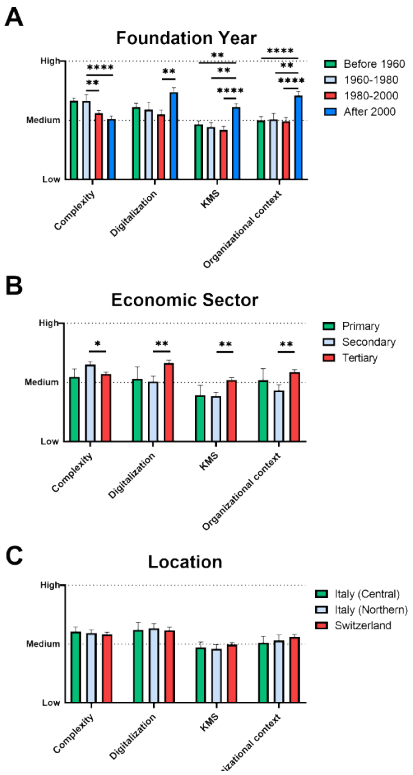

*Figure 5 KPI analysis for complexity-independent organizational parameters. Shown are KPI for complexity, digitalization, knowledge management system (KMS) and organizational context for each organizational parameter, i.e. foundations year period (A), economic sector (B) and head quarter location (C). Bars represent average KPI value (low=1 to high=5), error bars represent standard error of the mean. Tukey's 2-way ANOVA multiple comparison test p values: *<0.05; **<0.001; ****<0.00001.*

Organizational age had influence on each KPI (Figure 2A).

Younger companies showed a medium complexity compared to a medium-high degree in older companies (founded before 1980), this being statistically significant between companies founded in the 1960-1980 towards those founded in 1980-2000 ($p>0.001$) and after 2000 ($p>0.00001$).

The degree of digitalization was higher for organizations founded after 2000 (mid-high) compared to older organizations, with statistical significance towards those founded between 1980 and 2000 ($p>0.001$).

The maturity of the KMS showed to be higher in organizations founded in the 21th century. The difference was significant towards all categories ($p<0.00001$ vs 1980-2000, $p<0.001$ vs 1960-1980 and before 1960). Of note, only organizations founded after 2000 had a KMS maturity above medium level.

In line with both digitalization and KMS performance, the organizational context was shown to be medium-high for young organizations with less than 20 years of history compared to older ones, which sowed a medium-level KPI value ($p<0.00001$ vs 1980-2000, $p<0.001$ vs 1960-1980, $p<0.00001$ vs before 1960).

We then investigated the impact of the economic sector over the KPI's (Figure 2B).

Complexity was slightly above a medium level for organizations belonging to the secondary sector, while those belonging to the primary and tertiary sector showed a medium level of complexity. The higher complexity of the secondary sector was statistically significant only towards the tertiary sector ($p>0.05$).

As expected, the degree of digitalization almost reached a medium-high level only in the tertiary sector, while the other sectors reached a medium level. This difference was significant between tertiary and secondary sector ($p<0.001$).

With regards to KMS maturity, only organizations belonging to the tertiary sector demonstrate a medium maturity level, while those belonging to the other sectors show a low-to-medium degree of maturity.

The difference was significant in particular between the tertiary and secondary sector ($p<0.001$). Similar difference between secondary and tertiary sector was found with regards to organizational context.

While the primary sector reached a medium level, the only statistical difference was observed for the secondary sector being lower that the tertiary sector ($p<0.001$).

On the contrary, the location of the organizations that participated to the survey had no influence on the KPI's (Figure 2C). All KPI levels were found the be around medium level with no statistical differences.

Altogether, this analysis shows that digitization is more developed in both small and medium/large companies. Knowledge management and organizational context are more pronounced with small companies. Location has nor influence on the KPI's.

Besides analyzing parameters not considered in the calculation for organizational complexity, we also looked into the influence of complexity factors – i.e. customers location and numbers of employees - on each individual KPI.

Aim of this, was to understand if these individual complexity factors have any influence on digitalization, KMS and organizational context. Their influence on complexity KPI was not investigated, since customer location and number of employees are parameters used for the calculation of this KPI.

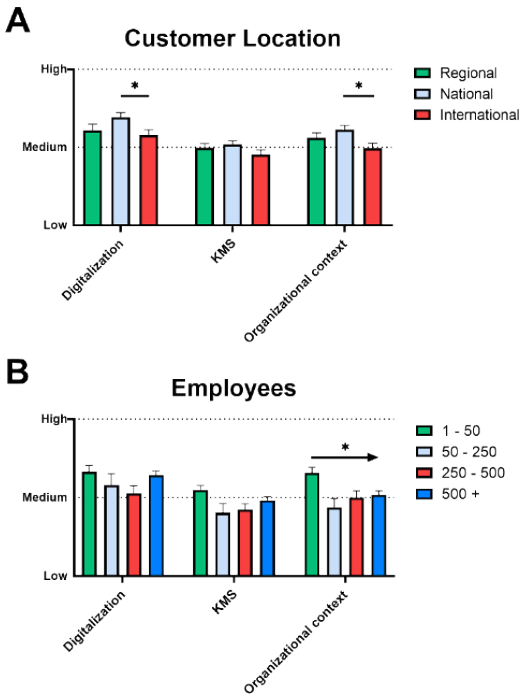

*Figure 6 KPI analysis for complexity-dependent organizational parameters. Shown are KPI for, digitalization, knowledge management system (KMS) and organizational context for each organizational variable that have been included in the calculation for the complexity KPI, i.e. customer location (A), and employees (B). Bars represent average KPI value (low=1 to high=5), error bars represent standard error of the mean. Tukey's 2-way ANOVA multiple comparison test p values: *<0.05*

Organizations with a national customer portfolio showed both a digitalization and organizational context KPI above the one observed for organizations with a regional or – higher and with statistical significance ($p<0.05$) – the ones with an international customer basis. No significant differences were observed with regards to KMS (Fig. 3A).

The dimension of the organization reflected by the number of employees did not have a statistically significant influence on digitalization and KMS.

This is spite of non-significant lower digitalization level in companies with 250-500 employees compared to companies with less than 50 or more than 500 employees.

On the contrary, the organizational context supporting knowledge management was found to be statistically significantly higher (medium-high) in small organizations with

less than 50 employees compared to organizations with more than 50 employees ($p<0.05$) (Fig. 3B).

3.3 Correlations between KPI's

We asked ourselves if there are positive or negative correlations between study KPI's, e.g. if a better organizational context favours digitization and if it can also favour a more effective knowledge management.

KPI performance value for each individual organization participating to the survey was taken into consideration.

To investigate this, we performed Pearson's correlation analysis, for which r value equal to 0 represent lack of correlation, values between 0 and 1 show positive correlations, and values between 0 and -1 show a negative correlation.

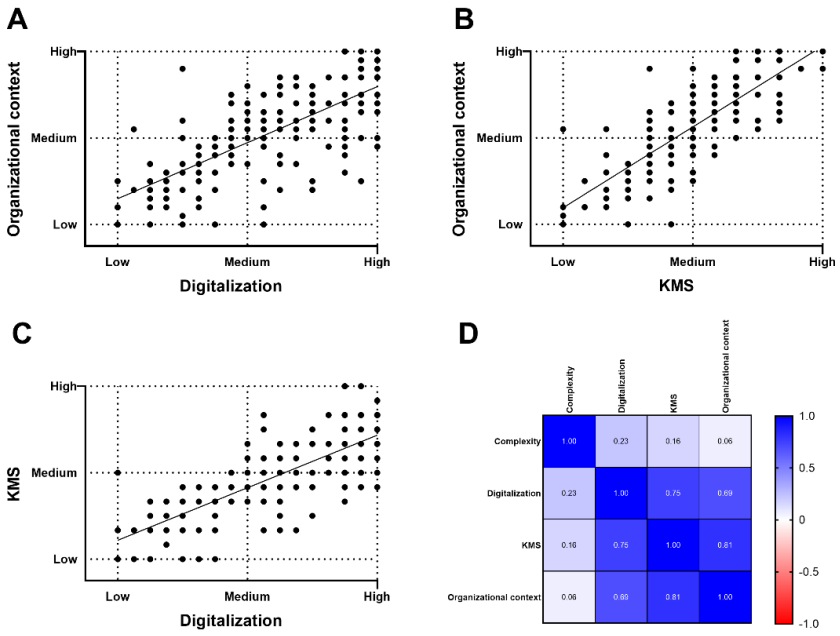

Figure 7 KPI correlation analysis. Shown are 2D plots comparing KPI values for organizational context vs. digitalization (A), knowledge management system (KMS) vs. organizational context (B), KMS vs. digitalization (C). Correlation trendline is depicted on each graph. Pearson's correlation coefficient r (D) between all KPI's is presented, including color-coding ranging from blue (positive correlation) to red (negative correlation). N=179

Based on the results in our survey, a Pearson's correlation matrix highlighted relatively high positive correlation between the following KPI pairs: digitalization vs. organizational context r = 0.69 (p = 4 x 10-27), digitalization vs. KMS r = 0.75 (p = 7 x 10-34), and KMS vs. organizational context r = 0.81 (p = 8 x 10-43).

The p values for all these correlations highlighted a high statistical significance.

The matrix also highlighted a positive correlation (i.e. r > 1) between complexity and other KPI's: digitalization (r = 0.23, p < 0.02), KMS (r = 0.16, p < 0.029).

The correlations with complexity, even if statistically significant, were not as high as observed for the pairs mentioned above.

The positive correlation between digitalization, KMS and organizational context was not only observed among pairs, but also among all three KPI in 3-axis representations (Fig 5).

This analysis showed that the performance and maturity of digitalization, KMS and organizational context are interdependent.

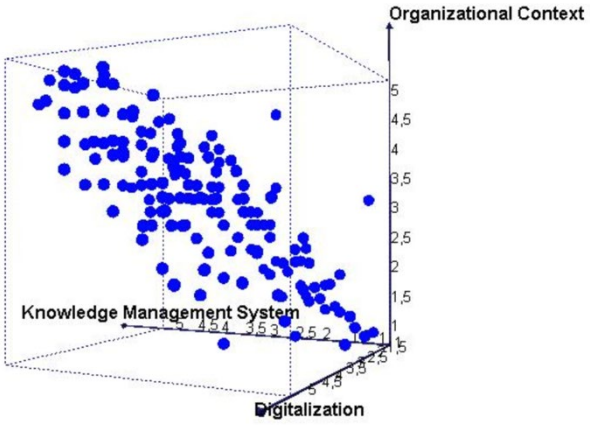

Figure 8 Correlation between knowledge management system, organizational context and digitalization. Shown are values for KPI's for organizational context, knowledge management system (KMS) and digitalization for each participants of the survey represented on a 3-dimensional scatter plot. N=179.

4 Discussion and Conclusions

In the beginning, we have analysed the answers to parameters belonging to the organizational complexity KPI. The first area of the survey proves that digitization is more developed in both small and medium/large companies whereas it has been clearly shown that knowledge management and organizational context are more pronounced with small companies. Is has been also highlighted a positive correlation between complexity

and digitalization confirming our hypothesis that a complex working environment most probably involves a higher level of digitalization.

Digitalisation and the adoption of knowledge management system was found to be statistically significantly higher in companies founded recently which shows that young companies are more aware of the importance of becoming digitally proficient in order to improve attractiveness and efficiency.

The overall picture that emerged has shown that organizations with high KPI for digitalization, knowledge management systems and organizational context are tendentially young, small, from tertiary sector and with national customer base.

Secondly, we found out that there is a strong interconnection between the 3 KPIs organisational context, digitalisation and adoption of knowledge management systems which reflects that a better organizational context favours digitization and a more effective knowledge management. The interconnection was observed among pairs as well with a varying degree of correlation.

Finally, the survey reinforces the idea that managing knowledge does not only involve mere documenting but it also strictly correlates on the ability of the company to keep up with advancements in digitalisation processes and promote favourable organisational context. In this challenging new economy, organizations should therefore encourage the creation of knowledge and endeavour to invest in tools and technologies necessary to support processes involved in knowledge management in order to gain competitive advantage.

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Community of practices, Knowledge Integration and Learning in Public Environments

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Abstract

The paper focuses on Community of Practice (CoP) in the public sector as a lever for the development of learning processes and organizational change. While existing literature suggests that CoPs may be considered as a tool for knowledge sharing and learning process, previous contributions have rarely analysed organizations in the public sector. We deal with an experience promoted by SNA (Italian School of Public Administration) to establish a community of managers specialized in staff training and belonging to different Italian public administrations. The community involved managers from all central administrations and government agencies (about forty organizations) that have cooperated for the rationalization, digitization and innovation of the programming processes of training activities for two years. Our results show that the community has facilitated learning and knowledge exchange and has helped SNA to define needs in terms of training of public servants. Our empirical study contributes to the understanding of the theoretical relationship between CoP and learning processes in the public sector, which has been neglected in knowledge management research.

Keywords – Community of practice, public administration, knowledge exchange, learning

Paper type – Academic Research Paper / Practical Paper

1 Introduction

The concept of Community of Practice (CoP) has been widely adopted in the private sector, representing a phenomenon under scrutiny in the academic literature for almost 30 years. CoPs are often considered as a mechanism to manage knowledge (Bolisani and Scarso, 2014; Kimble and Hildreth, 2005), a way to facilitate learning process inside the organization (Brown and Duguid, 1991; Wenger, 1998). In the public sector domain, instantiations of CoPs are not common and have been rarely investigated in managerial and administrative literature (Smith, 2016).

The aim of this paper is to analyse a peculiar public sector experience in which the introduction of a CoP has been carried out to foster the training process in the Italian Public Administration System. In the last thirty years Italian Public Administration has experienced several reforms clearly inspired by the New Public Management. The effects of these changes are still debated and no clear evaluation has been conducted, but according to public management scholars, they have been generally unsuccessful (Cepiku and Meneguzzo, 2011).

Notwithstanding, the implications of these reforms for public managers are the need of being involved in a long-life learning process in which building up new skills that should be improved over time. Reforms have emphasized the need to reach ambitious goals through a new management approach with continuous improvement of performance, the adoption of the benchmarking method and the measurement of customer satisfaction. Public sector managers operate effectively in a more and more complex and dynamic environment. They have to develop new skills to manage people and to satisfy stakeholder expectations in time of austerity and declining staff morale.

As argued by Larat (2017:89): "*In this sense, training the elite who will be in charge of public administration in the future must go further than merely teaching administrative rules and management techniques".* In this context, the role of training in the public sector could not anymore interpreted as a marginal topic or, at least, one of only narrow, technical interest. As argued by Pollitt (2015: IX) "*the nature of such training is closely linked to some of the most crucial questions in contemporary liberal democracy, and its implications go far beyond the technical".*

Training in the context of capacity development is the way to assure the quality of individual knowledge, skills or attitudes: it is a way to affect managers' behaviours and provide benefits to their organizations. "*In fact, some researchers share the view the training of civil servants can be regarded as a condition, which ensures the viability of public organizations. Thus it is necessary to establish a training system, which will maintain the ability to respond effectively to the challenges of the environment"* (Dolidze, 2017: 156).

Our paper analyses a peculiar case of defining training policies through the adoption of a CoP.

In Italy the National School of Administration (Scuola Nazionale dell'Amministrazione, SNA) provides training courses to all central public administrations. Before 2015, Italian Public Administration experienced a critical situation as reported by Van Wart and Hondeghem (2015:18): "*…the SCS training provided primarily narrowly focused on agency-oriented legal and technical issues such as in the Italian case…".*

The challenge has thus been to overcome the limitations of this model, trying to identify in an original way training needs and programs for Italian civil servants. This attempt was put in place also thanks to the creation of a CoP in which discussing and sharing training issues and policies.

The paper is developed as follows: in the next paragraph, we discuss the role of training policies in the public sector, in paragraph three, the role of the CoP in the public context. Finally, the methodology and the case are presented and the main results are discussed.

2 Defining training policies in the public sector

Training is a traditional topic in management studies (Moore and Dutton, 1978), and it still represents an interesting issue to discuss in the scientific and practical domain. In particular, public sector literature has discussed mainly: 1) the role of competences (with a specific interest to behavioural ones), 2) the governance of public training, with reference to the actors in charge of offering training programs for civil servants and to the methods to be adopted in the training process.

As far as it concerns the role of competences, the general argument is to move from technical programs to behavioural ones. This is mainly due to the fact of considering key administrative personnel as managers. As stated by Larat (2017:89): "*what is at stake is on the one hand the ability of administrative managers to carry out their mission of public service to the full and to meet the expectations of the citizens and, on the other hand, due to the training they receive, to determine the values and benchmarks for public action they will refer to*".

Several studies have examined and documented competencies needed by public administrators. Nordegraff (2000) identify three groups of key competences of public managers: interpretative competencies, institutional competencies, and textual competencies. The author underlines that the specificity of the competent public sector manager lies in the ability to operate effectively in an environment that is unstable due to the political situation. Bowman et al. (2004) argue that successful public manager must possess "skills triangle", which comprises three different types of competences: technical, leadership and ethical.

A variety of public reports have also attempted to study the civil servants competencies in specific countries. The Australian Public Service Commission identified skills like leading people, leading change, strategic thinking, decision-making and judgement, people and organizational development (Australian Public Service Commission, 2015).

The United States Office of Personnel Management developed executive core qualifications for the senior executive service that include leading change, leading people, results driven, business acumen and building coalitions (United States Office of Personnel Management, 2012).

More recently, Darling and Cunningham (2016) have suggested a range of distinct public sector competencies (very different than those identified as critical for the private sector environment) including: managing competing interests, managing the political environment, communicating in a political environment, interpersonal motivational skills, adding value for clients, and impact assessment in decision-making. According to these authors, private sector competencies reflect business environments where goals need to be specifically defined and implemented in a timely manner related to making a profit and surviving in a competitive environment. Public sector competencies instead are driven by environments exhibiting more complex and unresolvable problems and the need to respond to conflicting publics and serving the public good while surviving in a political environment.

In this context, as argued by Larat (2017:89): "*there is a need for modern public administrations to develop a dynamic, adaptive and differentiated system of selection and training of their senior civil servants in order to ensure that not only all public sector executives do possess the skills and competences required for their present position, but also that for those who are capable, they can be promoted to higher positions and then be prepared for this*".

This holds especially true in the so-called career based system (opposite to the position based system), characterised by competitive selections held at early stages in public servants' careers with higher-level posts open to public servants only. Career-based systems aim to put together a group of civil servants who should be well selected and trained. These two policies are a key issue in public human resource management.

As far as it concerns instead the governance of public training, with reference to the actors in charge of offering training programs for civil servants and to the method to adopt in the training process, literature offers insights related to the different actors who can be engaged and how they perform. For example, according to Pacheco and Franzese (2017:39): "*in Brazil, education for public managers is inspired by two main models: on the one hand, the academic model of theoretical education and research, achieving a University degree as MSc or PhD; on the other, the French model, based in Ecole Nationale d'Administration (ENA), to form permanent high staff for the state".*

Another way to approach this issue is to reflect on the governance of the training process and policies' definition. According to Dolidze (2017:155-156) it is possible to identify three different models: "*the centralized model is mostly used in the states with strong bureaucratic institutions and implies that the development of civil servants, including training and qualifications, as well as career promotion, is controlled by the government, and, in some cases, by a concrete state agency, ... The decentralized scheme is advocated by the NPM model and is based on the contractual delivery of training by*

non-governmental providers. Training and capacity building needs are determined by particular agencies or employees, and training providers selected on the basis of a free market – the best quality at the best price. The semi-centralized scheme is based on the cooperation between the government and private actors".

Literature has mainly debated how the education system can support training programs for civil servants, with a specific focus on public managers. Reichard (2017) described the most important European experiences in terms of executive academic programs for professionals. According to Reichard (2017): "*consequently, we observe a growing attractiveness of executive PA/PM degree programs offered by universities which results in an increase of supplying institutions at least in some countries (e.g. Germany, Italy, The Netherlands and the UK)".*

The provision of managerial education to civil servants is thus common all over Europe, with a strong base in the UK. What is not clearly debated in the literature is the way in which training needs are defined in the public sector. This is a slippery issue, because there are many differences in the public context. Every country has a different model, and even in the same country, public administrations (central or local) have different characteristics. If there is a centralized model, a single authority is in charge of defining the public training. In the decentralized model, public administrations have more freedom to define and satisfy their educational needs. The point is to understand how actors (universities, national public schools or other players) define their training programs. Actually, on this topic there is no a specific debate in the literature, even if this represents a sensitive issue in the practitioners' world.

The content of the most important programs (both in Europe or in other countries) are mainly based on general management (Reichard, 2017) and on behavioural competences, and the training needs are typically defined following a top-down approach. More specifically, in the centralized model, the central authority defines generic needs and offers directly or through private educational players specific programs. What are the methods to identify training needs? How do central governments or national agencies proceed to define them?

Our argument is to consider CoPs as a locus to share training experiences and to collect and define specific training needs for the central administrations. In the next paragraph, we will analyse the CoP concept and discuss ideas related to its adoption in the public sector context.

3 Community of practice in a public sector context

The idea of adopting the concept of communities of practice (CoP) within the public administration is not particularly widespread and it is related to specific issues. As argued by Smith (2016): "*Yet, existing research on communities of practice has a largely private-sector orientation with few studies applied to the public sector".*

One way to look at this phenomenon inside public administration is to adopt a social construction approach: public organization could be interpreted as dynamic and context

specific. In a general sense, according to Rooney and Mckenna (2008: 713): "*What this means for managers wishing to create the space for wise practice in public administration is that they must apprehend their organization from a phenomenological perspective — that is, as discourse communities and communities of practice".*

Following a social construction approach for understanding organizations in the public sector is a way to interpret them as a process where continuous interaction among different members and in a specific context takes place, with the aim of establishing practices. CoP is a way to facilitate the adoption of this perspective in the organization.

According to Pyrko et al. (2017: 390) "… *CoPs refer to groups of people who genuinely care about the same real-life problems or hot topics, and who on that basis interact regularly to learn together and from each other (Wenger et al., 2002)".* Koliba and Gajda (2009:100) argued that "*communities of practices can be understood phenomenologically, as relational structures that are mediated by and through the social construction of knowledge (Buysse et al., 2003; Nicolini et al., 2003). As such, they are spaces through which "communicative action" can take place (Polanyi, 2002; O'Donnell et al., 2003)".*

Even if it is not easy to provide a precise definition of community of practice, it is possible to identify several of its features (Wenger, 1998):

- it claims mutual relationships;
- it favours the sharing of the ways of doing things;
- it provides a shared language and gives the possibility of conversing without preambles as part of a continuous process;
- it sees to it that everyone knows what the others are able to do;
- it thrives on the sharing of symbolic elements or play content.

According to Wenger, in order to define CoP structurally it is necessary to reflect on three main themes (Wenger, 1998: 52). The first relates to the creation of meaning, which is connected to a definite process of negotiation. The second theme is that the process of negotiation of meaning is connected to the two dimensions of participation and depersonalisation. The last theme is that interaction between these two dimensions is fundamental in the process of establishing meaning at the level of single individuals.

The process of negotiation of meaning is activated through continuous interaction between the historical dimension, that coincides with the individual experience and the current/dynamic dimension which is associated with the practice that is being experienced. In other words, the interpretation of the practice depends on its content and on its past history. In order to interpret the content of the practice it is necessary to implement logics of participation and depersonalization. Participation represents a process of construction of relationships with other individuals which determines activation- as well as connection phenomena. The depersonalization dimension implies a process of formalization of individual and collective experience within the CoP. This

brings about that the symbolical manifestations of the CoP in terms of objects, artefacts, stories, sagas, refer to certain shared concepts and meanings.

The two dimensions of participation and depersonalization are characterized by relationship of duality, which implies complementariness and interaction. A process of reciprocal reinforcement is grafted whereby participation increasingly strengthens as common and shared meanings within the community are gradually elaborated, which in turn allow participation to be fostered. The concept of CoP is, moreover, linked to the theme of doing, and assumes a temporal dimension as well as a social one. The temporal dimension identifies the CoP's course of shared development. The construction of a common meaning is the outcome of a members' joint course. It needs to be emphasised how in the construction of a CoP, both "history" and the individual and collective stages of development are extremely relevant.

The social dimension refers to the interaction existing among the CoP members. In this sense practice may be interpreted as a process of social interaction and cannot be considered as a resource that may be coded and transferred from one individual to another.

Among the factors which facilitate the creation of community most relevant is the role of the construction of interpersonal relationships through carrying out activities of social interaction that endure through time.

Even if communities of practice are not a typical issue in the public literature, there are some exceptions. For example, Hatmaker et al (2011) studied the introduction of a CoP to integrate newcomers inside the organization, in order to facilitate the process of organizational socialization. In this sense CoP may augment formal socialization tactics such as training because they can offer participants the opportunity to engage in the practice of the profession or craft, rather than just learning about it in the abstract (Hatmaker et al., 2011: 399). The organization could foster CoP as a sort of socialization tactic, a way to create a space where newcomers could learn values, behaviours, language and technical issues.

In a recent study on knowledge sharing and communities of practise in a public organization, Smith (2016) reveals the structures, behaviours, and processes embedded in communities of practice that offer public managers a gateway to informal communication, build community through communication within and across groups, provide access to "know how" information from a diverse set of perspectives, and encourage peer comparisons.

In coherence with the call by Smith to go further in the study on communities of practice in public sector settings, our aim is to analyse a case of the adoption of a CoP within a public organization finalized to make the educational and training process more effective. In fact there is a gap in the literature on this issue as attempts to study communities of practice in a public sector context are related to educational more than to training policies. For example, Neubauer et al. (2011) studied the use of emerging technologies to connect students to practitioners in selected communities of practice.

What about public managers and their training? How is it possible for a public organization to deliver better standards in terms of training policies?

4 Methodolgy

We analysed empirical material collected within the Italian National School of Administration (*Scuola Nazionale dell'Amministrazione*, SNA) to identify actual experiences of a CoP, in which HRM managers from forty-three different Italian public administrations participated (see Table 1). In particular, our analysis was based on an interpretative and qualitative investigation (Birkinshaw et al., 2011) as data and information collected cannot be explained or illustrated without being familiar with the study material. This led us to the crucial problem of distance between observing subject and observed object (Van Maanen, 1979) necessary to obtain an accurate analysis of the phenomenon under investigation (Strauss and Corbin, 1998). We started collecting, elaborating and analysing conversation and practice in order to bring out the "viewpoint" of the researcher in the process of interpretation of the empirical material (Glaser and Strauss, 1967). This method is rooted in social constructivism (Berger and Luckmann, 1996; Gergen, 1989). Issues then emerged naturally from the data (Caven et al., 2012), rather than the data being fitted to predetermined categories. Fieldwork was carried out between September 2017 and early November 2019. The collection of data were carried out using a variety of methods, including participant observations, semi-structured interviews, and document analysis.

Participant observation

Participant observation is the primary source of data for this study. Participant observation is an approach that allows researchers to gain intimate knowledge of a social setting in a naturalistic way (Smith, 2017).Two of the authors of this paper have been part of the project team as Head of Department and External Consultant. During the period of participant observation, they acquired an initial familiarity with the "lexical territory" of the community (Van Maanen, 1979). During their fieldwork, the two authors spent two to three days a month in the community from 9 a.m. to 1 p.m. or from 2 p.m. to 4 p.m. Having free access to the community premises, they could establish formal and informal contacts and become relatively familiar with the managers. They recorded on a data sheet the activities of each shift, reporting verbal and non-verbal expressions, discussions and conversations.

Semi-structured interviews

These interviews were used as a way to cross check information and conclusions reached through participant observation and gain insider understandings of phenomena emerging from the participant observation data (Lofland & Lofland, 1995). We conducted 20 interviews with 20 of the forty-three HRM managers involved in the CoPs designed by SNA. The interviews were guided by a wide-ranging questionnaire. Interviews took

place at SNA headquarter. They were conducted in Italian, lasted one to two hours, and were taped and roughly analysed. We wrote memos to coordinate, developing and sharing a common view among the five authors. In the second step, all authors listened to the recordings. We compared raw materials and written notes taken during the interviews with the recordings. We first listened to all the interviews to recollect the general ideas expressed. We then reviewed the recordings, transcribing the interviews verbatim, stopping the recording after every sentence, to be sure that the meaning was clear. We did this immediately after recording and read the transcripts several times. This reminded us of the events, words and gazes, and helped us to remember what happened in each interview.

In translating and editing the excerpts, we tried to preserve their original meaning within the context of the whole interview. We are aware that the way in which subjects describe and discuss their work and relationships often reveals multiple senses of self, hence the complexity of unlocking individual and/or collective identities (Harding, 2008). We adopted the viewpoint of Ricoeur (1986) in seeing the organizational actors as readers confronted by a text. They are actively involved in creating the language of the context surrounding them, consisting of both organizational and narrative phenomena.

Internal documentation

Finally, we reviewed a series of formal sources, including SNA informative material, planning documents, internal reports and internal communications.

5 The community of practices

SNA was established in 1957 with the aim of creating a system of recruitment and training similar to the French ÉNA (Cepiku et al., 2017). SNA focuses its training offer on three main activities, the first two being multidisciplinary training programs (Cepiku et al., 2014):

- selection and training of public managers (similar to the French ÉNA selection procedure);
- compulsory training for middle managers appointed by their respective administrations after a selection procedure, with a relatively high level of enforcement;
- lifelong executive education on managerial, legal, and policy issues for all civil servants (through bilateral agreements either with single administrations or through voluntary participation by single civil servants).

SNA is responsible for the use of resources allocated by the government for the training of central public administration managers. In addition, SNA can stipulate agreements for the implementation of training projects with central and local administrations. The activities are coordinated by the President and from 2018 are structured as follows:

- five Departments specialised by type of users (Ministries and National Agencies) and by policy areas in which they are more directly involved;
- five didactic and scientific areas;
- two offices responsible for support services (Design, Information System).

In the wake of the 2009 reform, the governance and mission of SNA have been redefined to support the reform implementation process (Strategic Plan 2010–2012, Draft Strategic Plan 2013–2015). This priority has led to a comprehensive effort to redesign the training offered, starting with the initial training for appointed managers, previously centred around legal, economic, and, marginally, organizational skills and delivered through classical lecture teaching. In tandem, the debate on training methods has developed around four main elements: the use of cases, exercises and simulations, interaction with practitioners, and the consolidation of a comprehensive evaluation scheme (Cepiku et al., 2017).

5.1 The training planning and evaluation process

From 2013, the programming of the training provided by SNA for managers of central government administrations was divided into three steps:

(a) strategic programming developed by the political bodies of the central government;

b) the construction of the annual Catalogue of the School's training offer;

c) the actual composition of the classrooms for the courses in the Catalogue.

The first phase coincides with the drafting of the three-year training plan that the Administrations must, by law, transfer to SNA.

In the second phase SNA selects topics and projects considered as priorities and autonomously designs the Catalogue that contains the annual offer of the training courses.

In the third phase the Administrations, on the basis of the survey of their training needs request for their employees participation to the single courses allowing SNA to define the classrooms for each course.

At the end of the courses, an evaluation of the training process takes place through the administration of questionnaires to the participants, whose results are aggregated and represented in a four-monthly monitoring report.

In 2018, in parallel with its organizational redesign, SNA decided to systematically address some critical issues that had been identified over the years regarding the effectiveness, efficiency and sustainability of its training planning and evaluation model.

In particular, the following criticalities were found:

- a certain misalignment between the programming times of the administrations and those of the School;
- a worrying de-responsibility of the management of the administrations in the selection of course participants;

- a significant rate of absenteeism from courses with consequent loss of economic resources that cannot be reused for other courses and/or for other (perhaps more motivated) participants.

5.2 The Trainers' CLUB Project

The redesign of rules concerning the definition of training needs for central administrations has led SNA to promote a multi-annual project focusing on developing the capability of both Administrations and SNA to identify training needs and develop a coherent training offer (Cepiku et al., 2014).

SNA launched a project entitled "CLUB of Trainers" aimed at the creation of a "community" composed of the training managers of all Italian central public administrations. SNA, with the development of the project, intended to entrust the community with the objective of analysing and mapping, in a systematic way, problems related to the management of employee training and to propose improvement initiatives. A project team worked for three months with the Presidency of the School to set up the community (the Club) and for the definition of the working methodology to be adopted in the next implementation phase.

The Project Team was composed by the Head of SNA Department "Management and Innovation", the Head of SNA Information Systems, a contact person from SNA Presidency, three external HRM consultants and three tutors.

Starting from the analysis carried out by the Project Team on the main critical issues, the Club was asked to provide:

- shared analysis of the critical factors related to the planning and management processes of the training services;
- proposals for common solutions for all or some clusters of participating administrations.

During the three months of the project's life, the team also worked on the construction of an IT platform dedicated to the future activities of the community. This virtual space was used to manage the activities of community building and to present and discuss the tasks and objectives of the community. In terms of work methodology, SNA promoted bi-monthly collegial meetings at the School's headquarters and included in the community a contact person for the Presidency, two training experts appointed by the School and a contact person for SNA information systems.

The Project Team also proposed to the Club a section of themes, graphically represented in Figure 1, to be developed in the analysis of the problems and in the elaboration of guidelines or problem solutions.

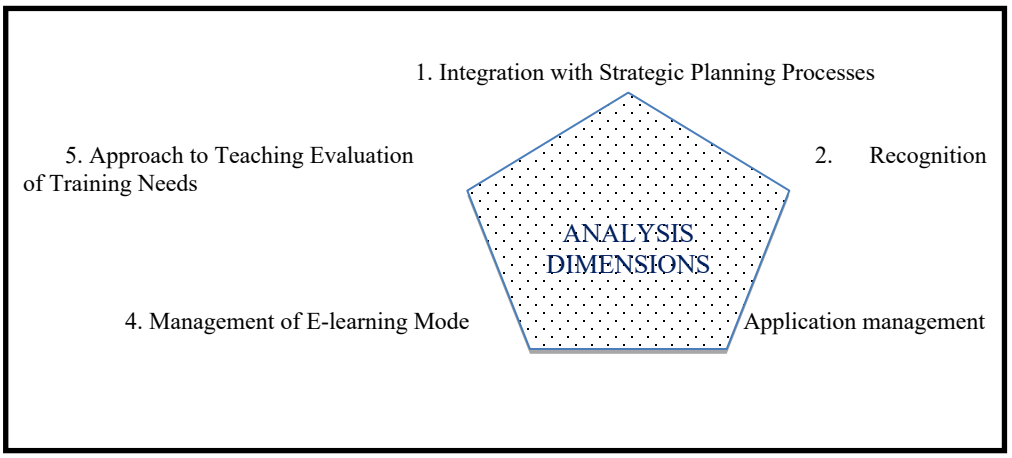

Figure 1 - The analysis model developed by the project team

The Community worked autonomously during the following two years, benefiting from the support of some members of the initial Project Team. SNA has issued invitations to participate to the community to all the HR Directorates of the administrations, specifying the usefulness of involving the subjects who were more directly involved in the management of the training processes.

In the maturity phase, 30 administrations (Ministries and Agencies) participated in the Club. The subjects participating in the Club were managers of complex units entrusted with the direct management of training.

The participants had very heterogeneous personal, professional and experience profiles: the administrations of origin were very different, in terms of the size, the presence of peripheral operational offices, the size of the team of professionals dedicated to training and the hierarchical position of the training office they coordinated. Public administrations involved in the "Trainers' Club" are listed in Table 1.

Table 1 - The public administrations involved in the "Trainers' Club"

1	Ministero dell'Economia e delle Finanze	21	Agenzia italiana del farmaco
2	Ministero dell'Interno	22	Agenzia Nazionale per le Politiche Attive del Lavoro
3	Ministero dell'Istruzione dell'Università e della Ricerca	23	ICE - Agenzia per la promozione all'estero e l'internazionalizzazione delle imprese italiane
4	Ministero della Giustizia	24	Agenzia delle Entrate
5	Ministero del Lavoro e Politiche sociali	25	Consiglio Nazionale dell'Economia e del Lavoro
6	Ministero della salute	26	Garante per la protezione dei dati personali
7	Ministero dell'Ambiente e tutela del Territorio e del mare	27	Agenzia Nazionale per la Valutazione del sistema Universitario e della Ricerca
8	Ministero degli affari Esteri e cooperazione internazionale	28	Ispettorato nazionale del lavoro
9	Ministero delle Infrastrutture e dei Trasporti	29	Istituto Nazionale Assicurazione Infortuni sul Lavoro

10	Ministero per i Beni e le Attività Culturali e Turismo	30	Agenzia nazionale per le nuove tecnologie, l'energia e lo sviluppo economico sostenibile
11	Ministero dello Sviluppo Economico	31	Istituto Nazionale della Previdenza Sociale
12	Ministero politiche agricole, Alimentari e Forestali	32	Fondazione Scuola dei Beni e delle Attività Culturali
13	Ministero della Difesa	33	Agenzia Nazionale per i Servizi Sanitari Regionali
14	Presidenza del Consiglio dei Ministri	34	Agenzia per la Coesione territoriale
15	Avvocatura Generale dello Stato	35	Agenzia italiana per la Cooperazione allo Sviluppo
16	Corte dei conti	36	Agenzia per le Dogane e i Monopoli
17	Banca d'Italia	37	Istituto Superiore per la Protezione e la Ricerca Ambientale
18	Autorità Garante per la Concorrenza e per il Mercato	38	Agenzia per l'Italia Digitale
19	Istituto Poligrafico e Zecca dello Stato	39	Istituto nazionale di STATistica
20	Autorità nazionale anticorruzione	40	Consip

5.3 How the community works

The practice community of the Trainers' Club, during the two years of activity, has met ten times for formal meetings at SNA headquarters and has developed other modes of interaction such as informal and self-managed contacts between participants, in-presence and chat meetings.

Already from the first formal meeting, the CoPs requested to SNA the possibility to modify the assigned objectives and the model of interaction with the School.

Participant observation and interview data reveal roles that communities of practice play in facilitating shared learning across public sector organizations:

1. Opportunity for peer comparisons;
2. Platform to channels for informal communication;
3. Source for shared "know how" and development of best practices.

The following description of the practices adopted by the community develops in relation to these three roles.

Opportunity for peer comparisons

Already at the first meeting the participants asked to be divided into four sub-groups whose composition best reflected the heterogeneity of the administrations represented. Such heterogeneity took shape not only in the size of the organizations (from a minimum of 150 units up to administrations with about 40000 employees), but also in the hierarchical position of the Training Office, the level of contractual classification of the training referents present in the Club, the presence or absence of regional administration structures, and the budget allocated annually for training. The groups met in different rooms of SNA headquarters and spent about three hours getting to know each other and discussing the definition of the basic conditions that would allow the community to operate effectively.

After this first moment of self-analysis within the four sub-groups, during the subsequent collegial discussion, Club participants discussed the role they played within

the Club with respect to the organizational position they held in their administration. Except for a few rare exceptions, participants were not HRM's top managers, but second-tier managers who were actually involved in training management. This was immediately declared a limit to the degree of autonomy with respect to the initiatives that the community would propose, but at the same time it was also considered an essential condition for analysing the problems in a concrete way.

On the basis of this first consideration on the roles of the participants and the diversity of the administrations, the community immediately expressed a request to SNA concerning the assigned objectives: the community would have considered the different organisational models used by the administrations as "configurations" placed along a continuum. Consequently, the Club would have worked to discuss the problems as they presented themselves in the different organizational models, considering specificities and proposing solutions. During an interview conducted by one of the experts of the Project Team at the end of the first formal meeting of the Club, the training contact from AGID (Italian Digital Agency, one of the public administrations involved in the community) declared: "*We are very interested in the Club's experience; it is the first time that people operationally involved in the training processes of my administration are called by the School to contribute to organizational development, as "experienced" and "informed of the facts".... but the only way to be really effective is for colleagues in the larger administrations to strive to develop a common vision of the problems, working on solutions that can be applied, even in a modular way, to all of us!".*

In the course of the sub-groups' work, a participant from another public organization (Ministry of Infrastructures) asked colleagues: *"For some of us from administrations who do not invest adequately in employee training and who do not have an organizational culture sensitive to this issue, being here could mean exposing ourselves to very discouraging comparisons... but if we are all willing to listen and work on proposals that can be practiced flexibly and with the support of the School, then I will gladly make my professional contribution".*

It was also common to see participants exchange business cards, phone numbers, and e-mail addresses and make plans to connect in the weeks after the meeting.

Platform to channels for informal communication

CoP members communicated and shared knowledge either via face-to-face OR person-to-person interactions or virtual ones.

From the earliest stages of the community life cycle, participants took advantage of the opportunity to make informal contact with each other. In many cases, the administrations to which the club participants belonged had already worked together in carrying out functions, providing services or implementing organizational development projects. However, these experiences had not allowed the establishment of stable collaborative relationships between managers and officials in the same sector. In previous occasions of cooperation between administrations, a hierarchical-institutional approach had prevailed,

whereby the structures interacted mainly in a formal way through communications and structured meetings between top managers.

The collection, analysis, and presentation of pre-meeting data able to trigger the discussions is highlighted as a valuable part of the meeting by participants. In the Club, on the other hand, a dense network of informal relationships was immediately established, facilitated by the possibility of direct and personal contacts between managers who shared similar issues.

In addition to the more structured conversations in the chat dedicated to the Club's activities, there were numerous examples of direct contacts and comparisons between individuals and sub-groups to exchange detailed information on a problem or examples of procedures and tools in use in their organizations for planning and managing training processes.

The familiarity among the participants, the recurring stories of individual experiences and the progressive building of relationships of esteem and trust stimulated the sharing of practices.

"*In a short time we were able to perceive a sense of community ... Having the possibility to contact directly and informally colleagues from other administrations was useful to deal in depth with the analysis of common problems and to suggest possible ways out"* - said one of the participants - "*Getting to know each other without interference has created the conditions to stimulate a form of mutual knowledge between professionals; this will certainly be useful in many other collaboration initiatives. Moreover, my feeling is that the sense of loneliness typical of our professionalism has been filled! For example, it seemed to me very useful to be able to talk to the Agenzia delle Entrate's manager [Agenzia delle Entrate is the Italian Tax Agency, one of the administrations involved] when we had to launch for the first time an e-learning training intervention on security issues. The Agency has a very important experience in this kind of initiatives and in the Club, the manager gave detailed testimonials and made available very clear materials to understand the steps of the design process of those courses*".

Evidence of inter-organizational exchange is seen during both structured and unstructured exchanges, but particularly in the informal interactions during meetings. Participants were in contact prior to, during, and after the meeting to connect on issues that they have in common or find out more details on what a community is doing in response to a particular challenge. When asked about the biggest benefits from meetings, participants responded with, "*the mixture of various experience together in one room. An honest and good exchange among participants*".

Source for shared "know how" and development of best practices

During meetings, participants from different public administration stood up and explained to the group why they had done so well or so poorly on specific issues. The discussion together with the sharing of anecdotes, informal comparisons, and confidentiality allowed participants to get ideas and brainstorm with each other.

One of the issues on the Club's agenda was the quality of strategic planning of training policies. Through discussion, the participants in the first meetings identified the critical factors that adversely affect the training performance achieved. In particular, the issue of the time lag between the strategic planning processes of the administrations and its effects on the management of relations between the administrations and SNA in the definition of the annual plan of educational activities was debated. The delays in the delivery to the School of the Training Plans by the Administrations and the strong variety of the methods with which they arrived at the definition of their training needs and at the formulation of the intervention requests of SNA had a strong impact on the capacity of the School to receive all the requests in the best way and to harmonise them in a balanced didactic Plan. In addition, the uncertainty produced by the delays and the differences in behaviour in formulating the training needs generated a high rate of abandonment or non-participation of the employees or evaluations of inadequacy of the courses with respect to the expectations of departure.

Therefore, several Club meetings were dedicated to the analysis of these topics, and to understand the factors that had slowed down or made those processes uncertain. Issues such as lack of connection between internal processes of the individual administrations and the ineffective link between the Administrations and the School were found reliant on countless operational and behavioural factors.

The community compared methods and tools used by the single Administrations to manage the connection between the Strategic Plan of the Minister and the annual Training Plan, and generated proposals that radically modified the process with which SNA manages the requests of the Administrations and composes the annual Catalogue of the courses offered.

A process reengineering intervention that engaged the Club for about six months was established:

- that the School would carry out preliminary activities of listening to the needs of skills by supporting the training referents in the interpretation of the Minister's Strategic Plans. The Club has dedicated two specific workshops to this activity in order to define the tool for the needs assessment;
- that the School would present its training offer six months in advance, trying in this way to direct the planning activities of the Administrations with greater clarity and certainty of time;
- that all the administrations would have adopted the same instrument for the representation of training needs and communication with SNA (the Annual Training Plan), whose characteristics have been defined by the community itself.

After two years of implementation of these changes, the rate of absenteeism of the participants, measured with specific quality indicators, also designed and tested in the Club, showed ample room for improvement, allowing SNA to recover economic resources and increase the number of courses provided.

From this point of view, a salient benefit of the CoP is to bridge formal and informal organizational boundaries in order to increase the collective knowledge, skills, and reciprocity of practitioners who serve in these organizations, as issues are inherently boundary-crossing (Snyder et al., 2004).

6 Discussion and conclusions

6.1 Managerial issues

The study reveals the organizational models, behaviours, and practices embedded in community that offer public managers a gateway to informal communication, build community through communication within and across groups, provide access to shared "know how", and encourage peer comparisons.

Mutual engagement between community members helped provide advice, solutions and acquisition of a collective learning process. The sense of community led to a common perspective of knowledge as a shared good, owned and maintained by the community. The possibility to discuss in depth, among experts and in a recurring and structured way, operational aspects related to the management of the training services provided by SNA, has allowed the creation of a common knowledge base on the strategic choices made by the public administrations, on the methodological options proposed by SNA, on the nature and dimensions of the sources of financing of the training activities promoted by the government for the training of the public senior management. In some cases, such as the definition of a methodology for the design of courses in e-learning, the pooling of experiences and best practices by some "more experienced" participants was the starting point to start up paths for the design of tools that up to that point had seemed very difficult to the administrations.

The CoP also had significant effects in terms of increasing the legitimacy of the actors involved in the system of institutional relations between public bodies.

With regard to legitimisation from organisations, Corso et al. (2009) argue that, if CoPs want to be recognised by the organization, they should demonstrate themselves to be active entities with their own structures. In line with this view, we showed that the participants, although not the top managers of HRM in their administrations, have acquired legitimacy and strength to propose changes, thanks to the legitimacy in the CoP of their professional profile and specific skills. The mutual recognition of that profile and the "institutional" support guaranteed by SNA contributed to increase the legitimacy of those subjects who held the effective governance of the training processes. Moreover, the results achieved by the CoP have also contributed to improve the image and reputation of SNA in the administrations, raising also its legitimacy profile as process owner of the national programming of the training policies in the public sector.

The experience of the CoP has had a direct implication in accelerating the digitisation process, both in terms of programming and training delivery processes. The IT platform

made available to CoP by SNA and dedicated to the collection of applications, the management of courses and the evaluation of activities, has contributed to a more significant orientation towards the computerization of work processes and communication flows between SNA and public administrations.

From the point of view of managerial implications, the case study shows how much the CoP has been a leverage for the participatory design of the training processes of senior public management.

The CoP was conceived by SNA, as said, to address some critical issues that had a negative impact on its performance.

The solutions developed within the CoP concerned:

- the temporal misalignment between the processes of planning and delivery of the training: the reengineering of the processes elaborated by the CoP introduced a phase of "listening" of the training needs of the different administrations and the standardisation of the process of elaboration of the Catalogue of the training offer, characterised by certain times and contents;
- the homogeneity of the profiles in the composition of the classes: the CoP has elaborated criteria and tools for the definition of standard training courses for specific managerial figures (Project manager, Security Manager, Manager of the economic-financial area, etc.). This has made it possible to inaugurate a phase in which, on the one hand, the individual administrations continue to carry out autonomously the survey of training needs and the identification of participants in individual courses, and on the other hand they contribute to composing classes with more homogeneous profiles, with positive effects on the climate and the quality of teaching;
- the communication flows between SNA and the administrations: the CoP has elaborated a single Template for the definition of the three-year training plan that the administrations have the obligation to transmit to SNA. The administrations, moreover, following the accurate discussions conducted in the Club on the theme of mutual interdependencies in the course planning process, have radically changed their behaviour, starting to respect the new deadlines regularly;
- the organization and control of the teaching activities: the CoP has outlined the new responsibilities of the "Training Referent", decentralizing part of the tasks of didactic organization to the administrations. The Referent, in fact, by definitively and formally codifying the list of participants in the individual courses, has become the person in charge of the training requests coming from the internal structures of the administrations and the person in charge of reconciling the different pressures exerted by the managers.

The innovations introduced have, among other things, led to a clear reduction in the absenteeism rate of course participants and to an increase in the number of hours of teaching and courses held during CoP's two years of activity.

6.2 Theoretical issues

The paper focuses on CoP in the public sector as a lever for the development of learning processes and organizational change. While existing literature suggests implementing CoPs as a tool for fostering knowledge sharing and learning process (Jeon et al., 2011; Zboralski, 2009), these topics have rarely been analysed in the public sector. From this point of view, our empirical study could contribute to the theoretical knowledge on the relationship between CoP and learning processes in the public sector, which has been neglected in knowledge management research.

In particular, the case analysed allows an in-depth examination of the role that CoP can play as part of process management models and training policies in support of broader strategic approaches to change in public administration.

The case study shows, in fact, how the use of the CoP as a tool to support the re-design of training service management processes, by the main Italian governmental training agency (SNA), appears effective with respect to the change needs of a heterogeneous set of public administrations.

In order to overcome the significant critical issues in the management of resources (financial and human) allocated for the training of senior public managers, the School set up a permanent working group, still active at the time the paper was drafted, which developed working methods typical of a CoP and proposed organizational solutions that have significantly improved the performance of the School in the design and delivery of training processes.

The changes proposed (and implemented) thanks to the interaction between the administrations participating in the CoP with the support of SNA project team, concerned both operational aspects related to the processes of organization and management of the School's training services, and the more general model of managing relationships between SNA and the administrations.

The case study shows how the CoP can support, also in the public sector, processes of collective learning and organizational change thanks to the enrichment of communication flows between participants, the transfer of specialist knowledge, the development of common languages useful for the interpretation of problems and the strengthening of professional identities.

Finally, the case makes clear that the CoP can contribute to a greater decentralization of the models of interaction between public actors, without affecting the institutional logic underlying the relationships between different administrations, and can thus undermine more formal and bureaucratic approaches to the management of key HRM processes.

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How AI Affects the Motivations Tourists Photographs

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Abstract

Service literature suggests that identifying the motivations of tourists is fundamental (e.g., Woosnam et al., 2016; Pomfret & Bramwell, 2016) to be able to adapt marketing strategies according to the different users' needs. However, today digital technologies and more generally service innovations have profoundly changed the decision-making of the tourists photographers. Some contributions (Lo *et al.,* 2011; Ozansoy Çardici *et al*., 2019) agree that the motivation that drives users to take photos is no longer linked just to memory but to the communication of personal identity, especially for the new generations. These changes depend on the use of digital tools such as the introduction of mobile with camera, social networks, and AI. Indeed, Huyn *et al* (2009) conceptualized the tourism in the mobile context, recognizing the use of mobile to search travel information through photo of other visitors; then, Prideaux & Coghlan (2010) investigated the photographic habits, using mobile phones or cameras as a tool of memory.

Several recent contributions (Munar & Jacobsen, 2014; Kozinets, 2017; Trinanda & Sari, 2019) focus on the evolution of tourist's motivation photo due to the development of social networks. Indeed, Munar & Jacobsen (2014) examined the reasons that drive tourists to share their photos on social networks, showing that the findings provide insights into motivational factors such as personal and community-related benefits, as well as social capital that influences the sharing of user-generated content. Besides, according to Kozinets (2017) the visitor became part of art domain with the selfie, not only for narcissistic reasons, as exposed by Fox and Rooney (2015), Sorokowski et al. (2015), and Lee and Sung (2016), but to express aspects of themselves through the art.

Findings show that AI is actually a tool able to influence and add new motivations for tourist photographer: in particular, AI improve the game and curiosity motivations, with the consequent rise of a different and new interaction with art. Future research could use a customer survey (Hulland *et al.,* 2018) to better understand which features of AI are the most appreciated by tourist photographers.

The purpose of the research is to verify, through a content analysis, what emerged in the literature on the first two steps of the tourist photographer motivations. Furthermore, after investigating through the observation, the theoretical framework, we will proceed to define a theoretical framework inherent in the emerging phenomenon of AI implementation also in tourism which at the moment is little treated in managerial literature.

Keywords – Cultural heritage, artificial intelligence, consumer behaviour, digital tourism, hospitality

Paper type – Academic Research Paper

1 Introduction

Susan Sontag has noted: [Photography's] main effect is to convert the world into a department store ora museum-without-walls in which every subject is depreciated into an article of consumption, promoted into an item for aesthetic appreciation (1977, p.110). Photography has always been linked to the world of tourism; on the other hand, who would imagine a trip without photos?

Most of the literature on service (Woosnam et al., 2016; Pomfret & Bramwell, 2016) focuses on the motivations that drive tourists to photograph, considering this fundamental action to be able to adapt marketing strategies according to the different users' needs .

However, today digital technologies have had a significant impact on the motivation of tourist photographers and on photography that has become more 'social': some scholars agree that the motivation that drives users to take photos is no longer linked just to memory but to present an image of themselves 'ideal', (Lo et al., 2011; Stylianou-Lambert, 2012; Ozansoy Çardici et al., 2019).

According to one of the recent contributions in the field, Carbon (2017) stated selfies "reveal something about the creator in particular, but also something about humans in general", in the same vein Larsen and Sanbye (2014) had wondered if selfies are public projection of imagine/idea of ourselves, or better, the desirable image to share within the network, but, depending on the field of research, the literature provides numerous other definitions for 'selfie' (Hess, 2015; Senft & Baym, 2015).

Motivations to take a pic	Platform	Sources(author/-s, year)
Find information and record memory	Mobile	Wang, D., Xiang, Z., & Fesenmaier, D. R. (2014). Adapting to the mobile world: A model of smartphone use. *Annals of Tourism Research,* 48, 11–26. Hyun, M. Y., Lee, S., & Hu, C. (2009). *Mobile-mediated virtual experience in tourism: Concept, typology and applications. Journal of Vacation Marketing, 15(2), 149–164.* Prideaux, B., & Coghlan, A. (2010). Digital cameras and photo taking behaviour on the Great Barrier Reef—marketing opportunities for Reef tour operators. *Journal of Vacation Marketing,* 16(3), 171-183.
Narcisistic	Social network	Kozinets, R., Gretzel, U., & Dinhopl, A. (2017). Self in art/self as art: Museum selfies as identity work. *Frontiers in psychology, 8, 731.* Trinanda, O., & Sari, A. Y. (2019, May). # MeTourism: How selfies affect re-visit intention in narcissistic age. In *1st International Conference on Economics, Business, Entrepreneurship, and Finance (ICEBEF 2018)*. Atlantis Press; Leung, L. (2013). Generational differences in content generation in social media: The roles of the gratifications sought and of narcissism, *Computers in Human Behavior*, vol. 29, pp. 997-1006.
Community and sharing benefits	Social network/Mobile	Munar, A. M., & Jacobsen, J. K. S. (2014). Motivations for sharing tourism experiences through social media. *Tourism Management*, 43, 46–54. Gretzel, U., & Yoo, K. H. (2008). Use and impact of online travel reviews. In P. O'Connor, W. Höpken, & U. Gretzel (Eds.), *Information and communication technologies in tourism* (pp. 35e46). Vienna: Springer Ozansoy Çadırcı, T., & Sağkaya Güngör, A. (2019). Love my selfie: selfies in managing impressions on social networks. *Journal of Marketing Communications*, 25(3), 268-287. Wang, D., Xiang, Z., & Fesenmaier, D. R. (2014). Adapting to the mobile world: A model of smartphone use. *Annals of Tourism Research,* 48, 11–26. Lo, I. S., McKercher, B., Lo, A., Cheung, C., & Law, R. (2011). Tourism and online photography. *Tourism Management,* 32(4), 725–731.

However, unlike mobile e social network, the impact of AI on the motivations of tourist photographer is still poorly addressed. The present study addresses this gap in the literature, exploring the evolution of tourist's motivation to take a photo with the advent of AI through a qualitative research, due to the newness of the topic (Lee, 1999). In particular, we analyze a single case study to develop the conceptual framework of the relationship between evolution of new technologies and tourist's motivations. Indeed, we have chosen an exploratory case study, Google ArtSelfie, and we connected it to the three technologies examined respectively: mobile with camera, social networks and their connections, and finally, Artificial Intelligence.

Then, we carried out a qualitative cluster analysis with concrete examples through quotes on the social network sites – as proposed by Croidieu et al. (2016) – to favour a more complete understanding of the ongoing changes. Data selection was made jointly by all three authors (Silver and Lewins, 2014) to decrease subjectivity (Krippendorff, 2013), and to give more reliability to both dataset and results.

The paper develops as follows. The next section offers a review of tourism motivation and tourism motivation photo. Then, an overview of tourism motivation photo in digital era. The remainder of the paper describes the research process, leading to an analysis of a single case study, Google ArtSelfie.. The conclusions offer insights into how evolution of technologies and, above of all, AI affect the tourism motivation photo.

2 Tourism motivation

According to Crompton (1979), most of the discussions about tourism-motivation tend to revolve around the concepts of `` pull '' and `` push ''. The first motives are used to explain the choice of destination; the second ones are useful for explaining the desire to go on vacation. In general, motivation arises when an individual needs to satisfy a need. According to the theories of motivations (Herzberg et al., 1959; Maslow, 1970; Lunenburg, 2011), the presence of a goal is necessary so that individuals can be motivated to satisfy a need; moreover, they must perceive the purchase of a product or service as a positive effect on the satisfaction of that specific need. In this perspective, the role of the marketing process is fundamental to satisfy needs of users (Mill & Morrison, 1985).

In this regard, tourism managers should know the implications of their marketing strategies on the target audience, in order to better determine the success of the marketing policies adopted (Goossens, 2000).

The recognition of tourist motivation is the basis for the development of the offer and the competitiveness of tourist promotions. In particular, in a highly competitive market such as tourism where the heterogeneity of tourism products is increasingly high, it is essential to understand in depth the driver of the motivation of tourists.In the studies on tourist behavior (Heitmann, 2011), in addition to the demographic and social structure of tourist, the most relevant question is 'why people travel?'. To answer this question, several scholars (Plog, 1974; Crompton, 1979; Dann,1981; Mannel & Iso-Ahola, 1987; Pearce, 1988; Plog, 2001) have proposed different classifications of the factors that influence the travel decision (Figure 1).

Table 1. Tourism motivation-based on literature

Authors	**Tourism motivation**
Dann, G.M.S., Tourist Motivation: An Appraisal, 1981, *Annals of Tourism Research*, vol.3 no.2, page 187 – 219.	Dann proposed seven approach: ● Travel as a response to what is lacking yet desired; ● Destination 'pull' in a response to motivational

	'push'; ● motivation as fantasy; ● motivation as classified purpose; ● motivational typologies; ● motivation and tourist experiences; ● motivation as auto-definition and meaning.
Crompton, J. L. (1979). Motivations for pleasure vacation. *Annals of tourism research*, *6*(4), 408-424.	Crompton distinguishes 7 socio-psychological motives: ● escape from a perceived mundane environment, ● exploration and evaluation of self, relaxation, ● prestige, ● regression, ● enhancement of kinship relationships and facilitation of social interaction; ● and 2 cultural motives: novelty and education.
Mannell, R.C. & Iso-Ahola, S. 1987. The Psychological Nature of Leisure and Tourism Experience. *Annals of Tourism Research.* Vol. 14, 314-331.	Mannell & Iso-Ahola proposed two dimensional tourism motivation model: approach (seeking) and avoidance (escape). They suggest that people are motivated to travel to: ● Escaping personal environment ● Escaping interpersonal environments ● Seeking personal rewards (self-determination, a sense of competence or mastery,challenge, learning, exploration and relaxation. ● Seeking interpersonal rewards (social interaction)
Plog, S.C. (1974), "Why destination areas rise and fall in popularity". *Cornell Hotel and Restaurant Administration Quarterly*, Vol. 14 No. 4, pp. 55-58. Plog, S.C. (2001), "Why destination areas rise and fall in popularity: an update of a Cornell quarterly classic. *Cornell", Hotel and Restaurant Administration Quarterly*, Vol. 42 No. 3, pp. 13-24.	According to Plog, tourists may be classified along two dimensions: ● allocentrism/psychocentrism, who seek adventure and the experiences of new cultural and environmental challenges ● energy, which describes the level of activity desire by tourist
Pearce, P. (1988), The Ulysses Factor: Evaluating Visitors in Tourist Settings, Springer-Verlag: New York, NY.	Pearce developed the TCL model: it demonstrates how tourists can change their motivations over time; motivation levels are influenced by past experiences. This model has strengths in terms of considering dynamic factors influenced by experiences obtained from career history.

Therefore, the variety of models and factors adopted and discussed by scholars show that there is no single criterion that can generalize all types of tourists to fully understand their destination choice.In particular, in this article we focus on a particular type of tourist and aspect of his motivation to travel: tourist photographer.

2.1 Tourism motivation photo in pre-digital era

Photography has always been an important tool for historical documentation and memory preservation; capable of immortalizing a moment, making it tangible (Stylianou-Lambert, 2017).

The ability of photography to organize the world as an exhibition is underlined by Sontag:

[Photography's] main effect is to convert the world into a department store ora museum-without-walls in which every subject is depreciated into an article of consumption, promoted into an item for aesthetic appreciation (1977, p.110)

Photography has for long been tied to tourism and travel activities. It seems impossible to imagine traveling without taking photos.

Many scholars have reflected on the fundamental role of photography in the tourism sector (Cohen et al., 1992; Hillman, 2007; Scarles, 2012; Höckert et al., 2018). Travelers entering a new environment are attentive to local life and other objects and try to capture in their photos those characteristics of local life that are most affected (Cohen et al., 1992); sometimes oblivious to the rules or restrictions required by law (Chalfen, 1979).

Susan Sontag (1973) supported that the tourist's compulsion to take snapshots of foreign places reveals how taking photos can become essential to live an event; at the same time, to communicate experiences with the help of tourist photographs.

According to Sontag (1977), tourists use photography as a tool to appropriate the place they are visiting temporarily; almost as if they wanted to appease the fear of being in an unknown situation.

Tourists build their travel memories through photographs; they are considered as directors of theatrical performances in which the places and destinations photographed are the stage and the traveling companions or the local elements are the actors (Edensor, 2000).

However, the question that scholars have asked is 'why and what is the tourist eye attracted to? (Figure 2).

Urry (1990) initiated the literature on this topic in 1990: he states that when we go away and become tourists, "we look at the environment…we gaze at what we encounter…and the gaze is socially constructed" (p. 1). With the notion 'tourist gaze', Urry argues that the tourist gaze identifies what is out of the ordinary and what is other. According to Urry, individuals travel to the same, specific shot that they saw in a brochure or on a postcard in order to take the same pictures. For the study of the circulation of objects and cameras it reflects the hegemony of vision in modern tourism (Urry, 2002). Following Urry's thought, Cohen et al. (1992) shifted attention from the tourist gaze to the interactions between photographers and locals. Scholars believe that "outsiders" enter a new environment as momentary visitors find themselves in an ambiguous situation that has an impact on their motivation. Everything that leads them to look for photos of this unknown environment for which they are most affected. According to Garlick (2002), photographs are not only constructed for representation to those who did not travel but

also for the tourist himself or herself who may be convinced by the pictures that the holiday was better than it actually was. Later, Schroeder (2002) declares that the superficiality of tourist experiences brings a banal photograph and that the camera is only a barrier to obtaining an authentic and pure experience. In contrast, Gillet et al. (2016) connected travel photography and a process by which tourists must create original and creative images that have meaning for themselves. In their study, Gillet et al. (2016) found that some tourists felt almost obliged to take photos and that there is a positive connection between photography and the happiness of tourists. According to Chalfen (1979), tourist photography contains two general types of photographic images: first, photographs taken by tourists and, second photographs created for tourists by members of a host community. In both cases, Chalfen (1979) states that the tourist is not free in the act of photographing different destination.

Table 2. Tourist motivation photo-based on literature

Authors	**Tourist motivation photo**
Urry, J. (1992). *The tourist Gaze*. London:Sage Urry, J. (2002). *The tourist Gaze, Second edition*. London: Sage.	*The objects and technologies of cameras and films have constituted the very nature of travel, as sites turn into sights, they have constructed what is worth going to sightsee and what images and memories should be brought back (2002, p.129).*
Cohen, E., Nir, Y., & Almago, U. (1992). Stranger-local interaction in photography. *Annals of Tourism Research*, *19*(2), 213-233.	*It induces them to seek to capture in their photos those features of life by which they are momentarily most strongly impressed (i.e., what appear to them to be the most "authentic," "typical," or "exotic" subjects) (p.214)*
Schroeder, J. (2002). *Visual consumption*. New York: Routledge.	'*the ritual act of photography seemed paramount—one must take a picture when confronted with such an important sight. The camera acts as a proxy for seeing (p.72)*
Gillet, S., Schmitz, P., & Mitas, O. (2016). The snap-happy tourist: The effects of photographing behavior on tourists' happiness. *Journal of Hospitality & Tourism Research*, *40*(1), 1-21.	*We also found evidence of positive relationships between the frequency of photographing on holiday and life satisfaction as well as between the importance of photographing and positive emotions. It can be concluded that a combination of taking many pictures and finding this activity important contribute, respectively, to positive emotions and life satisfaction, two substantive components of happiness. Accordingly, our evidence suggests that photographing on holiday does make people happier.(p.18)*
Garlick, S. (2002). Revealing the unseen: Tourism and photography. *Cultural Studies*, 16, 289-305	*tourists can perhaps promote a new way of seeing, one in which we draw nearer to what remains unseen in the photographic images that dominate our lives today (p.303).*
Sontag, S. (1977) *On Photography*. London: Penguin Books	Tourists use photography as a tool to appropriate the place they are visiting temporarily; almost as if they wanted to appease the fear of being in an unknown situation. *to photograph is to appropriate the thing photographed. . . . It means putting oneself into a certain relation to the world that feels like knowledge – and, therefore, like power (p.4)*

Garrod, B. (2009). Understanding the relationship between tourism destination imagery and tourist photography. *Journal of Travel Research*, 47(3), 346–358.	*the fundamental motivation of tourists traveling to a destination, is to gaze on the panoramas, landscapes, buildings, people, and other manifestations of place they have been led to expect to find there through exposure to visual representations carried in tourism advertisements, television broadcasts, movies, brochures, travel books, and picture postcards* (p.347).

Recent contributions (e.g. Höckert *et al*., 2018; Mostafanezhad and Norum, 2018) shift the attention towards selfie-taking as a new way of looking at tourism. Scholars argue that the 'tourist gaze' has been turned towards ourselves, reaching a new level of self-centeredness in which the 'tourist self' plays a leading role in most of the holiday photos.The development of digital technologies and the explosion of social networks has stimulated this change in the tourist gaze and has impacted on the motivation of the tourist photographer (Nikjoo & Bakhshi,2019) as shown below.

3 Tourism motivation photo in digital era

Photography no longer seems to be a tool used to keep memories but it is increasingly becoming a tool for communicating the identity of the individual. Digital cameras, mobile, photo blogs and other devices have become tools for a new generation of users (Van Dijck, 2008). The act of photographing has become more 'social': sharing one's travel experiences contributes to providing added value to these tourist experiences making them particularly significant (Wang et al. 2012). Through photography, tourists intend to present an "ideal" image of themselves (Stylianou-Lambert, 2012). According to Trinanda & Sari (2019), in the tourist context, selfies are the consequence of technological developments: when the cameras were still in celluloid, tourists took a limited number of photos and moments are expected; now with smartphones and huge digital memory it is possible to take an almost unlimited number of photos. Selfie tourism is a new way of looking at tourism: the camera has become an extension of oneself. Bugeja *et al.* (2018) agree that:

> *"portraits and self-photography is conceptually not new, but, new technology has enabled the ease of capturing photos in larger quantities. Rather it acts as a mirror at which tourists look to take their pictures prior to, as well as when they are taking photos. Tourists are thus not looking through the screen at the destination, but at the screen to see themselves (p.114)".*

So now it has gotten higher on "Look, I'm here!" rather than "This place is beautiful". Below we show the evolution of photography and the corresponding impact on the motivation of the tourist photographer.

3.1 Mobile phone to search information and record memory

Smartphones, advanced mobile phones with software applications play an important role in people's lives and this evolution has opened up and innumerable possibilities in different industry.

Most of the literature (Xiang *et al.*, 2015; Dinhop & Gretze, 2015; Wang *et al.,* 2016; Petrescu & Bran, 2020) links the use of smartphones to the tourist experience and how these new tools influence the travel experience that has become highly 'mobile'. According to Xiang et al. (2015) we have seen two phases of the implementation of the Internet in the tourism industry: the first (1990-2002) in which the Internet has been adopted by the whole sector and the second (2001 to date) in which the attention has been moved from the website to mobile systems (which incorporate the Internet, communication technologies, GPS and photography) which have transformed the tourism sector even more and impacted on consumer behavior. Anja Dinhopl (2015) agree that we are witnessing a moment in the transition of photography, one of the main practices of the tourist context: in particular, the social practices and technological tools that users use to photograph are changing. The results of these changes can be summarized as follows:

1. connectivity and immediate sharing (Dinhopl, 2015);
2. interest of the digital screen that invites socializing and playful shooting (Haldrup and Larsen 2009);
3. the boundaries between everyday life and holidays are blurred (Wang *et al*. 2016).

Globally, the number of smartphone users estimated for 2020 is 2.87 billion (Statista, 2019) and over half of the world's web traffic is now achieved via mobile phones. All this shows how the use of these devices has enormous influence both on the supply and on the tourist demand.

Smartphones manage to guarantee the iteration between the physical and the virtual world and this is particularly important for tourists who in this way can get in touch with the environments they visit at all stages of their journey.

Today smartphones and tablets have GPS systems through which it is possible to store information (e.g. latitude and longitude) of each photo taken by a user. The motivation of tourists to record photos with their mobile phone is also driven by the possibilities offered by some online services (eg Flickr.com) that allow one to share and upload photographs with precise geographical data. The use of the mobile phone offers tourists what Urry has called "imaginative mobility" (2000). So people photographed to photograph what they 'consumed' already in the form of an image: "*Mobile reproductions are more important than life itself (Larsen, 2006, p.249).*

Therefore, smartphones and mobile devices are used for different reasons during the tourist experience. However, a large part of the literature (Wang & Fesenmaier, 2013; Wang *et al.,* 2016) shows that the main uses concern the search for information on the places you intend to visit, as a facilitating tool for planning travel and user travel. A second use concerns photography: tourists have developed routines and habits that carry

on the travel experience. For these reasons, they use the smartphone to take photos in order to keep travel memories and, subsequently, share the images on their social networks because it is now a consolidated habit in daily life and is a way to occupy periods of inactivity of the journey itself (Wang *et al*., 2016).

3.2 Social network to sharing experience

Since the advent of social networks, the increasing propensity of tourists to share content that previously was limited to restricted circles of friends has emerged.

According to McKercher (2016), at least 500 million photographs shared via social networks every day, while already twelve years ago, in a work by De Bruyne, Instagram reached no less than 100 million shared media volumes, 349 million instagram posts with hashtag #selfie are posted on Instagram in 2016 (Wang 2017).

Therefore, Lambert (2012) agree that one of the reasons that push tourists to photograph themselves in the places they visit and publish them on social media, is to demonstrate that they have actually been there. According to Suonpaa (2008) this demonstration of presence ends up becoming a game thanks to the bi-dimensionality of the photographs thanks to the combinations of lights, shadows and perspectives. Again Lambert, in a previous work (2010), recognizes how tourists play with the prospects by simulating climbing the Eiffel tower or straightening the tower of Pisa or kissing the Rock of Aphrodite in Cyprus.

In a 2008 study by Vazire *et al*., it is observed that the publication of travel photos, intended as a comparison with others and in need of self-affirmation and attention, is peculiar to narcissistic individuals who seek a comparison from top to bottom. Being more specific, two different types of comparison are observed: the narcissistic one of "I am better than you" and the envious one of "you are not better than me".

The "envious" approach is generally associated with the massive use of social networks (Krasnova, Wenninger, Widjaja, & Buxmann, 2013), however other authors associate the habit of publishing selfies on social networks with narcissistic visions of self-celebration, (Buffardi & Campbell, 2008; Mehdizadeh, 2010), promoting projections of themselves outside (Fox, Bacile, Nakhata, & Weible, 2018; Lee & Sung, 2016).

The growing importance of the world relating to social networks, as demonstrated by Sigala (2018), allows us to affirm that the real success of a trip does not depend only on experience, but rather on the positive comments and "likes" obtained on the diaries of travel published on social networks. In fact, as in Kozinetz (2010) it is highlighted that one of the main attractions of sharing photographic contents on social networks is the immediacy of publication and related comments and feedbacks.

Based on Wang's work, a subsequent elaborate by Munar et Jacobsen (2013) demonstrates how in the case of tourist photographers the sharing of the travel experience takes place through audio-video content, mainly from photographs, which can be considered the new postcards.

In addition to the evident narcissistic-envy reason, there is an additional motivation for sharing through their social networks their own travel photographs: selflessly supporting others in the pre-trip experience and in its planning. (Von Hippel, 2005; Baym, 2010).

However, in a subsequent Qu and Lee study in 2011, the mainly narcissistic purpose of sharing is confirmed as support for other people is also seen as a moment of self-affirmation. Not surprisingly, by suggesting and reviewing their trip, the tourist considers himself/herself useful and his/her opinion relevant to the choices of others. Finally, to definitively sanction how the sharing of photos online is mainly animated by narcissism, in some studies it is observed that both the photographic profiles, and specific applications for mobile phones, allow to manipulate, even deeply, the photos taken before they are posted online, in order to reach as many positive comments as possible (Toma & Hancock, 2010; Fox & Rooney, 2015).

Based on previous literature, mobile and social networks seem to provide only a partial explanation of the impact on the motivation of the tourist photographer. In light of new technological developments, further efforts are needed to understand how technological evolution and in particular the advent of Artificial Intelligence has had an impact on the motivation that drives tourists to photograph. In this regards, we elaborate a theoretical framework for investigation: in particular, we have identified six blocks in the literature which represent the motivations of tourists to photograph (Figure 1).

Figure 1. The framework for investigation-building blocks of tourism motivation photo based on the literature.

4 Research methodology

4.1 Research aim and framework for investigation

Based on the overview of the above literature, we aimed to better understand the evolutionary process of the motivations that push tourists to photograph with the advent of artificial intelligence, and problems to the debate on the motivations of the tourist photographer present in the literature. This exploratory study was developed to provide theoretical and empirical insights.

First, it uses a theoretical framework to investigate the phenomenon. Second, empirically examine the various theoretical hypotheses. In particular, we studied the potential of artificial intelligence as a driver for the development of new motivations that push the tourist to photograph.

We have described the reasons that emerge from the literature in our literature review above. We have decided to use a theoretical model to guide the results to limit the scope of relevant data by focusing on specific variables identified on the basis of the literature (Tavallaei & Talib, 2010). In this way it will be possible to analyze the differences / similarities between the results obtained and the specific categories.

4.2 Research method and data collection

The research adopted a qualitative approach due to the exploratory nature of the investigation (Halinen and Törnroos, 2005). As a research context we have chosen an evidence from the cultural world: ArtSelfie of Google Art Project. It is generally agreed (Yin, 2002) that the case study method is suitable for examining multiple features of a phenomenon and the interrelationships between them. The choice of the research context on this case study is justified because of its being an explanatory case of the evolution of tourists' motivations in the same way as the evolution of technology. Art Selfie is characterized on an artificial vision technology based on machine learning. In particular, it is an initiative that combines the popularity of the self-timer on the mobile phone with the passion for paintings and, to some extent, wants to make art more accessible for everyone. We chose to analyze the Google ArtSelfie Instagram profile. Instagram, as a context of analysis, has already been used in research on tourism (Fatanti & Suyadnya, 2015). Our dataset, consisted of 460 entries posted, counting about 2,000 words.

4.3 Data analysis

A content analysis (Weber, 1990) was conducted for data analysis. In this regard, the TextSTAT software is used, which offers the options we need to update (eg Word Frequency, the use of concordance). The use of this software has already been proposed

by service scholars (e.g., Jani and Hwang, 2011). Data analysis took place following the following two steps:

1) word frequency (articles, prepositions, conjunctions, proper names);
2) concordance analysis to highlight the most frequent and relevant links between words;
3) The coupling of words and examples promoted an understanding of the underlying meanings of the content of the tourist's communication by tracking back single quotes; this third step revealed latent contents (Borkowski *et al.,* 2012).

The information collected has been analyzed in relation to each categories of the theoretical framework and is discussed in connection with the evidence that has emerged.

5 Findings

In the analysis of tourists' comments, one of the most quoted words, which represents an expected result, is app. The term is associated with words that express a sensation / feeling (e.g. cool and love) and with words that express an action (download and playing). Table 3 summarizes the most significant evidence.

Funny 'and' game 'are two more common words in tourist quotes. Both terms are associated with the infinitive verb 'see' as if to underline the fun of observing the use of the app.Furthermore, the agreement between 'funny' and the adjective 'very' highlights the fun and joyful feeling of using the app.

Among the most quoted verbs are the perception verbs 'feel' and 'love''. These verbs express a state rather than an action and are most often associated with the verb 'like' indicating a feeling / desire. Indeed, the verb 'look' associated with 'like' and 'alike' indicates similarity.

Finally, the verb 'try', placed among the ten most quoted words, is associated with the demonstrative adjectives 'that' and 'this', almost as an expression of the spatial relationship between the individual who speaks and an object.

Table 3. Quotes ArtSelfie

Most frequent words	**Concordant word**	**Exemplifying Quotes**
App	Cool Love Download Playing	**"This app is cool"** **"Still love this app"** **"Download app!"** **"Been playing with the Google app that matches your selfie with museum portraits"**
Game	See Changer	**" In addition to this little game to see what painting your selfie looks like, you can review masterpieces in detail and find out about art news"** **"Omg I didn't realize they bypass your face and go straight to your soul. Game changer."**

Funny	Too very See	**“Hahaha is too funny! What !is the name of the app? Will you show it to me?”** **“It is very funny to see how successful the program is, I recommend it a thousand just tried out the Google doppelganger Arts & Culture challenge”**
Feel	Like Good Dapper	**“70% similarity! Feel like a heroine with paintings or a face on a pendant, like me”.** **“Feeling real good about this”** **“How do I feel about this? Feel dapper”**
Look	alike like much	**“Beautiful! we almost look alike”** **“It looks like a person”** **“Ha, looks so much like you! I know that look. Hope you are well.”**
Love	This Photo My	**“I love this early example of Baroukh's transition from classical figuration to more abstract portraiture”.** **“lovely photo”** **“Google Arts & Culture has a artist selfie section, where you can discover your #doppelganger and I think that I loved my two comparisons!!”**
Try	That This	**“i’ll have to try that! Perfect pic btw! Looks just like you and it is a great painting”** **“I have wanted to try this so badly!”.**

6 Discussion/Implications

Findings show how tourist photographers' motivation change with technological evolution. Indeed, technological innovation stimulates the birth of a more 'social' photograph helping to provide added value to tourist experiences (Wang et al. 2012).

The ArtSelfie case offers adequate results as motivations that push tourists to photograph have changed with the advent of new technologies and, above all, of artificial intelligence. Advancing on the results emerged in literature, we show how AI affects the categories of the tourist photographers’ motivation (figure 1).

6.1 Discussion

6.1.1 Record Memory

This category was the main motivation for tourists to take photos. Tourists have captured the magical moments of their holidays to jealousy preserve travel memories or show them to their friends. From the analysis, it would seem that AI has obscured this category in view of "stronger" motivations. We believe it is a 'hidden' motivation: on the other hand it is important to consider that first of all, with the advent of the smartphone and a huge digital memory, amd online storing capacity, it is possible to take photos at any time almost without consideration. Furthermore, we have studied the comments and

reviews present only on Instagram and it is clear that even if it has not been explicitly stated, having potentially preserved the combination that most has impressed them in the gallery of their mobile phone.

6.1.2 Emotion

The 'emotions' category was associated with the motivation of tourists to capture the shots from which they were most affected and attracted. Even today we continue to talk about emotions but in a different way: in particular, the analysis shows that people have feelings of pleasure in seeing their faces compared to the great characters of the time. For these reasons the word 'love' used both as a noun and as a verb of feeling is among the top ten most frequent words of the analysis.

6.1.3 Curiosity

This category contemplated the curiosity of photographing places that tourists had imagined and desired through brochures and travel books. Curiosity is a motivation that still drives tourists to photograph, albeit with a greater focus on 'themselves'. The verb 'try' that is present in the first ten most used words is significant of the propensity of tourists to photograph or better photograph themselves. In the quotes we read the curiosity of tourists to 'try' the application to find out which character their face would have been associated with.

6.1.4 Happiness

The act of photographing contributes to the happiness and satisfaction of the travel of tourists. The words 'game' and 'funny' show the propensity of tourists to photograph for fun. The correlation with the verb 'see' demonstrates the link between the ArtSelfie application and the game and fun emotions of tourists.

6.1.5 Narcissism

This motivation emerged in the literature on the use of social networks in the tourism sector. On the other hand, with the advent of social media, photography has become more 'social' and there is a transition to the era of selfies. In the analysis of the case, the motivation linked to the promotion of oneself and the sharing of one's photos still emerges. In particular, the verb 'look' associated with the verbs 'like' and 'alike' underlines the willingness of tourists to 'show other social users' which historical character they have been associated with, thus promoting a 'different self'.

6.1.6 Culture, Knowledge

The motivations related to 'culture, knowledge' still drive tourists to photograph today. In particular, the verbs of perception 'feel' and 'love' associated respectively with adjectives like 'good' or 'this / that' show that tourists feel good to see their face associated

with heroines or knights of art history. It is no coincidence that many tourists share their photos by posting a review of their 'doppelganger'. In fact, once the match is found, Google Art Selfie will give you a lot of information on your famous "look-alike", from the author of the portrait to the museum that houses it.

Therefore, applications such as ArtSelfie could be a solution to stimulate not only fun and play but to make art accessible to everyone.

6.2 Implications

Our study contributes to the conceptualization of the motivation of tourist photographers in a highly technological context. The work proves useful to serve research by providing more details of previous scholars on the link between technological evolution and the motivation that drives tourists to take photographs.

As demonstrated by our results, the evolution of technology and especially AI and facial recognition algorithms have had a potential impact on the motivation of photographing tourists.

Our analysis in a practical context can be of help to scholars and professionals who have made great efforts to analyze and understand what are the reasons that drive tourists to take photographs of their journey (Urry, 1992; Schroeder, J. 2002; Gillet *et al.*, 2016). From a theoretical point of view and consistent with the contribution of Vazire et al. (2008), our findings also contribute to opening the debate on the possibility of combining the motivation that drives tourists to take photography and to use social media to share their experiences with the birth of an era characterized by narcissistic individuals who have need self-assertion and attention.

Combining the motivation of tourists with the evolution of technology and in particular AI, also allows to extend the debate on the 'curiosity' that drives users to take photos during their trip (Garrod, 2009). In the same way, we stressed that curiosity is a strong motivation that drives tourists to take photos. However, in addition to the curiosity of photographing unknown places (Garrod, 2009), we show that tourists have a greater focus on 'themselves' and on the propensity to photograph their faces.

So, we are at a time when photography has become more 'social' and users are driven to take photos out of the desire for curiosity to see themselves in a different way or simply for fun. Unlike the previous contributions (Urry, 1992; Wang et al., 2016) in this way it would seem that the main motivation that in the past pushed tourists to photograph - that is to say record memory and search information - no longer exists. Adding to the previous contributions, we emphasize that with the development of technology and especially AI, taking photos has become a daily gesture and in all probability we conclude that the motivation for record memory is still present but “hidden”.

7 Limitation and future research

Some limitations of present study may address the planning of future research. In particular, the choice of content analysis as our methodology leads to some limitations deriving from the difficulty of comparing what the content affirms with what reality reveals. Furthermore, conducting interviews with tourist photographers would be useful to integrate and compare the results and improve the reliability of the study. In terms of the context of analysis, a wider range of evidence from projects of further tourist realities would have been useful to improve the evidence. So new investigations are possible and encouraged.

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Voluntary Intellectual Capital Disclosure and Big Data. Empirical Evidence from a Sample of Knowledge-Intensive Italian Companies

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Abstract

The present research aims at analysing the level of IC disclosure provided by a sample of knowledge-intensive Italian companies through an innovative tool - the web - considered as the most used vehicle to collecting, managing, conveying and sharing BD to investors and other stakeholders. From a methodological point of view, the research adopts a manual content analysis conducted on the websites of a sample of listed Italian companies belonging to the ICT sector. Results show that Italian companies operating in the knowledge-intensive sectors are aware of the importance of providing information on IC to the audience of investors and stakeholders and are exploiting the potential and opportunities offered by the web 2.0 and BD partnership.

Keywords – Intellectual capital; Big Data; Web sites; disclosure; Italian companies.

Paper type – Academic Research Paper

1 Introduction

In recent years, the globalization, the diffusion of the new technologies, the change in consumption processes and the deregulation of many industrial sectors have marked the transition from the industrial economy to the knowledge economy (Lev et al., 2005). In the knowledge economy, intangible resources have acquired greater importance than tangible business models, imposing themselves as key factors for the achievement of competitive advantages sustainable and greater economic-financial performance (Lev et al., 2005; Smriti and Das, 2018). In this scenario, the importance of *Intellectual Capital* (IC) emerged as a set of intangible resources related to knowledge (skills, skills and abilities of employees, databases, routines, reputation, image and relationships established between the company and the ecosystem in which it operates) which allow companies to create value for themselves as well as wealth for the socio-economic environment in which they operate (Dumay and Guthrie, 2017). Given its relevance, reliable and timely information on the IC of companies has become fundamental both for managers to enhance internal decision-making processes and for investors and various stakeholders to refine their company evaluation and, therefore, allocation processes of financial resources. As highlighted by Goebel (2018, p. 2), the IC "plays a key role in corporate communication"; therefore, it becomes necessary for companies to provide all its stakeholders with an adequate flow of information capable of signalling the economic value of IC-related resources as well as their contribution to the creation of value. However, both national and international current accounting systems are inadequate to provide exhaustive information to investors and other stakeholders on the real value of the intangible resources of the companies and the value of the real drivers of the its performance. This has led academics and practitioners to reflect on the opportunity to develop alternative tools to provide more detailed information on IC. In the last twenty years several approaches have been implemented for the measurement and reporting of the IC; however, none of them has become a universal reference (Joshi et al., 2010; Dumay, 2016). Moreover, the introduction of new technologies such as the *Internet of Things (IoT), 3d printing, Cloud computing, Artificial Intelligence, Blockchain* and *Big Data* (BD) has led to a further transformation in the processes of creating value for companies and in business models, leading to decisive changes also in the accounting and reporting practices of information (Dumay and Guthrie, 2017; Al-Htaybat et al., 2019; D'Ippolito et al., 2019). In particular, the BD were received as a tool finally able to overcome the limitations of traditional financial statements by allowing companies to provide more comprehensive information, able to support investors and other stakeholders in understanding and estimating the real economic value of the intangibles

and therefore of the IC (Warren et al., 2015; La Torre et al., 2018). This is particularly useful for companies that can be defined as knowledge-intensive, that is, those in which the role of investments in the management and development of knowledge resources (such as research and development, human resources, knowledge, brands, digital technologies etc.) it is predominant compared to that of physical resources. In fact, these companies tend to report a widely reduced operating value compared to their real economic potential and consequently experience greater difficulties in finding capital and financial resources, given the information asymmetry and the strong uncertainty that is created in the market (Bukh et al., 2005; Oliveira et al., 2006; Sonnier et al., 2009). Some studies on the topic (eg Bozzolan et al., 2003; Oliveira et al., 2006) show that, as a consequence, these companies tend to provide greater voluntary disclosure of the IC to make up for the limitations of traditional financial statements and favour the investor resource allocation process; therefore, it can be assumed that they can represent valid best practices in the field of IC communication (especially via the web, given their core business). The present study intends to contribute to the literature by proposing an analysis of the websites, intended as the main sources of BD, of a sample of 13 listed Italian companies belonging to the Information and Communications Technology (ICT) sectors and therefore considered as best practices in the field of web communication. The ultimate goal is therefore to analyse the level of disclosure on the IC provided by knowledge-intensive Italian companies through the web, considered as the source and the vehicle most used for BD communication. In addition to this paragraph, which represents its introduction, the paper is composed by five paragraphs. The second paragraph is dedicated to a brief review of the literature; paying particular attention to the definition of IC and BD and to the main points of contact between them, as well as to the main studies conducted on IC disclosure. In the third paragraph the methodology used is illustrated, the fourth illustrates and proposes a discussion of the results of the study and the fifth is dedicated to the final considerations.

2 Literature review

2.1 Intellectual Capital e Big Data

Over the past twenty years, numerous scholars (Dumay and Garanina, 2013; Secundo et al., 2017; Ndou et al., 2018) have dedicated their studies to the concept of IC and its main dimensions, proposing different definitions of it. Considering also the value of IC as strategic factor not only for the competitiveness and financial performance of the company but also for the ecosystem of stakeholders in which it operates, the European Commission defines the IC as the "intellectual material, knowledge, experience, intellectual property and information that can be put to use to create value" (Stewart, 1997; European Commission, 2006; Dumay, 2016, p. 169).

The IC company is usually broken down into three traditional capitals (Guthrie and Petty, 2000; Bozzolan et al., 2003): 1) human capital; 2) structural capital and 3) relational capital. *Human capital* is defined as the sum of the skills, knowledge, capabilities, creativity, motivations and attitudes of employees acquired through experience or specific training programs. (Bontis, 2001; Joshi et al., 2010; Smriti and Das, 2018). *Structural capital* represents coded and rooted knowledge within the company in the form of consolidated processes, routines, copyrights, patents, hardware, databases and information systems. It can be considered as the structure that supports the company's human resources in the processes of creating value. (Bontis, 2001). *Relationship capital* represents the company's external IC projection in terms of relationships established with stakeholders such as suppliers, partners, customers, etc. It represents the knowledge that flows from the outside to the inside of the organization and that is transformed into the economic value of the company through the implementation of strategic partnerships and alliances, customer satisfaction and loyalty, the development of an image and a positive reputation on the market and the creation of a strong brand (Bontis, 2001; Joshi et al., 2010).

Therefore, IC must be see not as a static concept but as a set of interconnected capitals which, when properly managed and valued, contribute systemically to the process of creating value, allowing the company to obtain a lasting competitive advantage and – consequently - to obtain economic and financial performances higher to the competition.

In the last few years, the advent of the fourth industrial revolution has led to a progressive digitization of the internal processes for creating the value of companies as well as accounting and reporting of information, envisaging an evolutionary scenario in the communication between companies and stakeholders (Dumay and Guthrie, 2017 ; Al-Htaybat et al., 2019; D'Ippolito et al., 2019). In particular, big data have given new impetus to corporate reporting by designing an innovative context for the sharing of information between company and stakeholders based on the use of *hypertexts, hyperlinks* and multimedia files such as audio and video which have increased interactivity , and the accessibility of information, promoting the timely and instantaneous sharing of financial and non-financial data through digital platforms (Al-Htaybat and von Alberti-Alhtaybat, 2017; Al-Htaybat et al., 2019).

Big data are in fact considered as huge volumes of digital data, which can be found in various sources, which when properly processed can generate structured knowledge and tangible benefits for organizations (Secundo et al., 2017). They possess six fundamental qualities: volume, variety, speed, truthfulness, variability and value that make them a unique tool capable of supporting managers, investors and other external stakeholders in making better estimates of the value of the company, supporting the creation of the value, solve potential problems related to internal processes and improve the reporting processes of financial and non-financial information (Al-Htaybat and von Alberti-Alhtaybat, 2017). The latter aspect is fundamental because it highlights how BD can mark an evolution in corporate reporting by ensuring a multiple and continuous exchange, through different

information sources and platforms, and in various formats, of timely and relevant data (Al-Htaybat et al., 2019). However, in order to be useful, BD need to be adequately refined, treated and managed and above all to be conveyed through dynamic channels suitable for capturing their value (Al-Htaybat and von Alberti-Alhtaybat, 2017) such as the internet and technologies web 2.0 (Al-Htaybat et al., 2019). The web has become the main channel through which companies can collect, manage and share BD through hypertexts and hyperlinks, audio, video and data analytics software, increasing the accessibility, interactivity, timeliness and usability of information and therefore, overcoming the static nature and the delay with which information is transmitted in traditional financial statements (Htaybat and von Alberti-Alhtaybat, 2017).

The big data and web 2.0 connubial, revolutionizing the accounting and reporting practices of companies, has given new life to IC research because BD has been accepted as a new tool capable of providing a satisfactory level of disclosure on IC (La Torre et al. , 2018; Ndou et al., 2018). The big data can be considered as the company's structural capital and therefore as an intangible asset which can improve the value creation process and guarantee a competitive advantage (Secundo et al., 2017). The big data and web 2.0 allow to increase information transparency decreasing the information asymmetry with investors and stakeholders (Secundo et al., 2017); in fact, they allow to overcome the limitations of traditional financial statements by providing better information on the intangibles owned and developed by the company (La Torre et al., 2018).

This especially in the context of knowledge-intensive high-tech companies that make substantial investments in the acquisition and development of intangible resources, which are systematically excluded or undervalued from the financial statements (Bukh et al., 2005). Furthermore, these companies are characterized by a significant level of complexity and management decentralization, by a high rate of renewal of the resources and technologies used and above all by a conspicuous volume of tacit knowledge which constitutes a core element of the IC (Palazzi et al., 2019). Furthermore, knowledge-intensive companies operate in environments characterized by strong competition and high future variability of market conditions which make forecasting analyses of economic results very complex (Bozzolan et al., 2003). In these companies the BD represent an important input and output of their production processes as well as a key element of their IC; hence, knowledge-intensive companies can be considered best practices in the use of BD both in support of management processes and in support of external communication processes.

2.2 Prior research on IC disclosure

IC research has evolved through four main stages (Dumay and Garanina, 2013; Secundo et al., 2017; Ndou et al., 2018). In the first stage of the research, academics and practitioners focused mainly on studies and analyses aimed at acquiring awareness and recognizing the potential of IC; in the second stage, research on IC began to consolidate

and spread like wildfire with the development of additional methods to identify, measure and report of IC companies (Dumay e Garanina, 2013); the third stage focuses on the concrete analysis of the practical implications deriving from the use of IC-related resources in business management processes (Dumay and Garanina, 2013). The fourth and final stage expands the investigation perspective by considering the relationships between the company, stakeholders and the wider socio-economic environment in which it operates. This study intends to be placed in the fourth stage of IC research, proposing an analysis of the websites, intended as main sources of BD, of a sample of 13 Knowledge-Intensive Italian Companies with the aim of analysing the level of disclosure provided on the IC.

The previous researches that investigated the quantity of voluntary disclosure of the IC are mainly located in the second and third stages and are focused on the analysis of the annual reports as a possible source of information. Many studies have also shown a strong influence exerted by the industrial sector of belonging on the level of disclosure of the IC provided (Bozzolan et al., 2006; Oliveira et al., 2006; Bruggen et al., 2009; Sonnier et al., 2009; Goebel, 2018). Specifically, companies considered as knowledge-intensive, belonging to sectors characterized by a high rate of innovation and renewal of the resources and technologies used, as well as based mainly on the acquisition, management and exploitation of intangible resources in their processes of creation of the value, tend to provide a greater quantity of IC disclosure to: (1) reduce information asymmetry with investors and other stakeholders; (2) decrease uncertainty and risk perception (3) improve the allocation of investors' financial resources and stakeholder decision-making processes; and, (4) reducing the cost of capital (Bozzolan et al., 2003; Oliveira et al., 2006; Bruggen et al., 2009).

The limitations of the annual reports has stimulated researchers to analyse new sources and more dynamic vehicles able to satisfy the information expectations of stakeholders on the IC (Cuozzo et al., 2017). Pisano et al. (2017) analysed the level of disclosure on human capital provided by a sample of European companies through a web 2.0 social network - LinkedIn; Lardo et al. (2017) used a sample of 40 European football clubs to evaluate the level of disclosure on the IC provided through social media (Facebook, Twitter, Google Plus, Instagram) and the relationships between the disclosure itself and the market value, the volume of revenues and price of players; Duff (2018) examined the level and quality of voluntary disclosure on the IC conveyed by a sample of professional accounting consultancy companies in Great Britain through a multiplicity of tools such as: annual reports; Corporate Social Responsibility - CSR reports and websites; Terblanche and de Villiers (2019) analysed the level of disclosure on the IC provided through Integrated Reporting - IR by a sample of companies listed on the South African market; Manes Rossi et al. (2018) focused on the university context, analysing the websites of Italian public universities to examine the level of IC disclosure provided as well as the characteristics of the websites in terms of accessibility and usability; e, Ndou et al. (2018) conducted a case study on an Albanian university to verify how BD

generated through different online platforms such as websites and social media are influencing the IC disclosure.

These studies mark the transition from the third to the fourth stage of IC research and highlight how other means made available by the new industrial revolution such as the new digital technologies (BD and web 2.0) are marking an evolution in corporate reporting, representing a new path for transmitting to investors and other stakeholders useful information excluded or underestimated by traditional reporting tools.

3 Research methodology

The study focuses on a specific sample of companies listed on the Italian stock exchange. Using the "super sector" classification for industrial sectors reported on the Borsa Italiana website, only companies belonging to one of the sectors classifiable as knowledge-intensive and therefore operating in ICT were selected. Therefore, the selected sector is the Media, including 13 companies. These companies make high investments in the acquisition but above all in the production and internal development of intangible resources related to knowledge and innovation and are characterized by a high technological rate of their production processes and information systems (Sonnier et al., 2009). As such, on the one hand, they adopt innovative business models made available by the digital revolution such as BD and web 2.0 applications that allow improving the effectiveness and efficiency of internal processes. On the other hand, they exploit these innovative resources to improve the process of external communication with investors and other stakeholders, overcoming the limitations of traditional financial statements. This allows it to decrease the perception of risk by possible capital bearers and to guarantee a greater flow of financial resources from the markets (Bozzolan et al., 2003, 2006). Thus, these companies can be considered as best practices in the field of IC communication through innovative digital tools such as the web and BD.

The analysis of the voluntary disclosure of the IC focuses on the official websites of the companies considering only the web pages in digital format (HTML) with annexed hyperlinks and hypertexts, thus excluding the files conveyed in other formats such as pdf , word or power point (Striukova et al., 2008; Cormier et al., 2009). This allows capturing only the information that can be transmitted via the web and not in classic formats and which, as such, constitute a distinct source of information (Striukova et al., 2008; Cormier et al., 2009). The method used to conduct research on websites is content analysis. Content analysis has been defined as a "search technique for obtaining replicable and valid inferences from data based on their context" (Krippendorf, 1980, p. 31). It is the most used method in the works that examined the IC disclosure and is considered reliable, objective and empirically valid (Guthrie et al., 2006; Cuozzo et al., 2017). The content analysis has been conducted referring to the framework most used by the majority of active literature on the topic (Guthrie and Petty, 2000; Bozzolan et al., 2003; Guthrie et al ., 2006; Striukova et al., 2008; Duff, 2018). It derives from the initial framework developed by Sveiby in 1997 and subsequently modified by the aforementioned authors

based on the peculiarities of the geographical contexts, industrial sectors and information vehicles used.

Table 1 provides a list of all the elements (24) examined grouped in the 3 categories.

Table 1 - Framework for the IC voluntary disclosure analysis

	Item	Description
	Internal capital (structural)	
1	Patents	Information on patents acquired or developed.
2	Copyrights	Information on the copyrights held.
3	Trademarks	Information on the company's trademarks.
4	Corporate culture	Information on the company's social, psychological and cultural environment.
5	Management processes	Information on management processes.
6	Information systems	Information on the internal and external information systems used by the company in its processes.
7	Communication systems	Information on the communication systems used both inside and outside the company.
8	Financial relations	Information on relations between the company and investors and lenders.
	External capital (customer/relational)	
1	Brands	Information about the brand or corporate brands and their value.
2	Customers	General customers' information.
3	Customer satisfaction and loyalty	Information on programs developed for customer satisfaction and consolidation.
4	Company reputation	Information on the perception of the company by stakeholders.
5	Distribution channels	Information on the main distribution channels used.
6	Business collaborations	Information on strategic alliances, partnerships and agreements entered into with other companies
7	Favourable contracts/licensing	Information on signed contracts or licenses obtained by the company.
8	Public relations	Information on stakeholder engagement: events, meetings, fairs, conferences organized to promote the company.
	Human capital	
1	Employee	Information on employees, company profiles and tasks.
2	Education and professional qualifications	Information on employee education and professional qualifications.
3	Training	Information on training programs developed for different categories of employees.
4	Human resource management	Information on human resource management.
5	**E**mployee / partner innovation	Information on creativity and technological inventions developed by its employees or partners
6	Recruitment policies	Information on the recruitment and turnover policies adopted.

7	Career opportunities	Information on career opportunities offered to aspiring candidates.
8	Diversity	Information on the equal opportunities policies adopted.

The information collected through the manual content analysis of the websites was coded following a fundamentally dichotomous approach, that is based on verifying the presence or absence of the information contained in the framework described above (Pisano et al., 2017; Manes Rossi et al., 2018).

4 Result and discussion

The data contained in table 2 illustrates the general results of the content analysis conducted on the websites of the 13 selected companies operating in the ICT macro-sector.

Table 2 - Results of the content analysis for each category

	Tot.	Average	%	Var.	Min.	Max.
Internal capital (structural)	8	6.31	79%	0.73	6	8
External capital (relational)	8	7.15	89%	1.14	5	8
Human capital	8	5.8	63%	6.91	1	8
Total	24	18.58	78%	15.77	12	24

In line with previous studies (Striukova et al., 2008; Lardo et al., 2017; La Torre et al., 2018; Manes-Rossi et al., 2018; Ndou et al., 2018), the results show that Italian Media companies operating in the knowledge-intensive sectors, are aware of the importance of providing information on IC to the audience of investors and stakeholders and are exploiting the potential and opportunities offered by the web 2.0 and BD partnership.

In fact, each company in the sample provides on its website, on average, about 18.54 items out of the 24 analyzed, representing about 78% of the total, with a minimum of 12 and a maximum of 24 items. This allows us to confirm the hypotheses previously made on knowledge intensive companies (Bruggen et al., 2009; Sonnier et al., 2009; Goebel, 2018) and to confirm how they can be considered best practices in the use of BD in external communication processes with stakeholders. These companies operate in highly competitive environments characterized by rapid technological progress and therefore invest heavily in the acquisition and internal production of intangible resources such as digital information systems, innovations, development and training of human resources, research and development to obtain sustainable competitive advantages compared to the competition (Bozzolan et al., 2003,2006; Bukh et al., 2005; Sonnier et al., 2009).

About 89% of the items in the relational capital category have been reported on the websites of Italian ICT companies. This result is in line with what has been observed by the prevalent literature on the subject (Guthrie and Petty, 2000; Bozzolan et al., 2003;

Guthrie et al., 2006; Bruggen et al., 2009; Goebel, 2018). It allows us to confirm how, in the context of the knowledge economy, characterized by the globalization of markets and by strong competition existing no longer on the product in the strict sense but on related services and on marketing, relational capital has taken on a fundamental importance for companies. Therefore, the information on this capital is of great importance for communicating to stakeholders how the company is able to create value from the inside out by focusing on the development of medium and long-term relationships with suppliers, partners and customers. On the contrary, the less attention paid to human capital, although it contrasts with the fact that knowledge-intensive companies rely heavily on the development and training of human resources in their value creation processes, in some way can be explained by the desire to such companies not to reveal much information on strategic resources to which the know-how and the tacit knowledge assets of the company is linked. In fact, such information could create damage to the company because it could be exploited by current and potential competitors to imitate the company or take away strategic resources, eroding market share (Bozzolan et al., 2003).

These considerations can also be extended to the analysis of the individual elements of the three capitals whose results are shown in table 3.

Table 3 - Content analysis results for single elements

Intellectual capital elements	N. of company	% of company
Internal capital		
Patents	2	15%
Copyrights	3	23%
Trademarks	13	100%
Corporate culture	12	92%
Management processes	13	100%
Information systems	13	100%
Communication systems	13	100%
Financial relations	13	100%
External capital		
Brands	12	92%
Customers	9	69%
Customer satisfaction and loyalty	9	69%
Company reputation	11	85%
Distribution channels	13	100%
Business collaborations	13	100%
Favorabile contracts/licensing	13	100%

Public relations	13	100%
Human capital		
Employee	7	54%
Education and professional qualifications	10	77%
Training	9	69%
Human resource management	7	54%
Employee / partner innovation	11	85%
Recruitment policies	7	54%
Career opportunities	9	69%
Diversity	6	46%

In particular, from the analysis of the individual elements of the framework, it emerges that the majority of the information of internal capital (trademarks, management processes, information systems, communication systems and financial relations) and some information of relational capital (distribution channels, business collaborations, favorable contracts/licensing, public relations) are reported by all the companies in the sample, as well as information on corporate culture and brands are reported by almost all of the sample (92%). These data confirm the results of other studies (Guthrie and Petty, 2000; Bozzolan et al., 2003; Guthrie et al., 2006; Oliveira et al., 2006). As for human capital, information on: employee / partner innovation (85%); education and professional qualifications (77%); and career opportunities (77%) and training (77%) are the most reported. This testifies to the centrality of the elements of human capital in ICT companies and the possibility offered by the web 2.0 and BD partnership to offer information that is excluded or only partially reported in traditional financial statements (Bozzolan et al., 2006; Bruggen et al. , 2009; La Torre et al., 2018). Particular attention should be devoted to the information on gender policies that is reported only by 46% of the sample. This result could be explained by the fact that, in compliance with the European directive 95/2014 on non-financial information, the companies in the sample may have opted for other tools (e.g. Sustainability Report or IR) to transmit this information or have prepared a specific gender balance.

Finally, as regards internal or structural capital, in line with previous studies (Guthrie and Petty, 2000; Bozzolan et al., 2006; Guthrie et al., 2006; Oliveira et al., 2006; Duff, 2018), the items most present on the websites of the companies analyzed are: management processes; Informative system; communication systems; e, financial relations. This result testifies how in the knowledge-intensive Italian companies the need to meet the information expectations of the stakeholders emerges regarding the internal structure of the IC and all that is at the basis of the creation of value (management processes); moreover, it is also indicative of the fact that for these companies the BD are

considered part of the structural capital in the proper form of information systems and communication systems.

5 Conclusions

This study contributes to the debate on IC disclosure in the fourth stage of IC research, exploring an innovative vehicle through which companies can transmit information to stakeholders on IC. Specifically, an analysis of the websites, intended as the main sources of BD, of a sample of 13 listed Italian companies belonging to ICT sectors was proposed to analyze the level of disclosure on the IC provided.

The analysis has shown that the Italian knowledge-intensive companies have acquired a marked awareness about the importance of providing information on IC and, for this purpose, are exploiting the potential and opportunities offered by the web 2.0 and BD union. In fact, the results showed that the companies analyzed provide a high level of disclosure on the IC via websites. This result can be traced back to the attempt to reduce the uncertainty and risk perceived by investors regarding the economic-profit prospects of companies, improve the decision-making process of the stakeholders and create positive effects on the market in terms of decrease in the cost of equity (Bozzolan et al., 2003,2006; Bukh et al., 2005; Sonnier et al., 2009). Therefore, this study, although conducted on a limited sample, demonstrates how the BD on the IC conveyed via the web allow overcoming the limitations of traditional financial statements, providing a high level of disclosure to all interested parties. Particular attention is paid to external capital which incorporates information relating to collaborations, distribution channels and relations with stakeholders to emphasize the contribution given by the IC to the creation of value for the outside while limited attention is dedicated to certain aspects of capital human as training and management of human resources, whose data are particularly sensitive and their diffusion can create negative consequences in competitive terms.

From the point of view of the practical implications, the research will be useful for standard-setters and practitioners: the former will be able to draw methodological indications useful for the elaboration of guidelines for the external communication of the IC that contemplate the use of BD and the web; the latter will have useful information to improve the IC disclosure of companies by using communication tools other than traditional annual reports. Academics will also be able to benefit from this research, which can be used as a reference for developing similar analyzes in different geographical and / or product contexts.

However, the study has limitations that can also be considered as ideas for future research. In particular, the analysis was conducted on a small sample of companies belonging to specific industrial sectors and was conducted over a single year. Therefore, future research could be conducted on larger samples including companies belonging to other sectors and could also include qualitative analysis of the information on the IC conveyed by the companies.

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Enhancing Healthcare Decision-making Process through Accounting Tools: Findings from the Surgical Field

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Abstract

Healthcare decision making process is a cognitive process included a choice between option as categories and diagnosis; its complexity is due to the involvement of more peoples and the gap between information availability and necessity. It could be affected by several factors including cognitive shortcut of decision makers. To identify these biases of decision-making process and improve its quality Kahneman identified a tool: the checklist.
This study aims to analyse firstly the clinical decision process of orthopaedic surgeons, secondly it aims to understand if and how the more information availability derived by the use of an accounting tool (Time Driven Activity based Costing) can modify the decision-making process.
Both goals regarding the decision making process about management of follow-up of patient undergoing a knee and hip arthroplasty surgery.
To achieve its goals semi-structured interviews with three orthopaedic surgeons from three different working contexts were conducted.
Several biases affected the decision-making process of orthopaedic surgeons choosing follow-up path of their patients; in particular, physicians are mainly influenced by consolidated practice and by the decisions of other departments or opinion leaders.
The information derived using an accounting tool might be helpful to improve or modify decision process, although further empirical studies are required to test the feasibility and utility of the tool.
This study fosters the debate between practitioners and scholars about the use of tools to improve quality decision process in healthcare sector.

Keywords – Decision making process, Clinical Decision making, Healthcare organization, Time Driven Activity Based Costing, Big data.

Paper type - Academic Research Paper

1 Introduction

Decision making is a complex and progressively unpredictable process which relies upon precise information availability (Sousa et al, 2019)

In healthcare the decision-making process, called "clinical decision process" (Higgs et al, 2008), is a part of more complex process named "clinical reasoning". The topic of a clinical reasoning has been studied for more than thirty years, three fields of research have characterized it and they are related to:

- Understand the process of clinical reasoning
- Knowledge and memory related to clinical reasoning
- Mental representation of clinical reasoning (Norman, 2005).

Although, up to now there are no unique definition of this concept; moreover, there are several definitions of it and they are very different from each other (Durning et al, 2013).

For clearness, in healthcare literature often clinical reasoning and clinical decision making have been used as synonymous to define "*the process by which a healthcare practitioner decide what to think and do with a patient"* (Christensen et al, 2017), but During provides a precise definition of clinical reasoning "*the mental process and behaviours that are shared (or evolve) between the patient, physician, and the environment"*. In this article, according to Higgs et al. (2008), we refer to clinical reasoning as the whole process of physician thinking during his practice within clinical decision making is a step of it, made to emphasize the outputs or decisions. In particular, clinical decision process is defined as a *complex dynamic and under pressure* (Hausmann et al, 2016) process included a choice between option as categories and diagnosis (Higgs et al. 2008); its complexity is due to the involvement of more peoples and the gap between information availability and necessity. Moreover, in healthcare organizations decision making process became even more heavy in terms of information necessity. Accordingly, given that the goal of a healthcare institution is creating higher value for patients at lower costs (Porter, 2010), information availability about effectiveness and efficiency of treatments among patient value-chain becomes fundamental to address this challenge. For these reasons, managers of healthcare organizations need solutions would allow them to improve decision-making and business processes together with communication among doctors, patients, and administration, as well as an effective access to different data (Olszak, Batko, 2012).

It should also be noted that within clinical decision process the state and the action spaces of physician (decision maker) are strictly influenced by the patient, there is a sort of interdependence between the two actors that can lead the entire process and its results

(Lippa et al, 2017). Hence, clinical decision process could be influenced by several factors like external context (Robinson et al, 2020), environment, complexity of the task (Higgs et al, 2008) and by the capabilities, confidence, and emotions of practitioner (Smith et al, 2007). According to Kahneman et al (2011) the human process of decision making can be affected by several bias due to the human mode of thinking. In Author's opinion there are two modes or systems of thinking: the system one, or intuitive system is characterized by quick thinking, unawareness and little effort; as a contrast, the system two, or reflective system is characterized by slow thinking, awareness, deductive reasoning and more concentration. By using the system one, peoples incur in cognitive shortcut that can affected decision making process (Cristofaro, 2017). To help decision makers to avoid this bias and improve the decision making process Kahneman et al (2011) identified the checklist: a tool to improve the quality of decisions finding defects in the process.

Furthermore, this work focuses on the lack of data availability and the above-mentioned gap of information necessity and availability for practitioner. In the era of "datafication" (Lycett, 2013), big data may represent the solution to provide information: increasingly analytic insights are employed within top-performing organizations to guide both future strategies and day-to-day operations (Lycett 2013). This change is already progressing into financial processes but has not yet been substantively impounded into accounting and auditing (Moffit and Vasarhelyi, 2013). However, according with Wang et al. (2018), healthcare sector is characterized by a beginning low and slow adoption rate of big data, compared to other sectors (like media and retail sectors such as commerce and finance). Thus, it would be appropriated the employment of tools aimed at obtaining useful information for the whole operation of healthcare organizations. To this aim, managerial accounting tools can be considered effective also for information collecting within the healthcare context. Especially within the accounting field applied to healthcare, several authors have identified the Time Driven Activity Based Costing (TD-ABC) as a managerial tool (Kaplan and Porter, 2011) which fosters collaboration between clinicians and clerical workers by mapping the whole value-creation process (Dombrée et al, 2014; Baratti, 2010; Demeere et al., 2009). Moreover, TD-ABC is particularly suitable for the surgery field (Akhavan 2015) due to the higher process standardization.

TD-ABC could bring more, and better information related to times, processes and costs. It can probably overcome the leading obstacle to a widespread adoption of analytics (LaValle et al., 2011), which is identified with the lack of knowledge about the use of analytics as support of business and value improvement. In accordance with Moffit and Vasarhelyi (2013), the accounting models should evolve and change in order to focus more on data content, atomicity, data linkages; as a consequence, information gathering should be switched from a periodic aggregation of data to a real-time flow. In healthcare providing, this improvement would be considerable useful for clinical management (both clinicians and administrative staff) in order to quickly understand the efficacy of a treatment and its resource consumption.

To achieve its goals the paper has the following outlines after this introduction, including the main theoretical background the second one focuses on the research problem addressed by this work. The third section reports the methodology of the study, while the fourth section presents the research findings. Section five, the last one, discusses the results obtained and provide some considerations about the contribution of accounting tool in clinical decision process.

2 Research Problem

The study focuses on follow-up of knee and arthroplasty surgery due to the high frequency and demand that characterize these surgery procedures (SDO - Hospital Discharge Report 2016).

Accordingly, it is fundamental to specify the concept of follow-up to which we refer: *"a check on someone who has been examined before in order to assess the process of a disease or the results of treatment"* as reported by Dictionary of medical terms.

As reported by some estimates provided by Bcc Research, the world market relating to joint reconstructions should reach a value of 26.81 billion dollars by 2025, with a number of interventions equal to 5,198.38 million.[1] The moment of follow-up decision was chose to analyse a different aspect of clinical decision making, studies tended to focus of clinical decision making within the hospital on in emergency situation (Flynn et al, 2012; Lo and Katz, 2005; Hess et al, 2015) but we want analyse the process related to the long management of the patients.

Given the above, this work has a twofold aim: firstly, it aims to analyse the clinical decision process of orthopaedic surgeons about the management of follow-up of their patients after a knee and hip arthroplasty surgery implementing the checklist to three different surgeons in three different healthcare contexts.

The second goal of this paper is understand if and how the more information availability derived by the use of an accounting tool (Time Driven Activity based Costing) can modify the decision-making process about the management of follow-up of patient undergoing an knee and hip arthroplasty surgery.

3 Method

To analyse different scenarios of orthopaedic surgery world, three semi-structured interviews with three different orthopaedic surgeons from three different working contexts were conducted. In particular, have been interviewed an orthopaedic surgeon working in a public trauma centre hospital, a university professor director of "Scuola di specializzazione" and an orthopaedic surgeon working in several private hospitals. All the respondent work in Italy, in different regions and have at least five years of experience.

[1] *Global Joint Reconstruction Market: Focus on Procedure Number, Type, and Country - Analysis and Forecast, 2018-2025*

Firstly, to contextualize and define the topic a definition of follow up was required to all respondents.

To achieve the first goal, Kahneman's checklist was submitted to the three respondents. According to Cristofaro (2017) the checklist was adjusted to make it suitable for the healthcare context and in particular it was focused on the follow up after knee or hip arthroplasty. To reach the second goal of this paper other three additional questions were performed. They aim at understanding how physicians' decision making process is expected to be modified after the introduction of a data sheet which collect information about clinical and organizational data on patients' management (healthcare processes, staff involvement, bed occupancy, pharmaceutical treatment, kind of therapies, examinations after surgery, functional improvements, relapses). It is important to underline that this data sheet is due to the application of TD-ABC.

These questions intend to highlight changes about the following dimensions of decision-making:

1. Effectiveness of information availability.
2. Improvements in decision-process.
3. Perceptions of physicians about usefulness of a managerial tool in patients' management.

4 Results

To facilitate the reading of findings it's important to specify that in this section, and in the following one, the surgeon working in a public hospital is reported as "SH", the surgeon director of "Scuola di Specializzazione" is reported as "SD" and the surgeon reported as "SP" is the one working in several private hospitals.

The three respondents define the term "follow up" as following:

SH: "The whole phase of clinical and instrumental control to which the patient undergoes after discharge."

SD: "An assessment in steps, decided by the operator, of a patient's post-operative conditions."

SP: "It is a path of scheduled visits to check the patient's condition over time"

The table 1 summarizes the responses to the Kahneman's checklist (2011). The biases reported are those defined by Kahneman (2011), they concern the possibility that decision can be led by:

1. own interest of decision maker (Self-interested);
2. preference of decision maker about one alternative (Affect heuristic);
3. team communication or absence of communication among team members (Groupthink);
4. past success (Saliency bias);
5. no fully evaluation of other alternatives (Confirmation bias);
6. information availability (Availability bias);
7. information base (Anchoring bias);

8. connection between alternatives or situation and decision maker (Halo effect);
9. history or past events (Sunk Cost);
10. excessive optimistic (Overconfidence);
11. excessive pessimistic (Disaster neglect)
12. excessive conservative (Loss aversion);

All the respondents showed the possibility that the *affect heuristic* influencing their clinical decision making as *halo effect* led their process. The *Saliency bias* it is another distortion came out by the interviews, even whit a little impact in the SD's opinion.

Table1: Application of Kahneman's checklist

Questions	**Bias/Code**	***Content Example***	**Respondent(s)**
In your choice of the patient's follow-up path, do you think there is any reason to think that the personal motivations of the clinical operator (orthopaedic doctor) influenced the prescription (number and frequency of checks)?	Self-interest	*"No, because the prosthetic follow-up is completely standardized"*	SH
		"Most likely yes"	SD
		"systematically not, however there is a percentage of variability linked to the patient"	SP
Is it possible that the choice of a specific follow-up path has been made on the basis of consolidated practice, rather than on the specific analysis from the context in reference to the specific contingencies of the patient?	Affect heuristic	*"Customizable follow-ups are rare. We do what the scientific literature reported"*	SH
		"Probably yes"	SD
		"Yes, it is possible"	SP
Are decisions regarding follow-up made at the operating team / ward level or at the individual doctor's (orthopedic patient's) level?	Groupthink	*"Decisions are made due to standardization of ward."*	SH
		"Decisions are made by operating team"	SD
		"In my working reality, the individual doctor decides because often the surgeons make follow up in their private clinics"	SP
a. If conflicting opinions emerge, are they sufficiently examined? How are any "conflicts" resolved?		*"Yes. Conflicts are resolved by ward director"*	SH
		"Conflicts are resolved by team leader and/or the oldest one"	SD
In your opinion, how much the choice of a specific follow-up path is influenced by the experience of the clinical operator regarding similar past situations?	Saliency	*"It Influences, because in addition to scientific bases, orthopaedic surgery also relies heavily on personal experience."*	SH
		"A little, because it is probably connected also with what you want to evaluate and with what literature reported"	SD
		Above all. The choice is influenced almost exclusively by similar past situations.	SP

When choosing a follow-up path, are different credible and reliable alternatives considered?	Confirmation	*"There are not many alternatives to standard follow-up"*	SH
		"Yes, they are"	SD
		"Not much. Alternatives exist but we don't consider them enough"	SP
What clinical information is used to make decisions about patient follow-up process? If you could have other information (non-clinical) which would you need?	Availability	*"Mainly comorbidities and type of surgery are used to make decision about follow-up. If I could have other information, I would like to know the patient's lifestyle habits and where he/she lives"*	SH
		"The ones reported by the literature"	SD
		"Patient's pain, functional skills, lifestyle habits and job"	SP
Which source provides you with the data referred to in the previous question?	Anchoring	*"A deeply patient's anamnesis"*	SH
		"The several international score that you want apply"	SD
		"Medical examination and patient itself"	SP
When choosing a follow-up path, is it possible that the decision was made (or influenced) on the basis of similar decisions made by other departments or other clinical contexts?	Halo effect	*"Yes. Scientific literature gives us many things"*	SH
		"Certainly yes"	SD
		"Yes. Opinion leaders and their modus operandi matter a lot"	
When choosing a follow-up path, how does the patient's medical history influence your decision?	Sunk-cost fallacy	*"It conditions a lot, for example in an epileptic or Parkinsonian patient it is known that a more frequent follow-up is necessary"*	SH
		"As far as the case of the clinical sphere is concerned, probably the embedding parameters make the difference"	SD
		"It could make follow-up more frequent"	
When choosing a follow-up path, do you usually consider extremely positive implication scenarios regarding the patient's specific contingencies?	Overconfidence optimistic	*"When choosing a follow-up path, I usually consider always positive scenarios"*	SH
		"I determine the extent of the follow-up both for what I have read in literature and because I think that is the right period to detect the progress of that situation"	SD
		"I define the period according to time for patient to can slowly start to have a normal life, without aids, without particular foreclosures"	SP
		"The choice is always ideal as	SH

		it should be"	
When choosing a follow-up path, always consider a realistic scenario regarding the patient's specific contingencies?	Disaster neglect	*"Actually, the period is defined because at that point I should have a data that tells me if that path is a positive or negative path."*	SD
		"That period has logic behind. It is the healing time of the tissues from the intervention. I can imagine them repaired in a month and for this I set that date for the medical examination."	SP
When choosing a follow-up path, do you usually consider extremely negative implication scenarios regarding the patient's specific contingencies?	Loss aversion	*"When choosing a follow-up path, I usually consider always positive scenarios because complications are infrequent in this kind of surgery"*	SH
		"Actually, the period is defined because at that point I should have a data that tells me if that path is a positive or negative path."	SD
		"The guideline is the same logic that I said before"	SP

Source: Authors' elaboration from Cristofaro (2017)

Concerning the impact of the TD-ABC data sheet on clinical decision making, the results are shown in Table 2, it reports the three additional questions and the responders' answers in brief.

Very different opinions raised up from the interviews, SH believes that the data sheet can be suitable for specific patients that require more information, e.g. patients undergoing hip and knee revision, while SD stressed the relevance of analysing data resulting from the data sheet to compare them with other departments practise; in contrast to this SP didn't recognize the utility of the tool due to the high number of information recorded making confusion for the decision maker.

Table 2: Interview regarding TD-ABC data sheet

Questions	Content Example	Respondent(s)
Do you believe that the shown data sheet, filled in with all the information requested, could somehow direct, modify or influence your choices regarding the patient's follow-up path?	*"It could in some cases such as revisions, first implantation in dysplastic patients or young patients"*	SH
	"Yes, perhaps the analysis of a substantial number of sheet collected allows me to change the patient's follow up path."	SD
	"I honestly don't know. In my opinion, it helps you to ask yourself more about what you are doing than about follow-up"	SP
Do you think it is a useful tool for your decision-making process?	*"Yes. It would be necessary to always make a qualitative assessment especially of the post-operative period"*	SH

	"Yes, the analysis of data derived by the use of data sheet can be an useful tool for my decision-making process"	SD
	"No. I don't think so"	SP
Why could this tool be useful??	*"Because analysing the organization we can improve it. In this way we can do the prosthetic Fast track that establishes, after 2-3 days from the operation, with a stable clinical picture, the going of patients directly in rehabilitation structures to free the surgical department allowing the entry of new patients"*	SH
	"Because it could somehow change what other surgeons say and verify what I do"	SD
	"Because it is too detailed, full of information, very specific. To make it useful for that purpose I would probably save 5/6 information no more and I would provide only that to no confusing the decision maker"	SP

Source: Authors' elaboration

5 Discussion and Conclusion

The analysis of the interviews discloses a high impact of consolidated practice on clinical decision making about follow-up. This might be to have a two reasons: firstly it might be caused by a "standardization process" of this kind of healthcare pathway (Healy et al, 1998; Scranton, 1999). The other reason is due to a "cultural issue" related to the physician's training, which makes practitioners feel more confident in doing what they have always done (as reported by SP during his interview); such behaviour can bring decision makers to minimize the risks of their practice and exacerbate its benefits (Kahneman 2011).

According to all respondents, another variable that certainly influences the decision-making is the practice of other department decisions. Several reasons might explain this result and they are related to the scientific nature of medical science (based on scientific literature), as emerging by evidence based medicine (based on best practice) (Timmermans and Angell, 2001) or by the impact of "opinion leader" (Locock et al, 2001) in healthcare disciplines; in particular, this aspect came to light during two interviews. In respondents' opinion surgeons are more conducive to changing their practice based on the experience of those they deem most competent in the field.

It is important to highlight that answers (and the clinical decision making too) are influenced by work environment. This is especially evident from disagreement in team member consideration during follow-up choice; while in public structure as university department or hospital decisions are shared in team, the surgeons working in private structures makes its decisions on his/her patients by itself. This result is line with Smith et al (2007) and Eisenberg (1979) that identified external factors, features of clinician, clinician's interaction with his profession and the health care system, as the factors that can modify the decision process.

No direct evidence of self-interest bias is arisen by interviews; but regarding the decision about frequency of follow-up a particular consideration came out. According to all respondents the frequency of follow-up is established in line with literature, practice and in some rare cases according to patient's peculiarity. Nevertheless, another reason that can modify the follow-up frequency is the interest of physician in recording some data (clinical or not) to report them in a scientific study. In this case the period between one check and another might be not related at all with a patient condition or safety, but it related to a scientific interest of physician.

Moreover, with regard to the impact of TD-ABC data sheet on clinical decision making, according to all respondents some information within the "documents" can surely modify (probably improve) their decision process. The respondents could not declare with certainty the usefulness of the tool because maybe because they could only analyse it on theoretical level.

At the moment, however, for practitioners this tool is overfull of information and in respondents' opinion this can compromise its feasibility and utility.

This study shows several biases that can affect clinical decision process regarding follow-up after knee and hip arthroplasty. Checklists could potentially help physician to avoid these errors, but it needs to be integrated in daily practice.

Furthermore, the accounting data can affect the clinical decision process but further research on the empirical application of TD-ABC data sheet are required to test its utility and feasibility.

The study presents several limitations related to the use of qualitative method which implies interpretive role of researchers and limited extension of data. Moreover, only three physicians are interviewed. Nevertheless, the difference in terms of work environment of our interviewees reduces such a limit giving a good representation of Italian orthopaedic environment.

Another limitation regarding the topic addressed by this study, its specific literature background is on cognitive process that prevalently belonging to the psychological and healthcare fields, with few strong interconnections with managerial ones.

In conclusion, this study highlights the linkage between accounting data and decision-making process in healthcare context, by fostering debate among scholars in these fields. For practitioners, this study shows an experience of a quality decision making process tool employment that brings out some cognitive shortcut that can led the clinical decision process. Particularly with this regard, the study can contribute to debate by both scholars and practitioners about the application of tools that can improve quality of clinical decision process.

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The Role of Cooperatives for Social Innovation and Local Sustainable Development[1]

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Abstract

This conceptual paper investigates the role of cooperatives for social innovation and local sustainable development in the context of the Region Lombardy, which is the Italian most populated and most economically relevant region, as well as the region with the largest number of employees in cooperative enterprises. The discussion is based on an exploratory study involving 9 cooperatives through semi-structured interviews with members of the boards and managers with the aim of exploring subjective viewpoints and gather in-depth accounts on cooperatives as central actors within the Social and Solidarity Economy ecosystem. In the paper the results of the interviews are presented, some implications are derived from them and some problems are identified that could limit the cooperatives' capacity to unfold their full potential as natural carriers of social and sustainable innovation.

Keywords – cooperatives, social innovation, sustainability, Social and Solidarity Economy, local development.

Paper type – Academic Research Paper

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1 Introduction

According to International Labour Organization, the Social and Solidarity Economy (SSE) includes "enterprises and organizations, in particular cooperatives, mutual benefit societies, associations, foundations and social enterprises, which specifically produce goods, services and knowledge while pursuing economic and social aims and fostering solidarity" (ILO 2019, 66). Despite the differences in the legal forms, what is common to all these organizations is their "collective ownership and governance structures, which ensure that they respond to the needs of stakeholders that are different from investors" (ibidem).

Among the SSE organisations, a special role is played by cooperatives that in Europe "have been active since the early nineteenth century, helping various groups of people (consumers, producers, workers) to gain access to basic goods and services ranging from groceries to healthcare" (Borzaga, Salvatori, and Bodini 2019, 45). According to the 2019 report of the International Cooperative Alliance (ICA), more than 12% of humanity is part of any of the 3 million cooperatives in the world as members/consumers or employees/participants. Moreover, cooperatives contribute to the sustainable economic growth and stable, quality employment, employing 280 million people across the globe, i.e. about 10% of the world's employed population.

In Italy, cooperatives play a fundamental role within the SSE, if not in the total number of organizations (about 15% of the SSE organizations) certainly in the total number of employees (more than 75% of the employees of the SSE organizations). According to (ISTAT 2019), in 2015 (which is the last year for which official statistical data is available), 59.027 cooperatives were active in Italy, with 1.151.34 employees, producing a value added of more than 28,6 billion euros. In Lombardy, which the most populated and most economically relevant region in Italy, 8.314 cooperatives were active in the same year with 219.332 employees.

Social innovation and sustainable development are two core principles of the cooperative movement since, as value-based and principle driven organizations, cooperative enterprises are by nature a sustainable and participatory form of business (ILO-ICA 2014). Indeed, principle 7 of (ICA 2015) places the primary emphasis for cooperatives on concern for the sustainable development of their immediate local communities, with the goal of benefitting both the cooperatives members - who democratically own and control them – and the communities within which they operate. From this point of view, cooperatives can play a fundamental role for local sustainable development and social innovation, while maintaining a strong business orientation that makes cooperatives a relevant economic actor.

While the role of cooperative for local sustainable development and social innovation has been widely discussed within the literature (both academic and grey), how cooperatives frame their activities strategically as local development and social innovation initiatives is still a quite underexplored topic. In this conceptual paper, we

explore this topic in the context of the Region Lombardy, which is the Italian region with the largest number of employees in cooperative enterprises, with a specific focus on cooperatives that can be considered as small and medium-sized enterprises. More specifically, the paper presents the result of an exploratory study based on qualitative semi-structured interviews conducted with members of the boards and managers of 9 cooperatives with the aim of exploring subjective viewpoints and gather in-depth accounts on the role of cooperatives for social innovation and local sustainable development.

The paper proceeds as follows. In the next section some arguments are presented that support the claim that cooperatives are fundamental actors for social innovation and local sustainable development. Then the methodology of the exploratory study is described, and the main evidences emerged from the qualitative semi-structured interviews are presented and discussed. Finally, some conclusions are drawn from the discussion and the limitation of the study and some further research directions are indicated.

2 Hybridity as a source for social innovation and local sustainable development

According to (UNIDO 2017, 13) social innovation "refers to a novel solution to a social problem that is more effective, efficient, sustainable, or just than current solutions. The value of social innovations accrues primarily to society rather than to individuals" (UNIDO, 2017, p. 13). Mulgan, Ali, Halkett e Sanders (2007, 9) define social innovation as "the development and implementation of new ideas (products, services and models) to meet social needs". Social innovation amounts to a "complex process of introducing new products, processes or programs that profoundly change the basic routines, resource and authority flows, or beliefs of the social system in which the innovation occurs" (Westley and Antadze 2010, 2). In more general terms, (Moulaert and MacCallum 2019) defines social innovation as innovation in social relations based on values of solidarity, reciprocity and association and ethical practice for meeting needs, transforming social relations, and collectively empowering communities to shape the future.

At the local level, social innovation rests on two pillars: "institutional innovation (innovation in social relations, innovations in governance including empowerment dynamics) and innovation in the sense of the social economy – i.e. satisfaction of various needs in local communities" (Moulaert and Nussbaumer 2005, 2071). To achieve these goals, social innovation implies new organizational modalities and new socio-economic principles based on the development of collaborative relationships among a plurality of actors, including the direct beneficiaries of innovation (Bernardoni and Picciotti 2014, Pestoff 2012b). This gives cooperatives, and other SSE organizations, a central role among the actors of social innovation. Indeed, scholars, policy-makers and other stakeholders more and more refer to social innovation as the most valuable outcome of SSE (Tortia, Degavre, and Poledrini 2020, Moulaert and MacCallum 2019).

SSE organizations are characterized by "collective ownership of institutions which aim to transform labor relations, promote participative democracy, and design new wealth-sharing arrangements" (ILO 2019, 8). They are organizations that "follow social solidarity principles of pursuing social, environmental and redistributive justice through cooperative, associative and solidarity relations" (ibidem). Cooperatives share these principles with the SSE organizations, which is what makes cooperative different from typical profit-oriented organizations. However, cooperatives are enterprises and, as such, besides pursuing social goals, focusing on democratic values and principles such as solidarity, equality and inclusion (Kerlin 2010), cooperatives also pursue business goals. This is what makes cooperative different from other SSE organizations, such as the non-for-profit organizations. By combining the social orientation of the SSE organizations and the business orientation of enterprises, cooperatives are hybrid organizations and this property of cooperatives has relevant implications for their role as actors of social innovation.

In organizational studies, hybridity refers to the coexistence within the same organization of different (sometimes even conflicting) institutional logics, typically related to the public, private or third-sector domain (Brandsen, van de Donk, and Putters 2005, Evers 2008, Ebrahim, Battilana, and Mair 2014). Organizational hybridity is one of the main characteristics of cooperatives that "pursue multiple goals rather than having a single purpose. In fact, their very raison d'être is to pursue both economic and social goals" (Pestoff 2012a, 85). For cooperatives, the coexistence of plural logics is a permanent phenomenon (Besharov and Smith 2014, Mair, Mayer, and Lutz 2015, Battilana 2018). It represents a positive aspect (Kraatz and Block 2008), since "operating in institutional interstices and combining multiple logics (i.e. considering and adhering to multiple prescriptions) might open up opportunities, as organizations can access broader sets of resources and expand their practices, which allows them to be innovative, to create new products and services and to pioneer new ways of organizing" (Mair, Mayer, and Lutz 2015, 715).

In discussing innovation in third sector organizations, Osborne (1998) observes that their innovation capability depends more on their interactions with the local political context than on their organizational properties (such as the organizational structure and culture). In other words, the innovation capability is not one of their intrinsic characteristics. Vice versa, as for all enterprises, the innovation capability represents for cooperatives a survival condition (at least in principle) that should be pursued as a fundamental aspect of the organizational development strategy. The capacity of combining a business-oriented perspective with a social and solidarity-based perspective is what that can make cooperatives, as hybrid organizations, natural carriers of social and sustainable innovation.

Although the role that cooperatives as hybrid organizations can play for social innovation and local sustainable development has been discussed quite widely within the academic and grey literature, how cooperatives can play this role 'on the ground' at the

local level is still a quite underexplored topic. This leads to the research question this paper intends to address, i.e. "how small and medium-sized cooperatives can frame their activities strategically as local development and social innovation initiatives?".

3 Methodological approach

The paper is based on an exploratory study that involved 9 cooperatives based in different provinces of Lombardy and covering different areas of activity. The main characteristics of the selected cooperatives are summarized in the following table:

	Typology of the cooperative	**Dimension** (Number of employees)	**Role of the interviewed**
C1	Workers buy-out	medium	President of the board
C2	Work integration social cooperative	medium	President of the board
C3	Community cooperative	medium	CEO
C4	Work integration social cooperative	small	Executive director
C5	Work integration social cooperative	medium	President of the board
C6	Work integration social cooperative	medium	Executive director
C7	Community cooperative	medium	President of the board
C8	Community cooperative	medium	Head of administration
C9	Community cooperative	medium	President of the board

The interviews have been based on the methodology for semi-structured interviews described in (Adams 2015) and have been designed with the aim of exploring subjective viewpoints and gather in-depth accounts from the interviewed (Flick 2009). The interviews, that lasted about one hour each, took place between January 2020 and March 2020 and have been made by phone by two researchers. At the end of the interviews, the two researchers jointly codified the answers, made them anonymous and analysed them to elaborate an aggregated synthesis. The researchers then complemented the interviews with the analysis of documents published on the cooperative websites, e.g. the statute of the cooperative and the social responsibility report (where available).

To answer the paper research question, the semi-structured interviews have been designed to investigate issues related to the social and solidarity economy and the cooperative' attitude toward social innovation and local sustainable development. Moreover, given the role that, according to the literature, the cooperatives' hybridity can play to enable and support social innovation initiatives, in the interviews also questions related to the organizational and the governance structure of the cooperative have been included.

4 Major evidences from the interviews

The strict interaction with the local context, as an important stock of cultural and relational capital, is considered strategic by all the interviewed that consider the cooperative form as the best suited to understand local emerging needs, to answer them rapidly, and to give creative solution to problems that cannot be solved with more traditional public or private interventions. Moreover, all the interviewed stressed the cooperatives' central role in the SSE, as they contribute to the local development and, at the same time, can provide an answer to the economic and social challenges related to the ongoing transformation of work in the digital age. This confirms the importance of cooperative for social innovation and local development as described in the academic and grey literature. However, when asked what social innovation and local development mean for their organizations, the interviewed gave quite different answers, also depending on the field of activity of their cooperatives.

Most of the interviewed related social innovation to social justice, as equity and social inclusion, and to the cooperatives' capacity to satisfy social needs on behalf of public administrations according to the subsidiary principle. These interviewed consider the cooperative model as alternative to more traditional organizational paradigms and acknowledge the peculiar role of cooperatives within the SSE. However, how their cooperatives implement social innovation in their activities is more related to the development and implementation of new ideas (products, services and models) to meet traditional social challenges (poverty, exclusion, marginalization, etc.) than to the capacity to contribute to change the social system in which the innovation occurs. Therefore, these interviewed showed a reduced interest in wider challenges emerging from the ongoing transformation in the social systems, such as sustainability, quality of life, societal impact of new technologies, transformation of work in the 4th industrial revolution, etc. This result is unsurprising since most of the cooperatives considered operate in the welfare sector.

When asked about sustainable development and how sustainability can impact their activities, most of the interviewed refer, first of all, to economic sustainability, as the condition that will guarantee the cooperatives' survival in the long period and the possibility to achieve their social objectives. The strong focus on the internal economic sustainability is a direct consequence of the organizational hybridity of the cooperatives that, as enterprises, are expected to generate income from their activities in order to survive and develop. Actually, for 8 cooperatives in our sample at least 70% of their income derives from business activities (all the interviewed described their cooperatives as hybrid organizations pursuing, with different intensity, business, mutual and public values).

Only one of the interviewed explicitly describes sustainability as the foundation for a different economic development model. This is the case of the workers buy-out cooperative that, unlike the other cooperatives, is a production cooperative operating in an industrial context. In this cooperative, the adoption of a sustainability-oriented

perspective led to redefine the internal processes to make them more environmentally sustainable.

In some of the interviews the topic of decent work has been touched upon as a relevant aspect of social innovation. In the case of the workers buy-out cooperative, the interviewed explicitly relates the reasons that led to the establishment of the cooperative to the necessity of guaranteeing to its members a decent work after the closure of the company that employed them. Other cooperatives mention delivering quality jobs along with social protection and respect for rights at work among their objectives. The focus of those cooperatives is on three elements. The employment of older workers who had lost their work during the economic crisis and would have difficulties in finding new jobs due to their age. The female's employment, with the necessity of guaranteeing a better work-life balance. The need to assure contractual forms that can guarantee the workers' rights, as opposed to low-pay, low-benefit and low-protection jobs.

Quite interestingly, most of the interviewed do not relate (social) innovation to modernization, digitization or, more generally, to technology-driven innovation. All the cooperatives declare to use basic ICT tools, mainly for administrative purposes. Most of them (6 out of 9), consider digital innovation as a relevant aspect of their strategic vision. However, almost all the cooperatives in the sample (8 out of 9) declare low levels of implementation of digital tools, thus highlighting a relevant implementation gap.

Although some of the interviewed (especially those belonging to the work integration social cooperatives) relate the low technological level of their organizations to the typical human-labor intensive activities of the cooperatives, what emerges with evidence from most of the interviews is the lack of internal technological and managerial competences and skills.

5 Discussion

The small number of cooperatives that have been involved in the exploratory study does not allow to draw general conclusions. However, some elements emerge from the interviews that are relevant to answer the research question, i.e. "how small and medium-sized cooperatives can frame their activities strategically as local development and social innovation initiatives?".

First, the interviews confirmed the cooperatives' strict interaction with their local context, which allows them to re-embed "in progressive societal norms and creating or strengthening institutions that can mitigate or counteract perverse effects of 'business as usual'" (Utting 2015, 2).

According to the academic and grey literature, the cooperatives' embeddedness allows them to provide better and more adequate answers to the systemic challenges of the contemporary world by fostering an economic development model that contests the tenets, instruments and outcomes of the neoliberal agenda (Utting 2015). The interviews confirmed the re-embedding of economic practice as one of the

elements that differentiate cooperatives from other enterprises and that make them a central actor for the local economic and social development. However, considering how the interviewed described it, the role of their cooperatives for local development can be characterized more in terms of social entrepreneurship than of social innovation. They all mentioned the development and implementation of new ideas to meet social needs that can impact the broader context through a process that, in the words of (Westley et al. 2014), can be defined as 'scaling out', i.e. "the organization attempting to affect *more* people and cover a larger geographic area" (237). This is different from social innovation that "not only introduce innovation, but also manage the broader context, in such a way that the innovation has a chance to flourish, widening the circle of its impact" (254) through a 'scaling up' process that identifies "opportunities and barriers at broad institutional scales, with the goal of changing the system that created the social problem in the first place" (237).

For the interviewed, social innovation processes should be considered as the product of the interaction between the business subsystem and the wider political, economic, and social system. Based on this interaction, innovation mechanisms capable of prospering and affecting the local systems could be triggered. For most of the interviewed a greater formal recognition by the local institutions of the cooperatives as active parties in the definition of the interventions that affect the social system is an enabling element for the role of cooperatives as actors of social innovation.

With respect to the cooperatives' local embeddedness, a critical problem emerged from the interviews concerning the still scarce institutionalization of the relationship between the cooperatives and the local context. The interviewed reported that the relation is often only episodic and left to the individual managers and members of the board attitudes and interests without being formalized in the cooperative governance system. This is an aspect of the cooperatives' difficulties in implementing participatory governance systems, which can limit the cooperatives' social innovation capabilities. In fact, as it is well known from the literature, the inclusion of local stakeholders in the governance system would encourage the development of new organizational methods and new collaborative relationships between the actors of the local system. A more participatory governance would increase the cooperatives' capability to actively contributing to shaping the social system, thus going beyond the sphere of social entrepreneurship.

Second, all the cooperatives involved in the study are aware of the role that, according to the academic and grey literature, cooperatives can play to cope with global challenges, such as sustainability, climate changes, rising of social inequalities, deregulation, state retrenchment, financialization and commodification. However, beyond a general cultural commitment, also due to their local reach, the cooperatives did not implement specific measures geared to those topics.

What instead emerged quite clearly from the interviews is the cooperatives' commitment to employment creation and decent work as opposed to the tendency toward the commodification of work in the neoliberal agenda. This confirms the role that in the

contemporary debate is assigned to cooperative values, such as self-help, self-responsibility, democracy, equality, equity and solidarity, to prevent a 'self-employed precariat' from developing and to oppose neo-liberalism by offering alternative approaches (Ridley-Duff 2019).

Third, all the interviews confirmed the strong value-orientation of the cooperative model. This is a defining characteristic of cooperatives that in the literature has been related also to the resilience of the cooperative business model in times of crisis and downturn (Utting 2015, Birchall and Ketilson 2009, Roelants et al. 2012). The resilience of cooperatives has been confirmed by the interviews. After the Italian Government approved the Covid19 lockdown on March 9, the researchers contacted again the cooperatives by phone to ask them whether and to what extent they expect the anti-Covid19 measures to affect their activities. Whereas the Covid19 pandemic is estimated to impact negatively on the Italian economy with a 51% turnover reduction (SVIMEZ 2020), the interviewed cooperatives reported a reduction up to 30%. This data, as well as data concerning the performances of the Italian cooperatives during the financial crisis from 2008 to 2013 (Carini, Borzaga, and Fontanari 2015), confirms the peculiar role of cooperatives in time of crisis, also with respect to the creation of new and good employment.

Fourth, it is quite surprising that, despite their strong commitment to the creation of good employment, neither of the cooperatives involved in the study mentioned the potentially critical impacts of the 4.0 revolution on human employment. As observed above, this can be partly explained by considering that most of them operate in the welfare sector. However, considered together with their quite low level of implementation of digital tools and their general lack of technological and managerial competences and skills, this observation points to a critical aspects that can reduce the small and medium-sized cooperatives capability to contribute to the development of the Social and Solidarity Economy.

In most of the cooperatives involved in the study, including the largest ones, the distinction between the competences of the board and the managerial activities is not clear, with members of the board also performing typical managerial functions (e.g. the management of the human resources). This can be considered as an index of the scarce penetration of a managerial culture within the cooperatives studied. Although all the interviewed agreed on considering their cooperatives as hybrid organizations, the preponderant role of the board clearly indicates that in those cooperatives the logic of enterprise has not been fully developed yet.

This is the most critical element that emerged from our exploratory study, since hybridity is the condition that would allow cooperatives to unfold their full potential as natural carriers of social and sustainable innovation. As (Sapelli 2015, 110-111) points out, this requires cooperatives to develop an 'organizing ability' through the development of a managerial culture different from both the 'logic of belonging', typical of the cooperative world, and the logic of profit, typical of enterprises. According to (Ebrahim,

Battilana, and Mair 2014), the development of the organizing ability within cooperatives presupposes a "growing shift toward the hiring of professional managers, and the adoption of formalized practices such as strategic planning, independent financial auditing, and quantitative evaluation and performance measurement". However, to avoid the risk of mission drift that can derive from the managerialization of cooperatives, the need arises for "the selection and training of managers in tune with core social enterprise values" (Shaw 2006, 12). This is what the cooperatives in our study still lack and that represents the major skill gap that should be addressed to strengthen the cooperatives' role in the Social and Solidarity Economy.

6 Conclusions, limitations and further research directions

In this conceptual paper, we discuss the role of cooperatives for social innovation and local sustainable development based on an exploratory study conducted on 9 cooperatives in Lombardy. The results of the qualitative semi-structured interviews conducted with members of the boards and managers of those cooperatives confirmed the role of cooperatives as the natural carriers of social and sustainable innovation. The embedded nature of cooperatives and the strong value-orientation of the cooperative business model have been confirmed as important drivers for cooperatives as central actors for local sustainable development, even in times of crisis and downturn. At the same time, the interviews evidenced a lack of managerial culture and skills within the cooperatives, which can limit their capacity, as hybrid organizations, to contribute to the local sustainable development based on the principles of the Social and Solidarity Economy.

The study has been based on a small number of cases and this is its main limitation that does not allow to draw general conclusions. However, the aim of the study was not a systematic study of the cooperatives of Lombardy. Rather, based on evidences from the literature, and coherently with its exploratory nature, the study was intended to identify what aspects should be investigated with further researches to better understand the role of cooperatives for social innovation and sustainable local development within the social and economic context of the most populated and economic relevant region in Italy.

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Knowledge Transfer in Health Communities: Open Innovation perspective

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Abstract

This paper aims to investigate and understand existing knowledge and paradigm of community issues to shift towards new knowledge management models, where open innovation could improve communities' health with rightly managed to validate knowledge creation and integration.
The article is conceptual in nature and adopts a systematic literature review approach, based on the concepts of knowledge management and open innovation in the healthcare sector. It analyses the most relevant studies. The paper's contribution consists of how it connects open innovation in healthcare to knowledge management. The aim is to build a conceptual framework defining the main objectives of the article: (1) knowledge transfer and co-creation both inside and between health communities; (2) valid knowledge transfer through open innovation. So this paper aims to identify main definitions, concepts, and background theories.
The analysis showed that 66 articles (22 in PubMed and 44 in Web of Science) are related to the topics of knowledge management and health ecosystems; open innovation and health; knowledge co-creation and community; knowledge transfer and open innovation, during the past ten years period (2011-2020). All articles were analysed in detail and divided to categories. This paper aims to investigate and understand existing knowledge and paradigm of community issues to shift towards new knowledge management models, where open innovation could improve health communities to validate knowledge co-creation and integration.
This study proposes knowledge management approach and managerial paradigm shift from ecosystems to health communities. Identified the main articles and definitions in the field of knowledge transfer and health communities, proposed perspective of open innovation

Keywords – health communities; knowledge transfer; knowledge management; open innovation; co-creation

Paper type – Academic Research Paper

1 Introduction

Managerial practices aim to grasp understanding the health ecosystem as a whole (Laihonen, 2012). But paradigm changes and medical professionals still often have a too poor understanding of patients and their needs, and poorly represent real views of the smaller communities (Bullinger et al., 2012). It should thus be attempted to integrate the community and use of 'experiential' knowledge, like the personal experience with the particular health issue. That kind of integration to health care research should contrast formal, clinical knowledge and enroll innovations right to the problem-solving (Bullinger et al., 2012; Steininger et al., 2010; Serrano-Aguilar et al., 2009) Such communities could be initiated by patients themselves or by external stakeholders, but it necessarily should include stakeholders and professionals from the biomedical value chain to extend processes and control validation and using the created knowledge to seek the best results. The patient role changes from the listener and knowledge taker, into collaborative, involved in their health knowledge creation and integration as an equal partner (Allarkhia, 2015). This is how the healthcare sector is evolving into a knowledge-based community with diverse stakeholders: patients, their relatives, hospitals, pharmaceutical companies, the media and more (Bose, 2003), who share a wealth of information on health issues, thus affecting to the quality of health care. The main problem is still active that different actors of health communities have different informational sources, where information is not censored, safe or valid (May et al., 2007). Also there are many examples when the situation became harmful - how uncontrolled information really harmed not just a few persons but all public health: anti-vaccine movement (Stein, 2017; Hussain et al., 2018) which led to measles breakthroughs (Stanley, 2019; Mavragani&Ochoa, 2017) or increasing of other diseases. The main goals of health-generating communities should be to make more effective use of both face-to-face or online, positive-influencing knowledge and practices; collect, create, share and use them to empower learning communities to build health; the management of an existing knowledge network to fulfill the desired knowledge flow (Tang, 2017). People want to get health information fast (here-and-now) and from sources that can trust (Quintana et al., 2001; Petraite et al., 2018; Mazenyte&Petraite, 2019), where patients could find validate personalized information. Of course, digital technology should drive communities to sustain efforts for developing collaboration that enables social, economic and public value creation (Romanelli, 2018). But each community faces different challenges in addressing a variety of health issues, so it is important to identify them and find the most appropriate solutions.

Community members are motivated to exchange information and share their knowledge; actors are useful in the process of innovation because they are self-interested, contribute to the activity and work to meet the needs of the community (von Hippel, 2016). With the help of this knowledge, new pathways are being developed that can facilitate access to healthcare, change attitudes from clinical solutions to health problems, and help people find the right answers to their health concerns.. There we can find the right place to apply OI and get the best results both in knowledge transfer inside

community (outside-in) and also in knowledge transfer between different, separate communities (inside-out). Community members became creators who co-creates innovation and contribute to value creation (Kohler & Chesbrough, 2019). Open innovation (OI) is becoming one of the most important tools to address complex problems in the research of health sciences. Different solutions, platforms are available to the community and also to domain experts as to particular problem solvers (Hill et al., 2017).

For this study, we define communities as social networks instead approach of ecosystems to understand how to transfer knowledge inside the community and between different communities. We using a transdisciplinary approach to explore both, medical and managerial contexts to find out a variety of articles and relevant needs.

2 Material and Methods

The article is conceptual in nature and adopts a systematic literature review approach, based on the concepts of knowledge management and open innovation in the healthcare sector. Papers have been selected to search for our research domain to find the most important scientific articles for selected topics. Articles have been explored via the PubMed and Web of Science platforms, published in the past 10 years (2011-2020) (see Figure 1).

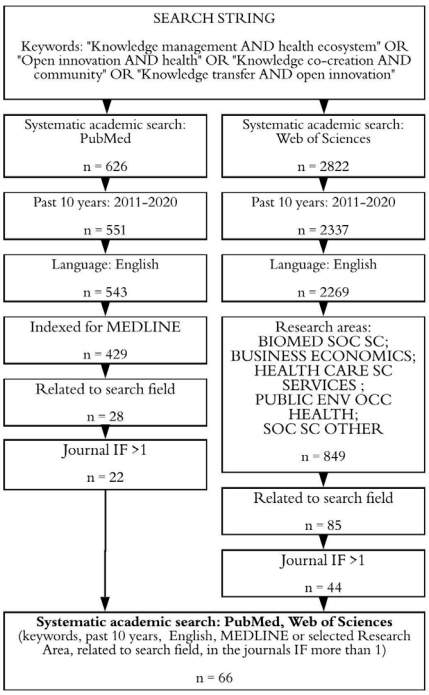

Figure 1. Analysis of PubMed and Web of Science platforms

The analysis showed that 626 papers in PubMed and 2822 papers in Web of Science are related to the topics of knowledge management and health ecosystems; open innovation and health; knowledge co-creation and community; knowledge transfer and open innovation. Keywords were paired by the groups of interest. During the past ten years period (2011-2020) PubMed showed 551 and Web of Science showed 2337 papers related to the research topic. Papers that were in other languages than English or didn't fit into research areas or searching fields or were in very low indexed journals (Impact Factor less than 1) were excluded from results. There are 66 articles related to chosen topics in the field. All articles were analysed in detail (see Annex 1): title and authors, keywords, publishing year, Impact Factor (IF), subject of paper (in 3 categories) and DOI.

The paper's contribution consists of how open innovation in healthcare connects to knowledge management. The aim is to build a conceptual framework defining the main objectives of the article: 1) knowledge transfer and co-creation both inside and between health communities; (2) valid knowledge transfer through open innovation. So this paper aims to identify main definitions, concepts, and background theories.

This paper aims to investigate and understand existing knowledge and paradigm of community issues to shift towards new knowledge management models, where open innovation could improve communities' health with rightly managed to validate knowledge creation and integration.

3 Results of literature review

There was selected to analyze 66 articles in total from the platforms: PubMed and Web of Science. Articles were revised and the first-order category assigned for each article based on the subject of the article, individual categories consisted of such categories as Disease Management; Digital Health; Ecosystems; Community Empowerment; Precision Medicine; Software Development; Diffusion Of Innovation; Drug Management; Open Innovation; Patient Empowerment; Maternal Health; Health Platforms; Community Management; Online Communities; Co-Creation; Know-Do; Entrepreneurship; Community Health; Health Systems; Health Services; Environment Health; Business-Model Transformation; Public Health; Patient-Centered Care; Health Literacy, Value Creation; Collaboration; Society and others. First-order categories were revised once again to assign more generalized subjects, eight categories were formed: Knowledge Management; Knowledge Translation; Open Innovation; Innovation; Health Management; Health Ecosystems; Co-creation; Value Creation. Categories were discussed once again and agreed that the most common subjects of articles were two: knowledge transfer and health community. See Annex 1 for detailed results.

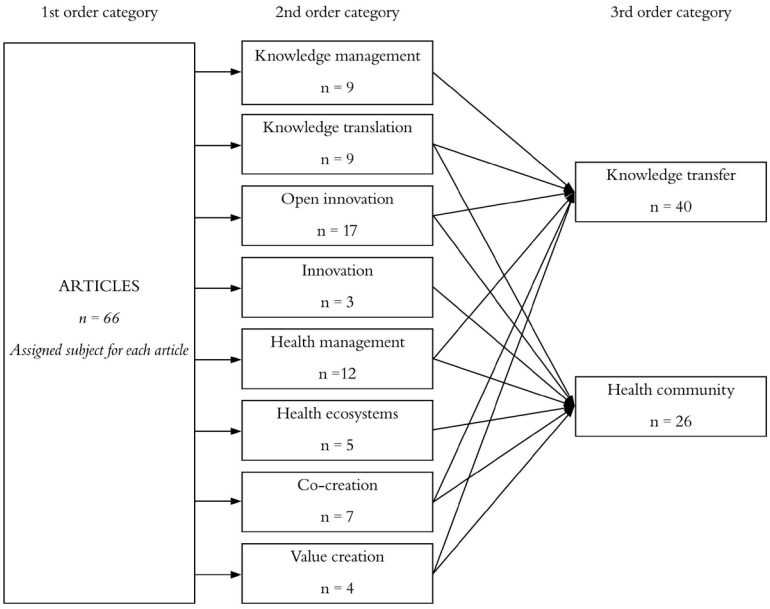

Figure 2. Results of literature review: categories

A literature review has brought attention that the two most discussed topics in analyzed articles: knowledge transfer and health community (see Figure 2). 3rd order category was developed during the systematic literature review process, it has shown that all articles were talking about knowledge transfer and/or health communities in one or another way. It was direct interfaces or indirect matches that could be applied to those categories. For example, an article talking about healthy ecosystems were signed into the category of health community in order that we could adapt relevant theories, methods or approaches to our research.

Our literature review suggests to raise new models of knowledge transfer inside and between smaller health communities instead of wide ecosystems approach which is usually in the center of attention. New models would create additional value both to healthcare and managerial research ant practices. Term of an ecosystem is borrowed from biology and in designed ecosystems, organizations come together by co-specializing with each other, creating bonds that engender collaboration, without excluding competition (Jacobides et al., 2018). While the term health community still doesn't have the static definition in managerial sciences. It is noted that there are differences between the usual "community health" and the health community. The concept of the health community remains poorly defined despite relevant literature. Various terms such as the community of practice, patient collaboration, active patient, patient empowerment, or participation are used (Greenhalgh et al., 2011; Vallentin-Holbech et al., 2020). But still, it is not exactly the right example for our approach. Literature suggests more definitions and

approaches to online health communities. But online communities face challenges such as knowledge co-creation to develop valid knowledge, knowledge integration, and sharing between different communities, personal data issues, and also - face-to-face communities lack the right definition – the need of comparing different categories has a high demand. Health communities could be divided in different categories such as online health communities (OHCs) "are an increasingly popular source of health information and peer-to-peer support, particularly for patients with chronic health conditions" (Magnezi et al., 2015) or direct, face-to-face health communities "Direct face to face user and provider collaboration to co-design products or services, and includes a focus on the aesthetics of a service" (Robert et al., 2015) (see Table 1).

Table 1. Indicators of direct health communities and online health communities (OHCs)

Type	Indicators	Authors
Direct health community (face-to-face)	Direct contacts; Clear goals; Societal focus; Patient safety and health care quality; Co-production, co-design, co-creation; Measured results; Rejection of paternalism; Active patient in the treatment process; Quality of services; Health care system improvement; Small, coordinated groups; Aims for every actor; Clear decisions; Inbetween sharing; Challenge that patients to not participates in decision making; Obstacles as low health literacy and lack of knowledge; Previous experinces of poor care; Lack of confidence; Inconvienient place or time scheduling	Gustavsson, 2016; Levinson et al., 2005; Greenhagh et al., 2011; Longtin, 2010; Bergerum et al., 2019; Robert et al., 2015
Online health communities (OHCs)	Source of health information for community members; Peer-to-peer support (especially for patients with chronic diseases; Allows to connect on convienient time to exchange personal experiences, treat plans, indications and self-management; Public sharing; Support each other in need; Foster collaboration and knowledge co-creation between patients, researchers, health care professionals, and other stakeholders; Multilateral exchange of knowledge and ideas to create new knowledge; Differences between "online health support groups, that typically include patients only" and OHCs, that not only encompass participation from patients but also includes health professionals as discussion moderators"; Tensions among users; Providing ethics and data protection; Dealing with too lot information, which is not usually valid; No clear goal; Daily sharing without results; Professional conflicts between actors.	Amann, J., & Rubinelli, S., 2017; Amann, 2017 Magnezi et al., 2015; Colineau & Paris, 2010; Josefsson, 2005; Hilliard et al., 2015; Maloney-Krichmar & Preece, 2005; Bullinger et al., 2012;

Thus, there is no agreed definition of the health community and too little examples of it. Such limitations on literature confuse all stakeholders and raise indifferencies because no agreed model is proposed. We facing the complex issue: to define the health community in managerial sciences and to design an appropriate model for transfer knowledge (via open innovation perspective: both inside and between health communities). Even OI is classically applied and defined to business models „Open

innovation is the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively. [This paradigm] assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology" (Chesbrough, 2006), „Open innovation described as a distributed innovation process that is based on purposefully managed knowledge flows across enterprise boundaries" (Chesbrough, Vanhaverbeke & West, 2014), „The boundaries between a firm and its environment have become more permeable; innovations can easily transfer inward and outward between firms and other firms and between firms and creative consumers, resulting in impacts at the level of the consumer, the firm, an industry, and society" (Bogers et al., 2017), yet open innovation perspective in healthcare is starting to discuss more and more in various approaches (see Table 2).

Table 2. Definitions of Open Innovation in healthcare

Definition	Authors
"OI used to investigate the adoption of an open health platform by patients, care givers, physicians, family members, and the interested public. OI practices in health care lead to interesting innovation outcomes and are well accepted by participants"	Bullinger et al., 2012
„The OI concept, therefore, postulates that ideas and knowledge should be used as both inputs and outputs for the innovation process. In contrast to other industries, the healthcare industry holds peculiarities that influence and restrict the OI concept. Differences in organizations, norms, regulations and data protection, intellectual property protection culture as well as innovation complexity and information asymmetry"	Reinhardt et al., 2014
„OI in health, as we define it, refers to new forms of collaboration between different actors involved in the health innovation process. Notably, it refers to new kinds of collaboration between public sector (health service and/or research organisations) and private sector organisations; health service/research organisations and their employees (practitioners and researchers); health service/research organisations and the patients and citizens they serve."	Gabriel, Stanley& Saunders, 2017
"A fundamental premise of open innovation is that inter-firm knowledge transfer can accelerate R&D. In industries where complexity and a diversity of capabilities, and specialized infrastructure are required to bring a solution to market, open innovation is touted as a business method where channels of external cooperation can be synergistic. Healthcare is such an industry"	Silva, Schaibley & Ramos, 2018

The main goal of knowledge transfer is to identify, (co-)create, integrate, share, distribute existing and new knowledge, and unsuccessful process of it will have negative impacts for future value creation (Ng et al., 2012). Knowledge transfer also could be considered as adopting accessible knowledge to new contexts for the generation of new ideas and improving innovation processes (Christensen, 2003). Most scholars are using online communities definition for describing knowledge collaboration or transferring

(Faraj et al., 2011), but they're also noted, that context of OI in the context of health communities is still lacking (Secundo et al., 2019; West and Lakhani, 2008; Dahlander et al., 2008). Noted, that there is a growing need for effective community knowledge transfer and knowledge boundaries investigation. OI mechanisms would help for users or actors of communities to achieve valid knowledge transfer (Secundo et al., 2019, Randhava et al., 2017). There are some literature, that proposes the main dimensions of knowledge transfer in OI, describes roles and relations between involved actors, talks about objects and mechanisms of knowledge transfer (Battistella et al., 2016; Secundo et al., 2019), but still, we do not have enough understanding what are the main differences and challenges in the healthcare system, we reach a gap, where the sensitivity of topic is must discussed and models of knowledge transfer in healthcare through OI perspective proposed. There is the main need to focus on described gap exploration and got in-depth analyses with proposals of checked, adapted, and valuable models.

4 Conclusions

Our findings contribute to existing research with the highlights of health communities as potential knowledge creators and integrators. In general – health communities should work as co-creation between various stakeholders (patients, medical professionals, researchers etc.) and valid knowledge transfer through open innovation between other communities. By taking health communities in the agreed model, it is necessary to highlight the potential to the innovation processes. This article explored the existing relevant literature related to the topics of knowledge management and health ecosystems; open innovation and health; knowledge co-creation and community; knowledge transfer and open innovation. Paper has identified two main 3rd order categories: health communities and knowledge transfer. Findings showed that OI is approachable to the healthcare sector and has wide possibilities of using, but yet – health communities lack definitions and models to find out valid knowledge transfer model from existing literature. So this article lays as a background and present opportunities for the further research of health communities, defining it and creating models of informational flows, knowledge co-creation, and integration aka knowledge transfer, inside and between those communities, what forms an interesting avenue for future research.

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ANNEX 1. Articles related to chosen topics in detail

PubMed

	Article	Keywords	Year	Journal	1st order category	2nd order category	3rd order category
KNOWLEDGE MANAGEMENT & HEALTH ECOSYSTEM							
1.	Klucken, J., Krüger, R., Schmidt, P., & Bloem, B. R. (2018). Management of Parkinson's Disease 20 Years from Now: Towards Digital Health Pathways. Journal of Parkinson's disease, 8(s1), S85–S94. https://doi.org/10.3233/JPD-181519	Parkinson's Disease, Management, Treatment, Digital Pathways, Innovation, Healthcare	2018	Journal of parkinson's disease IF: 1,702	Disease Management; Digital Health	Innovation	Health community
2.	Laihonen, H. (2012), "Knowledge structures of a health ecosystem", Journal of Health Organization and Management, Vol. 26 No. 4, pp. 542-558. https://doi.org/10.1108/14777261211251571	Health Ecosystem, Knowledge Flows, Complexity, Health Care Management, Finland, Health Services Sector, Knowledge Transfer, Complexity Theory	2012	Journal of Health Organization and Management IF: 1,306	Ecosystems	Knowledge Management	Knowledge Transfer
3.	Chaut T. Et al (2013) Knowledge Translation in Rehabilitation Engineering Research and Development: A Knowledge Ecosystem Framework. Archives of Physical Medicine and Rehabilitation. DOI: 10.1016/j.apmr.2012.07.032	Activities Of Daily Living; Knowledge; Occupational Therapy; Rehabilitation; Self-Help Devices; Technology Transfer	2013	Archives of Physical Medicine and Rehabilitation IF: 2.441	Ecosystems	Knowledge Management	Knowledge Transfer
4.	Tana, S., Umniyati, S., Petzold, M., Kroeger, A., & Sommerfeld, J. (2012). Building and analyzing an innovative community-centered dengue-ecosystem management intervention in Yogyakarta, Indonesia. Pathogens and global health, 106(8), 469–478. https://doi.org/10.1179/2047773212Y.0000000062	Dengue, Community Participation, Empowerment, Waste Management	2012	Pathogens and Global Health IF: 1.969	Community Empowerment	Innovation	Health community
OPEN INNOVATION & HEALTH							
5.	Silva, P. J., Schaibley, V. M., & Ramos, K. S. (2018). Academic medical centers as innovation ecosystems to address population -omics challenges in precision medicine. Journal of translational medicine, 16(1), 28. https://doi.org/10.1186/s12967-018-1401-2	Precision Medicine, Genomics, Biomarker Collaboration, Open Innovation, Diagnostic Technology, Technology Transfer, Licensing, Industry Alliance, Data Ecosystem	2018	Journal of Translational Medicine IF: 4.197	Precision medicine	Health Ecosystems	Knowledge Transfer
6.	Hill, A., Loh, P. R., Bharadwaj, R. B., Pons, P., Shang, J., Guinan, E., Lakhani, K., Kilty, I., & Jelinsky, S. A. (2017). Stepwise Distributed Open Innovation Contests for Software Development: Acceleration of Genome-Wide Association Analysis. GigaScience, 6(5), 1–10. https://doi.org/10.1093/gigascience/gix009	Open Innovation, Crowdsourcing, Genome-Wide Association Study, PLINK, Logistic Regression	2017	GigaScience IF: 4.688	Software Development	Open Innovation	Knowledge Transfer
7.	Wass, S., & Vimarlund, V. (2016). Healthcare in the age of open innovation – A literature review. Health Information Management Journal, 45(3), 121–133. https://doi.org/10.1177/1833358316639458	Diffusion Of Innovation, Health Information Exchange, Informatics, Review Literature As Topic	2016	Health Information Management Journal IF: 1.742	Diffusion Of Innovation	Knowledge Management	Knowledge Transfer

8.	Melvin Reichman, Peter B. Simpson, Open innovation in early drug discovery: roadmaps and roadblocks, Drug Discovery Today, Volume 21, Issue 5, 2016, Pages 779-788, ISSN 1359-6446, https://doi.org/10.1016/j.drudis.2015.12.008.	N/D	2015	Drug Discovery Today IF: 6.369	Drug Management; Open Innovation	Open Innovation	Knowledge Transfer
9.	* Hanna Hopia, Mari Punna, Teemu Laitinen, Eila Latvala, A patient as a self-manager of their personal data on health and disease with new technology – challenges for nursing education, Nurse Education Today, Volume 35, Issue 12,2015, Pages e1-e3, ISSN 0260-6917, https://doi.org/10.1016/j.nedt.2015.08.017.	N/D	2015	Nurse Education Today IF: 2.442	Patient Empowerment	Knowledge Management	Knowledge Transfer
10.	Minna Allarakhia (2015) Exploring open innovation with a patient focus in drug discovery: an evolving paradigm of patient engagement, Expert Opinion on Drug Discovery, 10:6, 571-578, DOI: 10.1517/17460441.2015.1037271	Lead Patient, Open Innovation, Patient Centricity, Patient Engagement	2015	Expert Opinion on Drug Discovery IF: 4.421 (2018 m.)	Patient Empowerment	Open Innovation	Knowledge Transfer
11.	Salter, H, Holland, R (Science for Life Laboratory, Solna; Karolinska Insitutet, Solna, Sweden; and Oxford Gene Technology, Yarnton, Oxford, UK). Biomarkers: refining diagnosis and expediting drug development – reality, aspiration and the role of open innovation (Review). J Intern Med 2014; 276: 215– 228. doi: 10.1111/joim.12234	Biomarkers, Companion Diagnostics, Genomics, Personalized Medicine	2014	Journal of Internal Medicine IF: 6.051	Disease Management; Open Innovation	Open Innovation	Knowledge Transfer
12.	Dandonoli, P. Open innovation as a new paradigm for global collaborations in health. Global Health 9, 41 (2013). https://doi.org/10.1186/1744-8603-9-41	Partnerships; Innovation; Global Health; Maternal; Newborn; Child; Maker Movement; Open Innovation; Disruptive Innovation; Frugal Innovation	2013	Globalizatio n and health IF: 3.406	Maternal Health	Open Innovation	Health community
13.	Angelika C. Bullinger, Matthias Rass, Sabrina Adamczyk, Kathrin M. Moeslein, Stefan Sohn, Open innovation in health care: Analysis of an open health platform, Health Policy, Volume 105, Issues 2–3, 2012, Pages 165-175, ISSN 0168-8510, https://doi.org/10.1016/j.healthpol.2012.02.009.	Open Innovation Public Integration Health Care Communication	2012	Health Policy IF: 2.293	Health Platforms	Open Innovation	Knowledge Transfer
KNOWLEDGE CO-CREATION & COMMUNITY							
14.	Emma Haynes, Minitja Marawili, Brendan Makungun Marika, Alice G. Mitchell, Jodi Phillips, Dawn Bessarab, Roz Walker, Jeff Cook, Anna P. Ralph, Community-based participatory action research on rheumatic heart disease in an Australian Aboriginal homeland: Evaluation of the 'On track watch' project, Evaluation and Program Planning, Volume 74, 2019, Pages 38-53, ISSN 0149-7189, https://doi.org/10.1016/j.evalprogplan.2019.02.010.	Aboriginal Health Inequity; Australian Aboriginal; Co-Design; Community-Based Participatory Action Research; Empowerment; Health Systems; Indigenous; Knowledge Exchange; Reciprocal Knowledge Co-Creation; Rheumatic Heart Disease	2019	aluation and Program Planning IF: 1.240	Community Management	Health management	Health community

15.	Precision Medicine Goes Global: How to Get It Right? Four Ways to Mobilize Scientific Knowledge Vural Özdemir OMICS: A Journal of Integrative Biology 2018 22:8, 539-543 https://doi.org/10.1089/omi.2018.0104	Innovation Governance; Knowledge Mobilization; Precision Medicine; Responsible Innovation; Technology And Society	2018	OMICS (Journal) IF: 2.370	Precision Medicine	Knowledge management	Knowledge Transfer
16.	*Amann, J., & Rubinelli, S. (2017). Views of Community Managers on Knowledge Co-creation in Online Communities for People With Disabilities: Qualitative Study. Journal of medical Internet research, 19(10), e320. https://doi.org/10.2196/jmir.7406	Co-Creation; Community Networks; Community Participation; Internet; Patient-Centered Care; Telemedicine	2017	Journal of Medical Internet Research *IF: 4.945*	Community Management; Online Communities; Co-Creation	Co-creation	Health community
17.	van den Driessen Mareeuw, F., Vaandrager, L., Klerkx, L., Naaldenberg, J., & Koelen, M. (2015). Beyond bridging the know-do gap: a qualitative study of systemic interaction to foster knowledge exchange in the public health sector in The Netherlands. BMC public health, 15, 922. https://doi.org/10.1186/s12889-015-2271-7	Public Health, Health Promotion, Innovation System, Know-Do Gap, Implementation, Knowledge Exchange, Stakeholders	2015	BMC Public Health IF: 2.567	Know-Do; Health ecosystem	Knowledge Management	Knowledge Transfer
18.	*Kitson, A., Powell, K., Hoon, E., Newbury, J., Wilson, A., & Beilby, J. (2013). Knowledge translation within a population health study: how do you do it?. Implementation science : IS, 8, 54. https://doi.org/10.1186/1748-5908-8-54	Knowledge Translation, Population Health, Engaged Scholarship, Co-KT Framework, Health System Redesign	2013	Implementation Science IF: 4.525	Knowledge Management	Knowledge Translation	Health community
KNOWLEDGE TRANSFER & OPEN INNOVATION							
19.	Savory, C. and Fortune, J. (2015), "From translational research to open technology innovation systems", Journal of Health Organization and Management, Vol. 29 No. 2, pp. 200-220. https://doi.org/10.1108/JHOM-01-2013-0021	Healthcare Technology; Mode 2 Knowledge Production; Open Innovation; Patientrack; Quadruple-Helix; Translational Research; User Driven Innovation	2015	Journal of Health Organization and Management IF: 1,306	Difussion Of Innovation	Open Innovation	Knowledge Transfer
20.	Melder, A., Burns, P., Mcloughlin, I., & Teede, H. (2018). Examining 'institutional entrepreneurship' in healthcare redesign and improvement through comparative case study research: a study protocol. BMJ open, 8(8), e020807. https://doi.org/10.1136/bmjopen-2017-020807	Diffusion Of Innovation; Entrepreneurship; Health Services Research; Knowledge Translation; Organizational Innovation; Qualitative Research	2018	BMJ Open IF: 2.376	Entrepreneurship, Difussion Of Innovation	Knowledge Translation	Knowledge Transfer
21.	*Hanna Hopia, Mari Punna, Teemu Laitinen, Eila Latvala, A patient as a self-manager of their personal data on health and disease with new technology – challenges for nursing education, Nurse Education Today, Volume 35, Issue 12, 2015, Pages e1-e3, ISSN 0260-6917, https://doi.org/10.1016/j.nedt.2015.08.017	N/D	2015	Nurse Education Today IF: 2.442	Patient Empowerment	Knowledge management	Health community

22.	*McKibbon, K. A., Lokker, C., Keepanasseril, A., Colquhoun, H., Haynes, R. B., & Wilczynski, N. L. (2013). WhatisKT wiki: a case study of a platform for knowledge translation terms and definitions--descriptive analysis. Implementation science : IS, 8, 13. https://doi.org/10.1186/1748-5908-8-13	Diffusion Of Innovations, Research, Knowledge Translation, Implementation Science	2013	Implementation Science IF: 4.525	Knowledge Management; Difussion Of Innovation	Knowledge Translation	Knowledge Transfer

*Article found in more than one category of results

WoS

	Article	Keywords	Year	Journal	1st order category	2nd order category	3rd order category
KNOWLEDGE MANAGEMENT & HEALTH ECOSYSTEM							
1.	Cori, L., Bianchi, F., Sprovieri, M., Cuttitta, A., Ruggieri, S., Alessi, A. L., … Gorini, F. (2019). Communication and Community Involvement to Support Risk Governance. International Journal of Environmental Research and Public Health, 16(22), 4356. https://doi.org/10.3390/ijerph16224356	Environment And Health; High Risk Areas; Contaminated Sites; Risk Governance; Human Biomonitoring; Environmental Monitoring; Risk Communication; Training And Education	2019	International Journal Of Environmental Research And Public Health IF: 2.468	Community Health	Health Management	Health community
2.	Menear, M., Blanchette, M.-A., Demers-Payette, O., & Roy, D. (2019). A framework for value-creating learning health systems. Health Research Policy and Systems, 17(1), 79. https://doi.org/10.1186/s12961-019-0477-3	Learning Health Systems; Framework; Quality Improvement; Health System Performance; Value-Based Care; Canada	2019	Health Research Policy And Systems IF 2.218	Health Systems	Value creation	Health community
3.	Floch J, Zettl A, Fricke L, Weisser T, Grut L, Vilarinho T, Stav E, Ascolese A, Schauber C. User Needs in the Development of a Health App Ecosystem for Self-Management of Cystic Fibrosis: User-Centered Development Approach JMIR Mhealth Uhealth 2018;6(5):e113 DOI: 10.2196/mhealth.8236	Self-Management; Cystic Fibrosis; Mobile Health; User Centered Design	2018	JMIR Mhealth And Uhealth IF 4.301	Patient Empowerment	Health management	Health community
4.	Identifying the social and environmental determinants of plague endemicity in Peru: insights from a case study in Ascope, La Libertad Rivière-Cinnamond et al. BMC Public Health (2018) 18:220 DOI 10.1186/s12889-018-5062-0	Plague; Social And Environmental Determinants Of Health; Qualitative Methods; Risk Perceptions; Complex Systems; Public Health Policy	2018	BMC Public Health IF 2.567	Health Systems	Health management	Health community
5.	Healthcare model with use of information and communication technology for patients with chronic disease By:Lisiecka-Bielanowicz, M et al Annals of Agricultural and Environmental Medicine 2016, Vol 23, No 3, 462–467 www.aaem.pl	Healthcare System; Chronic Disease; Organizational Model; Health Information Management; ICT Systems	2016	Annals Of Agricultural And Environmental Medicine IF 1.03	Disease management; Health Systems	Knowledge management	Knowledge Transfer

6.	Mary Ruckelshaus, Emily McKenzie, Heather Tallis, Anne Guerry, Gretchen Daily, Peter Kareiva, Stephen Polasky, Taylor Ricketts, Nirmal Bhagabati, Spencer A. Wood, Joanna Bernhardt, Notes from the field: Lessons learned from using ecosystem service approaches to inform real-world decisions, Ecological Economics, Volume 115,2015,Pages 11-21,ISSN 0921-8009, https://doi.org/10.1016/j.ecolecon.2013.07.009.	Ecosystem Services; Human Development And Conservation; Spatial Planning; PES; Decision Support	2015	Ecological Economics IF 4.281	Ecosystems	Knowledge management	Knowledge Transfer
7.	Hsieh, H.-L., Lin, H.-J., Shih, S.-S., & Chen, C.-P. (2015). Ecosystem Functions Connecting Contributions from Ecosystem Services to Human Wellbeing in a Mangrove System in Northern Taiwan. International Journal of Environmental Research and Public Health, 12(6), 6542–6560. https://doi.org/10.3390/ijerph120606542	Mangrove Ecosystem; Ecosystem Functions; Ecosystem Services; Human Wellbeing; Component Connection Network	2015	International Journal Of Environmental Research And Public Health IF 2.468	Health services	Health Ecosystem	Health community
8.	Managing Interoperability and Complexity in Health Systems By:Bouamrane, MM et al DOI: 10.3414/ME15-10-0001	Medical Informatics; Health Information Management; Knowledge Bases; Biological Ontologies; Systematized Nomenclature Of Medicine; Information Storage And Retrieval; Classification; Systems Integration	2015	Methods Inf Med IF 1.024	Health Systems	Health management	Knowledge Transfer
9.	Perspectives to Performance of Environment and Health Assessments and Models-From Outputs to Outcomes? By:Pohjola, MV et al Int. J. Environ. Res. Public Health 2013, 10, 2621-2642; doi:10.3390/ijerph10072621	Assessment; Model; Evaluation; Environment; Health; Performance; Management; Quality; Uncertainty; Effectiveness	2013	International Journal Of Environmental Research And Public Health IF 2.468	Environment Health	Health management	Health community
10	The role of social networks in the governance of health systems: the case of eye care systems in Ghana By:Blanchet, K Health Policy and Planning 2013;28:143–156 doi:10.1093/heapol/czs031	Social Networks; Health Systems; Ophthalmology; Health Services; Management	2013	Health Policy And Planning IF 2.717	Health Systems	Health management	Health community
11	Susilowati Tana, SittiRahmah Umniyati, Max Petzold, Axel Kroeger & Johannes Sommerfeld (2012) Building and analyzing an innovative community-centered dengue-ecosystem management intervention in Yogyakarta, Indonesia, Pathogens and Global Health, 106:8, 469-478, DOI: 10.1179/2047773212Y.0000000062	Dengue; Community Participation; Empowerment; Waste Management	2012	Pathogens And Global Health IF 1.969	Community Empowerment	Health management	Health community

12	Critical Issues in the Development of Health Information Systems in Supporting Environmental Health: A Case Study of Ciguatera By:Goater, S https://ehp.niehs.nih.gov/doi/10.1289/ehp.1002575 https://doi.org/10.1289/ehp.1002575	Ciguatera; Climate Change; Ecosystem Health; Environmental Health; Health Information Systems	2011	Environmental Health Perspectives IF 7.736	Ecosystems	Health ecosystem	Health community
OPEN INNOVATION & HEALTH							
13	Maha Shaikh, Natalia Levina, Selecting an open innovation community as an alliance partner: Looking for healthy communities and ecosystems, Research Policy, Volume 48, Issue 8, 2019, 103766, ISSN 0048-7333, https://doi.org/10.1016/j.respol.2019.03.011.	Strategic Alliances; Partner Selection; Open Source Community; Open Innovation; Open Ecosystem; Company Engagement With Open Source; Company-Community Relationship	2019	Research Policy IF 5.425	Ecosystems	Open innovation	Health community
14	Hussey, P et al 2019 Building infrastructure for digital health using Open innovation 2.0 in co design of a meta data registry framework to support integrated care.. International Journal of Integrated Care, 19(S1): A18, pp. 1-8, DOI: dx.doi.org/10.5334/ijic.s3018	Digital Health; Interoperability; Data Dictionary; Co Design; Innovation	2019	International Journal Of Integrated Care IF 2.489	Digital health	Open innovation	Knowledge Transfer
15	Nambisan, S, Siegel, D, Kenney, M. On open innovation, platforms, and entrepreneurship. Strategic Entrepreneurship Journal. 2018; 12: 354– 368. https://doi.org/10.1002/sej.1300	Ecosystems; Entrepreneurship; Open Innovation; Platforms	2018	Strategic Entrepreneurship Journal IF 2.956	Ecosystems	Open innovation	Knowledge Transfer
16	S. Fernandes, M. Cesário, J.M. Barata, Ways to open innovation: Main agents and sources in the Portuguese case,Technology in Society,Volume 51,2017,Pages 153-162,ISSN 0160-791X, https://doi.org/10.1016/j.techsoc.2017.09.002.	Open Innovation; Cooperation; Agents; Sources; Scope; Scale	2017	Technology In Society IF 1.67	Community health	Open innovation	Knowledge Transfer
17	*Wass, S., & Vimarlund, V. (2016). Healthcare in the age of open innovation – A literature review. Health Information Management Journal, 45(3), 121–133. https://doi.org/10.1177/1833358316639458	Diffusion Of Innovation; Health Information Exchange; Informatics; Review Literature As Topic	2016	Health Information Management Journal IF 1.742	Diffusion Of Innovation	Open innovation	Knowledge Transfer
18	Jeffrey R. Davis, Elizabeth E. Richard & Kathryn E. Keeton (2015) Open Innovation at NASA: A New Business Model for Advancing Human Health and Performance Innovations, Research-Technology Management, 58:3, 52- 58, DOI: 10.5437/08956308X5803325	Culture Change; Business-Model Innovation; Open Innovation; Crowdsourcing	2015	Research-Technology Management IF 1.407	Business-Model Transformation	Open innovation	Knowledge Transfer

19	Henrike, Hannemann-Weber; Schultz, Carsten The impact of health care professionals' service orientation on patients' innovative behavior, Health Care Management Review: October/December 2014 - Volume 39 - Issue 4 - p 329-339 doi: 10.1097/HMR.0b013e31829d534c	:Idea Generation; Patient Innovative Behavior; Rare Diseases; Service Orientation; Shared Goals; Work Adaptivity And Proactivity	2014	Health Care Management Review IF 2.636	Disease Management	Innovation	Health community
20	Using users: When does external knowledge enhance corporate product innovation? By:Chatterji, AK et al https://onlinelibrary.wiley.com/doi/full/10.1002/smj.2168 https://doi.org/10.1002/smj.2168	Innovation Strategy; Knowledge Sourcing; Open Innovation; Health Care Strategy; Intellectual Property Strategy	2014	Strategic Management Journal IF 5.572	Knowledge Management	Open innovation	Knowledge Transfer
21	Programmes and calls for public health research in European countries By:Conceicao, C doi:10.1093/eurpub/ckt152	N/D	2013	European Journal Of Public Health IF 2.234	Public Health	Health management	Knowledge Transfer
22	*Dandonoli, P. (2013). Open innovation as a new paradigm for global collaborations in health. Globalization and Health, 9(1), 41. https://doi.org/10.1186/1744-8603-9-41	Partnerships; Innovation; Global Health; Maternal; Newborn; Child; Maker Movement; Open Innovation; Disruptive Innovation; Frugal Innovation	2013	Globalization And Health IF 2.554	Dffusion of Innovation	Open innovation	Knowledge Transfer
23	*Angelika C. Bullinger, Matthias Rass, Sabrina Adamczyk, Kathrin M. Moeslein, Stefan Sohn,Open innovation in health care: Analysis of an open health platform,Health Policy,Volume 105, Issues 2–3,2012, Pages 165-175,ISSN 0168-8510, https://doi.org/10.1016/j.healthpol.2012.02.009	:Open Innovation; Public Integration; Health Care; Communication	2012	Health Policy IF 2.075	Public Health	Open innovation	Knowledge Transfer
KNOWLEDGE CO-CREATION & COMMUNITY							
24	Tomaselli G, Buttigieg SC, Rosano A, Cassar M and Grima G (2020) Person-Centered Care From a Relational Ethics Perspective for the Delivery of High Quality and Safe Healthcare: A Scoping Review. Front. Public Health 8:44. doi: 10.3389/fpubh.2020.00044	Person-Centered Care (PCC); Patient-Centered Care; Ethics; Relational Ethics; Patient Safety; Quality Of Care; Health Systems	2020	Frontiers In Public Health IF 2.031	Patient-Centered Care; Health Systems	Health management	Health community
25	Co-Creating a Virtual Alcohol Prevention Simulation with Young People By:Vallentin-Holbech, L et al Int. J. Environ. Res. Public Health 2020, 17, 1097; doi:10.3390/ijerph17031097	Living Lab Methodology; Co-Creation; Participatory Research; Empowerment; Self-Efficacy; Alcohol Prevention	2020	International Journal Of Environmental Research And Public Health IF 2.468	Patient Empowerment	Co-creation	Health community

26	Priharsari, D., Abedin, B. and Mastio, E. (2020), "Value co-creation in firm sponsored online communities: What enables, constrains, and shapes value", Internet Research, Vol. 30 No. 3, pp. 763-788. https://doi.org/10.1108/INTR-05-2019-0205	Online Community; Literature Review; Value Co-Creation; Online Co-Creation Community	2020	Internet Research IF 4.109	Community; co-creation	Value creation	Health community
27	King, C., Murillo, E., Wei, W., Madera, J., Tews, M.J., Israeli, A.A. and Kong, L. (2019), "Towards a shared understanding of the service experience – a hospitality stakeholder approach", Journal of Service Management, Vol. 30 No. 3, pp. 410-428. https://doi.org/10.1108/JOSM-11-2018-0375	Hospitality Industry; Service Experience; Stakeholder; Service Eco-System; Community Of Practice	2019	Journal Of Service Management IF 3.23	Community; Ecosystems	Health ecosystem	Health community
28	Loignon, C., Dupéré, S., Fortin, M. et al. Health literacy – engaging the community in the co-creation of meaningful health navigation services: a study protocol. BMC Health Serv Res 18, 505 (2018). https://doi.org/10.1186/s12913-018-3315-3	Health Literacy; Participatory Action Research; Knowledge Translation; Co-Creation; Health Literacy; Aboriginal Peoples; Underserved Populations	2018	Bmc Health Services Research IF 1.932	Health Literacy, Community Health	Knowledge translation	Knowledge Transfer
29	Kofi Osei-Frimpong, Alan Wilson, Fred Lemke Patient co-creation activities in healthcare service delivery at the micro level: The influence of online access to healthcare information, Technological Forecasting and Social Change, Volume 126, 2018, Pages 14-27, ISSN 0040-1625, https://doi.org/10.1016/j.techfore.2016.04.009.	Value Co-Creation; Online Health Information; Service Encounter Process; Healthcare; Mixed Methods	2018	Technological Forecasting And Social Change IF 3.815	Public Health; co-creation	Value creation	Knowledge transfer
30	Jull, J., Giles, A. & Graham, I.D. Community-based participatory research and integrated knowledge translation: advancing the co-creation of knowledge. Implementation Sci 12, 150 (2017). https://doi.org/10.1186/s13012-017-0696-3	Community-Based Participatory Research; Integrated Knowledge Translation; Engagement; Collaboration; Health Systems; Co-Creation; Knowledge; Implementation	2017	Implementation Science IF 4.525	Community, knowledge management; value creation	Co-creation	Health community
31	*Amann J, Rubinelli S Views of Community Managers on Knowledge Co-creation in Online Communities for People With Disabilities: Qualitative Study, J Med Internet Res 2017;19(10):e320 DOI: 10.2196/jmir.7406	Community Networks; Internet; Patient-Centered Care; Telemedicine; Community Participation; Co-Creation	2017	Journal Of Medical Internet Research IF 4.94	Community Management; Online Communities; Co-Creation	Co-Creation	Health community
32	GREENHALGH, T., JACKSON, C., SHAW, S. and JANAMIAN, T. (2016), Achieving Research Impact Through Co-creation in Community-Based Health Services: Literature Review and Case Study. The Milbank Quarterly, 94: 392-429. doi:10.1111/1468-0009.12197	Co-Creation; Knowledge Production; Health Research Systems	2016	Milbank Quarterly IF 7.425	Community Heath;Co-Creation	Co-Creation	Health community

33	Stephen P Osborne, Zoe Radnor & Kirsty Strokosch (2016) Co-Production and the Co-Creation of Value in Public Services: A suitable case for treatment?, Public Management Review, 18:5, 639-653, DOI: 10.1080/14719037.2015.1111927	Co-Production; Public Services Reform; Active Citizens; Active Communities; Public Service-Dominant Logic; Co-Creation; Public Value	2016	Public Management Review IF 3.162	Public Health; Health Services	Co-Creation	Health community
34	By:Van Oerle, S et al Coordinating online health communities for cognitive and affective value creation August 2016Journal of Service Management 27(4):481-506 DOI: 10.1108/JOSM-09-2015-0264	Value Drivers; Health Services; Services Management; Service Co-Creation	2016	Journal Of Service Management IF 3.23	Health Communities	Value creation	Knowledge Transfer
35	Zhao, J., Wang, T. and Fan, X. (2015), "Patient value co-creation in online health communities: Social identity effects on customer knowledge contributions and membership continuance intentions in online health communities", Journal of Service Management, Vol. 26 No. 1, pp. 72-96. https://doi.org/10.1108/JOSM-12-2013-0344	Co-Creation; Health Services	2015	Journal Of Service Management IF 3.23	Health Services	Co-Creation	Knowledge Transfer
36	*Kitson, A., Powell, K., Hoon, E. et al. Knowledge translation within a population health study: how do you do it?. Implementation Sci 8, 54 (2013). https://doi.org/10.1186/1748-5908-8-54	Knowledge Translation; Population Health; Engaged Scholarship; Co-KT Framework; Health System Redesign	2013	Implementation Science IF 4.525	Knowledge Management	Knowledge Translation	Knowledge transfer
KNOWLEDGE TRANSFER & OPEN INNOVATION							
37	C. Anthony Di Benedetto, Adam Lindgreen, Marianne Storgaard, Ann Højbjerg Clarke, How to collaborate really well with practitioners, Industrial Marketing Management, Volume 82, 2019, Pages 1-8, ISSN 0019-8501, https://doi.org/10.1016/j.indmarman.2019.08.001.	Academics; Businesses; Collaboration; Innovation; Practitioners; Research; Societal Impact; Universities	2019	Industrial Marketing Management IF 4.779	Collaboration	Knowledge Translation	Knowledge transfer
38	Chifundo Kayoka, Ambumulire Itimu-Phiri, Adam Biran, Rochelle H. Holm, Lasting results: A qualitative assessment of efforts to make community-led total sanitation more inclusive of the needs of people with disabilities in Rumphi District, Malawi, Disability and Health Journal, Volume 12, Issue 4, 2019, Pages 718-721, ISSN 1936-6574, https://doi.org/10.1016/j.dhjo.2019.05.007	Disability; Malawi; Open Defecation Free; Program Implementation; Sanitation	2019	Disability And Health Journal IF 1.471	Disease management ; Community Empowerment	Health management	Knowledge Transfer
39	Yun, J.J.; Liu, Z. Micro- and Macro-Dynamics of Open Innovation with a Quadruple-Helix Model. Sustainability 2019, 11, 3301. https://www.mdpi.com/2071-1050/11/12/3301#cite https://doi.org/10.3390/su11123301	Sustainability; Open Innovation; Micro Dynamics; Macro Dynamics; Quadruple-Helix; Innovation Ecosystem	2019	Sustainability IF 2.592	Ecosystems	Open Innovation	Knowledge Transfer
40	Secundo, G., Toma, A., Schiuma, G. and Passiante, G. (2019), "Knowledge transfer in open innovation: A classification framework for healthcare ecosystems", Business Process Management Journal, Vol. 25 No. 1, pp. 144-163. https://doi.org/10.1108/BPMJ-06-2017-0173	Open Innovation; Intermediary Networks; Healthcare Ecosystem; Knowledge Flow; Knowledge Transfer	2019	Business Process Management Journal IF 1.88	Knowledge Management	Healthcare ecosystems	Knowledge Transfer

41	Randhawa, K., Josserand, E., Schweitzer, J. and Logue, D. (2017), "Knowledge collaboration between organizations and online communities: the role of open innovation intermediaries", Journal of Knowledge Management, Vol. 21 No. 6, pp. 1293-1318. https://doi.org/10.1108/JKM-09-2016-0423	Communities Of Practice; Open Innovation; Knowledge Management; Innovation Intermediaries	2017	Journal Of Knowledge Management IF 4.604	Community Empowerment; Knowledge Management	Knowledge Translation	Knowledge Transfer
42	Julia Olmos-Peñuela, Paul Benneworth, Elena Castro-Martínez, Does it take two to tango? Factors related to the ease of societal uptake of scientific knowledge, Science and Public Policy, Volume 43, Issue 6, December 2016, Pages 751–762, https://doi.org/10.1093/scipol/scw016	Research Structures; Hybrid Scientific Governance; Research Micro-Practices; Open Research Behaviours; Openness; Scientists' Characteristics	2016	Science And Public Policy IF 1.575	Society	Knowledge Translation	Knowledge Transfer
43	FARRER, L., MARINETTI, C., CAVACO, Y., & COSTONGS, C. (2015). Advocacy for Health Equity: A Synthesis Review. The Milbank Quarterly, 93(2), 392-437. Retrieved May 27, 2020, from www.jstor.org/stable/24369857	Social Determinants Of Health; Consumer Advocacy; Evidence-Based Policy; Vulnerable Populations	2015	Milbank Quarterly IF 7.425	Social	Health management	Knowledge Transfer
44	*McKibbon, K.A., Lokker, C., Keepanasseril, A. et al. WhatisKT wiki: a case study of a platform for knowledge translation terms and definitions — descriptive analysis. Implementation Sci 8, 13 (2013). https://doi.org/10.1186/1748-5908-8-13	Diffusion Of Innovations; Research; Knowledge Translation; Implementation Science	2013	Implementation Science IF 4.525	Knowledge Management; Difussion Of Innovation	Knowledge Translation	Knowledge Transfer

*Article found in more than one category of results

Museums as Innovative and Community-Oriented Organizations

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Abstract

Museums as social and cultural institutions should drive innovation to strengthen the relationship with the audience, contribute to social value creation and develop community-oriented processes within cultural ecosystems. The study investigates to what extent Romanian and Italian museums are perceived as innovative by their audiences to understand how a museum could better meet the expectations of the audiences. As social value-oriented institutions, museums should involve their communities to contribute to cultural knowledge creation fostering audience participation by involving the users to co-create public value and shape the museum as an innovation-driven community. In driving innovation, museums are involving their audiences and stakeholders to contribute to cultural heritage knowledge within cultural ecosystems. Museums as community-oriented organizations should drive audience-centered innovation for cultural knowledge creation.

Keywords – museums, innovation, community, innovativeness perception.

Paper type – Academic Research Paper

1 Introduction

In the past few decades, museums have experienced impressive changes in the way they perceive and assume a cultural and educational role in society (Emery, 2001; Long, 2013), the way they develop and implement educational and public programs (Hooper-Greenhill, 2007), as well as how they perceive and cooperate with their communities by strengthening continuous involvement and engagement of the audience and driving users to contribute to sustaining museum knowledge and information sources for cultural value creation (Kadoyama, 2018; Simon, 2010; Holden, 2006).

In the twenty-first century museums should behave as engaging institutions that place the visitor at the center of museum experience in order to support the visitor to engage with objects and collections, and learn. The engaging museums helps strengthen diversity, social inclusion and cohesion, becoming a community meeting place (Black, 2012). The changes in museums are of such a large extent and profound that the definition of museums supported by the International Council of Museums is changing, but the process is so complicated, the stakeholders to be considered so various, that an agreement has not been met yet. Part of the challenges to be overcome is to understand the wide diversity of museum activities and their impact on societies and communities, including the social innovation that they could achieve. Thereby, Vicente, Camarero and Garrido (2015) have defined innovation within museums as tendency that enables the museum to better present its exhibits to the visitors and incorporate systems, processes, organizational and technological infrastructures in order to better contribute to cultural knowledge and value by interacting with audience. Thereby, innovation in cultural organization as well as museums has been interpreted as a means to react to inefficiency and organizational crisis as a way to repair and arrange the structure and policies (Vicente, Camarero and Garrido, 2015). Moreover, innovation should help museums to develop as organizations, evolve as institutions working in the service of society, and communities that contribute to sustaining value co-creation interacting with audiences (Minkiewicz, Evans and Bridson, 2014). As embracing both technological and organization innovation as a strategy, museums contribute to achieving social and economic performances promoting learning and development within cultural ecosystems (Camarero and Garrido, 2008; Borin and Donato, 2015).

Museums should select a change management strategy in order to face all contemporary challenges by dealing with complexity and creativity management (Janes and Sandell, 2007), leading the museum as an effective agent of social innovation, a community space and audience-oriented organization able to rethink how to promote future and sustainable development engaging the public within communities (Watson, 2007; Crooke, 2007).

All these transformations are tightly related to transformation within society and the changing expectations of the wider public, as well as with the evolving practices in the museum world and of the curatorial practices. This latter aspect is connected to

technological innovations, as well as innovative practices adopted by museums when designing exhibitions or various public programs. This innovative practice leads to a more appealing public offer, as well as to increased impact. We observe a direct link between the image of a museum and the amount of innovation associated with its name.

The motivations of the study rely on the need to relate visitors' perception about museum's innovativeness to communication and organizational arrangements and policies museums have to build in order to be perceived as innovative, social and value-driven organizations living within cultural ecosystems to build a sense of community involving the public. The present paper investigates to what extent Romanian and Italian museums are perceived as innovative by their audiences. To reach this aim we developed an online survey. The results help museum managers better understanding their audience and how they perceive museums from an innovation point of view.

This is both theoretical and empirical. Museums are driving innovation by involving the audience and constructing a meaning of their communities in the cultural heritage content definition. The paper is structured in six sections. Following the introduction, in the second section, the theoretical background relies on rediscovering museums as innovation-enabled and community-oriented organizations living within cultural ecosystems. In the third section, a study on the perception of museums' innovativeness is presented. The fourth section elucidates the discussion. Finally, conclusions are set out.

2 Museums as innovation-enabled and community-oriented organizations living within cultural ecosystems

Museums as memory, cultural and educational institutions are information-driven and information utilities, knowledge-based and learning-driven and community-oriented organizations that contribute to cultural value creation (Bagdadly, 2007; Freedman, 2000; Hein, 1998; MacDonald and Alsford 2001; Marty, 2007; Davies, Paton and O'Sullivan, 2013; Sheppard, 2000; Holden, 2006).

Museums should embrace an innovation-oriented view developing new systems, process, organizational and technological arrangement to contribute to cultural value by interacting with audience and better presenting cultural services to the visitor (Vicente, Camarero and Garrido, 2015).

As community-oriented organizations, museums contribute to local and urban development by strengthening educational mission (Tuffs and Milne, 1999) and proceed towards sustainable development by achieving economic and social issues in terms of cultural development and quality of life in the community (Pop and Borza, 2014). Museums should rethink a community vision (Baumann, 2001) to benefit society providing its educational, learning and cultural mission (Hein, 1998) and to develop innovation for social change and value creation processes to achieve cultural sustainability (Castells, 2001; Burton and Scott, 2007; Pop and Borza, 2016). Museums should open up to flexible and multiple interpretations of knowledge, rediscovering

constantly meanings when the truth is dependent on context (Davies, Paton and O'Sullivan, 2013). As working with and for communities, museums should define how to engage with their audiences, to deal with knowledge, how to control and share knowledge on cultural contents, and behave as an institution serving the purposes of society (Watson, 2007).

Museums should strategically promote interaction between museum staff, collections and the public, engaging with a working and active audience in an interactive process (Balogoun, Best and Lê, 2015) building social capital within a community whereas museums and users share same the interests and goals (Rounds, 2012), and the audience is an active agent that influences how museums act and represent what a museum examines (Karp, 1992). As engaging the audience, museums become a community meeting place in order to contribute to cultural diversity and social capital (Black, 2012). As involving local communities, museums are leading institutions of cultural and social growth by fostering and deepening community relationships by involving the members and representatives of local community in museum work and building long-term relationships (Kadoyama, 2018). As a community space and relevant institution to diverse audiences, the museum should continuously learn how to meet new needs and desires understanding the communities outside the museum to engage more successfully with a broader audience (Crooke, 2007).

Museums are seeking to contribute to public value by involving the public. Increasingly, museums have to enable the public to act as producer and creator of social and cultural value by making a contribution and becoming involved (Scott, 2010). As fostering social engagement and visitor's participation and building social capital by following an audience-centric view as a way to develop social innovation in cultural context (Consiglio, Cicellin, Scuotto and Ricchezza, 2017), the museum community as a whole should rethink how to define, establish, evaluate and measure their work, worth and results in the public eye (Sheppard, 2000) developing interaction between museum staff and users as a source for cultural value creation (Romanelli, 2017). In particular, museums should exert favorable influence on visitor's behaviors by developing relational, services and digital capabilities and policies in order to attract new audience and involve visitors to be part of cultural heritage and knowledge content definition (Manna and Palumbo, 2018).

Museums as cultural connectors and meeting places of social innovation (Castells, 2001) contribute to promoting social value and action democratizing knowledge about cultural heritage in a changing world (Burton and Scott, 2007; Bautista, 2014) becoming audience-driven organizations (Gilmore and Rentschler, 2002) that select a visitor-oriented strategy for innovation and change. Museum foster technological and organizational innovation developing both market and service orientation (Camarero and Garrido, 2012). Museums as participatory institutions promote users' engagement and enable audience involvement in cultural knowledge processes (Simon, 2010) by involving visitors to take part in the production and value creation about cultural heritage enhancing

the opportunity for collaboration and networks between staff and communities (Kelly, 2010), developing interactive and collaborative forms between the museum and the public (Bonacini, 2012). Museums should involve the audience as a source for enabling value-oriented relationships. In particular, museums should shape and strengthen the visitor's experience as value co-creation process (Antòn, Camarero and Garrido, 2018).

As agents of social change, museums «are exploring the potential for greater community activism, believing that their own institutional sustainability is closely tied to community sustainability» (Sheppard, 2000, p. 64). Museums should engage with the public as social institutions working for sustaining, and maintaining public value (Holden, 2006). Museums as providers of authentic cultural knowledge (Russo and Watkins, 2007) are redefining cultural authority adapting to changing society (Bautista, 2014), maintaining a legitimizing role as a symbol of the community (Burton and Scott, 2007). Museums contribute to value creation making available and sharing their knowledge with audiences within a cultural ecosystem (Borin and Donato, 2015).

As social and cultural (instrumental, institutional and intrinsic) value-driven organizations (Holden, 2006), museums should proceed beyond a visitor-centered approach to build relationships with the public to create public value (Scott, 2010) and support the legitimacy of cultural value that museums contribute to create for society and within communities (Holden, 2006). Museums should develop the capacity to innovate from a social perspective. Innovative discourse and ways to interact with visitors and communities could determine museums to be active actors in society and their communities, to contribute to social inclusion, to participatory citizenship, to understanding various phenomena influencing the present world, such as migration, climate change or stigmatization (Antos, Fromm, and Golding, 2017). Applying an innovative approach, museums could better reach their mission and become more sustainable institutions (Pop and Borza, 2016) promoting social value (Burton and Scott, 2007). As driving innovation, museums contribute to economic, social, and environmental sustainability, appealing to a general public attracting more revenues from visitors. As innovative institutions, museums are attracting sponsors and other partners in order to promote joint collaboration and partnership. The relationships improve and this leads to development and efficiency. At the same time, an innovative museum becomes a sustainable institution also from a cultural perspective, which is essential for such an organization (Errichiello and Micera, 2018). Museums should create an environment that supports visitor engagement with collections (Black, 2012). Museums are increasingly involving visitors and communities in many ways fostering participation and involvement in cultural project (Simon, 2010). Switching from information to provocation could be based on technology and the creative use of technology. This enables museums not only to better communicate, therefore, convincingly transmit information and educate but also to engage with their communities (Buletić, 2017).

Technologies do not exist *per se* being socially constructed and shaped (Williams and Edge, 1996). Technology helps museums for change by moving from a collections-driven

approach to an audience-driven orientation (Bonacini, 2012). Technology helps museums to attract new audiences and enhance visitor's experience of exhibits (Vom Lehn and Heath, 2005). As becoming hybrid places, museums tend to recombine leisure and learning using entertainment as a means to support learning opportunities and attract new and wider public (McPherson, 2006). Technology could help museums in many ways. Firstly, it facilitates the delivery of information in a more appealing manner considering the changing preferences of the public. It could also help show artifacts and elements of the intangible heritage that would be otherwise out of reach (for instance lost heritage or which exists in some other place). Digitization could help museum visitors travel in time and space. A stimulating way to engage with visitors, in an innovative way, is using chatbots (Tzouganatou, 2018). They could be simply used as information-providing robots, or through gamification, they could enrich the museum experience, not only the knowledge gained during the visit. Another relatively novel technology that could be valorized by museums is 3D printing. It allows museums to offer visitors exact replicas to handle, enriching the museum experience, and allowing for a better understanding of the heritage (Cooper, 2019). Creative 3D food printing also offers many forms of engaging in a fun and educational way with the museum's public (Antlej, Leen, and Russo, 2017).

Virtual and digital technology enhance the museum as an institution serving the society providing cultural meaning, knowledge, legitimation of educational and learning mission. As embracing technology, museums tend to develop the virtual museum as a powerful metaphor for creativity as well as knowledge repositories (Carp, 2004). Virtual reality and artificial intelligence help drive innovation within museums. They offer a stage for visitors engaging and learning, contributing also to a rewarding museum experience. For instance, the type of narration and engagement leads to better or smaller educational outcomes (Moesgaard *et al.*, 2015). Digital innovation comes with specific challenges. For instance, too much gamification might lead to a shift of the attention from content to the game experience itself. Some general challenges are related to the difficulty to design a proper and effective digital strategy, the resistance and lack of digital knowledge and competencies of the museum's staff, or various privacy /legal concerns. 3D printing raises concerns with copyright and funding distribution (Cooper, 2019). As developing smart open innovation museums should select a strategy both to ensure economic funding and also enhance social performances enriching collaborative networks and long-term sustainability (Pop and Borza, 2016).

3 A study on the perception of museums' innovativeness

It is important to elucidate how people perceive museums' innovativeness. In the following subsections, the aim and method, the sample and respondents profile, and findings are presented in order to understand how museums are perceived as innovative and social institutions engaging visitors and meeting the needs of their audiences. Gathering information about how people perceive museum's innovativeness helps museums to plan innovation policies to better meet the needs of visitors and users of

museum information and knowledge sources. As innovative organizations, museums develop an innovation-oriented view to social and cultural growth that enables value creation processes within cultural ecosystems.

3.1 Aim and method

Understanding the perception of museums in the mind of the wider public would help museums managers better design their offer and communication strategies. One of the image-dimensions increasingly relevant is how innovative and creative museums should be. Therefore, the present research maps the perception of the Romanian and Italian museums from an innovation standpoint. To benchmark the results, the public was asked to compare the museums in their country with museums abroad.

A self-administered online survey was distributed online during March and April 2020. Considering various contextual limits, the questionnaire was kept to a minimum number of questions. The results allow us to identify how various types of museum visitors perceive the innovativeness of museums in general, and in their country specifically.

3.2 Sample and respondents profile

We used a convenience sample and administrating the survey online (via Facebook) during the same time (10 days). Due to a higher completion rate, the number of respondents in Romania is almost double (N=406) as compared with the one in Italy (N=207). There are noticeable differences also between the respondents' profile: 67% of Romanian respondents are female and 33% male, meanwhile in Italy the ratio is closer to 50% - 50% (50.2% female respondents and 49.8% male respondents).

3.3 Findings

Given the recent developments in tourism and travel and the increasing access of Romanian and Italian public to museums abroad, we intended to investigate perceptions related to the extent in which museums are considered innovative as well as to assess whether there are noticeable differences between how people perceived museums at home and abroad.

Therefore, we devised the questionnaire in a manner allowing us to differentiate between museums from the country of residence and museums from abroad as well as to distinguish, within each type of museums between main exhibition and temporary exhibitions and educational program for children and other, more general public programs.

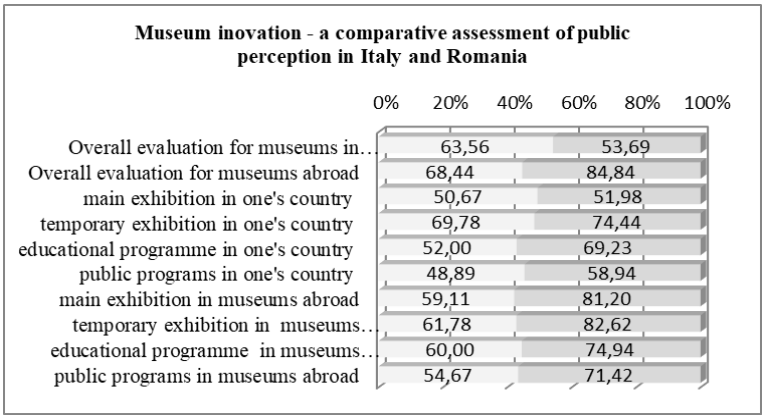

Fig. 1 – Museum innovation – a visitor perception

As shown by the chart above, there is a constant tendency for the Romanian public to rate museums abroad as being significantly innovative compared to museums at home across all categories (overall assessment, temporary exhibition, etc.) with the highest difference being registered for the overall assessment: 31.15%. The same happens for the Italian public, with the gap being less obvious: only 4.92% and a noticeable exception when it comes to temporary exhibitions: those at home are perceived as being more innovative than those abroad (69.78% as opposed to 61.78%).

Looking into data from respondents that have attributed a higher level of innovation to museums from their own country, findings indicate a systemic difference regarding respondents' perceptions over their cultural consumption and familiarity with museums.

As data indicates, the Italian respondents do not see themselves as particularly familiarized with museums, despite considering themselves as generally interested in cultural activities (90.29% of them attributed scores from 3 to 5 on a five points scale when asked to assess the affirmation: I see myself as a person generally interested in culture). On the other hand, Romanian respondents are scoring lower for the general interest in culture (66% reporting a moderate to high interest in culture) but see themselves as quite involved in activities related to museum visiting both at home and abroad.

scores from 3 to 5 on a five points scale	**Italy**	**Romania**
frequent museum visitor	55.3%	71.42%
familiar with museums from their own country	64.53%	80.78%
regular museum visitor abroad	69.41%	75.61%
general interest in culture	90.29%	66%

Fig. 2 – Public's perceptions of cultural consumption and museum visiting

To better emphasize how different are the perceptions of museum innovation, a profile of the most enthusiast respondent was constructed. We took into consideration the socio-demographic characteristics of respondents who attributed the highest level of innovation to museums from home. In Italy, the most appreciative respondent on museum innovation is likely to be a male, aged between 35 to 50, having a top management position and a university degree and living in a city with over 1 million inhabitants. Meanwhile, in Romania, museums are likely to be seen as highly innovative by a respondent having the profile of a female, under 25, with a university degree and no management position, living in a city of over 1 million inhabitants and working in business/economics.

4 Discussion

Understanding how visitors as users of museum information and knowledge sources perceive a museum as an innovative institution helps redefine and arrange strategies and policies for communication, organizational design, and new services infrastructure by rethinking organizational processes and human resources policies. Museums as communities contribute to promoting cultural value co-creation processes sustaining the interaction and dialogue between museum professionals and users as proactive co-producers of cultural knowledge contents, dialogue, and supporting cooperation among private and public actors as a relevant issue of multilateral relationships, social exchanges, and shared values.

The research issues elucidate the need for museums to rethink a strategic and organizational approach in order to build relational and social ties with audience to develop loyalty and trust-based linkages with audience as proactive actor that contributes both to economic and social sustainability of museums and cultural and educational mission of a museum as a value-driven and innovation-oriented community. In coping with increasing environmental complexity and uncertainty, museums should contribute to facilitating value (co-)creation processes, proceeding towards sustainability as a vision for action and change to drive the audience to learn and contribute to enhancing cultural heritage value and advance the progress of society.

5 Conclusions

Today, museums need to drive and anticipate changes by promoting innovation and building social relationships within cultural ecosystem to develop the museum as a community-oriented organization living within a cultural and social ecosystem for engendering collaboration and fostering communication with audience and the public to become an innovative institution that serves for society and within communities. As proceeding towards sustainability, museums should develop organizational, technological and human resources in order to promote continuous innovation as a key driver for change and action in order to contribute to cultural and social value within society. As

community-oriented organizations, museums should build strong ties and relationships with all the stakeholders of museum community enabling them as proactive co-producers of cultural heritage and knowledge as source that lead to public value creation.

In this study, there are theoretical, managerial, and organizational implications. Museums increasingly tend to emerge as innovation-driven organizations strengthening the relationship with their audiences to contribute to building the museum as a community within social and cultural ecosystems. In driving innovation, museums should intervene in organizational design and human resource management policies to re-plan how to better use and enhance knowledge, information, and technological sources. Museums more and more should pay attention to supporting the relationship with users and co-producers of museum knowledge and value.

In this study, there are some limitations. This study is the starting and preliminary section of a wider research project aiming at investigating the relationship between museums and audience on the capability to drive and appreciate innovation as a source for change within the cultural ecosystem and identify how innovativeness has a successful impact and issues on audiences' needs and experiences.

Further research perspectives imply to extend the investigation and consider the point of view of museum employees as professionals and managers within several European museums and compare with Romanian and Italian museums' strategies and policies aiming to exploit in turbulent times of environmental and external changes as the pandemic crisis has recently shown.

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Using Blockchain Technology for a Better Knowledge Management in a Supply Chain

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Abstract

The aim of this paper is to examine the state of researches on the knowledge management subject related to the supply chain, and its possible innovation based on the integration with blockchain technologies.
Knowledge management (KM) is the process of identification, organizing, storage, sharing and management of knowledge and information towards value creation. Organisations try to apply and embed it into their primary activities as supply chain processes (Akhavan, Philsoophian, Rajabion and Namvar, 2018).
Supply chains are configurations of firms working together in a network that constantly need to upgrade their operations and capabilities, both upstream and downstream, from raw material to end-use consumption. The information flows that lie at the heart of network members ' communication and collaboration are not only diverse sources of information, they also provide an opportunity to build knowledge-based resources that are an important part of the capabilities of the extended firm. Performance can be improved by sharing updated knowledge among the supply chain process and functioning through knowledge management tools (Jha and Karn, 2019).
Knowledge management is based on trust management. The Blockchain technology can be used as a method for managing trust in generating, storing, sharing, protecting and applying a variety knowledge. Blockchain can potentially improve knowledge management, in order to share successfully relevant data and information about the product and services included in the "chain". Despite to other initiatives to employ other technologies to share knowledge across the chain (such as "social manufacturing" or "cloud manufacturing" in the manufacturing industry (Zhi Li et al., 2017), the DLT (Distributed Ledger Technology) era introduces many opportunities like, "provenance certification" of stored information because of tamper-proof transaction history maintained in the distributed ledger, "knowledge automation" capabilities (Ziyuan Wang et al.

2018). The adoption of blockchain in the supply chain could create a new governance model for creating public value for a specific business process. This research aims to answer how to create the best connection between the business environment knowledge base and the supply chain management processes integrating blockchain technology.

Keywords – Blockchain, Supply Chain, Knowledge Management

Paper type – Academic Research Paper

1 Introduction

Knowledge management (KM) in supply chains is one of the most critical challenges faced by supply chain executives as they seek to establish collaborative projects in the supply chain. The need for the organizations to establish close relations with partners in the business and supply chain requires coordination, transfer and exchange of knowledge and best practices (Mariano, Dogan, Mogre, and Perego, 2010). Knowledge management can be viewed as a leverage mechanism for supply chain integration; the enhancement of intra and inter-relations across the supply chain; supply chain strategy alignment; and the reinforcement of knowledge transfer in product development (Perez-Salazar, Alfonso Cedillo-Campos and Hernandez Gonzalez 2017). Companies exchange information resulting in a potential for knowledge sharing and create value. Sharing and transferring knowledge in a supply chain increases the competitive advantage of the whole chain and guarantees the continuity of its operations (Scholz-Reiter, Delhoum and Stoll, 2007). Thus, knowledge exploitation plays an important role within each organization and between organizations integrating the supply chain, especially in the business relations between suppliers and customers. However, extending internal knowledge management programs to external sources is a demanding task because of some typical barriers (Barson et al. 2000) classified these barriers in four categories: technology barriers, organisation barriers; people barriers and finally cross category barriers which are featured by technology, organisation and/or people (Scholz-Reiter, Delhoum and Stoll 2007).

Since the efficient use of knowledge is critical to the survival and success of companies in competitive globalized markets, knowledge management systems (KMS) have become an essential tool for supply chain management (SCM) (Rodríguez-Enríquez, Alor-Hernández, Mejia-Miranda, Rodríguez-Mazahua and Sánchez-Ramírez, 2016). Organizations work in a global market climate that is marked by rapid developments, innovations in technology, increasing consumer demands and intensified competition. For organizations to survive in such a turbulent environment, they must promote their capacity to learn new practices and technologies and consistently improve their performance and long-term organizational success (Attia and Essam Eldin, 2018). The rapid digitisation of industry, or Industry 4.0, is trending in supply chain management. The opportunities surrounding digitisation have made it possible for supply chains to

access, store and process a large amount of data both from within a firm and externally (Schniederjans, Curado and Khalajhedayati, 2020). Information management is based on trust management and blockchain can be used as a confidence building tool to create, store, exchange, secure and apply a variety of information. The blockchain is a modern decentralized technology that can theoretically overcome the above problems and enhance the management of information.

This investigation seeks to answer the following research: Is Blockchain the technology for future improve trust and governance of Data, Information and knowledge in the Supply Chain Management?

2 Research Methodology

In this research study, we have used the systematic literature review methodology in the field of knowledge management, supply chain and blockchain. The list of papers was downloaded using Scopus (www.scopus.com), which is the largest abstract and citation database for academic reputed scientific research journals, books and conference proceedings. The literature review presented in this paper examines early views of the important investigations and developments within the areas of knowledge management and blockchain within the context of supply chains environments. For the research the authors have used follows keywords:

- supply chain and knowledge management
- supply chain and blockchain

The search results of the article are shown in the tables below:

Table I - Keywords “Supply chain and Knowledge management”

Source of data collection	**Search Syntax**	**Number of papers**
Search performed on Scopus on March 04, 2020 (www.scopus.com)	TITLE-ABS-KEY (“knowledge management”) AND TITLE-ABS-KEY (“supply chain”) AND (LIMIT-TO (SUBJAREA, “BUSI”)	328

Table II - Keywords “Supply chain and Blockchain”

Source of data collection	**Search Syntax**	**Number of papers**
Search performed on Scopus on March 04, 2020 (www.scopus.com)	TITLE-ABS-KEY (“Supply chain”) AND TITLE-ABS-KEY (“blockchain”) AND (LIMIT-TO (SUBJAREA, “BUSI”)	166

3 Framework - Theoretical background

3.1 Knowledge management

Knowledge management can be defined as the set of activities which allow organizations to create, store , distribute and apply knowledge. Knowledge management is an enterprise process. It is the process through which firms create and use their institutional or collective knowledge (Gunasekaran and Ngaic, 2007).

Knowledge has turned out to be one of the key motivating forces for business success. Thus, information management within an enterprise has become the central focus for all businesses. In general KM is "a process cycle for defining, transmitting, storing and disseminating information for reuse, understanding, and sharing and learning around the organization" (Chong, Ooi, Bao and Lin, 2014).

The aim of knowledge management is to develop approaches that will make it easier to get the right knowledge to the right person at the right time and in the right format (Halawi et al., 2006). Knowledge management would also help organizations to remain competitive by sharing information with external partners and knowing the products , services, strategies and best practices of their competitors (Attia, and Salama, 2018).

The importance of knowledge and knowledge-related capabilities as a competitive advantage is derived from the Resource Based View Theory (RBV). The resource-based view theory suggests that firms compete on the basis of their resources and capabilities. The resource refers to anything tangible or intangible possessed or acquired by a firm, while the capacity is to use resources to carry out tasks or activities (Attia and Essam Eldin, 2018). According to RBV, the theory assumes that resources are the source of a company's capabilities and that its capabilities are the foundation of its competitive advantage (Samuel, Goury, Gunasekaran and Spalanzani, 2011). The Resource Based View Theory (RBV) explains strategic resources that are valuable, rare , inimitable and non-replaceable and can make a massive contribution to social, economic and technological benefits.Knowledge is considered to be the most significant resource in knowledge-based view (KBV) theory. KBV's theory focuses specifically on the nature and role of knowledge in achieving new innovations. Developing superior knowledge resources that are embedded in products, processes and services provides a long-term solution; enhancing performance and competitive advantage (Jali, Abas, and Ariffin, 2017). Knowledge management (KM) bridges information demand and supply on behalf of learning processes and, consequently, organisational performance improvement. Knowledge assumes tacit and explicit forms. Tacit knowledge is deeply rooted in action, commitment, and involvement and, thus, it is hard to formalize and communicate. Explicit knowledge is codified and transmittable in formal, systematic language and thus it is captured in libraries, archives, and databases. There is a permanent interaction between tacit and explicit knowledge that moves across individuals, groups,

organisations, and back to individuals again (Schniederjans, Curado and Khalajhedayati, 2020).

3.2 Blockchain

Between 2007 and 2008, the world was shocked by the financial turmoil caused by the chain of financial collapses built on bad debt which triggered a crisis that had not occurred since the Great Depression. During this period, the world has witnessed the fragility and instability of a tightly interconnected and highly indebted global financial system. In response to these events, in October 2008, Satoshi Nakamoto published a white paper on a mailing list (Nakamoto, 2008). introducing the topic of blockchains to the world, outlining the benefits of a currency exchange system called bitcoin. To date, bitcoins and other cryptocurrencies are probably the most commonly recognized use case of the blockchain and as such are an adequate basis with which to explain the operating principles of the technology (Hughes, Park, Kietzman & Brown, 2019). The blockchain has been defined in several ways: the mainly accepted definition is that it is a distributed ledger. Distributed ledger technology (DLT) is a generic term that describes all the technologies that distribute information on multiple sites, countries or institutions and that includes the blockchain. A blockchain refers to an open, shared, de-centralized and distributed ledger in which transactions are recorded and added in chronological order with the aim of creating tamper-proof permanent records (Nakamoto, 2008). Blockchains are made up of nodes located on a communication network that uses some common communication protocols: each node on the network stores a copy of the blockchain and a consensus function is implemented to verify transactions to preserve the immutability of the chain (transactions they cannot be changed). Blockchain technology is unique in that it does not require a central server to store and retain data. As long as the network reaches consensus on what transactions have taken place in the past, it acts collectively as a server to host data. If a dishonest participant decides to change the previous data, the majority of the network quickly excludes it (Hughes, Park, Kietzman and Brown, 2019). Blockchain technology differs from most existing information systems projects by including four key features; non-localization (decentralization), security, verifiability, intelligent execution (Saberi, Kouhizadeh, Sarkis and Shen, 2018). A blockchain is an encoded digital accounting that is stored on multiple computers on a public or private network. As each transaction occurs, it is put in a block. Each block is connected to the one before and after it. Each block is added to the next in an irreversible chain and transactions are blocked together, hence the term "blockchain". The current blockchain could be compared to the internet adoption for commerce of several years ago which emerged disruptively in many established companies and heavily influencing supply chains (Treiblmaier, 2018). The advent of the blockchain is considered a digital revolution but at the same time it is a natural consequence of the development of the Internet (Firica, 2017). Similar to the Internet, blockchain is not a single technology, but operates on a number of technologies

that include the Internet as an infrastructure and uses the blockchain protocol to store transaction records and establish consensus rules (Treiblmaier, 2018). A big difference between the current Internet design and blockchain technology is that the Internet was designed to move information (not value) and to move copies of files (not original information). In blockchains, the value is represented in transactions recorded in a shared and protected ledger by providing a verifiable and secure transaction record with timestamp. These transactions are viewed through a verification process that is consistent with the network's consent rules. Once the new record is verified and added to the blockchain, multiple copies are created in a decentralized way to create a chain of trust. (Saberi, Kouhizadeh, Sarkis & Shen 2018). Two main types of blockchain stand out in terms of access control: the blockchain can be public or private (bitcoin uses a public version). Within a public blockchain, each transaction is public ("without authorization") and users can remain anonymous. Each user can join without requesting the authorization of other members. The network typically has an incentive mechanism to encourage participants to join the network. Bitcoin and Ethereum are examples of public blockchains. Within authorized blockchains, participants must obtain an invitation or permission to join. Access is controlled by a consortium of members (consortium blockchain) or by a single organization (private blockchain) (Wang, Hugh Han & Beynon-Davies 2018). In addition to being used in the financial sector, blockchain technology has found application and is also being developed in the logistics and supply chain activities. Blockchain is potentially a disruptive technology for the design, organization, operations and general management of supply chains.

4 Findings

4.1 knowledge management and supply chain practices

A supply chain is a network of collaborative firms that transforms raw materials into distributed products. Supply chain management is one of the practice used by companies to improve their business performance as well as to retain their competitive advantage, as competition is among supply chains and not between individual organizations (Attia and Essam Eldin, 2018). The advantages of supply chain management derive from the ability of a company to quickly exploit the entire network of suppliers, suppliers, buyers and customers. The information flows that lie at the heart of coordination and collaboration between network members are not only disparate sources of information, they also provide an opportunity to build knowledge-based tools that are an important part of the capabilities of the extended firm (Samuel, Goury, Gunasekaran and Spalanzani, 2011).

Supply Chain Knowledge can take on different formats such as forecasting, product design, competitor analysis, demand analysis, customer analysis and specific problem solutions.

Supply chain knowledge flows can be categorized into two categories. Formally structured (explicit) knowledge flows include transaction related information such as purchase orders, invoices and delivery schedules. The flow of tacit knowledge in the supply chain is more context-specific, largely unstructured and embedded in the relationship between supply chain partners. It consists of two components: the technological know-how and the cognitive component (Li, Tarafdar and Rao, 2012).

Explicit knowledge is discrete and digital, and can be easily transmitted through formal and systematic means. Examples include past records, such as archives or databases. Tacit knowledge, on the other hand, represents a higher level of abstraction than explicit knowledge. Tacit knowledge is difficult to codify, to transmit, It contains data that are processed, organized and useful, but the logic of its organization is often complex, implicit, and ambiguous (Shih, Hsu, Zhu, and Balasubramanian 2012).

Today, knowledge management (KM) is recognised as a way to improve SC performance (Ruel, Shaaban, Ducros, 2019) and information management is considered crucial to achieving sustainable competitive advantage in supply chain management. Knowledge management (KM) transforms information, data and intellectual assets to firms' perdurable value through recognising useful knowledge for running and managing operations (Lim, Tseng, Tan and Bui, 2017).

The resources of a firm are capital equipment, patents, individual skills, brands and reputations, financial resources, physical resources, technological resources or organizational resources. Knowledge could adds value to an organization through its contribution to products, processes and people, while knowledge management (KM) transforms information, data and intellectual assets into lasting value by identifying useful knowledge for management actions. KM tools support the organization in exploring, innovating, disseminating and automating corporate knowledge (Samuel, Goury, Gunasekaran and Spalanzani, 2011)

As a result, many partner companies in an integrated supply chain network cooperate with their suppliers and customers and share information and knowledge with a view to creating a collaborative network capable of competing effectively on the marketplace (Cai, Goh, De Souza, and Li, 2013). Members of the supply chain are expected to realize mutual benefits through collaboration, mutual trust, long-term commitment, partnership, frequent communication and sharing of information (Attia, and Salama, 2018). Knowledge sharing refers to the use of information assets across different business partners to focus on supply chain activities, identify market opportunities and/or capture business value. Inter-organizational knowledge sharing is a complex issue based on inter-organizational relationships. Inter-organizational knowledge sharing is a critical factor in the coordination, allocation and integration of collaborative resources across the supply chain (Cai, Goh, De Souza, and Li, 2013). Compared to sharing information, knowledge sharing contributes more to effective and efficient decision-making. The greatest challenge is to establish a trusting relationship between the parties (Shih, Hsu, Zhu, and Balasubramanian 2012). Knowledge sharing often implies the need to release certain

protected information, e.g. intellectual property, financial , strategic and operational information, to partners who may or may become competitors. Knowledge sharing involves some level of risk as one partner can not fully dictate how the other partner can use shared knowledge (Cai, Goh, De Souza, and Li, 2013). With respect to supply chain management, trust is essential to cultivating a successful relationship and promoting cooperation and sharing of expertise across the supply chain. Inter-organizational trust not only influences the nature of a business relationship, but also, more importantly, impacts strategic alliance outcomes in terms of information exchange and knowledge sharing (Chen, Lin, and Yen, 2014).

4.2 Blockchain and supply chain management

The supply chain consists of a series of activities and states that the products cross in their path from the initial suppliers to the final customers. When the parties actively and collaboratively manage the activities and relationships in the supply chain to maximize customer value and obtain a sustainable competitive advantage, we can speak of supply chain management (SCM). It represents a conscious effort by supply chain companies to develop and manage in the most effective and efficient way possible (Dujak, Sajter, 2018). A supply chain often intersects business functions and national borders with a large network of business partners. These interactions increase the vulnerability of the supply chain and can lead to its disruption. To reduce these vulnerabilities, supply chain professionals need to identify potentially vulnerable links and assess their level of risk (Min, 2019). Blockchain is potentially a disruptive technology for the design, organization, operations and general management of supply chains. The ability of the blockchain is to ensure the reliability, traceability and authenticity of information, together with intelligent contractual relationships in a trustless environment, all leading to an important re-design of supply chains and supply chain management (Saberi, Kouhizadeh, Sarkis & Shen 2019). According to Chang, Chen and Lu, (2019), with the blockchain there is a "business tracking reengineering in supply chain" (BPR). “The BPR refers to the "radical rethinking and redesign of business processes to achieve significant improvements in contemporary critical performance measures, such as costs, quality, service and speed". As we saw earlier, several scholars have described the main benefits of using blockchain in a supply chain environment. Most of them focus on the benefits of improving the transparency and visibility of monitoring activities in business operations. Blockchains has been developing in various sectors, such as medical records management, supply chain, banking and financial services, insurance, Internet of things (IoT), sharing economy and distributed access control (Chang, Chen & Lu, 2019). In a global market, customers are often unaware of the sources of the products they buy and consume. To overcome this lack of awareness, blockchain technology can be implemented in supply chains to share information on the origin of products in a more transparent way with customers. (Montecchi, Plangger and Etter, 2019). This level of

transparency and visibility is essential to improve the traceability of the products, guaranteeing their authenticity and legitimacy through real-time monitoring. In addition to the security benefits, blockchain technologies can bring a multitude of management benefits to daily business practices, including:

- Reduction of costs/transaction times deriving from better managed blockchain platforms that do not require the involvement of third parties;
- Improvement of visibility along the entire supply chain, following greater transparency obtained through the open registers that anyone can access;
- Better relationships between business partners through the integration of digital and physical worlds, which includes a sharing of transactions and information flows along the entire supply chain.

Despite these potential benefits, blockchain technology can pose a number of implementation challenges that concern the lack of organizational preparation or expertise on the part of the actors involved, the inadequacy of technical infrastructure, scalability problems and limited financial resources for investments in blockchain. In this regard, it is necessary to develop managerial strategies to help companies overcome these challenges by fully exploiting the advantages of DLT technologies (Min, 2019).

5 Discussion

An growing number of studies are investigating the supply chain not only as a process by which a business obtains goods and services but also as a tool for competitive advantage. The supply chain can indeed be seen as a network of companies that, through cooperation, allow access to a pool of rare and inimitable knowledge. Companies may establish collaborative partnerships with partners in their supply chain to access complementary information sources more easily, at a lower cost and with less risk than would be possible if those expertise were established within the organization (Nagati and Rebolledo, 2013).

In this way, the knowledge base is the only basis for achieving competitive advantage and good management of its sustainability (Azizi, Maleki, Moradi-Moghadam and Cruz-Machado, 2016).

Efficient use of knowledge is critical to companies' survival and success in competitive globalized markets, the knowledge management system (KMS) has become an essential tool for supply chain management (SCM) (Rodríguez-Enríquez, Alor-Hernández, Mejia-Miranda, Rodríguez-Mazahua and Sánchez-Ramírez, 2016).

As global markets grow, supply chain managers face ever-changing markets, new global markets and a competitive environment. Organizations today operate beyond national boundaries so they can not rely solely on their internal quality activities (Azizi, Maleki, Moradi-Moghadam and Cruz-Machado, 2016).

Learning and KM can be seen as drivers for the development of the supply chain and as processes that could introduce innovation in supply chains (Samuel, Goury, Gunasekaran and Spalanzani, 2011).

Knowledge management typically relates to supply chain management by offering the required resources for handling large quantities of data generated by supply chain operators and their customers. Supply chain management requires managers to identify, track and control customer distribution activities across the entire supply chain, from procurement, storage, manufacturing and retail. All of these tasks include managing knowledge not only from the technical side through information systems, but also the consistency of the knowledge given in the supply chain through data processing and analytics, whether tacit or explicit (Schniederjans, Curado and Khalajhedayati, 2020).

The communication amongst partners to accomplish coordination and collaboration can be enhanced by Information and Communication Technology (ICT) (Mariano, Dogan, Mogre, and Perego, 2010). IT refers to the use of any networking, storage, computers and other tools, processes and infrastructures to produce, obtain, process, store, secure and share data or information. IT is certainly an important and productive tool and framework that can be used for information sharing and KM process facilitation. Intelligent hardware computing and software tools can play an important role in KM processes (Jalilvand, Khazaei Pool, Khodadadi and Sharifi, 2019). The technologies consisting of cloud computing and blockchain can be used together on the information systems side to provide the required advantage for KM and CCM. Cloud computing is a massively scalable computing model that provides as a service applications, infrastructure and networks, allowing real-time data sharing across the supply chain (Schniederjans, Curado and Khalajhedayati, 2020). Blockchains permit to store information in a tamper-resistant and irrevocable manner by reverting to distributed computing and cryptographic technologies. The primary purpose is to keep track of the ownership of tangible and intangible assets (Fill, and Harer (2018). Blockchain can function as a distributed, programmable and encrypted ledger to transfer, secure, store and quickly access high-security information. When the information is stored in Blockchain, it can't be rewritten and changed any more. This design makes Blockchain capable of having a permanent historical record. Application of unique features of Blockchain including high reliability, anonymity, transparency and data sharing , information invariance, etc., should respond to conventional knowledge management challenges (Akhavan, Philsoophian, Rajabion and Namvar, 2018).

6 Conclusions

Knowledge management plays a key role in the success of a collaborative network, as information sharing and knowledge assets are vitally important for the network, especially in the context of a supply chain. One of the significant reasons for taking advantage of knowledge management (KM) for each organization deals with using available knowledge in an optimized style, and it has done enough effort to increase

knowledge by its requirements. The use of knowledge management and its instruments assist each organization in learning from its previous mistakes and in using them for future success. The "knowledge governance" is another important aspect in the management of data and information stored in such Information Systems used to manage the knowledge thought the supply chain. The successful adoption of blockchain in the supply chain can be aimed to create a new governance model for creating public value for a specific business process built on a supply chain initiative that put together many stakeholders, both in public and private sector as well as regulators and auditors. This new "Open Government" model will ensure transparency, participation and collaboration (Manuel Pedro Rodríguez Bolívar, 2019). Most of the time the intellectual property of the knowledge produced by the different actors of the supply chain belongs to the customer of the supply chain, who often makes available, or requires the use of their own information system to store knowledge. this article evaluates the use of the blockchain as an information system for knowledge management in the supply chains, where precisely for the mechanisms of trust, interoperability and distribution of ownership of the data stored in the blockchain can be made available to anyone, including the final consumer, which would be given the opportunity to access the original information of the products, inserted in the knowledge base, directly from the source of the information itself, which would ultimately be independent of the will of the client to provide the information. Nowadays, due to the extended amount of knowledge and information, as well as the need for large servers for storing and maintaining the information, the DLT technologies are not yet mature, so the blockchain today can only store a limited amount of data and external systems (E.g. cloud) have to be used to allow the management of the content of the Knowledge base. Several studies and research are underway to allow large amounts of data to be stored in blockchains, such as blockchain databases. Finally, the use of blockchain in the supply chain management can represent a disruptive solution in order to create open market and improve the competitiveness of all markets.

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The Implications of Blockchain for Knowledge Sharing

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Abstract

Blockchain (BLK) is believed to have the potential to disrupt traditional business models through inherent features such as distributed, decentralized, peer to peer, and security-by-design. However, the academic community mostly dedicated its BLK research to financial and more recent supply chain disciplines, overlooking BLK implications in other domains. This research aims to fill the research gap of BLK implications for knowledge management by investigating the potential effects of BLK use for knowledge sharing. To do so, four state-of-the-art real use cases, namely, Orvium, ARTiFACTS, Everipedia, and Steem, have been reviewed and explored here. We identified the impact of BLK on the antecedents and benefits of knowledge sharing through content analysis of available data on websites and white papers of associated cases. The results were categorized according to benefits (cost reduction, growth, intangible benefits) and individual antecedents of knowledge sharing (intention, motivation, reciprocity, trust). The results of this research paper provide insights into the research community by presenting the current state and future research avenues.

Keywords – Blockchain (BLK), Distributed Ledger Technology (DLT), Knowledge Management, Knowledge sharing

Paper type – Academic Research Paper

1 Introduction

Blockchain (BLK) placed among the top five technology trends in the Gartner Hype Cycle for Emerging Technologies of 2018 (Kietzmann & Archer-Brown, 2019), having the potential to transform businesses, economies, and societies (Kamble et al., 2019). Information System research concerned with BLK sobered from the initial hype to reality by admitting that there exists a lack of technology-driven, systematic approaches to understand the potential of the BLK technology (Ostern, 2019). Thus far, much of the academic attention on BLK has currently focused on its ability to transform the financial services industry. Nevertheless, the implications of BLK are much broader. Organizations across all industries, ranging from finance and healthcare to manufacturing, supply chain, and retail can benefit from BLK (Angelis & da Silva, 2019) because its capabilities and features have the potential to offer opportunities for new ways of value creation (Morkunas et al., 2019).

Although Information Systems (IS) and emerging technologies could be considered as an enhancing contributor to Knowledge Management (KM) processes (Gold et al., 2001), our understanding of the relationships between BLK and KM remains limited. Frozza et al. (2019) reviewed the implications of BLK technology for KM and concluded that the decentralization aspect of BLK had not been explored sufficiently. Moreover, they identified that most studies are applying BLK to meet KM challenges rather than exploring new opportunities or innovative processes. We followed this research gap and described how BLK could facilitate KM. We reviewed four proofs of the concept of innovative BLK-based knowledge sharing platforms (Orvium, ARTiFACTS, Everipedia, and Steem).

The rest of this paper is organized as follows. In section 2, a review of the literature is provided. In section 3, we describe the research method. Section 4 presents the findings.Section 5 is dedicated to discussion. Finally, section 6 concludes the research.

2 Literature review

2.1 BLK

BLK is a decentralized online ledger that facilitates various peer-to-peer value transfers (digital currencies, physical commodities) without the need for having a trusted third party such as banks, accountants, or lawyers (Frizzo-barker et al., 2019). Since BLK is a distributed database comprising of records of transactions that are shared among participating parties, all the transactions must be verified by the consensus of more than half of the participants in the system. Therefore, fraudulent transactions would be unable to pass collective verification (Zhao et al., 2016). This is allowed because BLK works as a sequence of blocks that holds a complete list of transaction records in hash functions with a timestamp and a link to the previous block (Janssen et al., 2020).

As previous research indicated (e.g., A. Hughes et al., 2019), BLK is characterized by essential characteristics such as immutability, transparency, security, speed, and trustworthiness, which will change industry and commerce substantially, and will foster economic change on a global scale. Three main types of BLK platforms can be identified from the literature (Swan, 2015). BLK 1.0 is based on the digital currency and how the deployment of cryptocurrencies in applications relates to cash, such as currency transfer, remittance, and digital payment systems. BLK 2.0 is associated with digital finance and concentrates on applications that are more elaborated than based cash transactions such as stocks, bonds, loans, mortgages, smart properties, and smart contracts. BLK 3.0 focuses on digital society; it is mainly intended to find BLK applications in government, health, science, literacy, culture, and art.

2.2 BLK and knowledge sharing management

Some prior studies focused on BLK implications for KM processes. However, their scope was limited. For instance, BLK could be applied in KM to provide security in knowledge production and transfer, or to use smart contracts as a mechanism to ensure the collaboration of involved parties (Kostin et al., 2017). This is because knowledge and organizational best practices need to be protected from unauthorized copying, as the privacy of data and fairness in knowledge value exchange is increasingly crucial to both customers and organizations

Akhavan et al. (2018), in their study, proposed a Block-chained knowledge management model (BCKMM) through incorporating both KM and BLK concepts. They developed a knowledge services framework for the creation, application, and sharing of knowledge throughout the organization and especially between experts in a company by providing a decentralized framework. This framework exploits BLK concepts to achieve a distributed and flexible network to conquer the problems of traditional centralized KM models through developing the primary process of KM.

Li et al. (2018) developed a platform to make a secure and reliable way for knowledge sharing in untrustworthy environments using two advanced technologies: private cloud and BLK. It is implemented as a distributed network to share knowledge and record transactions, reducing the risk of sharing on the platform. It was primarily designed to minimize the risks of data modification, as it seeks to provide a secure method to ensure data immutability.

Hu et al. (2018) proposed the Reputation Based Knowledge Sharing (RBKS) model intending to explore the copyright protection of the knowledge owner. This system consists of a BLK-based reliable storage server, which is jointly employed to share and store knowledge, the main procedures being implemented through smart contracts to ensure safe execution. BLK is also employed to manage user interaction, ensuring transparent and reliable delivery of messages, while smart contracts are used for knowledge creation and knowledge sharing.

Sychov et al. (2019) view BLK as a way of record-keeping, preserving records, and preventing unwanted changes. They suggest BLK applications for access control and protection. BLK can also be seen as a tool that allows knowledge owners to be held accountable for complying with statements issued in BLK. It is viewed as a means of providing traces of provenance data based on access control, where only authorized users can verify changes made to any data file. Besides, it provides proof of change using digital signatures and timestamps (Mittal et al., 2018; Ramachandran & Kantarcioglu, 2018).

Finally, Frozza et al. (2019), who aimed at investigating the applications and implications of BLK technology in KM, observed that BLK had been mainly applied in knowledge sharing and distribution, retention, and identification domains. They also found that immutability, traceability, and automated decision-making were the main incentives behind BLK applications in KM.

The impact of knowledge sharing on organizational performance manifests in various mechanisms. Knowledge sharing influences organizational collaboration, absorptive capacity, innovative capability, or value co-creation (Cassia et al., 2020). The antecedents of knowledge sharing were identified as organizational culture, organizational structure, reward system, motivation, interpersonal trust, and management support (Farooq, 2018). Another study added individual factors: intention, trust, motivation, and reciprocity (Ali et al., 2019). Because the organizational factors are not relevant for our analysis, we used part of the research model developed by Ali et al. (2019) to link the concepts that can be affected by BLK with the benefits for an organization. The description of the used categories in the model can be found in Table 1.

Table 1. Definitions of antecedents of knowledge sharing based on Ali et al. (2019)

Antecedent	Description
Intention (I)	intention to share knowledge
Trust (T)	Individuals are more interested in sharing knowledge with those that they trust.
Reciprocity (R)	knowledge sharing is expected in return
Motivation (M)	personal benefits, normative consideration and community-related consideration

3 Research method

The empirical research on BLK is scarce, especially in the KM discipline. The novelty and low maturity of a research topic justify exploratory and theoretical research (Saunders et al., 2015, p. 175). Therefore, we conducted an exploratory content analysis of documents associated with the chosen BLK implementations. More specifically, we analyzed a purposive sample (see Saunders et al., 2015, p. 301) of four cases of BLK implementation in the KM field (see Table 2). The main criteria for choosing a case were the availability of the data about each case, the volume of data about the case, and the innovativeness of using BLK in the KM field.

For analysis, we used archival (secondary) data, mainly web presentations, and white papers. We analyzed the content of the data and identified features that can enhance the knowledge sharing process. Each feature is connected either with an antecedent (described in Table 1) or with a benefit that was taken from a research model from Ali et al. (2019). A brief introduction to each case is presented below. Table 2 lists the data sources. The former two cases are platforms focusing on academic publications (a particular case of knowledge sharing). At the same time, the latter two are social media related (for relations of social media and knowledge sharing see Panahi et al. (2016)).

- **Orvium** is a scientific publishing platform that helps researchers and institutions to share their work, create open access journals, and streamline peer review. Orvium aims at connecting researchers and publishers with trusted reviewers to accelerate publishing along with incentivized peer review.
- **ARTiFACTS** provides a platform for academic and scientific research that leverages BLK technology. Researchers can record a permanent, valid, and immutable chain of records in real-time, from the earliest stages of research for all research artifacts, including citing/attribution transactions. ARTiFACTS focuses on capturing and linking knowledge from its initial ideation throughout the research process to informal and formal dissemination.
- **Everipedia**, the world's first encyclopedia based on the BLK, is an open-source wiki network, decentralizing the Wikipedia knowledge base by allowing every editor to become a stakeholder in the network. Everipedia uses the EOS BLK platform to make contributors more accountable. Contributors to the network receive tokens based on their valuable contributions, which will finally represent virtual shares of the platform, meaning that for approved edits, they will get rewards. In contrast, for inaccurate ones, they will lose their credit (coins).
- **Steem** is a cryptocurrency linked to social media and built on content-focused Steem BLK, which was created in 2016. This project aims to provide a platform for decentralized application hosting and data storage. By using delegated proof-of-stake as a consensus protocol, a fast block time of three seconds and zero-fee transactions for users are made possible.

Table 2. Overview of used sources for each case.

Case	Sources [source id]
1. Orvium	https://orvium.io [1.1]
	https://medium.com/cv-vc/publish-or-perish-37199f819a16 [1.2]
2. ARTiFACTS	https://artifacts.ai/ [2.1]
	https://medium.com/artifacts/artifacts-and-innovative-education-services-pte-b65f4380cfe7 [2.2]
3. Everipedia	https://everipedia.org/ [3.1]
	https://www.coinsnetwork.com/2019/03/12/everipedia-decentralization-makes-censor-impossible/ [3.2]
4. Steem	https://steem.com/ [4.1]

4 Findings

The first focus of our research in this section is on the scholarly research publication and distribution under the BLK platform. The traditional scientific publication industry faces several inefficiencies that negatively affect the research community, such as the high cost of subscription to academic databases, the lengthy and biased peer-review process, copyrights held by publishers instead of authors, lack of rewards and recognition for reviewers, and proliferation of low-quality journals (Martin, 2018; Orvium, 2019). To address these challenges in the field, some startups came with the idea of incorporating a BLK-enabled open source and a decentralized framework for managing scholarly publications. Table 3 summarizes the most significant impacts we identified during an analysis of two BLK cases in the field of scholarly publications. As can be seen from the table, BLK brings potential features such as increased transparency and speed, and at the same time, decreased cost and time, into the scientific community, which will utterly enhance knowledge sharing.

The second area of BLK application for knowledge sharing in this paper is social media. The traditional social media platforms suffer from difficulties, such as the full control of the owners of social media platforms over their user data, earning money from the monetized users' data without sharing any reward with them, and censored or blocked access by some governments (Dhillon, 2018). BLK tackle some of these problems. We chose and analyzed (in Table 4) two examples to link their impact on knowledge sharing.

Table 3. BLK impact on knowledge sharing in academia

Ben	Ant	Feature	Quotations [source id]
CR	M	Streamline processes	[1.1] "*You control when to submit, peer review, and publish your paper in Orvium. We help you to manage all the publishing process.*"
CR	**I**	**Reduce publication time**	[1.1] "*Easy and fast peer-review management to improve the quality and efficiency of your peer review workflow.*" [2.1] "*Provide and receive 'real-time' attribution for novel work so you can rapidly build and demonstrate your body of scholarly contributions.*"
IB	T	Increase transparency	[1.2] "*By keeping track of all the activity that happens in the paper and the publication life-cycle. We use BLK technologies to establish an independent, decentralized, and immutable timestamped proof of what is happening in the publication process.*" [2.1] "*Keep all your research artifacts organized in one place and establish linkages in real-time for discovery and attribution.*"
G	M	Rewards for reviewers	[1.1] "*When you make peer reviews in Orvium you can get economic rewards and recognition badges that increase the impact of your profile.*" [1.2] "*By doing peer reviews and increasing your reputation, you will start gaining more privileges and rewards in the platform. We have several reputation levels to define some unique things that you could do in Orvium.*"
	T	Proof-of-existence	[2.1] "*ARTiFACTS helps to protect your original ideas and share them with other researchers by securely registering a 'digital fingerprint' (proof-of-existence or PoE) of your work to our BLK.*"
G	R	Collaboration	[2.2] "*Researchers will benefit from the ability to easily and securely share in-process work to speed collaboration and build reputation as research is conducted.*"

	M	Rewards for authors	[1.1] "*Orvium is the scientific publishing platform that helps researchers to share their work.*" [1.1] "*Improve your manuscript and increase your publishing opportunities with constructive peer reviews made by experts in your field.*"
CR	M	Free access	[1.1] "*The platform is freely available to all users globally.*"

note: cost reduction (CR), growth (G), intangible benefits (IB), Intention (I), Trust (T), Reciprocity (R), Motivation (M)

Table 4. BLK impact on knowledge sharing in social media

Ben	**Ant**	**Feature**	**Quotations [source id]**
G	I	Fast	[4.1] "*Steem has already surpassed Bitcoin in number of transactions and can scale to support 10,000 or more transactions per second.*"
	R	Unrestricted	[3.1] "*Everipedia uses BLK technology to help us fulfill our vision for a world where all knowledge is available to all people - a world in which everyone, everywhere can participate in sharing what they know and providing value to others.*" [4.1] "*Steem offers users the unique ability to publish and store different types of content directly and permanently into the immutable ledger of the BLK as plain text. Once stored in the BLK, data becomes available publicly for developers to build from.*"
	T	Uncensored	[3.2] "*Decentralization makes content immutable, which means censorship is impossible to exist, and knowledge can flow freely without interference*" [4.1] "*There is no single entity in Steem that can censor content that is valued by STEEM holders.*"
G	M	Rewards for participation	[3.1] "*IQ Tokens allow us to keep track and reward people for contributing to Everipedia, and as the value of the platform grows, the people who built it get to share in its success.*" [4.1] "*The users that take time to evaluate and vote on content are playing an important role in distributing the currency to the users who are adding the most value. The BLK rewards both of these activities relative to their value based on the collective wisdom of the crowd collected through the stake-weighted voting system.*"
	M	Democracy	[3.1] "*Anyone with IQ Tokens is a stakeholder in the Everipedia Network. Using IQ tokens to vote, users decide which new articles and edits are added to the knowledge base.*" [3.1] "*Everipedia allows you to create an article about anything as long as you have a citation. This allows for a much broader scope of content in the knowledge base.*"
	T	Ownership	[4.1] "*Steem users become platform stakeholders, maintaining control over their data.*"
CR	I	Free use	[4.1] "*Unlike most BLKs that are too slow and expensive to be used for apps, Steem is fast, free, and scalable.*"

5 Discussion

This section is divided into the interpretation of the findings, limitations of our study, and suggestions for future research.

5.1 Interpretation of findings

The results in Tables 3 and 4 show the main antecedents of knowledge sharing that are affected by BLK and the potential benefits for users that can be achieved by utilizing BLK for knowledge sharing. The technology itself helps mainly through smart contracts and users who get rewards for contribution. Furthermore, the speed at which the content is generated and finally shared is much higher compared to traditional platforms because no central authority needs to approve the content. However, it is done by the network (i.e., users). All of this can reduce costs and motivate the users to share their knowledge, which they would not share.

The first draft of every piece of scholarly research can be early published (before the review) and secured through Proof-of-existence mechanisms. The immutable proof that someone authored the publication brings trust, and the users are willing and able to share their ideas (research) much sooner than it would be possible in the traditional publication process. Due to BLK, knowledge is stored in a safe, secure, and decentralized way with a limited chance to be eroded, manipulated, censored, or blocked either arbitrary or intentionally by any entity. This function of BLK can impact knowledge sharing on a large scale because it increases the trust and reciprocity of the users. The trust of users is enhanced by the ability of users to control the data. Users can choose which information from their profile or even their uploaded content should be available to the public. Besides, BLK knowledge sharing platforms are unrestrictedly and democratically available for all who join the network, without a need to pay for subscription fees.

Motivation is crucial in knowledge sharing, and the possibility of incentivizing users can increase knowledge sharing. Authors, reviewers, or social media contributors get rewarded and recognized for their contribution to the network. It makes data monetization possible for every ordinary user, which was not possible in the past. As users are rewarded for their contribution, based on the peers' assessments, they have no economic reasons to damp the network by fake information or news, because their credit will decrease.

These potential main benefits of BLK application for knowledge sharing go beyond the common understanding of BLK use cases in KM, which are limited merely to curate information gathered in KM processes (Taylor, 2017).

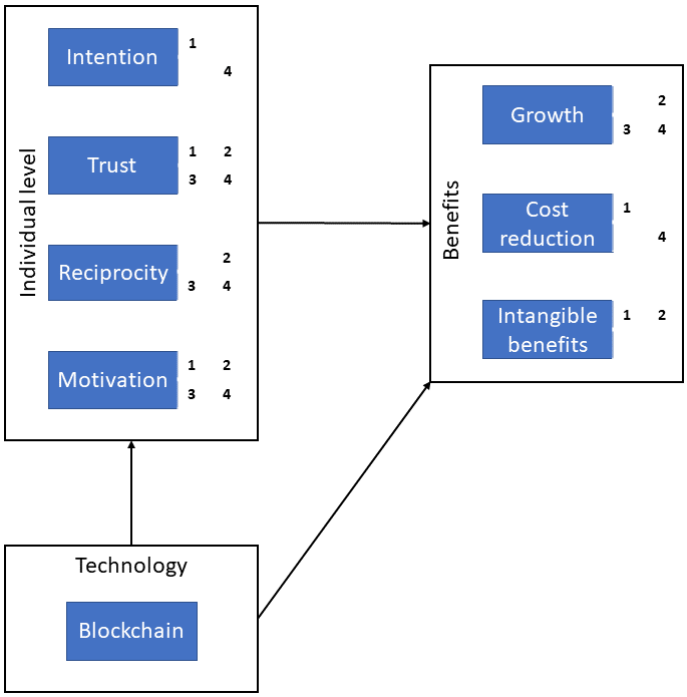

Figure 1. Identified concepts related to cases

5.2 Limitations

This research suffers from three main limitations. First, we used the content analysis of the sources from the white papers and websites of the associated cases. However, some of such texts might be just an articulation of the business owners' ideas and could be far from the empirical situation. At the moment, it is hard to judge the truthfulness of such information due to the lack of empirical data. However, future research is suggested to follow empirical approaches to assess their real impact in practice. Second, we investigated the role of BLK just for knowledge sharing use cases. However, we believe that BLK can also be applied for knowledge discovery purposes. The development of Artificial Intelligence (AI), together with the potentials offered by BLK, creates the perfect combination of KM and BLK. One of the main problems in the current AI market is the availability of accredited data. Decentralized and publicly available databases under BLK platforms have the potential to overcome this challenge. Startups such as Fetch are trying to leverage this opportunity and respond to this market need by processing and analyzing the BLK inherited data, resulting in creating a valuable set of knowledge and monetization of BLK data both for AI developers and organizations. There are lots of potentials to apply such knowledge in practice with the aim of business model innovation/transformation, such as commodity exchange and decentralized finance, smart

cities, smart homes, intelligent autonomous supply chain, and electric vehicle infrastructure. Hence, it could be a useful research agenda for future research. At the time of the current study running period, there is limited information base from such practices that prohibited authors from involving such cases in the research. However, we are aiming at following that research line in the future once the required information gets publicly available. Third, we have not taken the technical architecture of BLK platforms into account. Different DLT platforms (such as Tangle or Blocklattice) and different BLK architectures such as public and private have the potential to impact the realization of the expected benefits. Therefore, future research could investigate how different implementation alternatives of the underlying technologies might impact KM processes.

5.3 Further research

We reviewed four BLK cases intending to discover their role in knowledge sharing through the community. Even though there are other available cases in the field of knowledge-sharing platforms, through initial screening of their websites and whitepapers, we realized that the underlying business models, platforms, and general approaches are somehow similar among all. However, a thorough analysis of other cases, at least those listed in Table 5, would ground our results deeper in the data.

Table 5. Cases for further research

Knowledge sharing in academia	
Scienceroots	https://www.scienceroot.com/
Pluto	https://pluto.network/
DEIP	https://deip.world/
Frankl	https://frankl.io/
Social media	
Minds	https://www.minds.com/
Trybe	https://trybe.one
Dtube	https://d.tube/
Peepeth	https://peepeth.com/
Memo	https://memo.cash/
Twetch	https://twetch.app/
Dlive	https://dlive.tv/

Another way how our research could be extended is to develop and test a similar model (see Ali et al., 2019) that we used for the main categories in our analysis (Benefits and Antecedents). BLK does not have to have a direct impact on the antecedents and benefits of knowledge sharing but could play a mediating role.

6 Conclusions

BLK is believed to have the potential to disrupt traditional business models through the inherent distributed, decentralized peer to peer, and security features. This research

categorized the potential impacts of BLK on the effects and antecedents of knowledge sharing by reviewing four proof of concepts (Orvium, ARTiFACTS, Everipedia, and Steem). We highlighted the potential impact benefits of BLK on antecedents of knowledge sharing, such as trust, reciprocity, motivation, and intention. The role of BLK in knowledge sharing manifests through features such as rewarding and incentivizing, democracy, faster processes, unrestricted and uncensored publishing, and users' control over data.

We believe that this paper will help BLK to penetrate the field of KM research as it is one of the first research attempts (only seven results for "knowledge sharing" AND Blockchain search in WOS) to investigate the usefulness of BLK for knowledge sharing.

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Online Group Dynamics and Participatory Sense-Making: the case of Affective Polarization in Pandemic Times

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Abstract

A narrative is affectively polarized when the distribution of expressed feelings towards such a narrative shows two separated peaks. In this paper, we explore the distributions of feelings expressed by online users on Twitter in March 2020 using a sample of 7.9 million tweets related to the narrative of the COVID-19 pandemic. How people influenced each other affective states? Does affective polarization emerge? To answer these questions, sub-narratives are distilled from Twitter data by thresholding a structural parameter of a graph constructed with hashtags co-occurrence. Here, hashtags are considered as string identifiers of sub-narratives related to COVID-19. For such

sub-narrative, we found a polarized distribution of affective states, in which a radicalization of measured values emerged non-linearly for positive and negative valence of affective states, depending on the hashtag considered. We stress that our findings are not generalizable, but they suggest that such type of polarization was present online during social distancing, and that interactions may have non-linearly impacted the initial affective states of online groups' constituent parts.

Keywords – Polarization, COVID-19, Participatory Sense-Making, Physical Distancing

Paper type – Academic Research Paper

1 Introduction

On 11 March 2020, the World Health Organization (WHO) declared the state of a global pandemic due to the fast spread of the new SARS-CoV-2 virus. The disease caused by the virus, COVID-19, is a severe acute respiratory syndrome that rapidly generated large numbers of deaths worldwide. World countries have quickly implemented countermeasures to reduce the spread of the virus. Among such countermeasures, social distancing aims at minimizing the probability of contagion by forcing citizens to stay at home to reduce face-to-face interactions. This has increased active participation in online social networks, allowing social connections among citizens while still respecting physical distancing. This scenario has enabled the creation, consumption, and diffusion of virus-related content at large-scale using online social networks. Scholars have exploited such large-scale data to propose approaches for surveillance and forecasting of the disease (Dewhurst et al., 2020), to investigate the effect of social media on mental health (Gao et al., 2020), to study the spread of misinformation across different social networks (Cinelli et al., 2020). While on the one hand, people were struggling to distinguish trust-able content from misleading content in such "infodemic" (Cinelli et al., 2020; Ferrara, 2020), on the other hand, activism to fight the outbreak emerged online, thanks to the way narratives are conveyed by users through string identifiers (namely hashtags), e.g. *#stayhomesavelives*. Such sub-narratives related to the main narrative of COVID-19 enabled the active participation of people to "fight against the virus", providing slogans for being supportive and for being not isolated, both socially and emotionally.

While previous studies already found an experimental confirmation of this active participation, less attention has been paid to the distribution of feelings (here named also "affective states") of people participating to such narratives, and to how people influenced each other affective states with online interactions during the outbreak. In this work, addressing such a gap with a sample of Twitter data collected in March 2020, we found an emergent polarization of affective states for a sub-group of hashtags representative of COVID-19 related sub-narratives. The analysis of distributions of affective states containing these hashtags revealed an apparent non-linear relationship between the measured affective states with and without group interactions. This finding suggests that online narratives during a pandemic may have generated a twofold dynamic on affective

states of people: (1) a positive change towards higher positive values of affective valence, and (2) a negative change towards lower negative values, depending on the sub-narrative.

The article begins with a theoretical background section that wants to provide the reader with an excerpt of theories relevant to this work; then, a methodology is presented both as a generalized formulation, and as a particularization to the case study of COVID-19; results and discussion are presented in the subsequent section along with the main findings, while, the conclusion section summarizes the work done and opens reflection for future works.

2 Theoretical background: The networked nature of feelings

Van Kleef (2009) introduced the theory of emotions as social information, according to which the affective states of people should be investigated as a source of social information for the understanding of socio-physical phenomena. The main question that must be asked about the social nature of affective states in this sense is the following: how the emotional expressions of an individual can influence the affective states, opinions, and actions of other individuals? This broad question flows into narrower questions like: when and how do emotional manifestations contribute to the behavior of a group? How do emotional exposures affect conflict resolution or conflict exacerbation? Humans spend a high percentage of their time interacting with each other for a wide range of objectives moved by a diverse range of forces. In recent decades, the advent of social media in people's social lives has favored social-emotional exchanges and increased the speed with which emotions are transmitted (Jalonen, 2014)[1]. Emotions fulfill fundamental social functions, and help society members to face the various problems associated with life (Keltner & Gross, 1999), such as recently, those associated with the COVID-19 pandemic.

In such a problematic situation, the social distancing intervention to prevent the spread of the virus, defined more appropriately as physical distancing (Aminnejad & Alikhani, 2020), has canceled offline interactions and emotional responses transferring them to online social networks, which acted as a back-channel for users' sense-making and participation (De Jaegher & Di Paolo, 2007; Lipizzi, Dessavre, Iandoli, & Marquez, 2016) to the unfolding of events related to the pandemic. Spoor and Kelly (2004) suggested that emotions have a coordinating function in groups; in particular, they hypothesized that such coordination could become evident in two diverse ways: the first way is when perceived affective states are shared with others, which could facilitate coordinated action; the second way is when emotional expressions provide information on the current affective states for the surveillance and forecast, and the subsequent coordination (for example, the surveillance of mental health threats given by the lock-

[1] *It is worth mentioning that this tendency of using emotions to evaluate external stimuli, in particular referring to the consumption of information, it is a matter of debate for the spread of misinformation. The risk behind is that the tendency to react emotionally to information may facilitate the acceptance of information as "trustable" even if it is not.*

down condition during the period of social distancing). With respect to the first form of emotional coordination, Dezecache et al. (2013) support the hypothesis of unconscious tuning of affective states in a group as a form of collaborative behavior for the survival of group members; however, such unintentional emotional tuning combined with emotional vulnerability, typical of a disruptive situation like the recent pandemic, may be also detrimental for a group when the prevalent initial emotional state of group members has already a negative valence (Smith & Mackie, 2008).

It follows that, on the one hand, the social nature of affective states could favor encouragement in dealing with problematic situations that life poses, and in this sense the affective states of a group can converge positively, acting as a catalyst for mutual support; on the other hand, instead, the social nature of affective states could exacerbate an emotional divergence, which may negatively radicalize the affective states towards more extreme values. With such a theoretical background, and in the context of online Twitter discussions around the COVID-19 narrative, we aim at answering the following questions: how do affective states expressed on Twitter varied depending on sub-narratives related to the main narrative of COVID-19? Does a polarization of affective states emerge when comparing first expressed affective states[1] with affective states calculated considering interaction ties with other users contributing to the same sub-narrative? To address such questions, we present a generalized formulation of a methodology that combines subjective computational analysis of text[2] with a graph-based model for the estimation of changes in affective states of individuals contributing to a narrative. Then, we particularized the methods to the case study on COVID-19, and then answer the questions with a sample of 7.9 million tweets posted in March 2020.

3 Methodology

3.1 Generalized formulation: narrative contribution grounding and attributes estimation on a networked medium $\mathcal{M}$

Let N be a set of n string-based messages τ_i, each including a sub-string identifier $\hbar$, published by a set of agents U_N interacting on an online medium $\mathcal{M}$. We define the set N as the narrative shared by the set of agents U_N. Also, let $X_{u_i \in U_N}$ be an attribute (e.g. value of expressed feelings) of an agent u_i evaluated on the following set of string-based messages available:

[1] *Assuming "first expressed" as the first tweet of a user toward a sub-narrative to be available in our data sample.*

[2] *The reader will note that the model described in the methodology section has a generalized formulation, hence, text is generally referred to a string-based message of any kind. However, in the results we present, text is referred to the textual content of tweets, but not referred to the text inside a news hyperlink posted that points outside the social platform for its consumption (the reader may note that such "outside of the medium" text can influence affective states of Twitter users as well as the actual content of tweets. Although the generalized formulation we present can theoretically consider even such texts, the case study does not take them into consideration).*

$$C_{u_i} = \{\tau_i : (u_i \rightsquigarrow \tau_i) \wedge (u_i \in U_{\mathrm{N}})\} \subseteq N \quad (1)$$

Where $u_i \rightsquigarrow \tau_i$ means that the agent u_i published ($\rightsquigarrow$) a string-based message $\tau_i \in N$ on the medium $\mathcal{M}$. Therefore, $\forall\ C_{u_i}$ the attribute $X_{u_i \in U_{\mathrm{N}}}$ is the i^{th} element of the following set of n attributes of $X(U_N)$:

$$X(U_N) = \{X_{u_1}, X_{u_2}, \ldots, X_{u_n}\} \quad (2)$$

Now, let one consider a set of k sub-narratives η of N. Each sub-narrative η_j is a set of n string-based messages τ_i published by a set of agents U_{η_j} that includes in each τ_i the same sub-string identifier $\hbar$ plus also another sub-string identifier h_{η_j}.

Then, let one consider two sub-narratives η_k and η_z and their respective sets of agents U_{η_k} and U_{η_z} that share the two sub-narratives. An intersection $\xi_{U_{\eta_k} U_{\eta_z}}$ of the two sets of agents can be defined as the set of agents that creates a common-ground between η_k and η_z. These agents overlap their respective sub-string identifiers, meaning that their string-based message τ_i includes the sub-string identifier $\hbar$ in each τ_i, and also includes the sub-string identifier h_{η_k}, along with the sub-string identifier h_{η_z}.

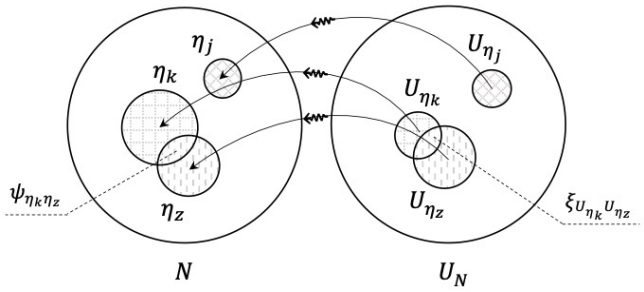

Figure 1 – Intersection of common-grounded sub-narratives of N shared by sub-sets of agents (i.e. users) of U_N.

Thus, the following subset of string-based messages can be formalized:

$$\psi_{\eta_k \eta_z} = \left\{ \tau_i : (u_i \rightsquigarrow \tau_i) \wedge \left(u_i \in \xi_{U_{\eta_k} U_{\eta_z}}\right) \right\} \subseteq N \quad (3)$$

where:

$$\xi_{U_{\eta_k} U_{\eta_z}} = U_{\eta_k} \cap U_{\eta_z} \quad (4)$$

$\psi_{\eta_k \eta_z}$ is what we call common-grounded-narrative since this is an indirect measure of the semantic overlap between the two narratives η_k and η_z shared by the intersection $\xi_{U_{\eta_k} U_{\eta_z}}$ between the sets of agents U_{η_k} and U_{η_z} (see Fig. 1).

Now, let A be an adjacency matrix where the generic element a_{ij} has value equal to 1 if the agents u_i and u_j share a same narrative, otherwise, it has value 0. Given A, the following set of attributes (e.g. expressed feelings) for each node can be defined as:

$$\hat{X}(U_N) = \{\hat{X}_{u_1}, \hat{X}_{u_2}, \dots, \hat{X}_{u_n}\} \tag{5}$$

where the generic $\hat{X}_{u_i}$ respects the following equations:

$$\hat{X}_{u_i} = \hat{X}_{u_i}(\bar{\rho}) \tag{6}$$

$$\lim_{\rho \to \bar{\rho}} \left| \hat{X}_{u_i}(\rho) - \hat{X}_{u_i}(\rho) \right| = 0 \tag{7}$$

$$\hat{X}_{u_i}(\rho) = \frac{\sum_{j=1}^{n} a_{ij} \hat{X}_{u_i}(\rho - 1)}{k_{u_i}} \tag{8}$$

k_{u_i} is the number of shared narratives of the agent u_i with all the other agents; ρ is an iteration parameter that updates the value of the attribute $\hat{X}_{u_i}$ according to the number of shared narratives multiplied by the value of the attribute $\hat{X}_{u_i}$ at the previous iteration. Eq. 8 is an adaption of the opinion estimation model described and used in (Morales, Borondo, Losada, & Benito, 2015; Olivares, Cárdenas, Losada, & Borondo, 2019; Primario, Borrelli, Iandoli, Zollo, & Lipizzi, 2017) with the following two main differences: (1) $\hat{X}$ is an expressed feeling (mood or affective state) rather than a measure of ideological opinion as in the original model; (2) since the present research work focuses on affective states and not ideologies (also called opinions), opinion leaders (elite agents with a fixed ideology over the iterations) are not taken into consideration, thus, we do not maintain fixed any affective state when varying ρ. The initial condition that defines the attribute $\hat{X}_{u_i}$ at iteration $\rho = 0$ is that $\hat{X}_{u_i}(0) = X_{u_i}$.

At this point, two types of attributes of the agents are available: X_{u_i} represents the attribute the agent u_i expressed through the corpus created with the first string τ_i published by u_i on the medium $\mathcal{M}$ contributing to a sub-narrative η_i. $\hat{X}_{u_i}$ represents the attribute of the agent u_i resulting from the interactions with other agents that contribute to the sub-narrative η_i. The initial condition is that $\hat{X}_{u_i} = X_{u_i}$.

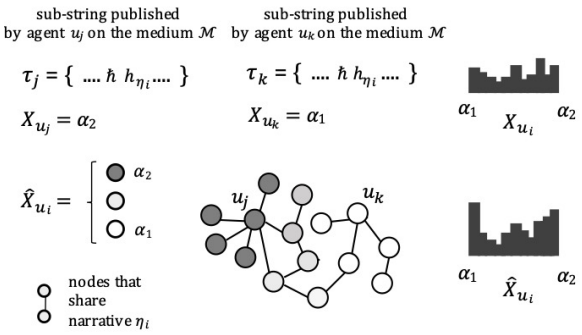

Figure 2 – Construction of frequency distributions of X_{u_i} and $\hat{X}_{\boldsymbol{u}_i}$. The histogram on top-right of the chart shows the distribution of attributes calculated only using string-based messages of agents; while, the histogram on lower-right reports the same attributes altered by graph-based ties with other agents.

It is therefore opportune to point out that this generalized formulation can fall in the context of any online social media ($\mathcal{M}$) with the following particularities: the agents are the users (u_i) of a social media platform, that are accountable for publishing content from which attributes can be extracted (e.g. affective states extraction or any other knowledge extraction). In this work, the published content is intended as textual content that is what we call string-based messages τ_i - e.g. text of tweets when the medium $\mathcal{M}$ is Twitter. The attributes X_{u_i} are values resulting from a measurement of the polarity of affective states extracted from the text posted by online users, a continuous variable defined in $[\alpha_1, \alpha_2] = [-1,1]$,; while, the set of agents' attributes $\hat{X}_{u_i}$ is a set of values resulting from the application of Eq. 8 to the polarity of affective states resulting from networked interaction with content published by other users (see Fig. 2). Given the attributes of individual parts that share a sub-narrative, and given the attributes of the same individuals, after interacting with other users that share the same narrative, we analyze the bi-variate distribution between X_{u_i} and $\hat{X}_{u_i}$ to study the relationship between the two estimations of affective states for the users of $\mathcal{M}$.

3.2 Particularization to the case study of COVID-19 data with Twitter as a medium $\mathcal{M}$

This experimentation presented in this article involves the analysis of 7.9 million of Twitter data to measure the dynamics of changes in affective states expressed in user-generated tweets published in March 2020 during the COVID-19 pandemic. The purpose of the experimentation is to analyze whether and how online users that contribute to a narrative, meaning that they participate to the formation and sense-making of that narrative, will be influenced by each other affective states according to the interaction ties they exhibit. In this sub-section, the generalized formulation of the model presented in the previous sub-section, is detailed for such experimental case study.

The reader can assume the following particularization of the variables presented in the generalized formulation: the medium $\mathcal{M}$ from which data are sampled is Twitter; a generic string-based message τ_i is the text of a tweet; the narrative N is identified by the sub-string identifier $\hbar$ = *#covid19*; the generic sub-narrative η_i is identified by a hashtag (eg. *#pandemic*) that co-occurs with *#covid19*; the agent u_i is a generic Twitter user account; The attribute X_{u_i} of u_i is a measure of polarity of affective states extracted from the text of the first tweet posted by the user u_i in a sub-narrative (identified by a hashtag) co-occurring with the main narrative *#covid19*; $\hat{X}_{u_i}$ is the measure of polarity of affective states calculated considering the influence of users who share the same narrative (Eq. 6-8). The measure of the affective states conveyed in a text is obtained with the approach described in (Lipizzi, Borrelli, & Capela, 2020; Lipizzi et al., 2019) with an unsupervised symbolic pre-processing based on n-grams frequency (Borrelli, Gongora Svartzman, & Lipizzi, 2020; Borrelli et al., 2020). The subjectivity of perception of a text could vary depending on many variables such as: the account considered, the context, the medium itself. The approach described by Lipizzi, Borrelli, & Capela (2020) uses benchmark keywords to be evaluated over a new text from a given point of view. Since the approach does not directly provide a single measure of the polarity defined in $[\alpha_1, \alpha_2] = [-1,1]$, the obtained values for each benchmark keyword had to be compounded in one single value defined in the interval [-1,1] with an appropriate normalization. Since the exposure of a content to a user can generate different affective states depending on who is reading the text, the approach described by Lipizzi et al., (2020) can be used for the calculation of $\hat{X}_{u_i}$ where interactions with content of other accounts are involved.

4 Results and Discussion

4.1 Emergence of common-grounded narratives deduced from $\xi_{U_{\eta_k} U_{\eta_z}}$

Clark and Brennan (1991) define successful grounding in communication when parties that communicate achieve coordination of both the content and the process; with this theoretical definition and inspired by previous works applying it to online social networks (Lipizzi et al., 2016), here, common-ground has been measured with the number of users that share and contribute to the same set of narratives. Here, we consider a high degree of common-ground as proportional to a high number of users contributing to the same set of sub-narratives.

We constructed a network of sub-narratives (identified by hashtags) related to COVID-19 similarly to the approach described in previous works (Bovet, Morone, & Makse, 2018; Etta, Galeazzi, Cinelli, Conti, & Quattrociocchi, 2020). The graph is constructed with hashtags as nodes, connected by an edge when they co-occur within a tweet; differently from previous works, we add a novel attribute to each edge of the graph.

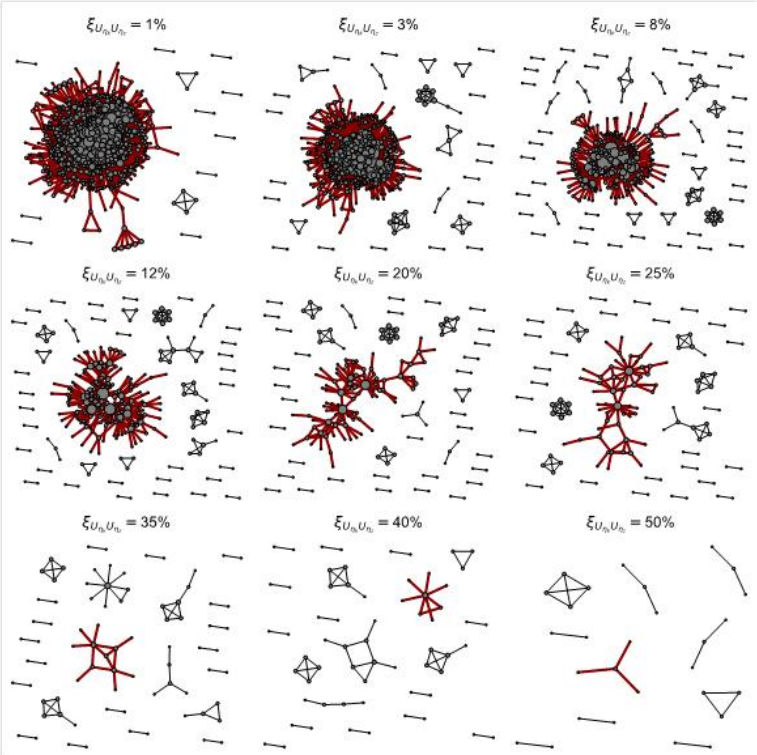

Figure 3 – Graph of sub-narrative (hashtags co-occurrence network), and analysis of common-grounded contribution using a threshold on the fraction of users in common of two generic narratives η_k and η_z. The size of nodes is proportional to the number of users contributing to that sub-narrative/hashtag.

Such attribute is the fraction of users that use the hashtags together, which is deduced from $\xi_{U_{\eta_k}U_{\eta_z}}$ (see Eq. 4). At this point, we are going to filter the graph by gradually increasing the value of $\xi_{U_{\eta_k}U_{\eta_z}}$ as shown in Fig. 3 and Fig. 4. We excluded the main narratives (e.g. *#covid19, #covid-19, #coronavirus,* etc.) leaving only sub-narratives as nodes of the graph; then, we selected ten hashtags that respected the following two conditions: (1) a node that never disappeared from the resulting graph when varying the value of $\%\xi_{U_{\eta_k}U_{\eta_z}}$; (2) a node that was always present in a connected component with the highest number of nodes (In Fig. 3 this components is visualized with thicker red edges). The set of hashtags resulting from the structural filtering is the set $\psi \subseteq N$ listed in Table 1.

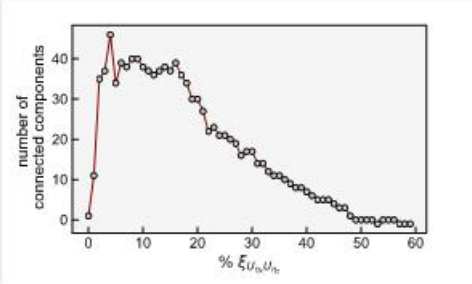

Figure 4 – X-axis represents the threshold that is chosen for the minimum percentage of users who contribute to the creation of a common-ground between different narratives; on the y-axis, the number of connected components that emerge from the hashtags network filtered according to the value of $\% \xi U_{\eta k} U_{\eta z}$

Table 1 – Set ψ of sub-narratives identified via thresholding on %ξ. It is worth noting that hashtags that have been used for running the data collection have been excluded - e.g., #covid19.

Narrative (η)	Narrative Identifier (h)
η_1	#stayhealthy
η_2	#washyourhands
η_3	#quarantine
η_4	#quarantinelife
η_5	#stayhomechallenge
η_6	#isolation
η_7	#highriskcovid19
η_8	#coronaoutbreak
η_9	#pandemic
η_{10}	#lockdown

4.2 Polarized distribution of affective states

For each of the sub-narratives indicated in Table 1, we measured the polarity of the affective states of Twitter accounts that contribute to each sub-narrative. In particular, two distributions of values are obtained: (1) the first distribution Fig. 4A, X_η, includes the polarity of affective states measured using the text of users' first tweet posted that includes the hashtag identifier of the sub-narrative; (2) we applied the model described by Eq. 8 to obtain the distribution $\hat{X}_\eta$ of the values of the polarity of affective states which takes into account the graph created with the group of users who share the same narrative - see Fig. 4B, and Fig. 2.

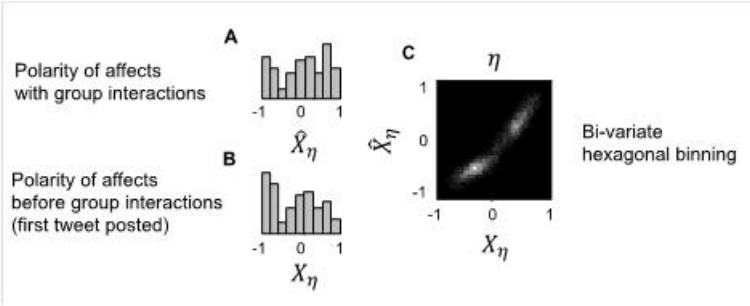

Figure 5 – Visual summary of the analysis carried out on each sub-narrative: (A) shows the distribution of values $\hat{X}_\eta$ obtained by calculating the polarity of affective states considering the influences received by the nodes (users) who contribute to the narrative η; (B) shows values of the affective polarity of the first tweet available of the users who contribute to the narrative η; (C) relationship between $\hat{X}_\eta$ and X_η using a bi-variate hexagonal binning, which is shown in Fig. 6 for each sub-narrative.

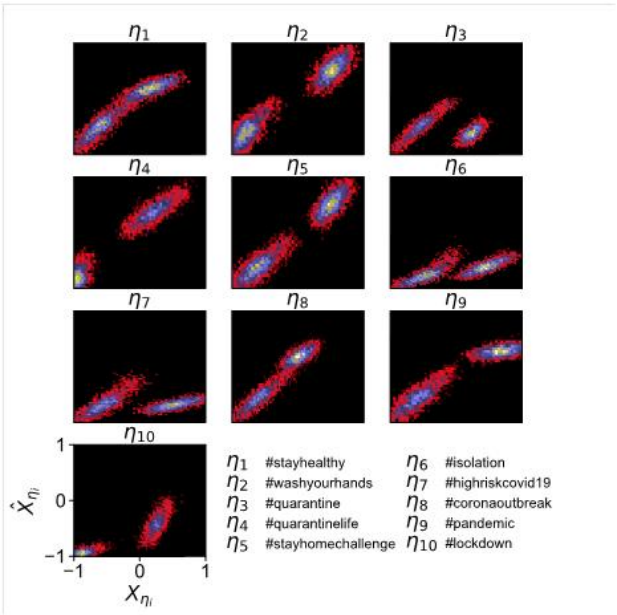

Figure 6 – Hexagonal binning of bi-variate data: X_η on the x-axis represents the polarity of affective states before group interactions (relative to the first available tweet published by users on the narrative η); $\hat{X}_\eta$ on the y-axis represents the values of the polarity of affective states with the influence of interaction ties; for each narrative η_k with $k = 1\ldots10$ the relationship between the two variables is shown. The color of the bin is lighter, where the density of data-points in the bin is higher, while it turns darker when the density is lower.

Fig. 6 shows two poles of affective states, which are distinguishable in each bi-variate distribution. The relationship that exists between the different narratives seems to be non-

linear, thus respecting the group hypothesis according to which the behavior of a group is not a linear combination of the individual parts (Lewin, 1951). The variables that we have analyzed are the affective states measured as a single contribution by a user (the first tweet published with the hashtag identifier of the sub-narrative) and the affective states calculated considering the influence given by the group of users who share the same narrative. It can be observed that the relationship between the two variables in most of cases is non-linear (see Fig. 6). For some narratives - #washyourhands, #stayhomechallenge, #quarantinelife - positive values shifted towards more positive values, while for other narratives - #quarantine, #pandemic, #isolation, #lockdown - negative values shifted towards more negative values. This confirms the twofold effect hypothesis (see Section 2) of social interactions on affective states: 1) a change of positive values of affective states towards more extreme values with the influence of the group, 2) a change towards more negative values of affective states with the influence of the group. In the first case, interactions with users who share the same sub-narrative lead to a positive affective condition (e.g. this could favor optimism, confidence in the fight against the virus – see hashtags: #stayhomechallenge, #washyourhands). In the second case, it may lead to a pessimistic view of the situation (see hashtags: #highriskcovid19, #isolation).

5 Conclusion

The problem of studying changes in affective states due to participation and sense-making in online social networks enabled narratives was studied using the case of the recent COVID-19 pandemic, a worldwide threat to public health. We have presented a generalized mathematical formulation to model the problem on a generic online medium with interacting agents, with a particularization to the Twitter case. In our empirical exploration, we have selected ten narratives (identified by ten hashtags) that emerged via thresholding a graph of hashtag co-occurrence using a parameter representative of the level of co-participation of Twitter users to sub-narratives related to the COVID-19. For such sub-narratives, we found presuppositions for polarization of affective states. This has suggested that interactions with content published by other users could both foster the feeling of mutual support to fight against the virus, but also increase negative affective states that may generate possible exasperation. It is also clear that, although the dynamics seen here are limited to a relatively small sample compared to the entire lock-down period, the reported results on a 7.9 million tweets dataset draw attention to the mechanisms of segregation and how a period of forced closure can potentially produce a non-linear shift of collective conditions of affective states. The non-linear relationship observed may suggest approaches that go deeper into the theory of dynamical systems and chaos. The findings may also have an implication on the design of systems to help reducing dysfunctions in groups and promote collaboration (Iandoli, Klein, & Zollo, 2007; Iandoli, Ponsiglione, & Zollo, 2010; Iandoli, Quinto, Spada, Klein, & Calabretta, 2018), on different contexts where polarization is relevant (Desmarais, Moscardelli,

Schaffner, & Kowal, 2015; Kowal, 2017); moreover, the study may have implications on the understanding of the resilience of crowds after events (Barker et al., 2017; Hosseini, Barker, & Ramirez-Marquez, 2016), and on the diversity and complexity of socio-cognitive mechanisms underlying the subjective perceptions of external stimuli at the scale of individuals and groups.

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Enabling IC in European Capitals of Culture. The case of Matera2019

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Abstract

The main purpose of this study is to identify the characteristics of the Intellectual Capital (IC) that can be included in IC studies applied to territorial realities and cities alike. The aim of this study is to analyse the concept of IC and its application to cities, specifically the assessment of IC enabling factors of European capitals of culture (ECoC). Hence, this study explores whether and how IC approach can be applied to study the ECoCs related phenomena from a managerial point of view.
Amongst those which have succeeded throughout the years, there is one, in particular, that is represented by the City of Matera, former ECoC 2019.
Considering the novelty of this topic, neither the approaches nor the impact evaluation related to the appointment as ECoC are known, yet.
The city of Matera was designated in 2014 as ECoC, also because of a gradual process of cultural, economic and tourism development in the decade before. Results show that IC dynamics related to a city with a capital status demonstrate relevant factors and characteristics referring to the traditional dimensions of IC (structural capital, human capital and organisational capital) which are generated before and after the title of ECoC.
There is a common acknowledgement that, so far, theories on IC have primarily concerned companies and firms and have analysed factors enabling visualisation, management, measurement, reporting and disclosure of intangible resources. Some scholars (Dumay 2013; Edvinsson 2013) have called for the need to extend the analysis of the role of IC in different contexts. To this regard, in recent years research work has been much promising on the role of IC for countries (Edvinsson and Stenfelt, 1999), cities (Carrillo, 2004), public sector (Huggins and Weir, 2007; Schiuma et al., 2008; Schneider and Samkin, 2008; Dumay et al., 2015), non-profit (Kong, 2007; Donato, 2008) and for communities (Chatzkel, 2006; Bounfour and Edvinsson, 2005). All that said, in the literature there not much focus on the analysis of implications of being a "Capital City" from an IC perspective. One of the most interesting cases is given by the role played by European Capital of Cultural (ECoC) in contributing to developing the city designed as capital and its surroundings (Burnham, 2009; Campbell, 2011; Garcia et al., 2009; 2010) as well as their reputation at the international level.
As far as this study is concerned, the research methodology is based upon a single case-analysis. This method is particularly well suited to the research in question, as it is very effective for the

analysis of complex phenomena which constitute a new field of research (Eisenhardt, 1989). This study, therefore, aims to show compatibility between ECoCs and IC approach through the presentation of the case of the city of Matera as ECoC 2019. The case-study shows an analysis that focuses on the relevant factors of IC before and after the recognition of the title of capital.
We aim to fill the gap in the existing literature about the IC determining factors of a Capital of Culture. With its results, this study has the ambition to become an effective supporting tool for policy makers, scholars, and practitioners willing to conduct policies of territorial development as connected to a capital. Moreover, this work can contribute to all those who would commit and embark on projects of recognition of their own city as a temporary capital, such as the appointment as ECoC and use IC to development of cultural attractiveness of the city, strategic planning and urban governance, which leads to local and urban.

Keywords – intellectual capital, capital of culture, knowledge management, knowledge city, knowledge-based organisations

Paper Type - Academic Research Paper

1 Introduction

There are arguments in favour of the pivotal role that Intellectual Capital (IC) plays in a knowledge-based society (Bukh et al., 2001; Montequín et al., 2006). As representing the intangible asset of an organisation, IC constitutes a significant portion of its value, which enables to gain advantages over competitors (Andriessen, 2004; Wall, 2005) because it contributes to justify the value difference between market value (Mouritsen et al., 2001; Wall et al., 2004; Beattie & Thomson, 2007; Bozbura et al., 2007; Yang & Lin, 2009). Scientific literature has presented several definitions of IC that are relevantly connected to company organizations and to their intangible asset. By this token, IC has been merely associated with human potential and people's role within organisations, while only a few are suggestions that link IC to cities' dynamics. Cities do also represent organisations and are fuelled by intangible assets hiding human factors and expressing knowledge at all levels. It is important to consider the possibilities of IC models and principles' application at the city level.

As company organisations compete with market competitor, cities also compete on their own platforms to increase competitiveness and welfare standards for its citizens. Hence, it could be argued that city IC is inextricably related to its welfare and competitiveness and its employment for performing the process of urban functions enables the acceleration of knowledge spread within the city itself. As far as cities are concerned, IC can be described by various factors, expressed by quantitative and qualitative indicators.

In the aftermath of the worldwide economic crises during the 2007 – 2010 years, cities all over the world were confronted with serious financial, economic and social challenges that were handled by the employment of IC of the city. IC's involvement into the development processes of the city has enabled to increase cities' business and industry competitiveness as well as spread of specific and high-level community competences as

referred to the spheres of administrative bureaucracy, management and innovation. Cities that have been able to develop knowledge and to build upon it are the same that have employed IC for solving development related problems and for enhancing their competitiveness.

The adoption of IC, related to knowledge and ideas' spread for wealth creation and renewal, in those cities has triggered economic growth and enhanced the establishment of open-to-knowledge sectors and innovation-based enterprises fuelled by creative and learning people.

Cities alike have employed knowledge as well as IC into the city to develop knowledge-based strategies in order to ensure city's successful competitiveness both at the local and international level. This is especially the case of Capital cities, comprising those cities that enjoy the temporary title of Capital. In contexts alike, beside economic functions, the city encompassed organisational, human, collective, social and knowledge functions which require more than the financial capacities of the city. As argued, IC has been conferred so much importance (Lu et al, 2010) in successfully ensuring competitive advantage, organizational success and performance that cities acting as Capital cities cannot do anything without IC to improve their new development and organisational performance and enhance community value.

In recent times, academics and researchers have opened the challenging avenues of IC research, labelled as the fourth stage. By this perspective, Dumay (2013), for instance, has suggested to investigate on how to leverage knowledge resources at the city level to be able to construct sustainably strong social eco-systems enabling organizations t flourish in a healthy way. Advocates of the fourth stage of IC research (Gray, 2006; Yeh-Yun Lin and Edvinsson, 2008) suggest to extend the fields of interest and connect IC role and value to the building of tightened economic, environmental and social eco-systems that are no longer viewed as single organizations but as a multiple actor-network acting at different levels (cities and communities, regions, countries). According to these views, knowledge is not only a crucial resource driving firms towards success, but it ensures that social, economic and environmental issues are addressed and managed in such a way to contribute to create sustainable and liveable social eco-systems.

This study has the ambition to contribute to the emerging fourth stage of the IC research and to do so it explores how ideas behind ECoC are highly compatible with the IC tradition. However, it is important to argue that a gap between IC and research on Capital of Culture has not been filled, yet due to the different disciplinary backgrounds between the two communities of research. If IC community is traditionally based on accounting and management disciplines, ECoC practitioners lay their basis on a multi-disciplinary root that goes from social and political sciences, development studies to culture and heritage management. Although such a high complementarity between the two realms, cross-fertilization between them has a great potential. From one hand, capital of culture approach overcomes the narrow correlation between IC and competitiveness as well as financial performance (Dumay and Garanina, 2013). ECoC's view, based on

public value's literature (Fontana, 2014) as well as on quality of life e resilience can be useful to extend IC outcomes. From the other hand, research outcomes of IC have not enjoyed consideration in innovations conducted in the realm of public management and administration (Dias et al., 2014). However, ECoC initiatives need to be governed, managed, and evaluated and there is a lack of research relating to the management, assessment and monitoring of ECoCs being poorly rooted in management studies. In other words, there is a compelling demand for tools enabling to manage and monitor ECoC initiatives from a managerial point of view.

Therefore, this study suggests a specific version of IC approach adapted to ECoC contexts to fill the gap in the literature. To do so, Matera 2019 is analysed through the IC perspective, with the purpose to extend the traditional IC framework and propose a new one that could be called the Capital of Culture IC framework that takes into account existing characteristics and factors of IC proper of ECoCs. Consequently, this study is guided by the following research question: *What are the IC enabling factors at the basis of ECoCs?*

The reminder of this article is organised as follows: Section 2 presents the literature review; Section 3 introduces the methodology. Section 4 shows the results of the study while Section 5 deals with the discussion. The last section draws the conclusions.

2 Literature review

2.1. IC of the city

Descriptions of IC refer to three main sets of a company's resources: human capital, organizational capital (or structural capital), and relational capital (or social capital or customer capital) (Stewart, 1997; Bontis, 1998). Intangible assets in the knowledge economy are considered important economic factors that generate wealth (Haskel and Westlake 2017). Considering this premise, over the last two decades IC has represented the lens through which researchers have conducted analysis on the value creation at all levels: at a micro-level, hence organisations and institutions (Fletcher et al., 2003; Kong 2010; Edvinsson, 2013; Guthrie and Dumay, 2015), at a meso-level, regarding local communities and eco-systems (Schiuma et al. 2008; Bounfour and Edvinsson, 2012; Guthrie et al. 2017) and at a national level (Lin and Edvinsson 2010).

Only recently, the concept of IC has been extended to analyse territory's entities as nations and regions (Dunleavy and Hood, 1994; Bounfour and Edvinsson, 2012). City level of analysis has been rarely studied since investigations have been conducted, mainly, at the national level after that some distinguished authors declared that IC is a strategic factor of economic development (Choo, Bontis 2002; Bontis 2002, 2004; Ginevičius, Korsakiene 2005; Cabrita, Vaz 2006; Alexander 2006; Lerro and Schiuma, 2008). Nevertheless, being in the process of its formation, IC is today anchored to

concepts related to economic and management perspectives that do not sufficiently analyse IC-related issues.

Emphasis on the study over IC at the territorial level has renovated the discussion on IC tout court by offering new frameworks to evaluate nations beyond the traditional financial indicators, hence, beyond their GDP. Krusinskas and Bruneckiene (2011) have contributed to the definition of IC of the city as its overall set of intangible assets that allow citizens, communities, institutional and economic actors to build and implement ideas, products and processes which are transferred into outcomes of city's economic, social and sustainable development. These authors suggested that because IC is a form of capital used for value creation processes aimed at generating welfare for the city, it follows that if not used yet, it can be treated as a set of intellectual resources available inside the city.

In the scientific literature there is discussion on the type of components of intangible assets that are comprised into IC, therefore, several definitions are put forward. If at one side, some authors take into account all components that compound IC, at the other side, some authors emphasise on large-scale sets of components. For instance, Edvinsson (2002) introduced the Skandia Navigator model that makes a clear distinction of the basic IC's components: human, process and customer capital. Other authors, instead, in assessing IC at the European level, have divided IC into human, structural and relational capital (Andriessen and Stam, 2005). Important contributions that initiated the analysis of IC, at the conceptual level, including nations argued that leaders of nations started to be aware of the importance in measuring knowledge assets whereas these determine the success of their economies (Malhotra, 2001). Moreover, as Choo and Bontis (2002) declared that it is important to understand the relationships that can increase the value of each sub-component of IC in order to approach success factors for each nation's economic development. Along these lines, another important contribution to discussion on IC of the city comes from Bontis (2004) who, while assessing the IC of Arab regions, revised the IC framework of organisations (Edvinsson and Malone, 1997) into the IC framework of nations. Such framework that moved to a national level perspective from a company level consists of five value-creating fields: national wealth (which replaces market value), financial wealth (instead of financial capital), market capital (rather than customer capital), renewal capital (it was innovation capital before). The same labels remained for the remaining constructs (see Figure 1). According to this view, IC of a nation comprises all those values of individuals, companies, institutions, communities which are hidden but that represent existing or potential sources for the creation of wealth. In other words, such hidden values stand as the roots for cultivating future prosperous wellbeing for the city as a whole and its communities.

Nevertheless, the dimensions of national IC that is found in the extant literature can be seen as similar to those developed for city's IC models whose approaches are similar to each other (Viedma, 2003; Carrillo, 2004; Schiuma and Lerro, 2008; Cabrita and Cabrita, 2010; Uziene, 2013). If is important to point out that IC contents, even though labels that

are given to each of them are different, converge towards the traditional IC elements: human capital, organizational/structural capital and relational/customer capital. Ricciardi and Dameri (2015), along Bontis' categorisation of the national IC components into subcategories, suggested the following main indicators of IC of the city:

1. Human capital indicates the key knowledge resource in the city. Amongst its indicators there are: numbers of graduated citizens, number of schools per capita, all elements that are useful to measure the capacity to transfer knowledge and education to citizens.
2. Knowledge and learning potential comprised into inter and intra-territorial relations established between citizens, companies and other territorial actors is labelled in different ways and its indicators include foreign trade in terms of export, tourism from abroad, incoming students and workers.
3. Potential learning and knowledge expressed by cultures, entities and institutions as well as rules is labelled in different ways and its indicators include measures of trust, respect, and confidence towards the rule of law as well as measures regarding observation and compliance to norms as proxy of positive social relationships.
4. Innovative products and organisations are labelled as renewal capital and their meaning goes beyond the mere intellectual property rights. Referring to the territory's capability to express innovation, indicators include the number of patents, scientific publications in highly ranked journals, innovative start-ups.
5. Processes, practices and procedures are labelled into process capital. Indicators include the number of software usage and availability, volumes of databases, archives, repositories, digital store per capita.

These models of IC at the national and city level stand as conceptual grounds enabling cities to contemplate effective strategies that may generate public value for the communities by leveraging on the endogenous IC (Benington and Moore, 2010).

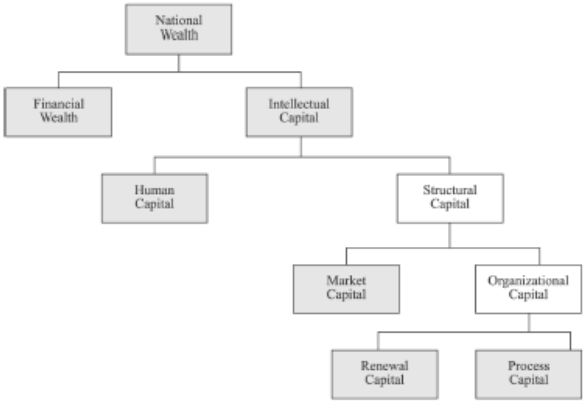

Figure 1 – Intellectual capital of nations (Bontis, 2004) – modifications of Edvinsson and Malone (1997)

2.2 An IC perspective for Capitals of culture

Little attention has been given to the realm of culture within the discourse of IC although it expresses itself in an intellectual and intangible resources based environment in terms of production and outcomes (Chong 2009). Culture is profoundly connected to knowledge that lies at the core of cultural cities that derive from the ideas of learning cities, information city, knowledge city (Donato, 2008; Sundström, 2011; Dumay, 2014).

On these premises, the character of cultural cities is shaped by the capacity of the city itself in building and consolidating knowledge as well as innovation that are functional in activating innovative processes, with a domino effect, inside the city and in compliance with the so-called fourth stage of IC as Dumay suggested (2016). According to the IC fourth stage authors' assumptions (Bounfour and Edvinsson 2005; Dumay and Garanina 2013), knowledge does not merely develop within organisations but flows out from dialogue and exchanges occurring between organisations and their networks, hence, between ecosystems with which businesses interact.

With reference to IC developed in cultural cities, Capital of Culture is the flagship cultural initiative of the European Union (ECoC) that moves into the field of the cultural strategies of the city aimed at improving its image and raise its visibility and profile, at the international scale, while exploiting local opportunities to generate considerable cultural, social and economic benefits that can help foster urban regeneration (European Commission, 1985). Launched by the European Union in 1985, ECoC was initially called the European City of Culture and was conceived in 1983 by the Greek Minister urging the need to give culture the same attention as politics and economics and to establish a project for promoting European cultures within the member states. Originating from a political awareness, the tile of ECoC has been given, since 1985, to cities designated by the European Union for one calendar year during which series of cultural events are organised within the designated city with a strong pan-European dimension. ECOc stems from the idea of enhancing richness and diversity of European cultures in order to maximise the social and economic advantages related to the long–term culture-based development strategy of the city and its surrounding region.

However, the ECoC idea is also grounded in the pivotal role that cities play in creating knowledge, culture, innovation and economic development. Hence, for these reasons, ECoCs are gaining an ever central role in territorial government and development which enable the conceptualisation of ECoC as related to the knowledge city. Or, as Ergazakis et al. (2004) have suggested, a knowledge city is a city that aims at a knowledge-based development resulting from knowledge creation and sharing at both the individual and institutional level (Edvinsson, 2006; Yigitcanlar et al., 2008).

In order to be selected, the cities are encouraged to apply by presenting a plan that shows resources, activities and expected impacts. As far as the candidature in 2019 of the City of Matera is concerned, its payoff phrase was "Together" that was also used for the first Dossier submitted for the application in 2013. After the designation of Matera as ECoC 2019, the city initiated a medium-long term cultural program aimed at sustaining

the urban renewal processes and new model of development for the newly designated Capital. To do that, the city leveraged on knowledge, research, new technology and innovation aimed at generating a sustainable participatory context through inclusion and social cohesion.

To be able to conceptualise and understand the multidimensional impacts of cultural initiatives through the IC lens it is important to cross-fertilise the IC discourse with the challenges posed by the cultural sector and vice versa in the context of cities of culture, more specifically, temporary Capitals of Culture.

3 Methodology

3.1 Research method

As far as this study is concerned, the research methodology is based upon an exploratory case study (Stebbins 2001; Yin, 2008). This method is particularly well suited to the research in question, as it is very effective for the analysis of complex phenomena which constitute a new field of research (Eisenhardt, 1989). This research method enables the authors to carry out an empirical investigation that analyses *"a contemporary phenomenon inside its real-life context (*Yin 1984, p. 23). Moreover, this method is consistent with that analysis to the extent that: (i) it focuses on a current situation; (ii), it involves collection of information to provide the neatest picture of the phenomenon; (iii) the research question refers to "how" or "why" events happen (McCutcheon and Meredith 1993: 240).

The exploration focuses on the City of Matera as ECoC 2019. The analysis is mainly developed at a micro (single organisations) and meso (community/neighbourhood/city) level. Empirical information has been collected through different sources of evidence in order to improve the validity and reliability of the findings (Dul and Hak 2008).

3.1 Selecting case-study

This study requires an in depth analysis of the case on Matera 2019. For this reason, it focuses on the City of Matera which stands as a unique phenomenon in the Southern Italian context as far as the European Capital of Culture realm is concerned. Although the unfolding of similar examples in Europe, it is a unique case because it shows structural and context characteristics which are completely different to former European capitals of Culture.

Other European experiences of ECoC all represent cross-scalar and cross-sectoral initiatives combining cultural and urban innovation with community's capacity building. All former ECoCs experiences, in fact, have leveraged on strong and rooted civic activism resulting from people's capacity of producing cultural innovation. Contrariwise,

the lack a model of assessment of IC of ECoCs in Europe, hence, in the city of Matera, represents a specific element of the analysed case.

3.2 Profile of Matera as ECoC2019

Matera 2019 has involved more than twenty thousand people and citizens, 350 cultural and social entities (amongst those companies, universities and research institutions, citizens and customers) and has developed across the city of Matera, its Province and Region (Basilicata). The Municipality of Matera, for this purpose, has been allocated financial resources by the EU Programme on Capitals of Culture.

Matera 2019 is the result of thousands of events, workshops, walking tours, conferences and concerts running over 48 weeks after four years of programming and planning (2015 – 2019), of co-creation activities spread across the city and the Region and in different places (associations, impact hubs, parishes, cooperatives, etc).

3.3 Procedures of Data collection

This study uses a mixed methodological approach following Yin (2003, 2006, 2008), and McLeod (2008). Data has been collected through secondary data, such as documents and reports, and primary data (interviews and direct observation by the researchers).

Primary data (interviews) refer to interviews addressed to different categories of stakeholders (representatives of institutions, NGOs, non-profit and for-profit associations, companies, schools, universities, healthcare, churches and citizens). Questions were of an open-ended nature to elicit the most thorough answers from the respondents (Rubin and Rubin 2005).

Amongst the key actors interviewed there are: the Mayor of the City of Matera, the director and the president of Matera 2019 Foundation, the President of the Region Basilicata, the President of the Province of Matera, 5 representatives of the most active cultural organisations, three professors of the University of Basilicata and 5 citizens living in the city of Matera.

The choice of organising interviews for a multitude of stakeholders has two reasons: the first one has a technical nature and is connected to triangulation of data; the second one, with a substantial nature, refers to the analysis of different perspectives derived from the different nature of the stakeholders been interviewed. In the first phase, interviews were not structured and were aimed at providing interviewees with a first approach to the subject under investigation and helped a better understanding of the real-life context and the contingent complexity of the phenomena (Qu and Dumay 2011). The first round of face-to-face conversations lasted about two hours, were recorded, and notes were taken. Then, a follow-up meeting for each interviewee took place later to validate the answers and gain more profound insights into some topics. In the second phase, interviews have

been semi-structured and aimed at enhancing the phenomenon compared to this study's research goals.

Secondary data (documents) – with reference to analysed documents, this study has investigated the following documents: official documents, social media (i.e. Facebook), websites and press releases. Documentary analysis concerned, inter alia, official documents: the first and the second bid books, reports of the formal monitor meetings by the Selection Panel and the Monitoring and Advisory Panel.

3.4 Data validity and reliability

The nature of data collected, for the purpose of this study, is qualitative. To the aim of guaranteeing data validity and reliability we have proceeded with aggregation of data, at first, and later, with their triangulation. Such technique has been considered by Creswell (2007), to be equivalent to quantitative studies' reliability testing and it also guarantees that results deriving from quantitative research are credible, valid and accurate (Denzin, 1984; Stake, 2000). Authors have used four types of triangulation.

The first type is represented by data triangulation on the basis of research conducted by Katamba et al. (2016). Authors have analysed the data collected from different sources (interviews and direct observations, documents) which have been, later, compared to each other. The reason why triangulation of sources is important is twofold; first of all, it contributes to give a total and more complete vision of the analysed phenomenon. Secondly, it enables comparison of gathered data while allowing their reliability.

The second type of triangulation has a methodological nature and utilises different methods of gathering data from several sources in order to ensure that collected data is cleansed from those eventual weaknesses that each methods used could bring in.

The third type is called investigator triangulation. In this context, researchers have conducted autonomously, hence individually, the analysis of the phenomenon as far as documents are concerned. With regards to interviews, one of the researchers has personally conducted them and their contents have been analysed by each single researcher at a later stage. Considering direct observation, instead, researchers have investigated social networks of Matera2019 channels in an autonomous manner and at the individual level. Such technique has been functional to cleanse collected data from bias (personal opinion, ideas, perceptions, feelings) brought by each single researcher.

The last but not the least is the theoretical triangulation. According to this technique examination and implementation of data analysis have been conducted by each researcher who owns and carries theoretical background. In particular, one researcher has a background in organisational theories; the other one owns a management and accounting background. The positive implication of this technique is that it has emphasised on the common elements brought by each single researchers so that results appear cleansed by each researcher's theoretical background.

The overall benefit of using all types of triangulations is related to the fact that they have favoured validity and reliability of data and enhanced awareness and acknowledgement of the phenomenon that is subject of this research. Using all triangulations has led to understand better and gain an overall knowledge of the context where Matera2019 has taken place and has enabled the implementation of positive outcomes or, eventually, negative ones.

3.5 Data analysis

The stage of analysis represents the interaction between researchers and data aimed at identifying its real meaning (Strauss & Corbin, 1998). Considering the qualitative nature of used data, the approach that authors have used makes reference to Charmaz (1983) "Grounded Theory". He suggested a methodology that is based, in the first stage, on identifying "key points" that are later transformed in "codes" (Katamba et al., 2016). In the second stage, methodology advances that the "codes" selected are gathered to be able to recognise "concepts" that allow to use data.

Thirdly, there is recommendation to start from concepts to later form "categories" standing as the basis upon which discussion of hypotheses are formulated.

As far as the research question at the basis of this study is concerned, it refers, in the first place, to the understating what are the IC factors that enable European Capital of Cultures, and, in the second place, to the role of the local government to support ECoCs.

However, to optimise the level of analysis with methodological debates and ideas, authors have widened Charmaz's theory (1983) in accordance to other researchers' speculations (Strauss & Corbin, 1990; Miles & Huberman, 1994; Creswell, 2007; Katamba et al., 2016).

4 Results

4.1 Description of the case-study Matera 2019

Matera 2019 is a longitudinal process initiated in 2008 and that culminated in 2019 with the exploit of projects and events, worth the nomination of the City as ECoC. Originated from the European Commission's initiative on culture, Matera 2019 stood as a cultural but also social experiment that has challenged the current way of planning activities within the city. What has been produced in terms of contents and impacts was made in the perspective of collaborative-based governance to the extent that innovation in terms of creativity, collaborative networks and organisation was brought in.

Different actors have been engaged at multiple levels and at different stages. Three are the phases that have led to Matera to leverage on the IC of the city and to bring the city itself to ECoC 2019:

1) The first one refers to the role played by a local cultural Association named Matera2019 that started a process of community engagement (citizens, local firms, other associations, professionals, institutions and NGOs) to collect the human capital available in the city. The objective of this phase was to obtain the designation of Matera as ECoC2019 which was, hence, fulfilled. This phase also showed a massive participatory and inclusive approach whereas many young, small businesses and various cultural and social associations of Matera were engaged;

2) The second phase refers to candidacy that is, when an institutional committee was established to steer the decision-making process at a more institutional level and to organise knowledge and learning potential in inter and intra-territorial relations. In this phase fall the two dossiers that defined define the principles, the structure of the program, the organization as well as financial resources. Also in this phase, participation of multiple subjects has represented a landmark: a consistent group of "digital" volunteers had been involved in the dossier drafting to narrate the experiences and the history of Matera on the websites.

3) The third phase refers to implementation after designation that leveraged on knowledge and potential learning expressed by cultures, entities and institutions as well as rules implying a high level of trust, respect, and compliance to EU clauses and parameters. The main goal of this phase related to the definition of an effective governance and a corpus of binding regulations for all actors and partners involved whereas, as an European award, ECoC means to comply with standard criteria and objectives defined at EU level.

Matera 2019 is the result of a long and enduring process devoted to promoting the development of a culturally and socially engaged community oriented towards the exploitation of intangible assets and resources to support future urban strategies policies. Matera 2019 was expected to deliver three different but interweaved impacts: social, cultural and economic. Indeed, results have been represented by a novel tourism for visitors, a renewed model of local development, a potential creative industrial workplace for European youth, a new lifestyle model for EU citizens.

4.2 IC enabling factors

The adoption of IC perspective to cities temporary named as capitals of cultures has allowed considering several enabling factors for Matera 2019. The presence of these factors enabled the city of Matera to imagine processes of development and innovation that with the appointment as ECoC2019 resulted in the built up of a reputation, hence, a strong brand, able to attract people and investments. More specifically, it is possible to identify three enabling factors that, together, enable a city to develop IC and lead to define the atmosphere of a Capital of Culture: creativity of the city, critical mass, and governance organisation structural capacity.

Amongst creativity related factors, it is important to make reference to the huge city's creativity potential that stimulates production of creative content or work in a creatively manner. Following Florida and Tinagli (2004) assumptions, creativity encompasses the creative class of scientists, engineers, university professors, poets, novelists, entertainers, artists, actors, designers, architects, nonfiction writers, editors, cultural figures, think-tank researchers, analysts and other opinion-makers. Besides, such creative class include young, highly educated and talented people.

The former President of the EU Commission, Manuel Barroso, mentioned creativity in the document (European Capitals of Culture: the road to success. From 1985 to 2010) and defined it as a source of stimulus for the EU policies of sustainable development in the EU. Hence, creativity is seen at the basis of ECoC's success, which leverages on the capacity to aggregate the highest number of creative actors.

With this regards, during an interview, a professor of the University of Basilicata claims:

> *"disposing of creative people has brought fresh life to our community and the city as a whole, boosting the local cultural, social and economic development".*

Continuing along these lines, another actor the cultural sector, during the research interview, declares:

> *"being rich of creativity for us has been functional to give a fresh look at the history and heritage of the city itself".*

In another interview, a cultural operator affirms:

> *"Commitment by each single actor to the vision of Matera 2021 has been shared from the very beginning to fight against the label given to this city as the Italian shame. Sharing the same desire and enthusiasm has been pivotal to maximise efforts toward a unique goal: making Matera the Capital of Culture"*

To demonstrate what has been declared during the interviews, there are document data that portray in a clear way the importance of creativity as a factor that enables the development of IC in ECoC.

The value of critical mass, as an existing factor in the city, is not only one of the main prerequisite to develop IC in a city, but it is also the result of a significant eradication by the engaged actors in the social fabric of the community of the city. As argued, it induces widespread collective action (Oliver and Maxwell, 1985) which is, otherwise, difficult to mobilise.

The Mayor of the City of Matera, after the nomination of Matera as ECoC, declared:

> *"Matera2019 is a social and cultural revolution that has been possible to carry on thanks to a significant people's support, in other words, people's critical mass. To be clear, critical mass has been so relevantly high that the old way of thinking in this city has been subverted".*

Critical mass, as a factor enabling IC in a city, is also found in the words of one of the headmaster of one of the most prestigious high school in Matera:

"pure communality and collaboration on Matera2019 project has is the result of each citizen's enjoyment in thinking critically of the future of this city. Critical mass has given the community the potential to magnify the capacities of single members far beyond what they could accomplish acting alone".

Another interviewee from the cultural sector, during the interview, affirms that:

"this is the project of a city that wants to take decisions. It is a city filled with critical mass and shared willingness to work collectively to connect people and its territory to enhance its heritage of all forms".

Demonstration of critical mass as a factor enabling IC is given in terms of people collaborative actions and communalities. In terms of collaborative action, critical mass is demonstrated by the fact that all actors participating to candidacy of Matera2019 have a strong spirit to share a common vision for the territory where they are eradicated. In terms of communality, critical mass is demonstrated by the high percentage of participation of actors during meetings and plenary assemblies. Belonging to a common place and history is at the basis of joint actions conducted by actors holding different skills and background.

As far as governance and organisation structure capacity is concerned experience has shown that the governance structure is a crucial factor in an ECOC's success (EU Commission, *European Capitals of Culture 2020 to 2033. A guide for cities preparing to bid*). Structure and governance refer to a system of institutional rules, policies and processes at the basis of management and coordination of roles and responsibilities. The organisational structure, therefore, has an impact on the development of an environment which stimulates creativity and innovation in a territory of reference. However, to be successful, a structure needs to have a supportive organisational culture meaning that culture has be attuned to the aims and functions of an organisation. When our interviewees were questioned on the role of culture in organisational capacity, there was consensus among all interviewees that a crucial relationship exists between culture and structure capacity. One of the interviewees affirmed:

"without the right values, cultural beliefs, behaviours, attitudes and norms organisation structure is less likely to be successful in supporting the management of events as ECoC".

During a public assembly, the representative of Matera Foundation 2019 publicly affirmed:

"context is critical in developing performing governance and organisation structure. An organisation may be responding to accountability and political pressures while attempting to support a reform or modernisation process".

Or, a less enthusiastic statement by one member of the cultural sector who states:

"the organisational structure and governance do not often create further value due to difficulty in ensuring a fair balance between decision-making and collaboration with other actors concurring in the realisation of ECoC as a big event. The risk is that part of the knowledge generated by putting people, attitudes, skills and capacities of all go to waste due to the fact that they are hard to manage".

Demonstration of the value of governance and structure capacity is given in terms of the capacity of an organisation to promote an environment that favours innovation within the territory where it operates in order to stimulate learning, create new knowledge, allow knowledge sharing and facilitate problem-solving.

5 Discussion

Since their conception, ECoC's projects have significantly put development and regeneration at the heart of cities to strengthen their sense of community. Former ECoCs have delivered positive outputs that are visible across their cities and give proof of an improved image of the city. Starting from a strong awareness about the city's identity, ECoCs have demonstrated a solid background in terms of stakeholder's participation and engagement. In fact, such EU appointment has been a great opportunity for all to take part in the year-long activities who have played a bigger role in their city's development bringing creativity, developing community's skills, both expressed and tacit knowledge, know-how, tangible and intangible resources. ECoC, as a project, represents a tool to develop the exiting IC of a city starting from factors that are already there and which may stimulate further development. These factors provide a practical advice to leverage on the concepts of creativity of a city and critical mass, and governance and organisation structural capacity.

These latter concepts belong, in this case, to the intangible assets that stand as enabling factors of IC of a city. It is possible to assume that these factors are very much connected to one another: creativity, emerging from creative connections of people operating in a context so as to stand as a constructive process out of social practices is critical to aggregate that critical mass that is treasured within a community. ECoC as an experience shows that existing critical mass can be strengthened, or even multiply, knowledge of a city for its development. Matera2019 demonstrates a significant increase of the city's existing IC which is originally enabled by endogenous factors at the city level, to ensure the success of ECoC performance.

Matera2019 leverages on the presence of specific enabling factors showing that structured creativity (meaning that it encompasses different actors at all levels: cultural, economic, social, etc.) and structured pre-exiting critical mass (meaning that it critical mass is reached by transferring individuals' thinking into an engaged constructive reaction leading to co-creation activities) do fit with the existence of a solid structure organisational capacity in the strategic management of the initiative and strategic thematic guidance on actions. Nevertheless, if the presence of co-governance giving the overall direction of the strategy should, in principle, catalyse the creation of further value related to knowledge generated by cultural events and programmes, in practice, it creates a knowledge management implication. The qualitative investigation has led the authors to converge on such critical concern connected to the managerial challenges implied in the practice of ECoC as mentioned in one of the interviews.

The sources of information convey the fact that Matera2019 Foundation, the organisational entity that has governed ECoC projects, showed a complex network including people from different institutions, such as public administration bodies, universities, business actors and other foundations. The implementation of ECoC programmes has implied intense interactions within and across emergent actors going beyond any organization's boundaries and traditional managerial control.

Matera2019, as a phenomenon, has implied the emergence of novel types of networks, shaped forms of organization where organizational boundaries became blurred and where the needs of the new governance and its related coordination and management issues have emerged. According to Borgatti and Foster (2003), the latter are the typical challenges of emerging network forms of organizations at the core of a possible research stream. Such a management challenge above leads to develop new and specific organizational solutions in order to effectively implement ECoC as a whole.

6 Conclusions

This article can be considered as a contribution of the so called fourth stage of IC research (Dumay, 2013) because it develops the IC perspective into a wider and different context than the company one. The application of the IC perspective to the ecosystems where business finds its space in a large standpoint has been present in the literature for some years, being applied in the context of countries (Edvinsson and Stenfelt, 1999), cities (Carrillo, 2004) and communities (Bounfour and Edvinsson, 2005). In the literature review we showed the specificities of these different studies and their characteristics in reference to the role of IC, its components and dimensions, and some possible ways of representation.

Despite the presence of these studies in the literature, our research has shown that a topic of increasing interest such as the role of the recognition of the title of capital has not had specific insights, under a IC perspective.

In particular, the meaning of the ECoC title from an IC perspective has not yet been the subject of specific studies, prior to this work. A fundamental premise of this work is therefore the recognition of the importance of the ECoC title, in light of its potential linked to the economic growth of the territories and the activation of sustainable development paths, based on culture and tourism, as well as that of enhancement of cultural identity in a perspective not only national, but also supranational (such as the European one).

In light of these considerations, the work went specifically to investigate, by means of a specific research question, what the IC enabling factors at the basis of ECoCs are. The answer was provided in this research through the use of a single case study, identified in Matera2019 European capital of culture. The analysis of the case, conducted through a deep relationship with the stakeholders directly involved in the pre-recognition application process and subsequent management of the qualification, led to the observation that three enabling factors appear to be the most relevant.

These enabling factors have been recognized in creativity, critical mass, and effectiveness of governance and organisational structure. These factors therefore do not represent the specific characteristics or attributes of the IC of a capital of culture, but are those that allow it to emerge and favour the development of the IC potential included in the city that has obtained (or wants to obtain) this recognition.

The development of IC for the city that competes for the appointment (or is nominated) to ECoC is therefore based primarily on the presence of a basis of creativity that can act as a driving force behind this process. Such creativity must have a sufficient critical mass in order to emerge, but must be managed in the correct way at the same time and for this a governance and organizational system is needed that is able to fully exploit these resources. The path of ECoC in a certain sense favours this activation in itself, because the process on which both the candidacy and the appointment is based, seems to be a natural driving force of these factors.

The considerations here developed can have interesting implications for all those who intend to propose for their city the path of candidacy for capital of culture (a process that takes place not only on a European scale, but in some countries also on a national scale). The observations presented are therefore potentially useful both for policy makers, but also for communities organized in associations, who want to promote the cultural identity of their territory, in a perspective of openness and comparison with the outside.

However, this study has an important limitation: being referred to a single case study, the concepts presented here cannot be considered generalizable, but can only constitute a first basis of analysis and debate on the enabling factors of IC in the context of cities, in particular of the ECoCs. This article claims potential future research concerning the study of new ECoC cases in order to confirm, expand, or even refute the perspective offered here. Potential future research developments also concern an expansion not only to the ECoCs, but to all those contexts in which the city obtains a title or recognition, for a limited or lasting period of time.

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Rethinking Sustainable Change within Public Organisations by Information Technology

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Abstract

Public organisations are changing by using the potential offered by information technology in order to better contribute to value creation moving towards sustainability as a vision for change and action. As organisations seeking sustainability by strengthening sources offered by use of information technology, public organisations select a community-driven approach and adopt a logic service view as strategic choice to enable and facilitate public value creation within society. Information technology is leading public organisations to identifying a pathway towards sustainability for driving change moving from providing information to managing and using knowledge, enhancing openness between transparency and accountability by developing smart and digital platforms as a mean that enables both knowledge and openness views. Public organisations contribute to value creation, innovation and sustainability within communities improving technological advances in government in order to develop digital, smart, lean and open platforms for social and knowledge exchanges that open up to promoting public value creation processes.

Keywords – public organisations, change, value creation, information technology.

Paper type – Academic Research Paper

1 Introduction

Today, public organisations have to deal with change by embracing information technology as a source to drive better functioning of organisation, services and communication with citizens. Public organisations serve the public interest as the result of dialogue with citizens (Denhardt and Denhardt, 2000) following a sustainability-oriented view as a vision for change to drive public decision-making, management and governance (Goodsell, 2006; Fiorino, 2010). Public organisations contribute to facilitating value creation-oriented processes by using the potential offered by the advent of information technology. The advent of information and communication technologies (ICTs) helps public organisations to communicate with citizens and various stakeholders as active co-producers of social, democratic and public value (Moore, 1995). Technology helps public organisations to drive change by involving civil society within a networked governance and developing open innovation by including external knowledge in decision-making processes (Hartley, 2005; Mergel, 2018).

ICTs help drive organisational change enabling technological, human, social and managerial sources (Orlikowski and Yates, 2006). In particular, ICTs help both to support institutional change within public administration (Gascó, 2003) and to focus on the interface between citizens and government, and facilitate the flows of information within government and for citizen right and access to information (Mayer-Schönberger and Lazer, 2008).

Technologies open up to digital and smart ecosystems where public organisations act as enablers of social and public value creation by involving civil society and following a service logic view and promoting shared community values in order to support dialogue, knowledge and information sharing, social exchanges, interaction and citizen-centred services effectiveness (Osborne, 2018; Dumay, Guthrie and Farneti, 2010; Stoker, 2006; O'Flynn, 2007; Moore, 1995). ICTs help public organisations drive networks that involve private and public actors, developing knowledge and capabilities in the pursuit of public goals (Janowski, Pardo and Davies, 2012). ICTs help strengthen collaboration and support the exchange between governments and civil society for service innovation, governance, administration effectiveness and support to institutional reform (Lips, 2012). ICTs are driving public organisations as digital and smart communities to support public value creation within open ecosystems (Larrson and Grönlund, 2014; Granier and Kudo, 2016).

Even if some studies elucidate the importance of information technology as a source to enable innovation and transformation of public organisations, there are few studies that investigate how public organisations adopt a change view by using the potential of information technology, Thereby, technology can work as an enabler of forces that drive public organisations into change. The study aims to elucidate how changing public organisations use technology as a means to develop digital and smart institutions that enable knowledge management approach and openness view as values and drivers of change within sustainability-oriented public organisations.

The use of information technology drives public administration to follow a sustainability-oriented view for change within public organisations that rediscover the importance of developing an orientation towards a knowledge management approach, enhancing openness as public value between transparency and accountability, developing the potential offered by information technology in order to build a community vision by encouraging the participation of citizens in public policy and services design.

The contribution of this study is to propose a framework of analysis to identify how public organisations are changing by embracing ICTs to develop as knowledge, open and community oriented institutions. This study relies on the analysis of literature that refers to the relationship between ICTs and knowledge management, openness and smart and digital advancements in designing and promoting the relationships between public organisations and citizens. Technology contributes to influencing the extension of change and exerting influence on three areas of managerial capabilities and development: implementing a knowledge management approach; promoting openness between

transparency and accountability; strengthening a community vision by smart and digital platforms opening up to a new season of the relationship of confidence between the citizen and the government.

The paper is structured in six sections. Following the introduction and methodological section, the third paragraph elucidates the role of information technology within public organisation seeking a sustainable change. In the second section, the fourth paragraph identifies the areas for driving change as enabled by the advent of information technology: developing a knowledge management approach to processes; promoting openness between transparency and accountability for revitalising democracy and participation; promoting a community vision by strengthening digital and smart platforms for value creation. In the fifth paragraph a framework of analysis is elucidated and the discussion follows. Finally, conclusions are outlined.

2 Methodological section

The study is theoretical and relies on a literature review relating to public organisations that aim to change by embracing information technology in order to develop knowledge management processes and enhance openness and promote a community-oriented vision by strengthening digital and smart platforms to contribute to value creation for public wealth. The selected contributions refer to the relationship between ICTs and knowledge management, openness, digital and smart platforms as evolution of advanced information technology in government. The selected contributions are interpreted in a narrative synthesis in order to elucidate new perspectives and advance theoretical frameworks on emerging issues (Denyer and Tranfield, 2006; Dixon-Woods, Agarwall, Young, Jones and Sutton, 2004).

3 Public organisations changing as technology-enabled and logic service-driven institutions

After the promises emerging by the wave of New public management doctrines and practice about efficiency and effectiveness, public organisations adopt a public value management view as a vision for change and value creation (Stoker, 2006; O'Flynn, 2007), moving towards an ecosystem and community view to sustaining knowledge and public value creation within society (Osborne, 2010).

According to Osborne and Brown (2005) while innovation as the introduction of new elements into a public service is considered to be as discontinuity with the past, change represents continuity with the past refers to the gradual improvement and development of the existing services provided by a public sector organization. Electronic government is emerging as a catalyst for driving strategic and organisational change within public organisations (Yeo, 2009). Technology provides resources that open up to successful change within public organisations promoting value creation processes, involving civil society and promoting collaborative processes (Fernandez and Rainey, 2006). Thereby, it

is necessary to pay attention to the risks of bureaucratization in terms of supporting bureaucracy than minimizing by using and developing information technology (Cordella and Tempini, 2015).

Public organisations adopt a sustainability-oriented approach as a vision for managing *res publica* within communities and creating value within ecosystems (Fiorino, 2010; Goodsell, 2006; Dumay, Guthrie and Farneti, 2010) by engaging stakeholders and involving civil society in constructing governance networks and shared partnerships (Hartley, 2005). So, public organisations have to adopt a logic service and new public service to drive policies and practices in delivering public services and interacting with citizens (Denhardt and Denhardt, 2000; Osborne, 2018). Following a logic service, public organisations drive change enabling the users to create value because «it is the citizen and/or service user who creates the performance and value of a public service, with the PSO acting as a facilitator of this process» (Osborne, 2018, p. 229). Public organisations adopt a service logic view (Osborne, 2018), promoting collaborative processes in order to achieve policy objectives within a community (Bourgon, 2007).

ICTs help both open up to and drive organisational and institutional change within public administration (Gascó, 2003; Orlikowski and Yates, 2006) for public value creation (Moore, 2003), and improving the administrative action and enabling government to better connect with citizens (Meijer, Bannister and Thaens, 2012). Information technology helps cultural and operational change within public administration by enabling a knowledge management approach in process management, promoting openness and revitalising democratic values and mechanisms for citizen participation, leading to digital and smart platforms for value creation. Information technology helps change within public organisations that benefit citizens by improving the efficiency of services (e-government) (West, 2004) and enhance democratic processes by involving citizens in policy-making and fostering public values as transparency, participation and accountability (e-governance) (Dawes, 2008; Bannister and Connolly, 2012). ICTs are driving digital and smart public organisations that contribute to supporting public value creation (Larrson and Grönlund, 2014; Granier and Kudo, 2016). As using information technology, public organisations have to become smart institutions engaging citizens (Mellouli, Luna-Reyes and Zhang, 2014).

4 How technology helps public organisations to change

Information technology can emerge as a source to drive innovation and change within public administration with regards to strategic, organisational and managerial issues. Changing public organisations follow a community-oriented vision driving digital and smart platforms as spaces for dialogue, move from an information provision approach embracing information technology to develop knowledge management in processes and to promote an openness-oriented view in transitioning from transparency to accountability.

4.1 Rediscovering knowledge capabilities: from information to knowledge management

Investigating the aspects related to knowledge management in the public sector is becoming a relevant research theme. Knowledge management refers to what an organisation knows and implies to transform data in information to use and value it as a strategic source (Bellamy, 2003). Managing knowledge as a fundamental resource in public policy formulation helps responsive governments meeting the needs of citizens to design and implement information systems by using technology in order to improve the organisational (Gates, 1975; Henry, 1974). Developing knowledge management within public administration helps improve quality of life for citizens within society (Wiig, 2002). As following a knowledge-driven and sustainable-oriented view, public sector organisations learn how to create, use, manage and share knowledge to contribute to value creation processes achieving social and environmental issues (Massaro, Dumay and Garlatti, 2015; Bratianu and Bolisani, 2015; Leon, 2013). Moreover, public organisations should move from an information management approach to knowledge management vision to driving and restructuring systems, processes and operations. Technology is a key driver for leading to enhancing and implementing knowledge management processes to sustaining organisational culture within public organisations (Girard and McIntyre, 2010). People, processes and technology enable knowledge management processes within public organisations. Developing technological and organisational sources and infrastructures opens up to knowledge management vision and culture within public administration processes (Cong and Pandya, 2003). ICTs help to transform public organisations by driving innovation and developing a knowledge management approach to problem solving in defining public policies (Edge, 2005) strengthening knowledge management-oriented processes and fostering citizen participation and governance (Al-Sudairy and Vasista, 2012). As knowledge-driven and technology-enabled responsive institutions engaging citizens, public organisations develop effective two-way transfers of knowledge between public organisations and stakeholders to better develop sustainable policy solutions (Riege and Lindsay, 2006). ICTs help support knowledge management development and implementation within public sector organisations (Suurla, Mustajarvi and Markkula, 2002). Thereby, while information management systems are well developed, technology tools for governing knowledge management sources are still in infancy. Public organisations have to invest in information technology systems and sources in order to drive knowledge management systems in transitioning from infancy to maturity in order to enhance knowledge as a source for value creation (Cong and Pandya, 2003; Wiig, 2002). Technology helps public organisations to develop knowledge management systems and enhance knowledge sharing culture using knowledge as a source to improve public services quality, accessibility, productivity and innovation (Fang, 2002).

4.2 Rediscovering the importance of openness: from transparency to accountability for citizen participation

Information technology makes public organisations as open, responsive institutions willing to serve the interest of citizens (La Porte, Demchak and Jong, 2002). Enabling openness, transparency and accountability by using information technology helps drive, support and facilitate cultural and technological change within public organisations. According to Grimmelikhuijsen, Porumbescu, Hong and Im (2013) transparency means «the availability of information about an organization or actor that allows external actors to monitor the internal working or performance of the organization» (p. 576). Transparency is seen by policy makers as a panacea for enabling good governance by driving democratic institutions as transparent organisations that restore public trust by empowering citizens in order to monitor government performance using ICTs and the Internet as enablers of transparency (Curtin and Meijer, 2006; Grimmelikhuijsen, 2009). Informing citizens helps to improve policies and enhance governmental legitimacy (Meijer and Thaens, 2003). Digital government relies on creating a digital ecosystem for public value creation by strengthening cooperation and opening to a data-driven culture and strategy ensuring openness, inclusiveness, engagement and participation in policy-making and service design to better serve citizens and business that access to social and informative exchange (Oecd, 2014). Governments use ICTs to promote information access and transparency of government organisations making public organisations directly accountable to citizens (Meijer, 2003). Public organisations should develop a citizen-centred view proceeding along a *continuum* between transparency and accountability (Fox, 2007). According to Bertot, Jaeger and Grimes (2012) using information technology helps change by sustaining a culture of transparency that is citizen-centred. Promoting transparency enables participatory, collaborative and open government that drives cultural change, supports citizen engagement and interaction with the public (Mergel, 2012; Jaeger and Bertot, 2010). Technology helps promoting a flow of information citizenry-government and effective citizen participation in the political process (Watson and Bundy, 2001) by enhancing the quality of democratic governance by providing better information to citizens enabling them to exert influence on policy making (Kakabadse, Kakabadse and Kouzmin, 2003).

4.3 Rediscovering a community-oriented view

The advent of ICTs and the Internet in government processes open up to a new digital governance era in terms of citizen-centred processes that facilitate the interaction government-citizen, drive the transition to client-based re-organisation and services digitalization (Dunleavy, Margetts, Bastow and Tinkler, 2006). In particular, Web 2.0 is driving e-government towards an integration and participation in terms of knowledge and services for an active citizen engagement (Dixon, 2010). Promoting change relies on developing a community/citizen centred approach (Meijer, 2011) and sustaining public

innovation by involving public and private actors to cooperate for value creation (Ansell and Törfing, 2014). The role of digitization is to help to facilitate and accelerate change within public organisations. E-government maturity models relate to technology as a source for human-centred change to benefit customers and citizens too (Andersen and Henriksen, 2006).

Technology helps empower the citizen as responsible partner in delivering public services (Linders, 2012). Technology enables smartness in government by enabling openness and knowledge (Gil-Garcia, Zhang and Puron-Cid, 2016). The advent of interactive and digital technology helps public organisations to adopt and strengthen a community/citizen and smart approach in order to sustain public values, equity and development (Larsson and Grönlund, 2014; Dunleavy, Margetts, Bastow and Tinkler, 2005). Technology facilitates networked co-production of public services strengthening a community vision (Meijer, 2011; Bovaird, 2007). Successful digital policies imply to build collaborative digital systems that involve public, private and no profit organisations working to achieve shared objectives (Dawes and Pardo, 2002). Building digital platforms and spaces contributes to developing services co-production and value co-creation (Fishenden and Thompson, 2013) in order to promote innovation and transparency, support citizen engagement, knowledge and information sharing (Harrison, Pardo and Cook, 2012). Digital technologies are leading public organisations to promote policy driven e-governance platforms (Janowski, 2015), evolving as smart communities that rely on proactive citizen participation, and help drive smart culture in government, empowering citizens as co-designers and co-producers of public services and leading to innovation and knowledge development (Larsson and Grönlund, 2014; Gil-Garcia, Zhang and Puron-Cid, 2016).

5 Discussion

As sustainable change-oriented institutions, public organisations tend to develop both knowledge approach to processes and openness view to communication as values that orient administrative action leading public organisations to embracing digital and interactive technology to build a community approach to value creation processes. As knowledge-driven and open institutions, public organisations aim to promote collaboration encouraging inter-organisational and long-terms relationships, and interacting with civil society. Public organisations develop the potential of technology to advance digital, smart and open communities as spaces and platforms that help encourage partnerships and collaboration among private and public actors within ecosystems.

As shown in figure 1, the main contribution of this study is to identify some pathways that enable public sector and services organisations as public value-oriented and sustainable-driven organisations that contribute to wealth of communities within social and economic ecosystems.

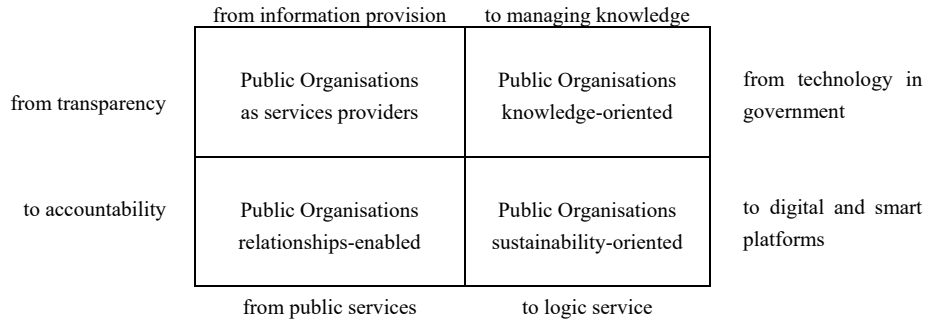

Figure 1 – Towards public organisations as sustainable communities

Public organisations consider the sustainability as a source for change that helps value creation processes and enables the wealth of people and business ensuring social, financial, economic and democratic performances. Developing digital and smart platforms offers a means for public organisations that change by following a knowledge management approach by ensuring openness, transparency and accountability as values that drive public organizations, companies, groups and people to interact for value creation processes.

6 Conclusions

Innovation and change always concern the life and development of public organisations over time. The advent of information and digital technology offers public sector organisations to take opportunities and face challenges to solve problems and questions related to efficiency, effectiveness, equity and democracy in redesigning and driving the relationships with citizens and/within communities. In particular, the themes of sustainability and change tend to strictly converge as drivers for identifying a value-oriented pathway that concerns the improvement of the relationships between public administration and communities. As developing the potential offered by information technology, service logic driven public organisations as select a community-oriented view to drive change and value creation processes adopting a knowledge management perspective to process, work and system innovation (proposition 1), strengthening openness from transparency to accountability (proposition 2) and developing digital and smart institutions (proposition 3).

In this study, there are some limitations. This study identifies some theoretical propositions and provides a framework of analysis in order to drive change within public organisations that follow a sustainable view to public value creation within communities. Thereby, empirical research and case studies are absent in the analysis because public organisations are still in infancy in dealing with technology and change for sustainability

as a source that enables innovation in governance and services design within ecosystems that helps change processes.

In this study, there are theoretical, managerial and organisational key implications. Developing the potential of information technology in government helps public organisations to bring together knowledge management approach and openness building collaborative spaces for social and information exchanges, and shared value, promoting a public value view to driving change and innovation within social and economic ecosystems. The advent of digital, smart and interactive technologies helps social and cultural change in the minds of employees, providers, people and groups enabling policies that foster continuous search of exchanges and interaction between public sphere and community sphere following an evolutionary approach to living the change. Technology-oriented changes contribute to reshaping and redesigning the structure of public organisations leading to a more flexible and *ad-hoc* organisation learning to understand how to contribute to value creation processes.

Further research perspectives imply to investigate how local autonomies and governments design and implement managerial, organisational and technological policies and practices that involve human resources and capital. Technological advancements and digital platforms contribute to enhancing the community development within public organisations that interact with civil society to develop knowledge sources and capabilities, value-oriented processes, and shared culture within public sector ecosystems.

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Managing Knowledge in the Era of Blockchain and Industry 4.0

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Abstract

The effect of digital transition on today's knowledge creation processes is becoming relevant for companies operating in different industries, and the body of literature examining this impact is fastly growing. Nevertheless, systematizing existing studies on digital technologies supporting the firm's knowledge creation processes to reconceptualise existing knowledge management models and paradigms is still a challenge. In this scenario, the SECI model can provide theoretical guidance to achieve this research objective. Indeed, through the implementation of digital technologies, firms are redesigning the way they access and manage knowledge. Therefore, this paper aims to critically analyse the literature on the impact of digital transition on knowledge creation by providing a novel structuring model. This model seeks to analyse the role of digital transition along the innovative digital knowledge creation processes identified (Webinarisation, Informalisation, Systematisation, Explication, Digitalisation), according to the traditional epistemological and ontological dimensions. Integrating these perspectives, the authors design the WISED model to evaluate the impact of digital transition on the knowledge-creating companies.

Keywords – knowledge management, industry 4.0, bibliometric analysis, literature review.

Paper type – Academic Research Paper

1. Introduction

Nowadays, knowledge is considered to be one of the most important and delicate resources to manage. In recent years, there has been a growing spread of industry 4.0 technologies at everyday life level, as well as the intensive use of social media for communication between people. Even knowledge had to confront and conform to these new realities. Industry 4.0 is characterised by a mass creation of smart objects for everyday life (e.g., smart mobility, home applications) and technologies for working life (e.g., Artificial Intelligence, Internet of Things, Big Data, Blockchain). Industry 4.0 technologies have great versatility, so they have penetrated every working sector (e.g., food, medical, luxury, services) and at every "value" stage (e.g., procurement, production, logistics, distribution) (Kumari et al., 2018; Majeed & Rupasinghe, 2017; Mattei, 2019; Miranda et al., 2019; Pace et al., 2019; Yin & Qin, 2019). Through sensors and man-machine interfaces, in each of these phases, information relating to the processed product and the provided service is generated; instead, the various applications to live the city and own home smartly generate information on the habits of the people. It follows that the technologies of industry 4.0 have both a technical and a social aspect as regards the people who interact with them (Oks et al., 2017). Industry 4.0 marks a shift in the production of goods and service provision towards a dimension that is no longer only real, but also digital (Kagermann et al., 2011; Lee et al., 2016; Leitao et al., 2016). Parallel to the development of a digital reality in which products, services and people have their virtual twins, the spread of Internet-based software tools, namely social media, has developed in recent decades with the main purpose of improving virtual users communications, interactions and communications (Thomas & Thomas, 2012). These social media have radically changed the way people interact with each other and search for information of interest (Macnamara & Zerfass, 2012). These tools have removed the spatial and temporal barriers that existed between people, by radically changing the way social relationships occur; in fact, people from different places and cultures can communicate easily and instantly (Galli et al., 2019). Then, people become part of a social network where information and communications take place intensely and immediately. Precisely, this high amount of information, together with the possibility of breaking down the space-time barriers of communication, has made these tools attractive also for companies and public administrations (Valkanas et al., 2017). Researchers have shown how social media, implemented adequately in companies, manage to have a positive impact on factors such as innovation, efficiency, productivity and decision making (Murphy, 2010).

From the synergy of industry 4.0 and social media tools, it has been possible for organisations to get, store and process an ample amount of data both from within and from externally a firm (Escribano et al., 2009; Laursen & Salter, 2006; Mazzola et al., 2016). For example, manufacturing firms can now obtain individualised customer data to personalise the sales process, product design and service. One application of this is through smart devices which record and shared data in order to identify opportunities

using learning algorithms (Feng & Shanthikumar, 2018). Digitalisation also allows for demand information to be shared directly both to actuators in plants and to the supplier in the supply network, leading to shorter changeover time and enhanced supply service level. The amount of data stored and disseminated has also enhanced both predictive accuracy and facilitation of prescriptive solutions (Schniederjans et al., 2020).

In today's highly competitive and knowledge-based economy, digital knowledge has become a fundamental resource for the development of any organisation (Acerbi et al., 2020; Eaton & Pasquini, 2020; Facer, 2011; Laudien & Pesch, 2019; Li et al., 2018; Rajabion et al., 2019). Digitalised knowledge management results in one of the most critical resources to achieve the level of successful organisation (Li et al., 2018). The digital revolution of industry 4.0 has questioned extant innovation and organisational learning theories (Natalicchio et al., 2017). For instance, Nambisan et al. (2017) analyse how organisational axioms has changed by the rise of digitalisation, such as the role of knowledge management (KM) processes to renew knowledge base and improve innovation performance (Nambisan et al., 2017). This evolving technological and organisational environment has required organisations to improve their KM processes (e.g., acquisition, storage, transfer) since a focus on internal knowledge or exposure to external knowledge is not sufficient to increase innovativeness (P. Centobelli et al., 2019; Ekbia, 2009; Lyytinen et al., 2016; Passaro et al., 2018; Trantopoulos, von Krogh, & Wallin, 2017).

Planned organisational processes affecting KM strategies are likely changing together with the direction identified by the adoption of advanced digital solutions (e.g., advanced business analytics, digital platforms, machine learning) for product and process innovation. For instance, the processes of knowledge acquisition, storage and transfer are changing not only in terms of data amount but also depending on the emergence of specific digital infrastructures (Li et al., 2018). Similarly, in adopting digital solutions, organisations have to acquire and transform different types of external knowledge compared to non-digital realities, so requiring the opportunity to use new knowledge management systems (KMSs) (P. Centobelli et al., 2019). It means that digital innovation has revolutionised the innovation processes flow, however asking organisations to think again the ways they can explore and use knowledge flows, and the way they can leverage on the adoption of digital platforms, infrastructures and artefacts (Ekbia, 2009; Lyytinen et al., 2016; Saini et al., 2010; Tiwana et al., 2010).

In this context, the main aim of this paper is to conduct a bibliometric review of knowledge management circulation literature in the era of industry 4.0 and social media. These types of literature analysis are very worthwhile in any research field because they provide the state of the art of a research field in terms of countries, topics and areas of research (Mishra et al., 2018). Scholars widely acknowledged the imperative role of classifying the research published on an exponentially growing research field to facilitate researchers and practitioners in attaining a deeper understanding of the field (Merigó et al., 2016; Blanco-Mesa et al., 2017; Nunen et al., 2018). The application of the

bibliometric approach based on performance analysis and network analysis techniques may enable to achieve this objective.

To provide a structured and encompassing overview of the knowledge management research field, this paper proposes: (1) a review of the knowledge management literature during this period of digital transformation; (2) an insight into the research field by using performance analysis and network analysis applied to a total of 5,416 publications, to identify key contributing countries in the field; (3) the identification of research clusters based on co-occurrence analysis within the string research domain; (4) therefore, this paper tends to formalize the actual knowledge creation model bridging a research gap concerning the lack of a comprehensive overview of the knowledge creation. The outcomes of this analysis offer deep insights into contemporary discussions, advancing the research field related to the contextual and multi-level phenomenon of knowledge management, and pointing out directions for future research.

This review is expected to make considerable contributions to the extant literature for the following reasons: 1) it offers an overview of the recent knowledge management researches that are facing with the digital transformation 2) it provides important information for future researchers summarizing the most significant field of interest and the most prolific countries; and 3) it identifies research scopes and empirical issues adopted by this stream of research. Besides, this study identifies new research streams and perspectives for further investigation that warrant special attention and offers valuable insights for future research.

The remainder of the paper is structured as follows. After the introduction, section 2 analyses the theoretical background and conceptual framework existing. Section 3 presents the methodology and data collection. Section 4 presents the results of performance analysis, whereas section 4 deals with the network analysis. Future trajectories for research on the topic are discussed in section 5. Finally, section 6 reports the conclusions and implications of this research.

2. Theoretical background and conceptual framework

2.1 Knowledge management and digital transformation

In recent decades, the knowledge management topic has become increasingly relevant within the debates on the management of an organisation. Starting from the first studies carried out by Nonaka, there have been many theoretical elaborations and practical applications related to this topic. However, during the fourth industrial revolution, a fundamental step forward on the subject took place since industry 4.0 technologies completely revolutionised the industrial landscape. If during previous revolutions the technology always changed, keeping the human at the decision-making process centre, in this case, the technology joins the man also in the decision-making phase. That happens

because the machine is no longer just a simple data collector, but is able to contextualize this data and make decisions by imitating human cognitive processes.

Furthermore, it should be emphasized that all people are always connected via mobile devices and social media platforms (Colbert et al., 2016; Haas et al., 2015; Schwarzmüller et al., 2018). This changed not only the way of communicating in the workplace and private life but also the social and communicative skills that people develop (Schwarzmüller et al., 2018; van Knippenberg et al., 2015). Therefore, it is inevitable that the model proposed by Nonaka for the creation and circulation of knowledge will also become involved in the change process brought about by the fourth industrial revolution since human is no more the only actor in the process and the human mind and human behaviour the only background for the knowledge spiral circulation.

The knowledge creation model proposed by Nonaka is based on two types of knowledge, namely, explicit knowledge and tacit knowledge (Nonaka et al., 2000; Nonaka & Konno, 1998). Explicit knowledge is a type of knowledge expressed formally through documents or formulas and usable quickly by everyone as it is structured formally and systematically to be acquired. Tacit knowledge, on the other hand, is not easily transferable as it is highly personal, intrinsic in behaviour and therefore challenging to encode in a unique language easy spreading. In order to transmit this type of knowledge, it is necessary to observe and try to reproduce this knowledge since it is achieved the right empathic process to be able to internalise this knowledge. So, it is possible to affirm that tacit knowledge is representative of the fluid state of knowledge, free to move where there are space and conditions to hold it. When this fluid knowledge is crystallised through formalisation, it turns into explicit knowledge that can be quickly passed on to other people and remains so until it comes into contact with another knowledge.

Knowledge then transits between these two forms, transforming itself and, therefore, generating new knowledge (Figure 1); this process is called by Nonaka the knowledge spiral evolution (Nonaka et al., 2000; Nonaka & Konno, 1998). The first step of knowledge transfer occurs when two people socialise and interacting with each other; they unconsciously assimilate ways of doing and thinking. From tacit, knowledge can be transformed into explicit through its translation into a form that is understandable by other people. On an excellent externalisation of knowledge, it is necessary both that tacit knowledge is well articulated through clarity of thought, use of metaphors or anecdotes, and that the way it is translated is understandable. Once formalised, this type of knowledge has much more simplicity not only to be transmitted to others but also to be combined with other explicit knowledge types and transcend own level. When explicit knowledge can be put into practice and internalised, it becomes not only an integral part of the person who has learned it but also a broader knowledge since personal knowledge has also been added to what has been learned. These four phases, namely, socialisation, externalisation, combination and internalisation, give life to the model known as the SECI model (Figure 1).

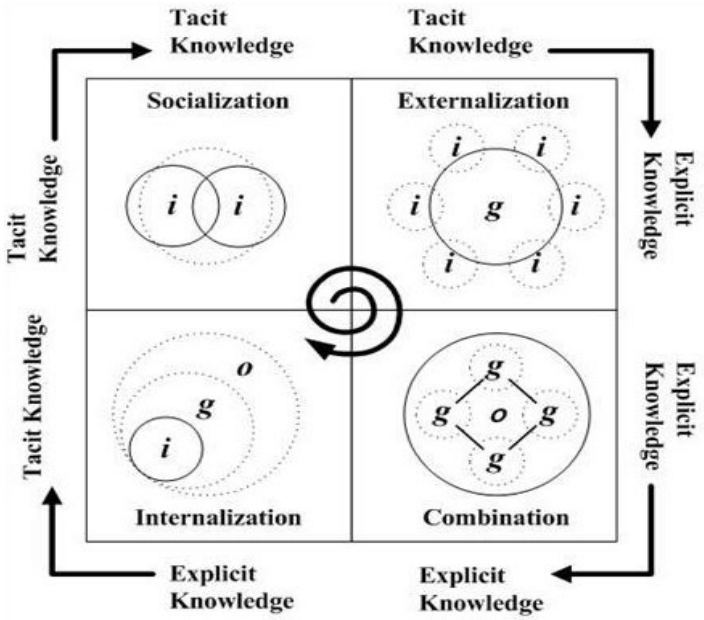

Figure 1: SECI model (Nonaka et al., 2000)

With the advent of industry 4.0 and the enabling technologies, new channels of knowledge creation have opened in which behind human interaction, there are also the human-machine and machine-machine interactions. People communicate with each other using social platforms, in the company, cyber-physical systems are used for production management. At the same time, private citizens increasingly integrate their home with sensors to be able to manage it remotely in a smart way; online data libraries are loaded daily by users so that other users from all over the world can consult them. Finally, there is to consider that artificial intelligence systems can process all the data uploaded to the network to support human decisions or even artificial ones. From a knowledge point of view, therefore, alongside the human one, which can be both tacit and explicit, there is a digital knowledge space that represents a node that is no longer inalienable in the model of knowledge management. In figure 2, there is a formalization of this new knowledge flow.

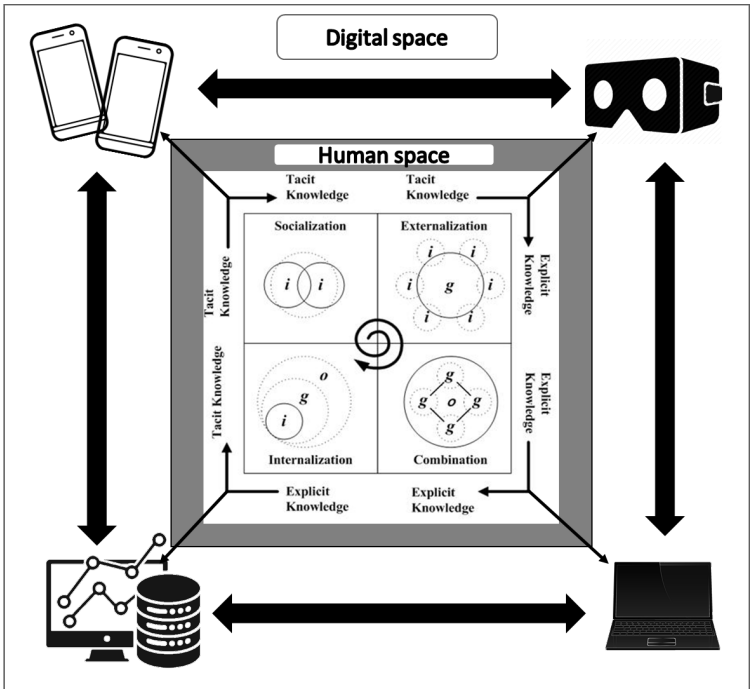

Figure 2: Digital - SECI model

This new dimension not only changes the spatial but also temporal dimension of knowledge sharing, having as a medium the digital structure, this can take place without people being physically close and deferred over time, thus also having significant time gaps between when a person passes on their knowledge when it reaches another person.

2.2 Explicit – Digital knowledge

The innovations in the digital field have made possible to bring many of the activities previously carried out into presence on social platforms; such as training courses, meetings, presentations and all those other educational or information activities that take place with the remote participation of the participants through the use of the web. Bringing explicit knowledge to the digital dimension is a catalyst for innovative processes; in fact, many companies take advantage of this opportunity offered by social platforms for crowdsourcing of information both within their organisations and with their customers. Social platforms have managed to leverage one of the fundamental points of the dissemination of knowledge, namely that of networking (Maravilhas & Martins, 2019). More extensive is the network of people who can learn, higher is the chances of combining this knowledge, and therefore higher the chances that new knowledge is created. The digitalisation of knowledge, therefore, has both the potential to create a culture of open innovation through collaboration within the entire network and to make

the network competitive with others (Almeida et al., 2011; Neto, 2005; Rodriguez & Martius, 2013). Considering also that enlarging the network, digitalisation allows having information exchanges in an almost immediate manner comparable to the timing of exchanges of information in presence; digitalisation can be defined as an expansive catalyst of explicit knowledge.

2.3 Tacit – Digital knowledge

Although there are schools of thought that support the non-digitisation of tacit knowledge, there have been various demonstrations of how web tools, albeit alternatively, manage to support the assimilation of tacit knowledge.

The question on the transformation of tacit knowledge into digital, as well as the passage through the digital channel of tacit knowledge itself is a slightly more delicate topic than the previous one and on which there is no unanimity of thought (Hislop, 2001; Jasimuddin et al., 2005; Maravilhas & Martins, 2019). There are two schools of thought, one, affirms that knowledge as tacit is hidden in a thought, actions and decisions taken by the human mind and as such not accessible to an artificial intelligence devoid of adequate cognitive and adequate dimensions (Johannessen et al., 2001; Mohamed et al., 2006). The second school of thought instead states that knowledge has different shades of tacitness and explicitness degree so that it is possible to pass from a purely explicit knowledge that can be easily converted and transferred digitally, up to a purely tacit knowledge that also could be assimilated and transmitted digitally provided that the digital system is capable of imitating human cognitive and emotional processes (Ambrosini & Bowman, 2001; Chennamaneni & Teng, 2011; Jasimuddin et al., 2005). As the degree of tacitness increases, the effectiveness of digitalisation decreases and therefore, the amount of tacit knowledge that can be transferred (Khan & Jones, 2011; Mayfield, 2010) However, different empirical studies have shown that the technologies of artificial intelligence, neural networks, IoT and virtual reality have reached such levels of efficiency that they are able to simulate human cognitive and emotional states (Brandon et al., 2020; Brown & Sandholm, 2019; Seo & Huh, 2019).

The leading IT tools useful in the transmission of tacit knowledge, range from communication tools (e.g., instant messaging, forums) to collaborative systems, multimedia sharing tools, video conferences, online communities and Web 2.0 tools (e.g., blogs, wikis and social media) (Davidaviciene & Raudeliuniene, 2010; Khan & Jones, 2011; Mayfield, 2010; Murphy & Salomone, 2013; Panahi et al., 2016). It is possible to transform digital knowledge into tacit knowledge through the demonstration or imitation of activities or processes that are reproduced through video, audio or text in order to unconsciously activate skills that are necessary for the performance of that given process or activity (Hildrum, 2009; Panahi et al., 2016).

2.4 Digital – Digital knowledge

The hypothesis that there could also be a digital dimension of knowledge was already proposed by Nonaka (Nonaka & Toyama, 2015; Nonaka et al., 2000), but it had never been possible to consider it a separate dimension until the era of Industry 4.0. The enabling technologies of this new industrial revolution have a power that has allowed the digital world to establish itself as an autonomous space for the creation and sharing of knowledge. The data collected by the sensors are transferred to the cloud, which increases the size of the web, creating an increasingly large Internet of things. The information accumulated here in a simple way or as big data, without a contextualisation, would remain a pure cluster of information (Dragicevic et al., 2019), but the different artificial intelligence technologies now have ample ability to reason, contextualise information possessed, represent knowledge, plan and learn (Kurzweil, 2005; Luger & Stubblefield, 2004; Parisi et al., 2019; Russell & Norvig, 2003). Both explicit and tacit knowledge can pass through the digital dimension. That allowed the creation of ontologies and rules to deconstruct/structure the natural language providing a digital ontological system which can be used for digital communication with other devices but also allows them to deconstruct it in a language that can be understood by human intelligence at all times, both to process decisions that are equivalent to those made by a man (Sikos, 2017).

2.5 Towards a digital knowledge-creating company framework

All in all, we contend that digital transformation, based on the use of fundamental digital technologies, is linked to knowledge management. This is enabled by the possibility to create knowledge along with traditional and digital processes. More in detail, there exist many digital technologies, each of which may serve one or more knowledge creation processes. In line with this reasoning, we seek to understand from extant literature on the digital transformation of business, on one side, which technologies contributes to the knowledge creation process, how, and related performance implications. Consequently, we propose a two-dimensional framework (Figure 2) to understand the digital transformation of the business that concurrently considers knowledge creation processes.

For instance, the Internet of Things represents a twin of the real world where data and information flow from a device to one other where these devices represent the interface between the real world and the digital one (Xue et al., 2013). These significant amounts of data are often structured as big data, and artificial intelligence techniques are able to analyse them and give back more and more straightforward data and information useful for the decision making (Grover et al., 2018; Delen et al., 2013; Lu et al., 2015; Metaxiotis et al., 2002; Wilson, 2007). By combining the types mentioned above of knowledge, it is possible to have nine different knowledge circulating ways. The first four ways involve human cognition only and have been already identified by Nonaka within the SECI model, that is, tacit-tacit, tacit-explicit, explicit-explicit and explicit-tacit. The

other five, instead, involve the digital dimension that knowledge can have, that is, explicit-digital, digital-tacit, tacit-digital, digital-explicit and digital-digital.

3 Methodology

Performance analysis and science mapping are bibliometric techniques that can help researchers to outline intricate knowledge patterns of the research field, investigate their properties employing statistical and mathematical methods, and monitor the field evolution in order to identify how authors, themes and researches are related (Morris and Van Der Veer Martens, 2008; Cobo et al., 2014; Mora et al., 2019).

In this paper, a bibliometric analysis based on performance analysis is adopted because the bibliometric analysis can deeply analyse, with mathematical and statistical methods, relationships among different bibliometric objects (e.g., authors, country, keywords) (De Bellis, 2009; Aria and Cuccurullo, 2017; Mora et al., 2019).

Citation analysis is one of the most common techniques used in the bibliometric analysis. Higher is the number of citations received by a paper, and higher is the relevance of that paper in the body of literature (Aria and Cuccurullo, 2017). Citation analysis is based on the assumption that authors cite papers they consider essential for the topic under investigation. In this sense, citations can be considered as a reliable parameter that measures how researchers or institutions interact with each other (Garfield, 1970; van Raan, 1996; Aria and Cuccurullo, 2017).

Citation analysis can be divided into two main techniques: bibliographic coupling and co-citation analysis (Small and Koenig, 1977; White and Griffith, 1981; McCain, 1991; White and McCain, 1998; Zhao and Strotmann, 2008; Gao and Guan, 2009; Yan and Ding, 2012).

A bibliographic coupling connection is established when two documents cite the same third document, whereas a co-citation connection is established when the same third document cites two documents. Bibliographic coupling analyses the citing documents (Kessler, 1963), whereas co-citation analysis, studies the cited documents (Small, 1973). Bibliographic coupling helps detect the actual connections into research groups (Yang et al., 2016), co-citation analysis helps see through a shift in theories and paradigms when examined over time (Aria and Cuccurullo, 2017). Usually, co-citation analysis is performed for mapping older papers, and it is a dynamic analysis which performs better within different time slices, whereas bibliographic coupling is used to map a current research front in a retrospective analysis (Aria and Cuccurullo, 2017). Therefore, in this paper, co-citation analysis has been performed to analyse the knowledge management body of the literature.

Figure 3 reports a conceptual scheme of the methodology adopted in this paper, which consists of three main steps:

1. **Material collection phase:** a detailed discussion about the academic database and keywords used to collect papers.

2. **Material pre-processing:** all the pre-processing operations to clean data and remove spelling mistakes from the database.
3. **Results analysis**:

   Performance analysis. This phase classifies papers from different perspectives:

   i. *Papers by time.* Chronological distribution of publications*;*
   ii. *Papers by country.* Papers distribution per country;
   iii. *Most relevant keywords.* Analysis of most used keywords.

Network analysis. In this phase, statistical and mathematical methods are used to examine the research field from an objective and quantitative perspective and identify different maps based on the research field structure (Mora et al., 2019; De Bellis, 2009; Ding et al., 2001; Godin, 2006). These maps are complex networks in which two or more units can be interconnected each other (Mora et al., 2019; Hashem et al., 2016; Ding et al., 2001) and they make it possible to understand "how specific research fields are conceptually, intellectually and socially structured" (Cobo et al., 2011, p. 1382). Once defined the aspect of the paper to analyse (e.g., authors, journals, documents, cited references, institutions, and countries), it is possible to build a graph where the nodes are the bibliographical elements considered, and the edges are the link between them (e.g. co-occurrence). The similarity degree between each node affects the network connection degree (Mora et al., 2019) and according to the similarity criteria, connections in the network can be different. The most common criteria used to measure similarity are co-citation analysis, coupling analysis, and co-occurrence analysis (He, 1999; Glanzel and Thijs, 2011). In this work, only a co-occurrence analysis has been used in order to underline the research field conceptual structure. Co-occurrence analysis is a content analysis technique that provides information about the similarity between two data by considering the references that they cite (Callon et al., 1991; He, 1999).

The details of each step will be discussed in the following sections.

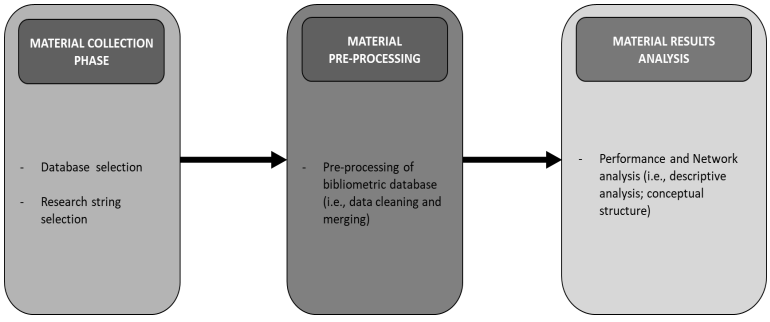

Figure 3. Methodology proposed

3.1 Material collection phase

In this paper, data was collected from Scopus database. This database represents a reliable and high-quality data source for literature analysis (Johnsen et al., 2017; Rebs et al., 2019). The search string used is:

> *TITLE-ABS-KEY ((("blockchain*" OR "block chain*") OR ("iot*" OR "internet of thing*") OR ("ai" OR "artificial intelligence" OR "machine learning" OR "deep learning") OR ("social media" OR "social network*" OR "social platform*" OR "social technolog*")) AND "knowledge" AND ("tacit" OR "explicit" OR "digital" OR "socialization" OR "externalization" OR "combination" OR "internalization"))*

In this way, it is possible to get all the documents dealing explicitly with the topic investigated. The asterisk was used to include a wide range of results (Chen and Jung, 2019). Data collection phase was conducted in March 2020, Papers since 1974 until nowadays are in the results list, but only papers in the English language published between 1985 and 2019 have been considered in the final sample; the papers before 1985 do not match with the research topic, and papers related to 2020 do not characterise the researchers' interest of the year entirely. Finally, to ensure the quality of review analysis, conference proceedings and book chapters were excluded, and only articles and reviews published in peer-reviewed journals were included in the final sample (David and Han, 2004; Newbert, 2007). At the end of this phase, the total number of papers considered for the following steps is 5,416 (5,069 articles and 307 reviews).

3.2 Material pre-processing

During this phase, the file including the database of papers was submitted to a pre-processing process to avoid duplications for spelling mistakes or contractions (e.g., *network* and *networks*, *IoT* and *Internet of Things* or *Internet-of-Things; knowledge-based system* and *knowledge-based systems*).

4 Findings

This section reports the descriptive and content analysis results, which will be discussed in detail in the following subsections.

The papers included in the research list are 5006, and they cover the period between 1985 until nowadays. Papers related to 2020 have not been considered because they will not represent the reference year, so in figure 4, it has been shown how these papers are distributed from 1985 to 2019. The first works concern the possibility for the Artificial Intelligence (AI) to support the knowledge engineering, maybe with the scope for the AI researchers to open new research direction due to get again found from the American

government (Russell & Norvig, 2003). In the ’90s, new technological development in the integrated circuit field relaunches the study in the AI field. Meanwhile, the Internet of Things (IoTs), formalised at the beginning of ’80s, starts to be studied as a technology able to return essential pieces of information, becoming a precious resource in the field of knowledge management. Whit the beginning of 21st century, the trend of papers published has grown exponentially. The IoTs has enlarged its data volume exceeding the ratio of 1 device connected for people between 2003 and 2010. The IoTs has become the most prominent knowledge network where information can be stored and transferred; it has made the internet sensories (e.g., temperature, pressure, vibration, light, moisture, stress), allowing us to become more proactive and less reactive. On the wake of a world overconnected, the artificial intelligence, with the help of machine learning and deep learning techniques, becomes the first technology of Industry 4.0 involved in the knowledge management field because able to acquire, process and information useful for the managing of organisations or own house. However, in 2008 also the blockchain technology faces up in the technological background and in the last few years becomes strong support in the storage and transfer of knowledge guaranteeing the possibility to verify the trust of information.

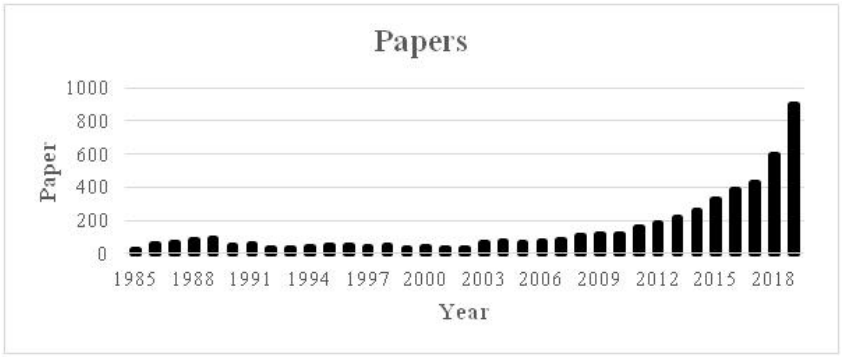

Figure 4. Chronological distribution of publications

From all the 92 countries involved in this field, only the first seven of them have a production higher than the 5% of the whole published; the rank is headed by the USA (1362 papers - 27%) followed by China (553 papers – 11%) and United Kingdom (527 papers – 10%). Also considering only the single country production (SCP), the podium stays the same, this phenomenon can suggest that the technological innovation in the field of knowledge management is a core business for the most productive countries. The only nations with a considerable multi-country production (MCP) index are Vietnam (1.00), Russian Federation, Bosnia and Bahrain (0.50) and Jordan (0.17). Figure 5 can better explain the geographic distribution and the differences in the top10 of country publications.

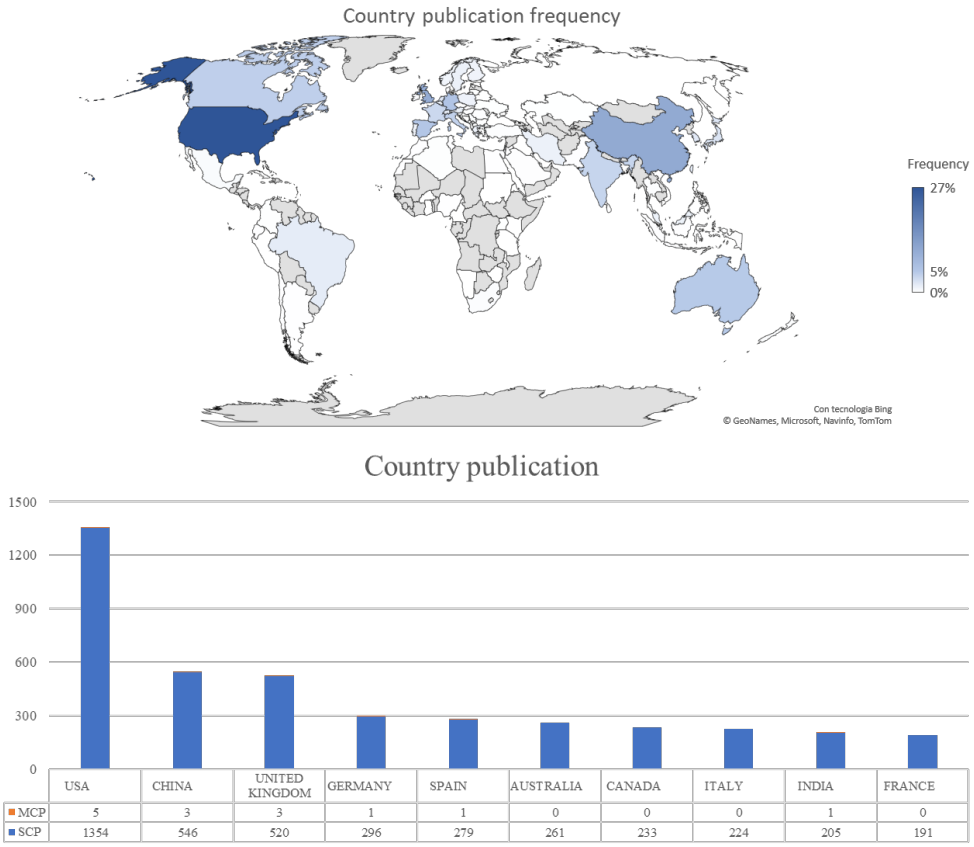

Figure 5. Papers distribution per country (grey countries do not belong to the list) and top10 of country publication

Figure 6 depicts a word cloud of the most used words included in the dataset. The dimension of each word in the word-cloud depends on its frequency in the dataset (consisting title, abstract and keywords). As expected, basic terms like knowledge, data, network, system, are the most common. On the contrary, there is a low frequency of the other concepts like creation, transfer and sharing or blockchain, Internet of Things and artificial intelligence; only machine learning looks to be underlined in the number of words.

Figure 6. Word cloud.

Focusing only on the author's keyword used, the research topic structure looks a little bit clearer. In table 1, it is possible to note that the leading technologies used in the field of knowledge management are the AI family (Artificial intelligence, Pattern Recognition, Machine Learning, Artificial Neural Network and Deep Learning) with a presence in the 10.73% of papers. This predominance over other technologies seems justified by the fact that AI technologies have entered the world of knowledge management much earlier than the other two IoT (3.18% of papers) entered during the last year of the '90s while blockchain (0.32% of papers) only since 2017.

The central aspect in knowledge management investigated is the generation phase, knowledge discovery, knowledge acquisition and knowledge extraction are present in the 1.50% of papers.

Tabella 1: Most used author's keywords

	Author Keywords (DE)	Articles	Frequency
1	Artificial Intelligence+Pattern Recognition+Machine Learning+Artificial Neural Network+Deep Learning	537	10,73%
2	SOCIAL MEDIA	371	7,41%
3	IoT+Internet	159	3,18%
4	KNOWLEDGE MANAGEMENT/ENGINEERING	96	1,92%
5	KNOWLEDGE Discovery + Acquisition + Extraction	75	1,50%

6	EXPERT SYSTEM	69	1,38%
7	DATA MINING	57	1,14%
8	DECISION SUPPORT SYSTEM	48	0,96%
9	KNOWLEDGE REPRESENTATION	47	0,94%
10	LEARNING	47	0,94%
11	EXTREME LEARNING MACHINE	43	0,86%
12	KNOWLEDGE SHARING	40	0,80%
13	ONTOLOGY	38	0,76%
14	KNOWLEDGE	37	0,74%
15	KNOWLEDGE BASED SYSTEM	33	0,66%
16	SOCIAL CAPITAL	26	0,52%
17	FUZZY LOGIC	25	0,50%
18	NETWORK	25	0,50%
19	BIG DATA	24	0,48%
20	INNOVATION	23	0,46%

In this section, the co-occurrence analysis with author's keywords is performed (Figure 7). Ignoring isolated nodes, author's keywords plotted are 720.

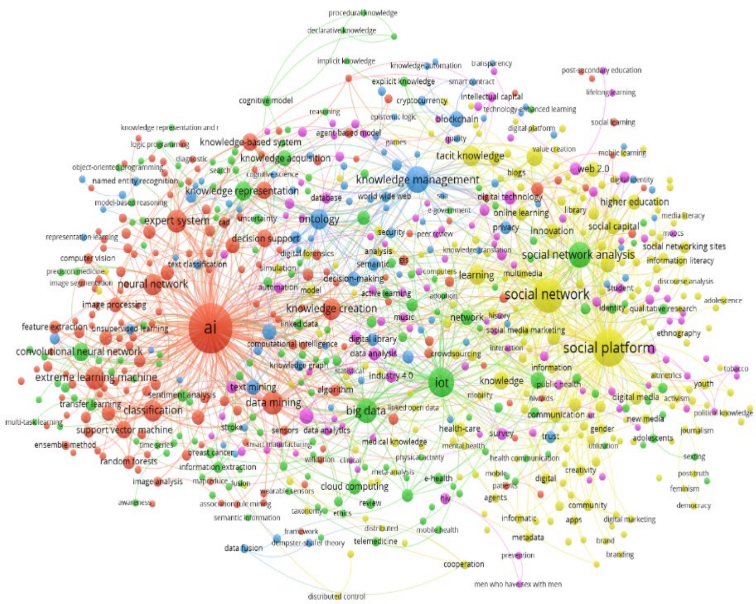

Figure 7. Keyword Co-occurrences

Four different macro clusters emerge in Figure 10:

- *Cluster 1: Webinarisation* (yellow cluster with 208 keywords)
- *Cluster 2: Informalisation (*pink cluster with 107 keywords)
- *Cluster 3: Systematisation* (dark blue cluster with 85 keywords)
- *Cluster 4: Explicitation* (red cluster with 160 keywords)
- *Cluster 5: Digitalisation* (green cluster with 160 keywords)

Herein, we try to understand how extant literature on the digital transformation of business investigated the relationship between digital technologies and knowledge creation processes.

4.1 Cluster 1 - Webinarisation

Webinarisation involves all those activities of sharing explicit knowledge through social platforms or other web tools that transform this knowledge in digital knowledge.

Cluster keywords concern with two fairly specific terms: *social network* and *social platform*. For all the papers in this cluster the knowledge is submitted at the social media world, and this has been possible thanks to the mass diffusion of IT services and facilities (Fakhar Manesh et al., 2020).

In the digital era, each one around the world can access to the internet, and each person or company can be own media brand; in a particular way, social media platforms (e.g., Facebook, Twitter, Instagram, LinkedIn, Pinterest) can give, for able people, the opportunity to have high visibility all around the world (Mary Jeyanthi & Mansurali, 2020).

Kroenke defined social media, "the use of information technology to support the sharing of content among networks of users" (Kroenke, 2018). It is out of doubt how the internet has shifted communications over the last 25 years, transforming interactions to enabling communication between dispersed and decentralised individuals and entities (Cripps et al., 2020; Y. Wang et al., 2017)

Furthermore, it is precisely this excellent dissemination power possessed by social media that makes them a relevant field for knowledge management and knowledge engineering, especially in the phase of sharing and dissemination. The high volume of knowledge that flows across the different network platforms, has made that attractive for companies, they can learn from users, competitors and industry as a whole, thereby try to support innovation in both social and commercial contexts (Perez-Gonzalez et al., 2017). Crowdfund knowledge is more comfortable for the company than before, and that let them have both a higher control and a high degree of openness in their crowdsourcing activities, enabling the opportunity to create products and services with current or potential customers, particularly in the B2C context; in this way, organisations are able to increase their degree of innovation and competitive sustainability (D'Andrea et al., 2019).

Cripps et al. (2020), with the help of a structural topic modelling, elaborated how the use of the social platform, like Twitter, represents a source of valuable information

regarding innovation in business markets and for the exchange of both high quality and relevant information (Cripps et al., 2020; D'Andrea et al., 2019). Similarly, Quinton and Wilson's (2016) highlight how the use of platform Linkedin could enhance business relationship development and business performance (Quinton & Wilson, 2016). The learning sector represents a critical sector where knowledge sharing and diffusion are fundamental. Many schools, universities and organisations have approached a method of teaching and collaborations creation that is no longer face-to-face limited classroom, but online courses open to everyone, namely, *MOOCs* (Massive Open Online Courses) (Brahimi & Sarirete, 2015). This method indeed allows extending the possibility of learning to a larger pool of people, different in gender, age and origin, thus widening the network in which knowledge can flow and therefore be renewed. Many platforms were born in the last years; the most known are Coursera and Audacity in the USA while FutureLearn, Iversity and FUN in Europe (Brahimi & Sarirete, 2015). However, if explicit knowledge of these methods finds great benefits, unfortunately, the tacit component is penalised. Physical contact and interpersonal interactions are lacking, so there are the main ways to transfer tacit knowledge (Voss, 2013).

4.2 Cluster 2 - Informalisation

Informalisation involves all those activities of sharing digital knowledge through social platforms or other web tools that transform this knowledge into tacit knowledge.

Within this cluster, the issue of the transfer of digital knowledge to tacit knowledge is addressed through collaborative systems and digital communication. Generally, how knowledge is transformed into tacit has always been few explored then all the other ways in which knowledge is transformed. As a consequence, the weight of this cluster in terms of keywords or occurrences is lower than the others (Haldin-Herrgard, 2000; Metaxiotis et al., 2002). When social media are used, hidden tacit knowledge is always present alongside explicit knowledge. Browsing, organising and playing with the sources of knowledge allows to unconsciously come into contact with mental patterns and ideas that start to cultivate tacit knowledge (Panahi et al., 2016). Various studies have shown how the use of social media enables to transfer not only the explicit component but also the tacit one. Indeed, the social dimension manages both to have a facilitating role in the knowledge sharing since it allows the comfortable meeting of people and professionals, and as an amplifier, because it allows widening the knowledge that is made available to a broader audience (Buunk et al., 2019)

Grum and Gronau (2017) modelled a linguistic system based on augmented reality and cyber-physical systems (Grum & Gronau, 2017). Through the suggestions given by the augmented reality device, the digital system manages to transfer what are aspects of tacit knowledge assimilated previously into given ontologies.

4.3 Cluster 3 - Systematisation

Systematisation involves all those activities of sharing tacit knowledge through social platforms or other web tools that transform this knowledge in digital knowledge.

This cluster addresses the challenging problem of how tacit knowledge passes into the digital space; the main keywords used are text mining, Natural Language Processing (NLP), knowledge-base, digital library and ontology. Text mining is about a human-machine operation in which, starting from human speeches or text, the machine extracts data that can be relevant even though the text in which they are present is very elaborate and inaccurate. Text mining has three different perspectives, namely, information extraction, data mining and knowledge discovery in database (Hotho et al., 2005). Through the use of Natural Language Processing (NLP) and machine learning algorithms, text mining is able to access hidden information in the text and build mind semantic patterns for the human behavioural prediction. In this way, it is possible to enter the field of ontology which, by combining data and rules extracted, tries to create a digital encyclopaedia that AI programs can consult when it is necessary to elaborate or predict human behaviour.

There are sectors (such as education, research, health care, security) where tacit knowledge plays an essential role; this is the reason why it is necessary to keep up with the times to find the way to bring tacit knowledge to the digital level. As already said, the researchers prefer to deal with the issue of explicit knowledge, leaving aside the tacit one. However, in the literature there are various attempts to digitalise tacit knowledge in order to be able to keep it available within the company in the time; through the use of text mining and NLP, it is possible to build computer ontologies systems, able in generating human behaviour (Atrash et al., 2015; El-Diraby & Zhang, 2006). In this way, it is possible to predict illegal or terroristic web activities, or predict costumers churn in order to reduce their attrition or to extract physician-asserted drug side effects from electronic medical record clinical narratives (Coussement & van den Poel, 2008; Sohn et al., 2011; Zanasi, 2009)

However, the acquisition of knowledge does not necessarily come from one's own company within, but it is also possible to exchange it with other sector organisation creating a knowledge network (Li et al., 2018). When it opens up to knowledge synthesised by other entities, arises the problem on the knowledge quality; in particular on its trust and traceability. Li et al. (2018) proposed a knowledge exchange model between the various companies in the supply chain based on blockchain technology (Li et al., 2018). Each company contributes limited to its core business to increase the decentralised database. So, blockchain technology thus allows all companies to have this accumulated knowledge available, where the trust of each contribution is certified by blockchain protocols that also provide traceability information. In the context of the ontological construction of the tacit knowledge, this system is particularly useful since it allows companies to reduce the time spent in the process having a more extensive knowledge contribution (Atrash et al., 2015; Li et al., 2018). Furthermore, it is possible to

have the certainty of having data so much more secure as the knowledge chain grows, which is created as the ontology grows.

4.4 Cluster 4 - Explication

Explication involves all those activities of sharing digital knowledge through social platforms or other web tools that transform this knowledge into explicit knowledge.

Inspecting the nodes of this cluster, it has been observed how the main knowledge activities are the knowledge creation and the decision support through the use of any Artificial Intelligence technologies family (e.g., Artificial Intelligence (AI), Pattern Recognition (PR), Artificial Neural Network (ANN) and Deep Learning (DL)). All these are techniques capable of predicting the behaviour of a system by a data set or previous behaviours. That is the reason why it is possible to assume this cluster analyses the knowledge passage from the digital world (e.g. data present in a cloud) to an explicit knowledge formalised in a text, in an image or even in the behaviour of a robot.

There are many techniques for data analysis, but all data are processed, and the numerical result is converted in an explicit form standing by the available human behaviour database for the conversion algorithms (Delen et al., 2013). One of the most used techniques is the ANN. This technique, simulating the human behaviour mind, manages to acquire different cognitive patterns and to rework them. These non-linear algorithms are very flexible since they allow to work and predict even starting from incomplete, noisy and fuzzy information (Delen et al., 2013). The Bayesian network is another widely used method, mainly when the data is structured in groups. The algorithm is particularly useful when faced with multi-level learning problems: in fact, it manages to return a framework able to explain how to use the knowledge analysed inductively and how to acquire further abstract knowledge from the path (Lu et al., 2015; Wilson, 2007). No matter the data origin, AI technologies will always return to a new cognitive level in a systemic and clear form; for this reason, it is possible to assume that these technologies have a high learning power, both in knowledge creation and in knowledge representation (Delen et al., 2013; Lu et al., 2015; Metaxiotis et al., 2002).

One of the most widely used applications of knowledge passage from explicit to digital is in the field of marketing. Companies have information from external sources in the form of big data that, after right processing, can return information on customer behaviour when they buy online and what service characteristics they prefer based on the basket of preferred products during the purchase (Grover et al., 2018). In the same way, it is possible to characterize the sales and production strategies of its competitors (He et al., 2017). Artificial intelligence technologies not only carry out data mining processing but also make predictions starting by ontologies built over time. The information that can be reported to decision-makers is not only related to the current market situation but can also present any future scenarios based on past behaviour. Just think about the use of these technologies in the agricultural field to predict which fertilizer it is preferable to stock due

to support the next soil cultivation rightly, or in the tourist, field to predict which destinations will be more interesting in the coming seasons and what services offered are going to make them more desirable (Cattaneo et al., 2016; Piera Centobelli & Ndou, 2019; Garg et al., 2019; J. N. He et al., 2016).

4.5 Cluster 5 - Digitalisation

Digitalisation involves all those activities of sharing digital knowledge between machine entities; in this way, knowledge remains digital in the different steps of sharing.

The Internet of Things has a central role in the growth of this way to share knowledge.

The Internet of Things is one of the 4.0 industry technologies that are most deeply rooted in everyday life; people work, interact with other people and manage their private life moments through devices that IoT connects (Vanitha et al., 2020). At the same time, cloud computing was born, new services offered remotely to the various users of the network; these services can then be customised to improve their experience (Minh Dang et al., 2019). However, by personalising the requested service, users grant personal information about their lifestyle and their needs. That has led to the rapid development of virtual storage of such information which, having a large volume and a large variety of information within them, require structured techniques of big data analytics for their management and coding (Bibri, 2018; Gil et al., 2016). This cluster concerns the theme of knowledge that flows between different digital devices, and that is always stored and reworked within a digital dimension.

Social Network Analysis (SNA) can be the first useful method to investigate this field, considering that the first massive flow of information comes from social media network and social media platform.

Through SNA techniques, it is possible to understand what are the needs and slopes of a group of people and how they change over time. Being able to generate a historical data of this type, is very important both because it is possible to get information on current trends in a particular geographical region, and because it is also possible to summarise information on future trends thanks to machine learning algorithms (de Laat et al., 2007; Xu et al., 2014). For instance, it has been possible to make prevision about the preferred politic candidate during the 2007 democratic campaign for the Presidential election basing on American twits, or prevision about the most required professions in America during 2014 considering Linkedin database and the users' interaction on this platform (de Laat et al., 2007; Xu et al., 2014). However, SNA has not only a social aspect (e.g., polling, marketing) in fact, implementing the SNA jointly with cloud computing systems allows companies to improve the process of acquiring information with significant implications in every business area (e.g., operations, sales, purchasing function) and on operational and financial indicators (Castagna et al., 2020; Cegielski et al., 2012). Environmental, tasks and inter-organisational uncertainties are reduced since information flows are both better managed and well-integrated with previous classic knowledge

management systems; but this improvement has a minor impact on SMEs because they are not able to respond rapidly to technological changes that are affecting knowledge management (Castagna et al., 2020; Cegielski et al., 2012). If the IoTs cloud computing technologies are combined with the AI technologies analysis capabilities and the blockchain capability to certify the information that passes between the various devices, it is possible to create an open and decentralized manufacturing ecosystem (Li et al., 2018). In the framework proposed by Li et al. (2018), knowledge circulates through the phases of the SECI model, but in a wholly digital way. This knowledge of digital production would allow the achievement of high levels of efficiency and flexibility of the entire supply chain trying to optimize corporate objectives with lean manufacturing and green practices ones.

5 WISED framework

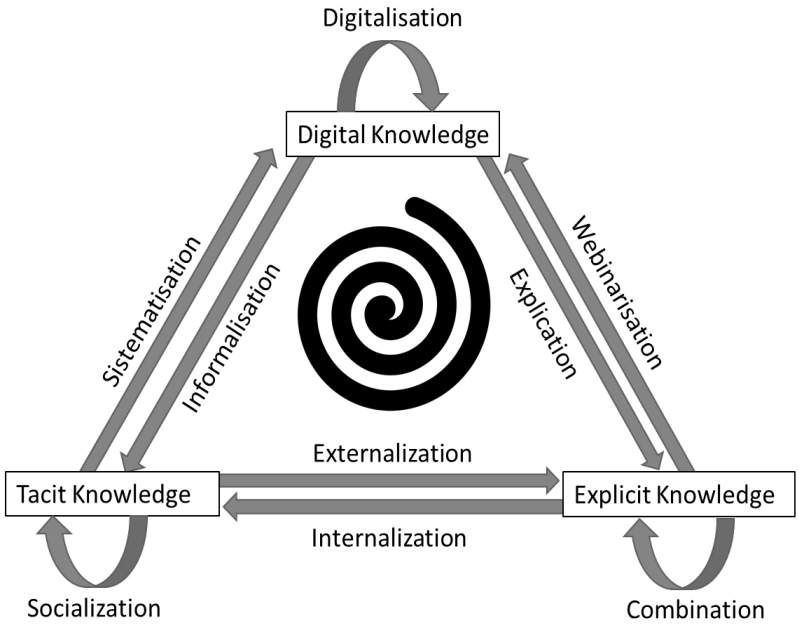

Figure 8 WISED framework

In this section, we develop a conceptual model to summarize the findings of bibliometric analysis.

The idea of such a model could be interesting from several viewpoints. In fact, despite the processes of knowledge management in this new era of the social media generation and fourth industrial revolution has been analysed in different areas of management literature, they have been generally analysed separately.

Bibliometric analysis can link together the various research conducted on a specific topic or more and to create a network in which the main clusters and the topics covered within them are highlighted. In this way, it was possible to highlight three fundamental aspects. The first is that the information technologies available are now at a high potential: they are capable of managing vast amounts of data and processing them to transform them into useful resources for decision making. The second is that these technologies did not remain within the company domains, but entered into the everyday life of all people; the cities are converting themselves into smart cities, automation is conquering the house management while online purchases have become real private advisory buying counters where every consumer is already projected towards the products that could better satisfy him. Finally, the third aspect, but certainly not less imperative there is the spread of social media and related social platforms that have allowed anyone with a web connection to communicate in real-time with any person on the globe. A large amount of data circulating through the web generated by a large number of people and with the possibility of being stored, processed and used has therefore allowed knowledge to find this new living space. That radically changes the possibilities of knowledge creation which is not limited to the single spiral of knowledge that takes place between two human minds, but there is a whole other combination of passages that also involve artificial intelligence. With these empirical pieces of evidence, this work aims to provide a conceptual model of knowledge creation that takes into consideration this new space of knowledge creation and the new methods by which knowledge can flow from one intelligence to another.

Webinarisation

Webinarisation is the process of embodying explicit knowledge into digital knowledge. Through the Webinarisation, the explicit knowledge created is shared via the web platform and converted into digital knowledge by the system (Cripps et al., 2020; Kroenke, 2018; Y. Wang et al., 2017). At this step, the text and multimedia acquisition systems are mainly active, and crowdfunding information is done in order to be redirected to the platforms that request it in a second step (D'Andrea et al., 2019). Once knowledge is registered on the network, it is difficult for it to be deleted from the digital space.

Informalisation

Informalisation is the process of embodying digital knowledge into digital knowledge. Through Informalisation, the digital knowledge that has been accumulated or generated is shared via the web platform and converted into tacit knowledge by the person who receives it (Panahi et al., 2016; Buunk et al., 2019). Neural network systems, pattern recognition, augmented reality, and cyber-physical systems are mainly active in this phase (Grum & Gronau, 2017). By simulating certain situations, the system induces the person to synthesize behaviours and ways of doing related to that situation.

Systematisation

Systematisation is the process of embodying tacit knowledge into digital knowledge. Through Systematisation, the tacit knowledge that impregnates actions on the web of the various users can be summarized and digitized (Atrash et al., 2015; El-Diraby & Zhang, 2006; Li et al., 2018). In this phase, the data mining, deep learning and NLP systems are mainly active, in this way artificial intelligence is able to synthesize behavioural and cognitive ontologies that can then be used in other cognitive processes by other artificial or human entities (Atrash et al., 2015; Li et al., 2018).

Explicitation

Explicitation is the process of embodying digital knowledge into explicit knowledge. Through Explicitation, digital knowledge stored on the web is reworked in the form of texts or multimedia files and proposed to users who are consulting it. Artificial intelligence systems are mainly active in this phase, and they are capable of synthesizing data and multimedia files capable of transferring the required concepts to human intelligence (Delen et al., 2013; Lu et al., 2015; Metaxiotis et al., 2002; Wilson, 2007).

Digitalisation

Digitalisation is the process of converting digital knowledge into a new and higher-level digital knowledge set. Through Digitalisation, digital knowledge stored on the web is analyzed, deconstructed and reworked by extracting information that previously had not been provided or was not accessible; this information is then redirected to other artificial intelligence if it is requested (Vanitha et al., 2020; Minh Dang et al., 2019; Li et al., 2018; Bibri, 2018; Gil et al., 2016; Xu et al., 2014; de Laat et al., 2007). In this phase, the IoTs systems are active, big data analytics, artificial intelligence that is able to manage the data flowing through the web independently.

6 Conclusions, implications and future research directions

This paper conducts a bibliometric review of knowledge management circulation literature in the era of industry 4.0 and social media. The application of the bibliometric approach based on performance analysis and network analysis techniques may enable to achieve this objective. The paper also visualizes the bibliometric networks for citations, keywords, and co-authorship patterns. There have been a good number of papers published in the KM domain over the years, many of them in the last decade. However, despite the fact that few good studies on KM have been reported in the last few years, a detailed bibliometric and network analysis to systematically and objectively recognize principal contributions, authors and growing research clusters have not been performed yet. This paper contributes to the body of knowledge by providing a comprehensive overview of KM literature in this way.

This study gives a noteworthy contribution to the body-of-knowledge on KM while broadening prior reviews (Kuah and Wong, 2011; Durst and Edvardsson, 2012; Ragab

and Arisha, 2013; Asrar and Anwar, 2016; Cerchione et al., 2016; Massaro et al., 2016; Centobelli et al., 2017) in seven ways. First, the present study applies bibliometric and network approaches to uncover the most influential articles, scholars, institutions, and countries as per the number of articles published and citations. Thus, this study goes beyond the systematic review of the domain. Second, scholars working on the logical intersection between digitalisation and KM domains may easily recognize the countries paying to continue research attentions in the KM areas; thus, interested scholars can perform joint research projects, share their ideas and results as well as can accept academic positions to research the mentioned field further. Third, it proposes five clusters based on keyword co-occurrences, namely webinarisation, informalisation, systematisation, explication, and digitalisation. Fourth, it proposed a conceptual model, i.e. WISED framework, to analyse the digital knowledge-creating processes. Fifth, the study supports researchers to underline the most influential articles. Sixth, the findings can assist the industries and governments to identify the leading research and development centres working in the field of KM for research projects. Seventh, editors organizing special and regular issues on the topic can invite leading authors and institutions.

As the managerial contribution is concerned, the present study offers opportunities to the practitioners and organizations engaged in KM in the era of the digital transition. The study further provides managers with diverse outlooks that enable them to enjoy the benefits of KM in their work. The bibliometric information about the KM literature has immense value for managers as it enables them to spot the KM expertise globally. Accordingly, the research projects on digital knowledge management can be developed considering this information.

Although this article significantly contributes to state of the art in the field of KM, nevertheless this study has selected only research articles and review articles; therefore, the inclusion of other types of documents (e.g., conference proceedings, book chapters, and editorial material) may lead toward different conclusions. Thirdly, we performed the co-citation analysis using network analysis with R and VOSviewer software. However, other methods and software may be used, such as Gephi. Lastly, the bibliometric analysis in the present study focuses on the general themes of digital knowledge creation processes, and not restricted to KM up to a particular topic.

Some gaps in the literature have emerged from the study of the five new areas of knowledge creation. The first is the lack of theoretical and practical studies on how tacit knowledge interfaces with the digital sphere. Although tacit knowledge is difficult to manage, research efforts are required to be able to have solid theoretical bases and application cases to be able to debate on the topic (Brown & Sandholm, 2019; Johannessen et al., 2001; Maravilhas & Martins, 2019; Mohamed et al., 2006; Seo & Huh, 2019). Another gap is the lack of empirical studies on corporate performance of the impacts of digital knowledge on business models (Torres et al., 2018; Trantopoulos, von Krogh, Wallin, et al., 2017).

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Innovation Labs to Foster Digital Innovation: a Management Framework

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Abstract

The paper aims to discuss the role of Innovation Labs as innovation management model fostering continuous innovation practices within organizations operating in the digital ecosystem. An Innovation Labs management framework is proposed, through the analysis of a case study, with the main purpose to collect further insights on the field and to catalyse research interests in a field on which the attention of the academic and practitioners' world is growing even more.

Innovation Labs are Innovation management models based on the construction of an innovative space with physical, virtual, hybrid and relational features. They are based on the development of a platform that contemplates tangible and intangible infrastructure dimensions aimed at fostering creative and critical thinking, promoting and supporting user-driven, open, and continuous innovation approaches; to facilitate stakeholders' engagement in innovations processes; to better understand users' needs; to drive digital transformation; to imagine and defining innovation opportunities; and to continuously develop new solutions capturing and delivering value to society in order to drive the organization in finding the best ways to generate knowledge and digital culture, introduce technology, digitize operations, and implement digital strategies for continuous and digital innovation. The research of new solutions, practices, and management models enabling continuous innovation dynamics and digital exploitation is a current hot topic both for scholars and practitioners (Fecher et al., 2018). Among emergent practices, Innovation Labs have appeared as a valuable answer to organizations' needs to develop digital culture and continuous innovation

attitudes (Osorio et al., 2019). Although the practice of Innovation Lab is raising interests among scholars and practitioners, the literature in this field still reveals a lack of management models based on innovative approaches and methodologies and addressing current competitive challenges (Osorio et al., 2018). To address this gap and catalyse research interest, the paper is based on the analysis of a single case study. It has been conducted in an Innovation Lab to understand its functioning, and its management logic, as well as proposing a framework for its organizational management that could increase knowledge and suggest guidelines on the field, both for academic and practitioners.
The paper combines the insights from theory with the empirical evidence gathered by adopting a case study approach. Therefore, the proposed framework springs from a case study, i.e., an Innovation Lab designed to develop and foster innovation capacity and digital continuous innovation among organisations and stakeholders of a tourism regional ecosystem.
The originality and the value of the paper stand in the contribution aimed to enrich theoretical and practical knowledge on management issues of Innovation Labs and proposing a cycle-based framework for their successful management. The study puts particular attention to management issues of Innovation Lab as a "guide" of the digital innovation journey of an organization.
The study advances theoretical and practical knowledge about how effectively manage Innovation Labs and provides scholars and practitioners with useful insights and managerial implications for the development and management of these initiatives.

Keywords – Innovation Lab; Continuous Innovation; Management Framework; Digital Innovation

Paper type – Academic research paper

1 Introduction

The paper discusses the role of Innovation Labs as innovation management models fostering digital innovation practices within organizations operating in the digital ecosystem. An Innovation Labs management framework is proposed, through the analysis of a case study, with the main purpose to collect further insights on the field and to catalyse research interests in a field on which the attention of the academic and practitioners' world is growing even more.

Innovation Labs are Innovation management models aimed at fostering creative and critical thinking, to drive the organization in finding the best ways to generate knowledge and digital culture, introduce technology, digitize operations, and implement digital strategies for continuous and digital innovation.

The relevance of innovation to guarantee companies' competitiveness is acknowledged among scholars and practitioners (Schiuma, 2012). It is also true that innovation is a high-risk process that requires resources, competence, culture, and attitudes not even easy to raise and manage (D'este et al., 2012). In this regard, often, organizations rely on external entities for the exploitation of innovation processes, namely innovation intermediaries, R&D labs or innovation centers (Corre et al., 2005).

Nowadays, however, in the Digital Era innovation dynamics are changing. The digital ecosystem is even more dynamic and unpredictable, even more after the Covid-19. The global and virtual competition, as well as 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 common 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). But, even if equipped with high tech infrastructure, and skilled staff, current innovation actors, like R&D labs, or innovation centers, 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).

The research of new solutions, practices, and management models enabling continuous innovation dynamics and digital exploitation is a current hot topic both for scholars and practitioners (Fecher et al., 2018). Among emergent practices, Innovation Labs have appeared as a valuable answer to organizations' needs to develop digital culture and continuous innovation attitudes (Osorio et al., 2019).

Although the practice of Innovation Lab is raising interests among scholars and practitioners, the literature in this field still reveals a lack of management models based on innovative approaches and methodologies and addressing current competitive challenges (Osorio et al., 2018). To address this gap and catalyse research interest, the

paper is based on the analysis of a single case study. It has been conducted in an Innovation Lab to understand its functioning, and its management logic, as well as proposing a framework for its organizational management that could increase knowledge and suggest guidelines on the field, both for academic and practitioners.

2 Theoretical background

The notion of Innovation Lab has been introduced in the management literature to distinguish the creation of organisations' spaces dedicated to supporting, in different ways, the enhancement of innovation capabilities, and for developing and testing innovative ideas and solutions. Lewis and Moultrie (2005) define an Innovation Lab as a dedicated facility that encourages creative behaviours and promoting innovative projects by providing appropriate resources. Similarly, Magadley and Birdy (2009) point out the role of creative spaces to enhance innovation and describe an Innovation Lab as a physical environment in which employees can engage with each other to explore and extend their creative thinking beyond and above usual boundaries. So, the identification of the physical space dedicated to the development of creative and innovative skills is generally defined as the main feature of Innovations Labs (Bloom and Faulkner, 2016; D'Auria et al., 2017; Schmidt and Brinks, 2017). Magadley and Birdi (2009) state that there is a direct relationship between creative spaces, innovation and performance. Accordingly, an Innovation Lab is considered as a collaborative ideation space that helps organisations to break down the walls of the traditional laboratories and enable different people to get involved in creative and innovative activities. Not only employees but also the users and other potential stakeholders get involved in the activities of an Innovation Lab. A first fundamental distinguishing feature of Innovation Labs is that they are innovative spaces enabling organisations to embrace the paradigm of open innovation, user-driven innovation, and collaborative innovation by overcoming hierarchy and by promoting stakeholders participation into the co-creation of potentially successful innovations (Lewis and Moultrie, 2005, Memon et al., 2018; Osorio et al., 2019; Schmidt et al., 2015).

However, as pointed out by some authors, when just focusing on the creation of innovative spaces, Innovation Labs may become a kind of "*innovation theatre"* rather than an "*engine*" to successfully spur and support the development of the organisation's innovative behaviour. The idea of innovation theatre denotes that a significant pitfall of Innovation Labs is that they can be implemented mainly as promotional actions to demonstrate innovation. Instead, to be designed and implemented as management initiatives focusing on developing the capacity for innovation of an organisation (Blank, 2013). An Innovation Labs should foremost a management initiative to affect organisational behaviour in terms of propensity to innovation (Lewis and Moultrie, 2005; Magadley and Birdi 2009; Memon et al., 2018; Zurbriggen and Lago, 2019). For this reason, Innovation Labs' activities must be aligned with the organisation' vision and strategic goals and should be inspired by innovative methodologies and approaches

fostering stakeholders' engagement and satisfaction (Fecher et al., 2018; Osorio et al., 2019; Bogers, 2018; De Silva et al., 2019; Whicher and Crick, 2019).

Based on that, this paper proposes the following innovation lab's working definition.

Innovation Labs are 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.

Innovation Labs are aimed at fostering creative and critical thinking, promoting and supporting user-driven, open, and continuous innovation approaches, to facilitate stakeholders' engagement in innovations processes, to better understand users' needs, to drive digital transformation, to imagine and defining innovation opportunities, and to continuously develop new solutions capturing and delivering value to society.

Innovation Labs can drive the organization in finding the best ways to generate knowledge and digital culture, introduce technology, digitize operations, and implement digital strategies for continuous and digital innovation.

Considering this definition and that the academic literature, as well as common practices, reveal the lack of management models that improve the efficiency of an Innovation Lab and decrease the high rate of failure in this field, in the following, a real Innovation Lab has been analysed to gather insights to propose a management framework.

3 Research design

As previously highlighted Innovation Labs are emerging as management initiatives to address organizations' needs of developing digital culture and strategies and flourish continuous digital innovation attitudes.

Recently, several researches have addressed the phenomenon of Innovation Labs, but they have mostly analysed the structure and functions of these Labs. To date, there is still a lack of studies regarding the management models of these initiatives. (Osorio et al., 2018).

In such a prospect, the research aims to enrich theoretical and practical knowledge on management issues of Innovation Labs and proposes a cycle framework for their successful management. The study puts particular attention to management issues of Innovation Lab as a "guide" of the digital innovation journey of an organization.

The management framework has been developed by drawing from the literature on Innovation Labs and the analysis of activities carried out by a real Innovaiton Lab.

The paper combines the insights from theory with the empirical evidence gathered by adopting a case study approach. Therefore, the proposed framework springs from a case study, i.e., an Innovation Lab designed to develop and foster innovation capacity and digital continuous innovation among organisations and stakeholders of a tourism regional ecosystem. The research focused on the specific ways – the 'how' – in which Innovation Lab should be managed to: focus on the scenario to identify challenges and market needs;

transform challenges into opportunities; propose, design, experiment and validate possible innovative solutions; refine and reflect on solutions and lesson learned to enable continuous innovation. Data was collected through a variety of methods, including participant observations, semi-structured conversations with organizations' managers and project stakeholders, and active listening and understanding of online webinars carried out with actors involved. Data emerging from this fieldwork was integrated examining methodologies and paradigms on the basis of innovation lab theory.

This, to triangulate data gathered with various methods (Eisenhardt, 2002) to control and reduce the bias of single observation (Tarrow, 1995).

4 Research methods

The paper builds on an analysis of a single case study, i.e. the Transformalab, an Innovation Lab supporting companies wishing to undertake innovation paths, to be able to seize opportunities and generate innovative solutions for the relaunch of their business; as well as developing an entrepreneurial mindset and a culture for continuous innovation.

This research adopts the method of the case study (Yin, 2009) to test and validate the proposed framework through a contextualized analysis. The case study method is particularly recommended for the identification of relevant insights and the elaboration of theory starting from the analysis of examples and real situations (Eisenhardt and Graebner, 2007).

4. 1 Background – research context

The Lucanian tourism sector is strongly affected by the ongoing crisis.

It is estimated that Lucanian tourism in 2020 could register a drop of 47.75% (Statesman, 2020). The recovery of the Basilicata tourism sector will depend on the response and ability of adaptation of the tourist destination "Basilicata" to new challenges imposed by COVID-19.

The future of tourism industry should be rethought and designed based on tourists' new habits, needs, and expectations; active engagement of local communities; operators and organisations needs. Their creativity and innovative thinking should be stimulated and encouraged to find and adopt new approaches, mindset, processes, and to innovate tourism offer. New form of communication should be explored, as well as new relational dynamics able to guarantee the promotion of the territory and the development of a tourism ecosystem that should become authentic, welcoming, safe and that instills well-being and trust in tourists who will come back to visit the territory.

The Transformalab for tourism is an Innovation Lab promoted by the University of Basilicata which aims to support the development of digital innovations and business models of Lucanian tourism organisations by leading them in this period of crisis to become even more competitive and to be able to design and implement development

strategies. The activities combine the richness of the real experiential process with digital products and services so as to increase the value created and transferred to customers.

The Transforma Lab is a management model, based on 5 phases management framework, aimed at increasing the entrepreneurial and innovative capacity of organizations to create excellent value. It is configured as an innovation program that accompanies companies in the process of transformation and development of product, process and business model innovations, starting from a market need, or organizational challenge.

It follows the "Innovative Thinking" method by combining models and tools based on the principles of Open Innovation, Design Thinking, User-driven Innovation, Lean and Agile Methods. The aim is to lead organizations in the digital transformation process, in the development of innovative capacity, in change management, so as to better react to crisis, adapt to market changes, and improve the operational efficiency and profitability of the company.

The Transforma Lab for Lucan Tourism started with a phase of diagnosis of the challenges of Lucanian tourism companies. The auditing of involved companies has been accompanied by a series of thematic webinars broadcasted live on the social media. These webinars involved the actors of the regional tourist panorama.

The goal was that of defining, through the creation and proactive involvement of a community of experts, entrepreneurs, tour operators, DMOs, citizens, tourists and institutions, the main business challenges in the sector due to the covid-19.

The identification of these challenges should be considered as as the starting point at the basis of the constitution of innovation teams to set up with the ambitious goal of transforming challenges into opportunities, and then to generate innovative solutions during a final hackathon. Then, innovative digital responses and proposals has been appropriately tested and evaluated. Therefore, it results that validated outputs solving identified challenges in an innovative, efficient and remunerative manner have been generated. These have been then proposed to companies and stakeholders involved. Finally, Innovation Labs managers and operators made reflections on carried-out activities collecting feedbacks from participants and involved actors. This to verify the effectiveness of the program, if proposed objectives have been pursued, and to improve the method in order to propose even more effective innovation to customers and to generate valuable offer for companies and the ecosystem.

4.2 Data collection and analysis

One of the authors as part of the Transformalab had the chance to gather data during the exploitation of the project and beyond. His role was to lead the exploitation activities of the project and, as such, he was particularly interested in examining and documenting knowledge flow, objectives and key results occurring across the carried-out activities. Data was collected through a variety of methods, including participant observations

(Czarniawska, 2012) and semi-structured conversations with key project stakeholders. Data emerging from this fieldwork was integrated by further research carried out together with the other authors of this paper, particularly examining methodologies and paradigms on the basis of innovation labs theory. The idea here was to triangulate data emerging from various gathering methods (Eisenhardt, 2002) as to reduce the bias of a single observation (Tarrow, 1995).

The research was enriched by semi-structured conversations with key informants (Kumar et al., 1993), including internal and external stakeholders, and by active listening and understanding of online webinars carried out with actors involved. These webinars were based on semi-structured schemas using a flexible approach that allowed gathering the informants' perspectives on specific issues and checking whether informants could confirm insights and information the researchers already held (Myers, 2013).

Processes of data reduction, data display, inductive and iterative data analysis and conclusion drawing and verification were carried out (Corbin and Strauss, 2008; Miles et al., 2014).

The backbone of these processes was the creation and continuous editing of reports, in which keywords for the future of tourism experience, key challenges, main opportunities, and possible innovative solutions for Lucanian tourism ecosystem were identified and discussed. Moreover, a final hackathon with the participation of 36 team and more than 20 experts contributed to the realization of 23 possible innovative solutions in the form of digital prototypes delivered to the local tourism stakeholders and operators.

5 Findings: The Innovation Labs' management framework

Innovation Labs can represent an effective and efficient way to answer to the organisations' challenges of continuous improvement fostering digital innovations development. In this regard, a framework that supports academics and practitioners in the management of an Innovation Lab is required. The above described case study has been conducted to gather insights and understand the functioning, and common management practices of an Innovation Lab. The main emerged outputs have been compared and integrated with a previously conducted review on Innovation Labs.

As a result, five key subsequent phases distinguishing an Innovation Lab emerged: *focusing, engagement and enabling, developing innovative solutions, delivering and application support and reviewing and consolidating.*

The '*focusing'* phase is aimed at defining strategic intentions, developing a shared vision, and identifying necessary resources in order to develop a project plan. The second phase, namely '*Engagement and Enabling',* is devoted to the activation of 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 (Lewis and Moultrie, 2005; Schmidt et al., 2015). Moreover, according to users' needs and pursued innovation goals, the Innovation Lab may act as an innovation intermediary in order to provide opportunities to build communities and partnerships with

various stakeholders (Memon et al, 2018; Meyer et al., 2019). The phase of '*Developing innovative solutions'* starts once the challenges and objectives have been addressed. Here, traditional innovation management stages follow each other in order to exploit innovative projects transforming ideas into solutions or to develop innovative skills and mindset in users (Morel et al., 2016; Thorpe and Rhodes, 2018). During this phase, Innovation Labs should provide services like mentoring, coaching, or facilitating sessions with final users in order to gain feedback and control the risk of failure. Moreover, tools, equipment, and technologies for testing and prototyping should be made available under assistance. After the innovation development, the *'Delivering and application support'* phase is aimed at delivering and/or applying the generated value. In this phase, Innovation Labs provide consulting or mentoring services, assisting users in activities like developing time-to-market, go-to-market or growth hacking strategies; codifying learned knowledge; or improving routines. Moreover, Innovation Lab may play a strategic role in building bridges between companies and markets (Fecher et al., 2018). The last phase is about *'Reviewing and consolidating'* where activities carried out are reviewed and reflections come out. Final results from activities are compared with initial objectives to detect insights from which to learn and design new innovation activities and strategies.

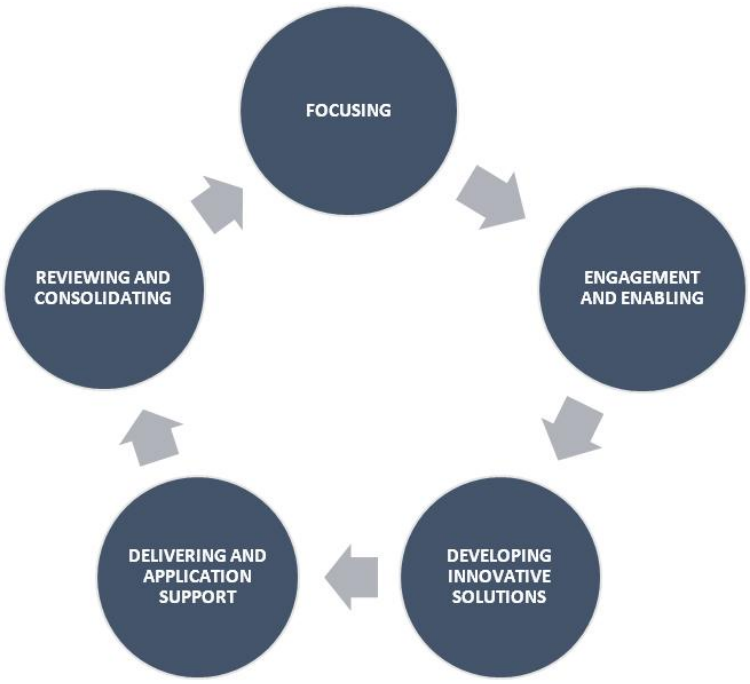

Fig. 1. "The Innovation Lab's management framework

6 Final discussions

In the digital ecosystem, competitive organizations are asked to introduce and accept technology, as well as evolves their business models and operations simultaneously with the scenario's evolution. Equipping traditional R&D labs or innovation centers with the latest technology and highly specialized team didn't turn out with expected results. The need for new practices to address current competitive challenges has emerged.

The paper proposes Innovation Labs as an answer to the organisations' needs to develop digital culture and continuous innovation attitudes. This study, analysing a case study, proposes a management framework built on the Innovation Lab perspective to explore some of the important issues that could contribute to an effective management of Innovation Labs.

The study advances knowledge about how effectively manage these Labs and provides scholars and practitioners with useful insights and managerial implications for the development and management of these initiatives. Although the framework requires more investigation to be validated, and the implications need further examination, this paper aims to catalyse research interest and calls for further research in this field.

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Living Lab as Engine of Entrepreneurship Development and Innovation in ECOC

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Abstract

Nowadays, Living Labs have become a very popular research topic in Innovation Management literature. The existing literature suggests that the Living Lab is a multidisciplinary phenomenon that can be seen simultaneously as an environment and methodology rooted in open and user innovation paradigms. These Labs are conceived as physical or virtual space in which to solve social challenges, especially for urban areas, by bringing together various stakeholders for collaboration and collective ideation. In a broader perspective Living Labs are user-driven open innovation ecosystem where business, citizens, government, institutions take an active part in innovation processes.

This paper analyses Living Lab as a catalyst of entrepreneurship development and innovation in a peculiar context such as a European Capital of Culture (ECOC). ECOC represents a yet under-utilised opportunity for cities and regions to develop existing and prospective local businesses, firstly via their engagement in the event. ECOC programme, indeed, has great potentials to trigger, strengthen and diversify local entrepreneurship by encouraging innovation, cross-sectoral cooperation, networking as well as internationalisation.

The study provides an analysis of the Open Design School, i.e. a Living Lab designed to invent, prototype and build creative and technological solutions to have been made available to the events planners of Matera European Capital of Culture 2019.

The Open Design School (ODS) has engaged in its activities many actors, such as businesses, entrepreneurs, citizens, an international team of professionals with the most diverse stories behind them. In doing this, the ODS has given to these actors the opportunity to approach interdisciplinary

experimentation and innovation, learn new skills and build new relational networks, in a process that has put the community at the centre of the mega cultural event.
Among the different actors involved in the ODS' activities, the study - Upon the Matera Basilicata 2019 Foundation's request who financed the research – looked at the Living Lab's suppliers and has investigated the following issues: what impact has the collaboration with the ODS generated on innovation capacity of its suppliers? What are the effects that cooperating with the ODS has generated on business model of its suppliers? More generally, has the ODS helped create a fertile milieu for developing innovative and entrepreneurial skills, new medium-long term opportunities for local community?
The study adopts an exploratory approach based on case study methodology.

Keywords: Living Lab, Entrepreneurship, Innovation attitude, ECOC, case study, Matera 2019.

1 Introduction

In an increasingly unpredictable and complex market, characterized by the rapid emergence of new technologies and growing globalization, organizations are discovering the advantage of creating innovation spaces, i.e. spaces dedicated to stimulating and cultivating creative and innovative thinking that can guide the dynamics of creating value (Wagner et al. 2017). Innovation spaces provide opportunities to engage with people, ideas, and technologies, experience participatory culture, and acquire the literacies and skills needed to prosper in the 21st century (Prefontaine, 2013).

Among the different forms of innovation spaces there are Living Labs. These Labs are conceived as physical or virtual space in which to solve social challenges by bringing together various stakeholders for collaboration and collective ideation. In a broader perspective Living Labs are user-driven open innovation ecosystem where business, citizens, government, institutions take an active part in innovation processes.

Living Labs can stimulate knowledge co - creation and co-design by exploiting the newest opportunities offered by ICT. They represent a novel system where increasing its own skills and improving competitive advantage. Regarding businesses, for example, Living Labs can give them the opportunity to develop and validate new ideas and have innovation process more effective thanks to the greater openness to collaboration with other companies and with end-users. About citizens or community, these Labs can offer them the chance of orienteering the production and delivery of services and products that serve real needs (Uzunidis, 2018, Leminem, Westerlund and A-G. Nystrom 2012, European Commission 2009).

Made-up by different stakeholders, resources and activities that enable and support innovation, Living Labs act as intermediaries between users and developers for the creation, the prototipation, the validation and the testing of new solutions and necessary lab infrastructure to do so, making organizations and all the local network more competitive (Bernhard R. 2012, Leminem, S., M. Westerlund and A-G. Nystrom (2012).

This study explores the role of Living Lab as a catalyst for innovation and entrepreneurship in the peculiar context of a European Capital of Culture (ECOC). The

context of investigation is one of two cities designed ECOC in 2019, i.e. Matera. In particular, the research analyses a Living Lab, that has been built to support the development of skills and infrastructures needed for the mega event of the European Capital of Culture Matera 2019, namely the Open Design School (ODS).

Specifically, the study explores the role of the ODS as a facilitator of innovation and entrepreneurial development in local community, and reports the results of a case study which has involved some ODS' suppliers and professionals who closely worked with the Lab to implement Matera 2019 program. In particular, the research investigates the following questions: what impact has the collaboration with the ODS generated on innovation capacity of its suppliers? What are the effects that cooperating with the ODS has generated on business model of its suppliers? More generally, has the ODS helped create a fertile milieu for developing innovative and entrepreneurial skills, new medium-long term opportunities for local community?

The remainder of this paper is organized as follows. Section 2 provides a general overview of the ODS project. Section 3 describes the methodological approach. Section 4 presents the findings of the case study analysis. Finally, in Section 5, concluding remarks and directions for future research work are presented.

2 The ODS project

The ambitious project of the Open Design School (ODS) was conceived as a "Living Lab", an innovation space to produce infrastructures and skills necessary for implementing the mega event Matera 2019, and to provide long-term benefits to ECOC citizens.

More specifically, the ODS project was inspired by "Open Culture" principles and designed to create and prototype creative and technological solutions in order to solve real-world problems and challenges, emphasizing the role of design as a form of collaborative cultural practice in a community development process, eliminating mistrust in creative skills and avoiding the loss of an important artistic and creative heritage for the production sector and community (Open Design School User Manual, 2019).

Open Design School was born from an idea by Joseph Grima. It was conceived as a fucina of ideas where teachers and students of the world can meet and design the essential concepts for the Matera 2019 preparations.

School because it is an opportunity to learn points of view, trades and cultures. Learning takes place between peers. A committee comprising, from time to time, a team of professionals with the most diverse stories behind them: the important thing is that each work group is one third foreign nationals, one third Italians and one third Matera citizens (source: https://www.matera-basilicata2019.it/it/programma-2019/progetti-pilastro.html).

In addition to the 13 staff members and the 64 external experts involved, the ODS hosted 39 highly qualified professionals and experts in different sectors, who have formed the pool of skills to approach complex research projects, that require rapid immersion and

a broad vision, and a dialogue between the creative scene of Basilicata and European partners.

Design because is the workshop watchword. The ODS teams have invented, prototyped and built creative and technological solutions to be made available to the event planners who will take charge of the exhibitions for Matera: European Capital of Culture.

Open because every project in the ODS actively involved residents and encouraged them to participate.

As an open innovation ecosystem based on knowledge sharing and continuous learning, the ODS has involved heterogeneous users, including ordinary people who have attended Lab workshops, designers or groups of students from several European countries interested in studying the ODS model and even local creatives who wanted to put some ideas into practice with the ODS team.

The ODS was also conceived to develop new networks and new economies and regenerate abandoned public spaces through the engagement of professionals and citizens in planning and implementing regeneration projects.

The variety of solutions produced by the ODS in response to its stakeholders' needs has been impressive. The Living Lab has developed 122 projects, including 76 installations and 38 research projects. Wider citizens' involvement was guaranteed through open events which included 37 talks involving 2020 people, and 28 workshops, involving 600 participants.

3 Methodological notes

To explore the role of the ODS as a facilitator of innovation and entrepreneurial development in Matera community, a case study was developed. In particular, at the Matera Basilicata 2019 Foundation's request who financed the research, the study looked at the ODS' suppliers and professionals who closely worked with the Lab to implement Matera 2019 program and has attempted to understand what effects the collaboration with the ODS generated on their innovation capacity and business model. Moreover, the study has sought to analyse if the ODS helped create a fertile milieu for developing innovative and entrepreneurial skills and new medium-long term opportunities for local community.

The case study method is applied since this is the most appropriate one for achieving a deep understanding of the investigated phenomenon. Over the past decades, numerous studies have demonstrated that the case study method can be successfully to probe beneath the surface of a situation and to produce a rich context for understanding.

For the purpose of this study, a "case" was defined as an in-depth interview with three suppliers and two professionals who closely collaborated with the ODS for Matera ECOC event.

The interviewees for the study enjoyed describing their own views on the collaboration with the ODS and Matera 2019 experiences. Therefore, participants' bias presented a very small problem in the study.

During the course of the first interview, several slight revisions were made to the interview protocol to adjust or rearrange questions that seemed unproductive. Notes from each interview were reviewed and highlights were identified. The transcript from each interview was reviewed and coded. The main approach to data analysis involved a detailed analysis of the interview transcripts. In addition to the interviews a documentary research has been carried out.

The interview was structured considering two main dimensions of analysis:

- the impact on the respondents' business model, generated by the collaboration with the ODS. The impact was analyzed referring to the Canvas model showed in Figure. 1;

- the improvement of entrepreneurial attitudes and propensity to innovate, as result of the collaboration;

<table>
<tr><td>KEY PARTNERS</td><td>KEY ACTIVITIES</td><td>VALUE PROPOSITION</td><td>CUSTOMER RELATIONSHIP</td><td>CUSTOMER SEGMENTS</td></tr>
<tr><td rowspan="3">Assess how much ODS has facilitated the definition of new relationships and the dialogue with suppliers, competitors, new customers, public bodies.</td><td>Assess how much the relationship with ODS has allowed to improve the ability to program and manage processes / activities and to learn new ways of using tools and machinery.</td><td rowspan="3">Assess how collaboration with ODS has changed the respondents' real or potential value proposition.</td><td>Evaluate the changes occurred in how respondents interact with users, due to the collaboration with ODS.</td><td rowspan="3">Evaluate how much the interviewees have acquired new customers and more information on the requests and needs of their users, as result of the collaboration with ODS.</td></tr>
<tr><td>KEY RESOURCES</td><td>CHANNELS</td></tr>
<tr><td>Assess how ODS has affected physical, intellectual and financial resources.</td><td>Assess how ODS has improved the ways through which respondents establish relationships with customers</td></tr>
<tr><td colspan="2">COST STRUCTURE
Assess the impact of the relationship with ODS on the interviewees’ cost structure</td><td>REVENUE STREAM</td><td colspan="2">Evaluate how much the collaboration with ODS has generated new business opportunities in the local context.</td></tr>
</table>

Figure 1. Canvas model and investigation areas

4 Findings

In the following the main results of the case study analysis are reported.

4.1 Impact on business model

Value proposition

From the interviews different effects on value proposition were highlighted. One supplier revealed that, inspired from some creations made during the collaboration, enlarged the range of products offered to its customers. Another interviewee noted an improvement in its design skills of wooden products and structure, and in turn, the possibility to add further value to its products.

Market Segments

Most of the interviewees have pointed out that collaborating with the ODS has allowed them to acquire new customers and expand the number of potential new customers as well as to improve knowledge about their customers 'requests and needs.

"Through the ODS I have expanded my contacts and networks "-

from the interview with a professional.

Customer Relationship

The analysis of the interviews revealed that thr ODS has meaningfully contributed to improve how most of the interviewees establish and manage relationships with their users/customers. Particularly working with the ODS has helped both suppliers and professionals to better involve their customers in co-creation of products and services.

Channels

Four respondents stated that the collaboration with the ODS has enabled the development of policies and strategies to reinforce their presence in market different from the local one.

Revenues Stream

According to the interviewees, working with the ODS has resulted in new business opportunities in the local context.

Costs & Financial Resources

The relationship with the ODS, did not produce worthy impact on cost structure and financial resources of interviewees.

A couple of them stated that the experience with the ODS has improved, even to a limited extent, their ability and propensity of searching for new funding.

Moreover, one supplier declared that collaborating with the ODS helped to better manage costs of its company.

Key Partners

The respondents highlighted the contribution of the ODS in establishing new relationships and greater dialogue with own stakeholders. Indeed, the collaboration with the Lab was an opportunity to broaden their relationship network and to get in touch with other actors involved in the planning and implementation of Matera 2019.

For four interviewees, working with the ODS has helped the search for and the creation of new partnerships.

Key Activities

The analysis of the data shows that the collaboration with the ODS has improved the ability to program and manage processes and activities for the majority of respondents.

> *"In addition to working in a team, I saw their design approach, their planning, and also how they manage the budget and apply their design system. It was an interesting lesson."*
>
> from the interview with a professional.

Furthermore, an interviewee declared that acquired more propensity to experiment new technology and channels and to adopt different work practices. In three cases, the collaboration allowed to try new work tools and equipment. One supplier had opportunity to try new technology to produce his handcrafts.

Key Resources

Physical resources

One professional declared that thanks to the experience gained by collaborating with the ODS, he has learnt the use of modular systems for different arrangement of spaces. Four interviewees stated that would invest to create innovation space in their own organisations.

Intangible resources

Among the most important knowledge resources acquired thanks to the relationship with the ODS, interviews analysis has highlighted knowledge regarding the application of new technologies in daily respondents' job, small woodworking techniques and design methods.

Collaboration with the ODS was also an opportunity to improve, even if to different extent for all the respondents, the ability of acquiring, transferring and sharing knowledge (Singh, 2008, Stockes, 2004; Werner et al., 2015).

Even if to different extent, all the interviewees declared they perceived some improvement in their ability to: managing complex projects; monitoring and evaluating projects, managing communication, building partnerships at national and international level, adapting to market needs, solving challenges and achieving goals in short time.

The collaboration with the ODS also helped four interviewees to enhance their speed of decision-making processes.

Finally, an improvement of reputation and recognisability at local level was an impact revealed by all the interviews.

4.2 The impacts on entrepreneurial attitudes and propensity to innovate

In order to evaluate the effects ***on entrepreneurial attitudes***, each interviewee was asked to indicate how much he/she had acquired or improved the following entrepreneurial attitudes, thanks to the collaboration with the ODS:

- communicate own ideas effectively to third parties and negotiate with them, understanding their viewpoints;
- solve challenges, take risks and face situations of uncertainty;
- gain confidence in own skills and decisions;
- solve problems in a creative way, following new and unusual paths;
- wait patiently for the results of own efforts;

All the interviewees declared that they have acquired / improved the ability to solve problems in a creative way, following new and unusual paths; four of them have acquired / improved greater confidence in their abilities and decisions; three subjects noted an improvement in the propensity to take risks, to face situations of uncertainty and accept the possibility of making mistakes; have acquired a better ability to effectively communicate their ideas to third parties and to negotiate with them, understanding third parties' viewpoint and have acquired / improved the ability to wait patiently the results of their efforts.

To investigate changes occurred in the propensity to innovate, "Innovation Questionnaire" proposed by APQI and Confindustria (2018) was used. From the interviews it arisen that working with the ODS has improved ability to explore, identify and select new ideas and opportunities; propensity to acquire innovative suggestions and proposals from employees, for the majority of the interviewees.

5 Final remarks

This paper has attempted to provide some first insights about how Living Lab can be catalyst of entrepreneurship development and innovation in a peculiar context such as a European Capital of Culture (ECOC). ECOC represents a yet under-utilised opportunity for cities and regions to develop existing and prospective local businesses, firstly via their engagement in the event. ECOC programme, indeed, has great potentials to trigger, strengthen and diversify local entrepreneurship by encouraging innovation, cross-sectoral cooperation, networking as well as internationalisation.

Referring to Matera 2019 setting, the study has focused on the Open Design School, i.e. a Living Lab designed to invent, prototype and build creative and technological solutions to have been made available to the events planners of Matera ECOC 2019.

The Open Design School (ODS) has engaged in its activities many actors, such as businesses, entrepreneurs, citizens, an international team of professionals with the most diverse stories behind them. In doing this, the ODS has given to these actors the opportunity to approach interdisciplinary experimentation and innovation, learn new skills and build new relational networks, in a process that has put the community at the centre of the mega cultural event.

Upon the Matera Basilicata 2019 Foundation's request who financed the research, the study looked at the Living Lab's

suppliers and professionals who closely worked with the Lab to implement Matera 2019 program and has tried to understand what effects the collaboration with the ODS generated on their innovation capacity and business model.

For the purpose of this study, a set of in-depth interview with three suppliers and two professionals who closely collaborated with the ODS for Matera ECOC event was carried out.

The interviews' analysis gives back a positive image of the impacts on innovation capacity and business model both of suppliers and professionals. Certainly the intensity of the impacts varied for each interviewee.

The ODS has activated a creative exchange between art, science and technology giving the opportunity to its users to learn new skills and build new relational networks, in a process that has put the community at the center.

After Matera 2019, the Living Lab with its know-how, talents and technologies, is still considered as an opportunity to give impetus to the future of local businesses. It can help local businesses to acquire new attitudes, to share ideas, to embark innovative scenarios, to prototype concrete applications and to boost research and training.

The ODS represents a strategic legacy of Matera 2019, to capitalize in order to continue to stimulate interest in the search for new ideas and opportunities, in the exploitation of new technological solutions and adoption of new approaches to products and services innovation. Investing in the ODS means to fuel local economy and boost the future of local community.

This study focused on a few number of suppliers and professional who collaborated with the ODS. Therefore, the research results cannot be generalized. Future developments of the study regard the implementation of further interviews as well as a longitudinal evaluation of the project impacts.

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Co-Creating Big Cultural Projects with Citizens in ECOC Setting: What Impacts on Arts and Cultural Organisations? Insights from Matera ECOC 2019

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Abstract

There is an interesting debate around the role played by a European Capital of Culture in the development and growth of creative and cultural organisations working in the city designed as cultural capital, in the sub-region and. Whilst it is understandable that the designation of European Capital of Culture of a city has an impact on the broader profile of the city and can give an improved credibility of the city's creative offer, there is a variety of experiences about direct impact on cultural organisations engaged with the development of the mega event European Capital of Culture. Leaving out the broader understanding of the changes occurring in cultural and creative industry in a European Capital of Culture, this study focuses on an analysis of the impacts of big cultural projects co-created with citizens on cultural organisations that have developed these projects. The impacts mainly concern changes occurred in organisation's business model, capabilities, growth and position in creative and cultural sector. The study adopts an exploratory approach based on multiple case studies. The cases regard five cultural organisations that have lead as many big projects within the Matera ECOC 2019 programme.
The cases provide a consistent scenario for deepening understanding of changes experienced by cultural organisations engaged in the development of big projects involving citizens in ECOC context.

Keywords: ECOC, cultural project co-created with citizens, evaluation, case studies.

1 Introduction

According to the EU commission report, the scope of a European Capital of Culture (ECOC) is to bring fresh life to the chosen cities, boosting their cultural, social and economic development. The involvement of citizens in the creation and implementation of cultural events is an essential trait of ECOC. In fact, the success of an ECOC and its legacy, closely depends on the broad and active participation of its citizens to cultural events and the creation of opportunities for a wide range of people to attend or participate in cultural activities.

Creative and cultural organisations play a key role in engaging citizens and favourite their large participation to ECOC program. Through their activities and projects, these organisations enable and widen the access to the culture and act as a powerful engine of ECOC.

On the other hand, for their part, creative and cultural organisations involved in the implementation of an ECOC program, experience the wave of this great event and its impact.

In the last years there was an interesting debate around the role played by ECOC in the development and growth of creative and cultural organisations working in the city designed as cultural capital, in the sub-region and beyond (see, e.g. Campbell, 2011; Garcia et al., 2010; Langen and Garcia, 2009).

Whilst it is understandable that the designation of ECOC of a city has an impact on the broader profile of the city and can give an improved credibility of the city's creative offer (Garcia et al., 2009), there is a variety of experiences about direct impact on cultural organisations engaged with the development of the mega event ECOC (Garcia et al., 2009). These experiences tend to remain under investigated. Over time most attention has been paid to macro effects generated by this peculiar mega event.

However, analysing the experiences and reflections of arts and cultural organisations of different sizes, working in different art form, based within an ECOC, is essential to understand more in depth how an ECOC can affect cultural organisations' capacity to sustain themselves and develop. This analysis can offer an accurate picture of the effects generated by an ECOC on micro scale, that can deeply affect also the legacy of the event.

Therefore, leaving out the broader understanding of the changes occurring in cultural and creative industry in a ECOC, this study focuses on an analysis of the impacts of big cultural projects co-created with citizens on cultural organisations that have developed these projects.

In particular, the study seeks to answer the following research question: does co – creating big cultural projects with citizens produce some impacts on capacities building, business model, growth and position in creative and cultural sector of cultural organisations leading the projects? To what extent? Does experiencing an ECOC produce changes in how cultural organisations connect with the external social landscape and catalyse social innovation dynamics (e.g. to boost citizen's cultural participation and civic engagement)?

The study adopts an exploratory approach based on multiple case studies. The cases regard five cultural organisations that have lead as many big projects within the Matera ECOC 2019 programme. The projects were designed to increase the interest of citizens in attending cultural events by experimenting in new ways of listening, of sharing experiences and of producing. They were carried out with the cooperation of a number of citizens, to infuse them with a sense of ownership and responsibility for the care, protection and regeneration of community culture.

The research sought the views of the cultural organisations on their experiences of active actors of Matera's year as European Capital of Culture (ECOC) in 2019 and explored impacts on their business development and growth.

The remainder of this paper is organized as follows. Section 2 provides the research background and introduces the conceptual model. Section 3 briefly describes the research method. Section 4 presents the case studies analysis and findings. Finally, in Section 5, concluding remarks and directions for future research work are presented.

2 Research background and conceptual model

Evaluating the impact generated by a cultural project / initiative is still a challenge. Recently, several scholars have produced some conceptual frames and notions to describe the value and impacts generated by arts and cultural initiatives (see e.g. Bunting, 2008; Coles, 2008; Holden, 2006; Knell & Taylor, 2011; McCarthy et al., 2004).

An analysis of the differences and interrelations of the notions and conceptual frames, as well as of the perspectives of analysis around the impacts of arts and cultural events, suggests an alignment around different kind of value and impacts generated by a cultural program / activity, which ranges from a micro to a macro perspective, according to a frame that considers the following dimensions strongly interrelated:

1. The generated value / impact for individuals experiencing the arts/cultural event/project;
2. The value generated / impact for cultural organization, that produces the arts/cultural event/project;
3. The value generated for the community / society.

These dimensions suggest that the value and impacts generated by an arts/cultural event or project can be examined according to a multilevel conceptual model which includes several level of analysis (see Figure 1).

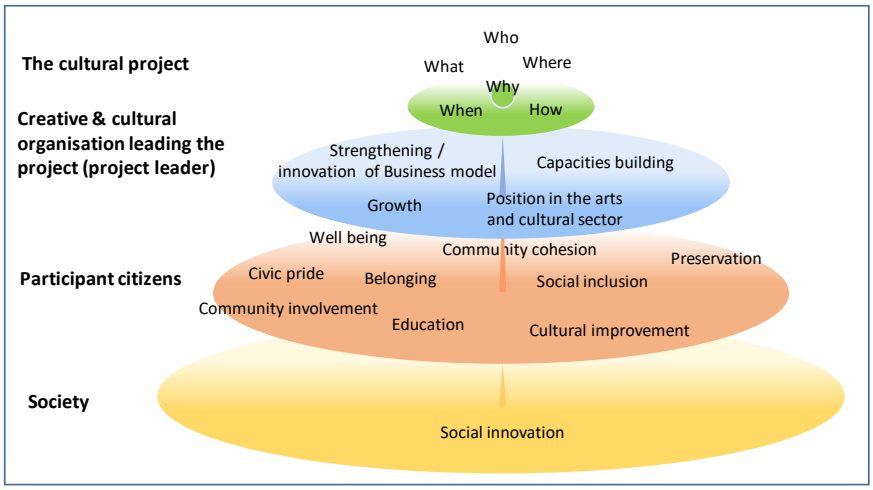

Figure 1. The multilevel conceptual model

The first level of analysis concerns a deep understanding of the event/project through a questioning method including six Ws which embrace as many questions, as follows:

- Why (the scope): what is the scope, the reason for implementing the cultural event/project?
- What (the focus): what is the key focus of the cultural event/project?
- How/Which (the process and the resources) what is the process, the set of activities and the resources to be deployed for the cultural event/project?
- When (the schedule): what is the schedule and pace of activities related to the cultural event/project?
- Where (the place and the context): in which context and place the cultural event/project will take place?
- Who (the stakeholders): what are the stakeholders involved in the cultural event/project?

The second level concerns the impacts of the event/project on cultural organization leading the project.

The impacts embrace capacities building, business model innovation and strengthening, growth and position in creative and cultural sector. The evaluation of the impacts can be carried out through several approaches and tools such as interview, questionnaire, observation, etc.

The Business Model Prism (Schiuma e Lerro, 2017) represents a useful tool to use in order to analyse the impacts regarding business model innovation and strengthening. It is a multidimensional framework derived from a wide review of the literature which can support the identification and the mapping of the peculiarities of the business models of the arts and cultural organisations. It takes into account the specific features of the value creation focus and the operation mechanisms of such organisations. It allows to analyse

the "as is" structure and logic of an arts and cultural organisation business model as well as to drive the design of innovation initiatives, i.e. the "as should be" business model.

The Business Model Prism is a three-dimensional prism that includes seven facets. The upper and lower facets indicate respectively: *the value and the social and cultural impact and the financing and the financial resilience*. The other five facets describe the remaining key dimensions of a business model of an arts and cultural organization, i.e.: *stakeholder, strategies, processes, organizational resources and partnerships* (see Figure 2).

The seven distinct but inter-linked facets, indeed, provide an ideal lens to understand the business model of an arts and cultural organization starting from addressing the following key questions:

- Social and Cultural Value & Impact – Why do we exist? What impact do we want to have? Which values do we want to propose and offer? What are our mission and vision?
- Stakeholders – Who are our key-stakeholders? What are their wants, needs, expectations and dreams?
- Strategies – What are we doing to satisfy our stakeholders and deliver value for them? What are the main products and services we are doing? What is our legal structure? How is currently our organizational structure?
- Processes – What are our existing processes? How do we manage our projects and programs? What are the characteristics of our productions? How do we generate and sustain demand? How do we do Research & Development (R&D)?
- Organizational Resources – What resources do we need to put in place, exploit and enhance to operate our processes?
- Partnerships – What partnerships do we need to build and enhance to implement our strategy and guarantee social and cultural values and impact?
- Funding and Financial Resilience – What are our current costs and incomes? What is our financial status?

The seven facets of the Business Model Prism provide as many lenses through which to analyse changes occurred in business model of the cultural organization that has lead the project.

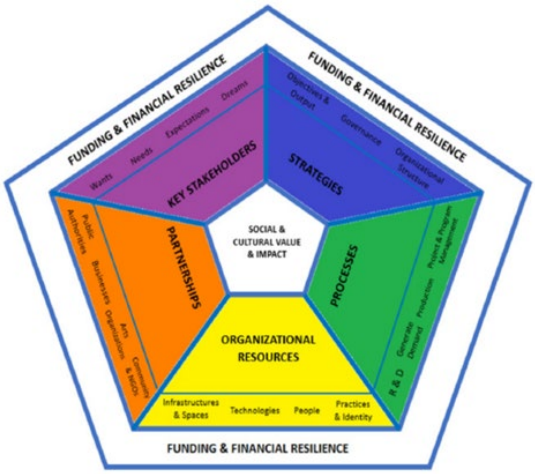

Figure 2. The Business Model Prism

The third level of analysis considers the effects of cultural event/project on citizens involved in the project development. The range of these effects is wide and covers four main individual's spheres: cognitive, ability, health and well-being, motivation (Matarasso, 1997, Michalos, 2005). The effects concern education, social inclusion, preservation cultural improvement, community cohesion, well being, civic pride, belonging, civic pride, community involvement. They can be evaluated through several tools such as interview, questionnaire, focus group (see e.g. Jackson, 2004; Matarasso, 1997, Michalos, 2005).

Finally, the fourth level of the model, concerns the impacts of the event/project on social innovation. It is well acknowledged that arts and culture represent fruitful field for the development of social innovation and civic engagement, as—by their own nature—they establish meaningful forms of dialogue among different societal actors (Cancellieri et al., 2018). Cultural events/projects can generate positive waves and activate processes that see citizens as active actors of social and cultural changes, but these "positive waves" occur in medium-long time and can be evaluated only over the years. Longitudinal studies referring to medium – long terms are required to evaluate these impacts.

3 Methodology

The study is developed as an exploratory research and uses a qualitative approach. The exploratory nature is justified by the fact that there is scarce research on the investigated questions. While, the adoption of the qualitative approach, it is explained by the fact that the investigated issues i) are focused on “specific meanings, emotions, and practices that emerge through the interactions and interdependencies between people” (Hogan et al., 2009, p.4); ii) are “pragmatic, interpretive, and grounded in the lived experiences of

people" (Marshall and Rossman, 2006, p.2); iii) regard somewhat "discerning humans' participation in what happens to them" (Fischer, 2005, p.411).

In particular, a multiple case study method is applied since this is the most appropriate one for achieving a deep understanding of the investigated phenomenon. Over the past decades, numerous studies have demonstrated that the case study method can be successfully to probe beneath the surface of a situation and to produce a rich context for understanding.

The study analyses five case studies regarding as many cultural organisations who had received funding from the Matera Basilicata 2019 Foundation to create and produce cultural events calling for citizens 'involvement and collaboration, under the ECOC 2019 programme. These organisations were labelled "project leaders".

The focus is on the effects that experiencing Matera 2019 and leading big cultural project in cooperation with citizens, have generated on the examined cultural organisations. In particular, the study seeks to analyse the changes occurred in their capacities building, business model, growth and position in creative and cultural sector. Moreover, the research enquiries if Matera 2019 experience has made cultural organisations more active in boosting citizens cultural participation and civic engagement.

The analysis of the impacts of cultural project on participant citizens and community (see third and fourth level of the proposed conceptual model) goes behind the scope of this research, therefore it is not treated.

For the purpose of this study, a "case" was defined as an in-depth interview with the project and arts manager of each cultural organisation. Data were collected from the managers over a four-month period using a pre-tested interview protocol that included questions designed to address one or more of the issues encompassed in the first and second level of the proposed conceptual model.

In general, the project and arts managers interviewed for the study enjoyed describing their own views and Matera 2019 experiences. Therefore, participants' bias presented a very small problem in the study.

During the course of the first interview, several slight revisions were made to the interview protocol to adjust or rearrange questions that seemed unproductive. Notes from each interview were reviewed and highlights were identified. The transcript from each interview was reviewed and coded. The main approach to data analysis involved a detailed analysis of the interview transcripts. In addition to the interviews a documentary research has been carried out. Data triangulation was obtained by the fact that the informants came from different types of organizations.

4 Cases analysis and findings

As previously mentioned, the study involved five cultural organisations, i.e. project leaders, that designed and developed as many big cultural projects under Matera 2019 programme. They are *Tx*, *Sx*, *Ax*, *Lx* and *Gx*. Organisations' names have been changed for confidentiality reasons.

The projects were original production in which temporary and permanent citizens became actors and co-authors themselves. Moreover, the projects proposed to break the barriers between the creators of culture and those who enjoy it, by giving to citizens an opportunity of playing an active part in the creative process and choose their level of engagement. This was with the aim of stimulate social innovation in the community.

As previously mentioned, in the light of the research focus, in the following the main results of the case studies analysis are reported for the first and second level of examination of the proposed model.

Understanding the event/project

An analysis of the big cultural projects was carried out through the questioning method including six Ws, i.e. Why (the scope); What (the focus); How/Which (the process and the resources); When (the schedule); Where (the place and the context); Who (the stakeholders), in order to gain a deep knowledge of the projects. For this purpose, primary and secondary data were collected and analyzed respectively through interviews and collection and analysis of reports, data from websites, magazine and newspaper articles.

Even though the focus of each project was different (see Table 1), the analysis highlighted some features concerning scope, stakeholders, process, resources, schedule and place, common to many projects.

Table 1. What – The focus of the projects

Organisation	The focus (What)
Gx	The project leader built a traveling theatre, similar to an abandoned ship in their town, that travelled through 5 peripheral communities by narrating stories extrapolated from the experiences of people living the peripheral areas. The aim of the project was to communicate the identity of peripheral areas of Basilicata all over Europe.
Tx	The project leader wanted to promote a totally different way to live the city. 300 Matera citizens co - created an emotional map with the project leader. This map was an exhibit that illustrates the important *places of memories* of Matera inhabitants.
Sx	The project leader's intent was to stimulate inclusion and social integration through work and art. The project leader shared and gave voice to the immigrants' talent, through a widespread academy, organizing workshops and events.
Lx	The project was a sort of itinerant Museum. The project leader revised some stories narrated by local communities concerning some objects recovered in the Mediterranean areas. Through the project, the organization wanted to create a bridge in the Mediterranean area and spread the real essence of the place identity.
Ax	The project leader produced a film to highlight some big issues of the peripheral European areas and involved the community in the production Literacy and in the cinematographic work. The objective was to promote a cinematographic language, stimulate the audience development and education and give voice to the territories of Basilicata.

About the scope (why), all the project leaders worked to stimulate social innovation as a source of growth and wellbeing and to translate the value dimensions proposed in the bid book of Matera 2019 into concrete purposes and activities by means of their projects.

The focus of each project, indeed, was the active participation of permanent and temporary citizens and the development of co-creation activities.

The analysis of the in depth interviews with the project leaders has highlighted some keywords characterizing the scope of all the projects, i.e. comparison, dialogue, encounter, memory, awareness, identity, integration, change and construction. These "key words" were the leitmotif of each project.

The interviews have also confirmed that in each project citizens were considered key resources to build and communicate the real identity of Matera 2019. Through their deep engagement in cultural activities, citizens experienced European social values, opened their minds, approached new ways of thinking, etc. In the same time, they had the opportunity to share with the rest of the world the ancient history of the city, its uniqueness, its renovation and its values.

The process and the resources (how) used by project leaders were quite heterogeneous. They employed different amounts of human, financial and material resources to accomplish their projects and chosen different methods to involve citizens. Moreover, some projects had international breath, while other ones were developed basically at local and national level.

About projects' stakeholders (who), the citizens were the main stakeholder. Thy were actively involved as volunteers and co-creators by each project leader in various phases of project, from the design phase to its implementation. Further stakeholders, involved, albeit to varying degrees in the various projects, were public bodies, associations, institutions and companies.

Finally, about the schedule (when) and the place (where), all the projects, after a crash test in 2018, were implemented during the 2019 and followed different calendar. Most of the evaluated projects were developed in Basilicata. In few cases, the project leaders decided to perform in national and international contexts.

The impacts of big cultural project on cultural organizations

The evaluation of the project impacts on the cultural organization leading it, interested three different areas: business model innovation and strengthening, capacities building, and growth and position in creative and cultural sector.

Business model innovation and strengthening

The analysis of changes occurred in business model innovation and strengthening as result of Matera 2109 experience was conducted referring to the seven components of Business Model Prism (2017).

From the interviews' analysis it arose that the participation to the ECOC program reinforced the value propositions of all the examined organizations. It is about value propositions mainly focused on promotion of cultural regeneration, enhancement and strengthening of awareness and identity of communities, regeneration of peripheral areas, by means of arts and cultural activities.

All the project leaders stated that Matera 2019 corroborated their purpose of using arts as a social enabler, a tool to connect people and a powerful channel to communicate with citizens and communities.

As a consequence of Matera 2019, the examined organizations have defined new strategic objectives or merely revised the old ones, in order to capitalize as much as possible their projects and the overall ECOC experience.

Even if each organization defined its peculiar objectives, there are some macro objectives that all the organizations mentioned in the interviews, such as:

- Reinforcement of cooperation at national and international level;
- Participation to international/ European calls;
- Scalability and capitalization of methodologies founding the implemented projects;
- Continuation of the project activities at regional, national and international level;
- Enlarging and improvement of the executed projects, by involving also public bodies;
- Achievement of financial sustainability in medium/ long term (without public funding).

All the examined project leaders faced the challenge to carry out a complex project with a medium budget.

This pushed them to modify and reorganize their internal processes. In particular, they learnt how to improve:

- Complex processes management - in particular cost and time management;
- Objectives' achievement by focusing on efficiency and time management;
- Projects' selection;
- Simultaneous management of parallel processes and activities;
- Programming and management of advertising, promotion and marketing;
- Communication activities, especially communication through social media.

The participation to the ECOC program, allowed the analyzed organizations to enhance their organizational, relational and human capital.

First, in the designing and planning of such huge cultural projects, organisations have developed innovative methodologies that now represent strategic assets that can be used to design future projects and activities.

The participation to the program encouraged also a wider use and adoption of technological solutions. Every project leader has improved its website and communication channels and has started to use social channels, (combined with traditional ones), innovative apps and technologies (e.g. AR, VR), in a more systematic way.

The participation to the ECOC program, allowed to the project leaders to acquire new competences and technical knowledge as well as an increased level of recognition and reputation at local and national level.

Unfortunately, the positive wave of impacts did not result in an increase of stable partnerships. The development of the projects allowed the project leaders to widen the networking with other actors in the creative and cultural sector and with public and private bodies, at a local, national and international level. However, these networks, turned into stable partnerships just in few cases.

Referring to stakeholders' network, the situation was different. In general, all the project leaders widened their networks, as a consequence of their project activities and their increased reputation.

They reinforced their relationships mostly at a local level. Most of the new or improved relationships involve:

- Local communities;
- Public administrations (even if in some cases public administrations slowed down the regular project development);
- Public bodies (e.g. schools, universities);
- Associations and organizations that operate in the creative and cultural sector;
- International artists and artistic organizations.

None of the mentioned changes that occurred in the business model can be properly exploited in the future without a stable financial situation and economic resilience.

The impact of ECOC participation on the financial dimension of business model was the most debated one. The project leaders payed in advance their project suppliers (with temporary debts). Unfortunately, the rules for expenses reporting were not clearly defined and were corrected many times during the projects development. This has generated frustrations and financial worries among the project leaders. From the interviews it arises that the major organisations 'concerns for the future are:

- The recovering of financial resources needed to capitalize the outputs of their projects. In this regard, the project leaders claimed their willingness to rely more on private funds (e.g. sponsor) and on their own profits rather than on public funds. They aim to obtain new funds thanks to the participation at public/European calls and to find new ways to exploit the value of the project outputs.
- The absence of policy directions and programs for capitalizing as much as possible the projects.

Capacities building

Human resources play a key role in the management of complex events such as the ECOC. For this reason, Matera Basilicata 2019 Foundation designed a capacity-building program (i.e. Build Up) for local cultural organizations involved in Matera 2019 activities. The characterizing topics of the program were: guidance to collaboration, overcoming state assistance dependency, setting up international networking, researching new models of sustainability and entrepreneurship, sensitiveness to social issues.

The Build-up process allowed to the project leaders to acquire a common language linked to the philosophy of Matera 2019 and to the development and implementation of the projects.

Overall, the Build-up phase was appreciated by the project leaders as an innovative training practice and a legacy for future ECOCs. However, the interviews analysis revealed non-homogeneous opinions regarding the Build Up effectiveness for the improvement and development of participants' competences. Most of the interviewees stated that attending the Build Up allowed them to improve their competencies merely in the following areas: communication, event organization and digital content management. In fact, according to the project leaders' opinions most of their knowledge and competencies enhanced mainly by implementing project activities, learning by doing and maintaining great perseverance. The project leaders improved their ability of how managing time, costs and teams effectively in complex settings, as well as they increased their willingness to set up international networking especially by planning and implementing their project.

Growth and position in creative and cultural sector

Most of the interviewed project leaders stated that their participation to the ECOC program did not result in more stable, improved and durable relationships with other cultural organizations operating at local and regional level.

Additionally, all the interviewees affirmed that despite the undeniable growth of organization's reputation and image, their position in creative and cultural sector is not changed. Undeniably being key actors of a mega event such as Matera 2019, has given them the opportunity to be associated to a strong brand. However, this has not changed meaningfully their position in the creative and cultural setting.

According to the project leaders this was motivated by several issues. Among these, the absence of a common vision and mission for all the actors operating in creative and cultural sector at local level, the reluctance to exchange and share information among the same actors, the lack of a stable and durable financial resilience.

About growth, all the interviewees stated that participating to a big and complex program such as Matera 2019 was a unique opportunity. Unfortunately, according to the respondents, the ECOC legacy is still undefined and there are not clear programs for the future. In this regard this study detected a high level of disenchantment and frustration among the respondents.

Even though there is not a common vision and clear plan of growth for cultural organizations that contributed to build and implement ECOC program, every project leader is formulating new solutions to capitalize and enhance its project.

However, this is not enough to guarantee a successful ECOC legacy. The positive waves generated by Matera 2019 will disappear quickly if all the different private and public actors involved in the mega event will fail to identify policies and concrete growth perspectives for local communities and production systems.

5 Conclusions

This research has focused on an analysis of the impacts of big cultural projects on business model, capabilities, growth and position in creative and cultural sector cultural of organizations leading the projects, in a European Capital of Culture.

The study has adopted an exploratory approach based on multiple case studies. The cases regarded five cultural organisations, namely project leaders, that have lead as many big projects within the Matera ECOC 2019 programme.

The analysed cases have provided a consistent scenario for deepening understanding of changes experienced by cultural organisations engaged in the development of big projects in ECOC context.

In particular, the on-field analysis showed that Matera 2019 has represented a fundamental opportunity of development and growth for the examined organisations. After the ECOC experience, they can leverage their strengths and reinvent their future in an Open future perspective – as the Matera 2019 slogan says.

However, the research has also revealed several problems faced by the investigated project leaders during and after the mega event.

The following table summarizes the main impacts on business model innovation and strengthening, capabilities, growth and position in creative and cultural sector, arose from the interviews. The impacts are reported according to the SWOT analysis template.

Table 2. SWOT analysis of the program

Strength	Weakness

- Improved knowledge and competences for:
  ▪ Management of complex projects;
  ▪ Management of simultaneous projects and activities;
  ▪ Communication;
- Higher reputation at local and national level (in a limited way at international level);
- New artistic and cultural outputs to capitalize;
- Improved planning ability;
- Research of new sustainable models that, over time, allow to reach a stable financial sustainability;
- Improved marketing/ promotion and advertisement capabilities;
- Scalability of the methodologies founding the projects;
- Reinforced relationships with the local communities (with some PA, citizens, associations and schools)
- New relationships with artists, organizations of creative and cultural sector and public organizations.
	- Lack of adequate financial and tangible resources to capitalize the projects;
	- Limited relationships with:
	  ▪ The other project leaders;
	  ▪ PA;
	  ▪ National and international institutions;
	- Uncertainties concerning the project accounting (timing and rules changed many times during the development of the projects);
	- No availability of suitable spaces for further development of the projects.

Opportunity	Threat
- Strength and awareness – at national and international level; - Attractiveness of Matera for new private investments; - Acknowledgment of Matera as a place where to live and create culture, innovation, good practices and economic growth; - Matera as a central point in the regional and extra regional tourist dynamics.	- Lack of cooperation between the project leaders – they are still not an influential group; - Lack of public program and policies, aimed at gaining a common vision and mission for all the project leaders; - Lack of common policies and programs formulated with the project leaders –regarding post Matera 2019; - Uncertainties about the availability of public funds to capitalize the outputs of the implemented big cultural projects, i.e. artistic and cultural, tangible, intangible and organizational heritages.

The results of the study are essential to understand more in depth how Matera 2019 has affected capacity of cultural organisations engaged in the ECOC program, to sustain themselves and develop. They offer an accurate picture of the effects generated on microscale and provide useful insights about the perceived legacy.

This study focused on a few number of project leaders involved in Matera 2019 program. Therefore, the research results cannot be generalized. Future developments of the study regard the implementation of further case studies as well as a longitudinal evaluation of the projects impacts.

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Transformation of the Relationship of Concepts of Information and Knowledge Based on a Four-Level Structural Model of Knowledge

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Abstract

Over the past few decades, the attributive point of view on “information” entered the discussion as something constituting or directly characterizing the physical world. Thus, some scientists, like L.Floridi, began developing the "philosophy of information." In the 80s, a four-level representation of "knowledge" spread (DIKW-structure), preceded by two-level representation. The basis is “data (concepts)” – individual facts characterizing objects, processes, and phenomena of the subject area. The DIKW-structure includes "data (concepts)", "information", “knowledge” itself and “wisdom”. For the two-level structure of “knowledge” graph and other mathematical methods of representation and processing have long been used, but not for DIKW. In 2012, a version of the graph and mathematical representation of the DIKW-structure was published in Russia. This shows that the four-level representation is most constructive for working with knowledge and information, and also provides the opportunity to objectively understand different approaches to information, their rationale formerly built on a verbal basis. We go from 500 different definitions to 6 small groups. A powerful group of attributive point-of-view remains as “information1”. “Information2” is the result of actions/communications of highly-organized living or technical entities. The Shannon approach based on statistical estimation is called "information3". Information derived from a data-links is “information4”, corresponding to “information” (in narrow sense) used in DIKW-structure of knowledge. The sentence plays an important part, acting as “information4”. From the linguistic point-of-view, it carries a semantic content, from the semiotic - a set of signs. The legal definition of information is called “information5”, defined as “the total amount of knowledge accumulated by mankind”, the “information in a broad sense”. Such an interpretation is the result of combining all types of knowledge components from the DIKW structure in a graph representation based on the

rules of discrete mathematics. This graph G is very complex, can also be obtained practically, in a special form based on the technology of direct imposition of knowledge via methods of AI and computer linguistics. The philosophical point-of-view we'll call "information6". An ontological comparative analysis of the four-level structure of knowledge with some interpretations of information and knowledge was carried out.

Keywords – data, information, knowledge, knowledge structure, wisdom.

Paper type – Academic Research Paper

1 Introduction

Scientists have been studying the problems of "*knowledge*" for thousands of years and began to pay attention to the problems of "*information*" only from the beginning of the twentieth century. A few decent interpretations of information existed already, based on semiotics (Eco, 2016), emerging from linguistics, but they gradually grew irrelevant. So, while some scientists worked only with "knowledge" (Alexeyeva, 1993), others - only with "information" (Floridi, 2011; Chernavskiy, 2009; Kolin, 2010). Few understood their tight interconnection (Cleveland, 1982; Ackoff, 1989; Zeleny, 2000; Kamp and Stokhof, 2008). Many definitions of "information" and "knowledge" appeared, in particular, the definitions of "information" numbered more then 500 (Beckman, 2009).

For a long time philosophers were engaged in the problems of knowledge (Alexeyeva, 1993). In the second half of the twentieth century, IT specialists actively joined in this, in particular, the area of "artificial intelligence" (AI) (Newell, 1982; Pospelov, 1990). To actively work with "information" and "knowledge", they applied various mathematical models, and began to move further away from the ideas of philosophers. Part of the clash took place about implicit knowledge (Polanyi, 1974).

Statistical theory of information (STI) of C.Shannon was a great success (Shannon, 1948). Some scientists decided to develop this success based on the *Theory of Semantic Information* (TSI) (Bar-Hillel and Carnap, 1953). However, they simplified the presentation of the semantics of the transmitted information, and information contained in texts, in comparison with the achievements of linguistics/semiotics. Constructive results were limited, as indicated by L.Floridi (Floridi, 2011).

Over the past few decades, the *attributive point-of-view* on "information" has begun to be discussed as constituting or directly characterizing the physical world (Burgin, 2016). At the same time, some scientists, in particular, L.Floridi, began to develop the "*philosophy of information*" (PI) (Floridi, 2011).

In the 80s, a *four-level representation* of "knowledge" spread (DIKW-structure) (Cleveland, 1982; Zeleny, 2000). Before that, a *two-level representation* was used in AI research (Newell, 1982). The DIKW-structure includes "*data* (*concepts*)", "*information*", "*knowledge*" itself and "*wisdom*". For a two-level structure of "knowledge", graph and other mathematical methods of representation and processing have been successfully used

for a while. But for DIKW-structure this was not done. In 2012 and subsequent years an approach to the graph and mathematical representation of DIKW-structure got published (Bronfeld, 2012b; 2016a; 2016b) and validated. This shows us that the four-level representation that is the most constructive for working with knowledge and information, and, on the other hand, provides an opportunity to objectively understand the different approaches to information, the rationales of which were built on a verbal basis. Then the number of definitions of "information" begins to fall, some turn out to be wrong, some duplicate the semantic meaning and you can go from 500 definitions to 6 small groups of definitions.

It should be noted that PI was actively developed and supported (Grnkovic and Hofkirchner, 2011; Burgin, 2016). Unexpectedly, the situation has escalated, the question arose about the existence of philosophy in a form that has been formed over thousands of years. Even L.Floridi himself claims "PI risks becoming synonymous with the philosophy" (Floridi, 2011). Some other scientific and technical areas also came under attack and peculiar interpretations. We act as representatives of the direction of AI, and we hope that our ideas will protect several scientific and technical areas, while the fate of the philosophy is for philosophers to decide.

2 Approach to the classification of points-of-view on information

There's a powerful group with an attribute point-of-view on information, as a component or directly characterizing the physical world. It's supported by some philosophers, physicists, and other scientists (Kadomtsev, 1999; Kolin, 2010; Burgin, 2016). Included are adherents to the theory of dynamic information (TDI) (Chernavskiy, 2009). We call this group of definitions "*information*1".

"*Information*2" is the result of actions/communications of highly-organized living or technical entities. (Wiener, 1948). STI of Shannon (Shannon, 1948) based on a statistical estimate of the amount of information, we'll call "*information*3".

Information derived from a data-links is "*information*4", corresponding to "information" (in narrow sense) used in the four-level structure of knowledge (Zeleny, 2000). It has many supporters from seemingly different backgrounds. Similar formulations appear among various respected specialists, for example, J.Martin (Martin, 1977), L.Floridi (Floridi, 2011), Russel S. and Norvig P. (Russel and Norvig, 2002).

The "*sentence*" plays an important part, acting as "information4". For linguistics, it carries a certain *semantic content* - propositionallity, for *semiotics* - a set of symbols. V.Tsvetkov (Tsvetkov, 2012) suggested calling it a *semantic information unit* (SIU), professor MacKay (MacKay, 1969) suggested calling it *logon* to calculate the amount of information.

The legal definition of the term "information" occupies a special place (RF FL, 2006) as "*information*5", "...information is: information (messages, data) regardless of the form of their presentation...". In (Verevchenko et al., 2002) it's noted that this interpretation is more important than just the legal "concept of "information" can be defined as the total

amount of knowledge accumulated by mankind." Let's call "information5" – "information in a broad sense." Such an interpretation is obtained via superimposing all knowledge components from DIKW-structure on each other in a graph representation based on the rules of discrete mathematics. This graph G ("information5") is very complex. It can also be obtained practically, in a special form based on *the technology of direct imposition of knowledge* via methods of AI and computer linguistics as described in (Bronfeld, 2012a; 2014a; 2014b).

The philosophical point-of-view on information, which includes PI, we'll call "*information6*" (Floridi, 2011; Grnkovic and Hofkirchner, 2011; Burgin, 2016).

3 Analysis of knowledge representation structures and ties to information

Now let's pay more attention to knowledge. Firstly, we'll look into scientific knowledge, personal knowledge, and the surrounding nature.

"Scientific knowledge claims to adequately reflect reality and speaks in the name of truth" (Kokhanovsky et al, 2004).

Personal knowledge is knowledge of a particular person, reflecting their experience and ideas about reality, usually not theoretical and systematic in form, and which helps them to navigate the world (Kokhanovsky et al, 2004).

Reality is the world around us with the totality of all existing objects, their interconnections, and natural phenomena (Kokhanovsky et al, 2004). Reality is objective and exists independently of a person, although there're other points of view. Let's, for now, consider the basic concept for many scientific and technical areas, which is also the basis of epistemology.

In any case, a person can describe the world only with the help of linguistic means, recorded as texts (Solomonik, 2016).

A text is a sequence of symbolic units united by a semantic connection, the main properties of which are connectivity, integrity, completeness, etc. Typical representatives of the structural-semantic units are words that serve as certain concepts, reflecting phenomena of reality.

Personal knowledge a person can express either with linguistic units or actions (Polanyi, 1974), which are also described using texts.

It turned out that we have concepts or data that reflect the level of certain parameters of reality (known or unknown to us) and expressed in the textual form (Kamp and Stokhof, 2008).

Let's take into account that knowledge is divided into explicit and implicit (Polanyi, 1974; Russel and Norvig, 2002), focusing on scientific knowledge, personal knowledge, and the surrounding nature.

To describe knowledge in AI, an idea of a two-level structure of knowledge, most widespread, has long since been formed (Newell, 1982; Russel and Norvig, 2002). The basis is data (concepts) - individual facts characterizing objects, processes, and

phenomena of the subject area with their properties. Then knowledge is well-structured data or data about data - metadata.

3.1 Four-level knowledge representation

Let's consider in more detail the four-level representation of knowledge, which we think is a more interesting concept of the systematology of knowledge in relation to information, and is acceptable for describing scientific knowledge, personal knowledge, and reality. Then, from the perspective of new results, we'll analyze the mentioned structures again.

Per DIKW-structure (authors M.Zeleny (Zeleny, 2000), H.Cleveland (Cleveland, 1982) and close to them in essence, R.Ackoff (Ackoff, 1989)) knowledge consists of:

- data (concepts);
- information;
- knowledge (in a narrow sense);
- wisdom.

Data is "...simplest element of knowledge, its purpose is unclear and ambiguous, it has a large degree of freedom..." (Zeleny, 2000).

"Information is characterized by higher concreteness of the goal, with combining of concepts or data ... Once the data is converted into information, it's difficult to return it to its original state (just as it's impossible to reconstruct individual observations from their average value) ..." (Zeleny, 2000).

"Knowledge covers the real process of processing input data ... including coordination of actions to achieve results, goals, or obtain products" (Zeleny, 2000).

"...wisdom is related to explainability: if a person knows why - not just what and how - then he's not only well-informed or well-grounded but possesses knowledge and competence..." (Zeleny, 2000).

This approach accurately describes the view of M.Zeleny (Zeleny, 2000) on knowledge - "...knowledge is a purposeful coordinated action...". Its only evidence or method of demonstration is to achieve the goal. Its quality can be evaluated by the quality of achievement (its product) or coordination (its process), especially if uncontrolled factors interfere.

Let's clarify some concepts, firstly, data (concepts), though this proves to be very difficult.

What can act as basic data elements? It's (Martin, 1977; Floridi, 2011) a number, aggregate of numbers, word (concept), phrase, individual letters and sounds, elements of graphics, images, audio and video recordings. Moreover, from any kind of media, both printed, handwritten, and machine sources, as recordings of individual signals from any kind of sensors.

What's important, the data can appear as a result of any type of processing, manual or machine-based, and take the form of tasks (orders) from a person. For systemics, what we consider "data" at the moment, will be considered as such in a specific system.

The basic data elements (X) will be represented as a set of unconnected vertices $v_1, v_2, \dots, v_i, \dots, v_k \in V$ (fig.1).

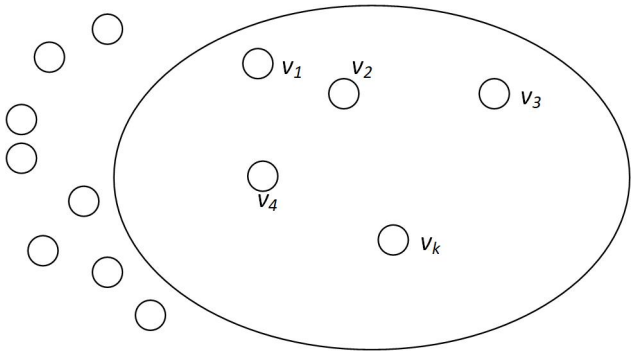

Fig.1 Data

On other components of the DIKW-hierarchy more below.

The well-known abovementioned representation of knowledge models as a two-level structure using semantic networks, which can be described as an undirected graph $G(V, E)$, where V – vertices, E – edges (relations) between them. Vertices correspond to definitions of data (concepts) in the form of a set X. Definitions of types of relations (connections) are defined as the set T connected by mappings $D: X \to V$ and F: $T \to E$.

3.2 Formal representation of the four-level structure of knowledge

Let's extend a formal representation of a two-level structure of knowledge to four-levels:

- data (concepts) – vertices V' of the graph $G_D(V', \emptyset)$ correspond to them, where $E = \emptyset$ - fig.1 (V' and E' to be defined later);
- information – graph $G_I(V', E')$, has at least one edge – fig.2;
- knowledge – path in the graph leading to a certain result (vertex) – fig.3;
- wisdom – explanation why this particular path is chosen from an infinite set – fig.4.

Data (concepts), in particular, include vertices $v_1, v_2, \dots, v_i, \dots, v_k \in V$ (fig.1), which are set directly. However, when solving a specific problem, an unlimited additional set of data may be required V_g, moreover $V \cup V_g = V'$ - the original fixed set X and additional X_d, analogously connections are fixed T and additional T_g, and $D_g: X_g \to V_g$. Therefore $D \cup D_g = D'$.

Both scientific knowledge and personal knowledge are full of additional data and concepts X_g (with connections T_g), relevant to reality, and necessary to solve emerging problems.

Information (fig.2) includes edges $v_1v_4, v_2v_4, \dots, v_3v_k \in E$.

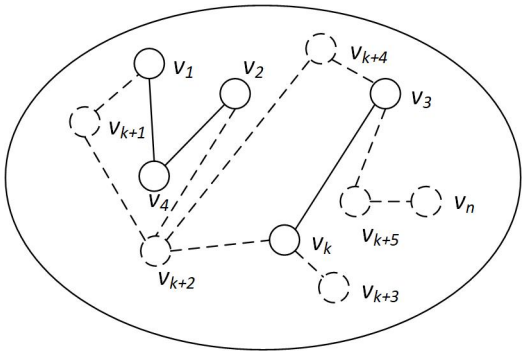

Fig.2 Information

I.e. hidden next to the basic data set V, an additional data set (concepts) V_g implicitly appears, connected with the initial data (concepts) in some way.

$v_1v_{k+1}, v_{k+1}v_{k+2}, v_2v_{k+2}, v_{k+2}v_{k+4}, v_{k+2}v_k, v_{k+4}v_3, v_kv_3, v_kv_{k+3}, v_3v_{k+5}, v_{k+5}v_n \in E_g$

These connections can apply to both *explicit* and *implicit* (personal) knowledge.

Then $E \cup E_g = E'$, which corresponds to $F_g: T_g \to E_g$ and $T \cup T_g = T'$.

The knowledge (fig.3) is known here, correspondingly, the solutions are known. But if the solution is unknown? This is what a new technology for IS-development based on TDIK is aimed at. Bear in mind that for many specific tasks (problems) it's initially known that there's a solution, just need to determine which one, specific parameters and clarify the implementation process

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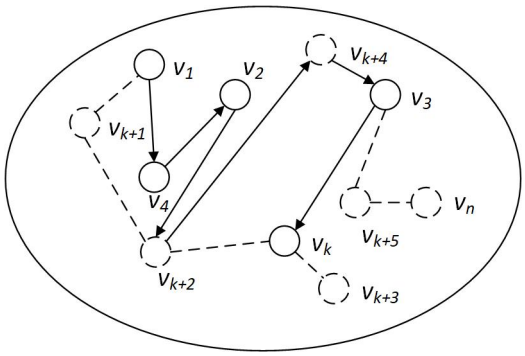

Fig.3 Knowledge

In fig.3 it's a set of specific routes from a group of starting vertices $V^0 \subset V'$ to a group of ending vertices $V^R \subset V'$:

$s_i = v_1 v_4 v_2 v_{k+2} v_{k+4} v_3 v_k \in S$,

where $v_1 \in V'$, and $v_k \in V^R$, $v_1, v_4, v_2, v_{k+2}, v_{k+4}, v_3, v_k \in V_S$,

$v_1 v_4, v_4 v_2, v_2 v_{k+2}, v_{k+2} v_{k+4}, v_{k+4} v_3, v_3 v_k \in E_S$,

and knowledge is a graph $G_K(V_S, E_S)$.

Wisdom (fig.4) is in explaining why a specific solution is needed compared to others, in a multitude of interpretations M_{si}, the usefulness of the i-th path s_i:

$m_{si} = v_{k+1} v_{k+2} v_k v_3 v_{k+5} \in M_{si}$.

And wisdom itself can also be represented as a graph $G_W(V_{M_{si}}, E_{M_{si}})$,

where $v_{k+1} v_{k+2} v_k v_3 v_{k+5} \in V_{M_{si}}$, $(v_{k+1} v_{k+2}), (v_{k+2} v_k), (v_k v_3), (v_3 v_{k+5}) \in E_{M_{si}}$.

In the explanation m_{si}, data can be used that's not involved in the original description V, but which is included in V_g.

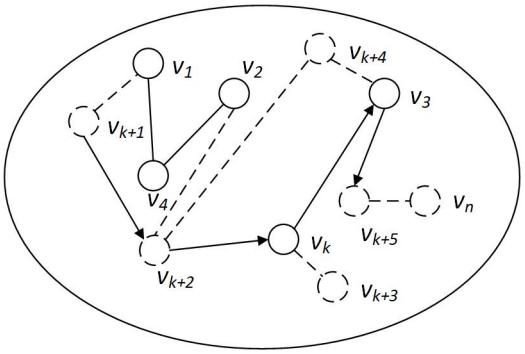

Fig.4 Wisdom

Let's note, graph $G_I(V', E')$ can generally have the form of a hypergraph with increasingly complex types of connections, and the paths s_i and m_{si} can have closed loops with the repetition of vertices and edges. A simpler example is considered here, more complex representation in any nonlinear variant won't change the essence of the issue.

It should be noted that graphs $G_D(V', \emptyset)$, $G_I(V', E')$, $G_K(V_S, E_S)$, $G_W(V_{M_{si}}, E_{M_{si}})$ can be combined the join operation of discrete mathematics, since $V_S \subset V'$, $V_{M_{si}} \subset V'$:

$$G_U = G_U(V', E') = G_D(V', \emptyset) \cup G_I(V', E') \cup G_K(V_S, E_S) \cup G_W(V_{M_{si}}, E_{M_{si}}) \quad (1)$$

The graph G_U is shown in fig.5, where it's shown that all vertices V' can be directly or potentially connected. The graph G_U is the "information5" - information (in the broad sense) that we've already talked about. The V' contains all information (concepts) available to a person, both specifically for the task being solved, and in any possible variant of its expansion. Within G_U are not only all possible kinds of information $G_I(V', E')$, but all possible kinds of graphs containing knowledge $G_K(V_S, E_S)$ and wisdom

$G_W(V_{M_{si}}, E_{M_{si}})$. Currently, there's no constructive option to pull some new, meaningful knowledge (a new path s_i') or explanation (wisdom) m_i' out of the chaos of the graph's connections, other than the approach worked out by millennia of consistently developing worlds science.

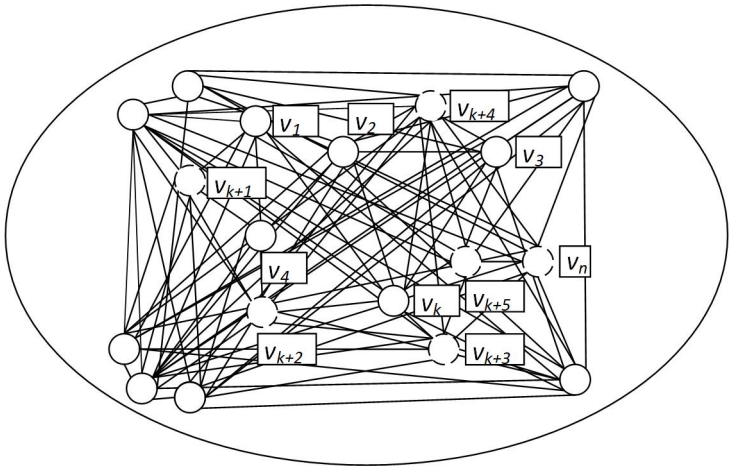

Fig.5 "Information5" – information in broad sense

The full formal description of the DIKW-structure (Bronfeld,2012b;2014b):

$$ZN = < X'^0, X'^R, D', F', G_I(V', E'), S, M_{sk} > \quad (2)$$

where X'^0 – subset of initial datapoints (concepts), $X'^0 \supseteq X^0 \subset X \subseteq X'$,

and X'^R – subset of final datapoints (concepts), $X'^R \supseteq X^R \subset X \subseteq X'$, relatively to which knowledge exists;

D' – definition of source data (concepts);

F' – definition of connections;

$G_I(V', E')$ – information;

S – paths on the graph that provide a useful transition from the initial subset X'^0 to final subset X'^R;

M_{sk} – interpretations explaining the utility of the k-th path s_k.

4 Ontological comparative analysis of the four-level knowledge structure with some of information and knowledge definitions

Let's carry out an ontological analysis of existing theories using a wider range of concepts, including meaning. We won't proclaim our creative impotence in the face of diverse nature, as a considerable number of authors do (Fridland, 2008; Grnkovic and Hofkirchner, 2011; Burgin, 2016),

We'll analyze the situation with the key definitions "information2", "information3", "information4", "information5" and identify some of their ontological connections between them and the DIKW-structure of knowledge.

We'll start with the data, having already examined its conceptual interpretation in section 1. It can include individual numbers, signals, and words – concepts (Martin, 1977; Verevchenko et al., 2002; Floridi, 2011; Solomonik, 2016). On one hand, it's known that the parameters are measured with certain accuracy and subjected to specific processing, often strictly standardized (ISO/IEC, 2009), on other hand, the verbal concepts are vague (Zadeh, 1973; Solomonik, 2016). L.Floridi (Floridi, 2011) also speaks about this and puts forward special, not easy to satisfy, requirements for the veracity of data.

The sharp contradiction between the real problems of practice (Zadeh, 1973; Dibrova et al,2008) and some theoretical constructions is important, for example, D.Chernavsky (Chernavskiy, 2009) - "…Information is the remembered choice of one option from several possible and equal…". This definition applies to data. What's different and equal about options in "the apple is on the table"? If the apple is a lemon, then information is completely different. Each concept may be inaccurate, but not so much as to be considered equal, although exceptions do occur. We must recall the point-of-view on the meaning of the speaker and the perceiver - "the speaker ... in the ability to express the same thought in different ways, and the listener in the understanding of semantic identity or the similarity of outwardly different statements" (Zholkovsky and Melchuk, 1967). The same contradiction is in (Brillouin, 1964).

Some have already sunk to levels of - "Information exists... It doesn't require mental efforts for interpretation. To exist, it doesn't need to make sense." (Stonier, 1990). But for the widest areas of scientific and technical fields, data/information without meaning is useless.

Moving on to "information2". The main interpretation here is the many definitions related to versions of the *theory of reflection*, both by man and sophisticated technical means (Wiener, 1948; Ursul, 1973; Fridland,2008), which may also be associated with information transfer processes. The peculiarity of such definitions is in only tracing how "something" is perceived by a person or complex technical means, without saying anything about what this "something" is. But since this process of "reflection" is taking place, it cannot be ignored, especially when transmitting information. Therefore, we'll use definitions of the "information2" as auxiliary ones.

This group also includes the "*semiotic theory of information*" (SemTI) (Eco, 2016) and TSI (Bar-Hillel and Carnap, 1953; Floridi, 2011; Zercal, 2014a). We'll note that SemTI is

a serious theory and science of semiotics, tried and tested for more than 100 years, and has serious practical applications. It would have had a lot in explaining problems with the information, if not for relative lack of knowledge of mathematical methods among its supporters, which had pushed semiotics aside when discussing problems with information.

Then TSI came to the fore as a reaction to the great and resounding success of C.Shannon with his STI. However, it always considered very simple structures in the context of information, which was quickly noticed by professionals. I.I.Grishkin has a good critical analysis (Grishkin, 1973). Still, real information, its semantic content, which has long been studied by linguists and specialists close to them (Eco, 2016; Solomonik, 2016; Russel and Norvig, 2002), in particular, semiotics and AI experts, were more complicated than those models used in the TSI. It now looks like a “child assembling a lego-car" instead of examining a real car. But we must admit that between back then and actual application of AI methods with knowledge models and a real study of the complexity of texts and working with them was at least a quarter-century. Now even synergetics is seeing use to study the depths of textual content (Belousov,2016). The criticism of TSI by L.Floridi, who called one of its key contradictions "the Bar-Hillel–Carnap paradox" (Floridi, 2011), was already a "belated shot" at something that hadn't yielded any new theoretical and practical results except more and more new publications.

Regarding the Shannon approach in the framework of STI (“information3”) and the approach related to G – it’s suitable for obtaining vertices, and for the analysis of edges and routes in the graph of both the graph G_I and the graph G_U. Consider fig.6.

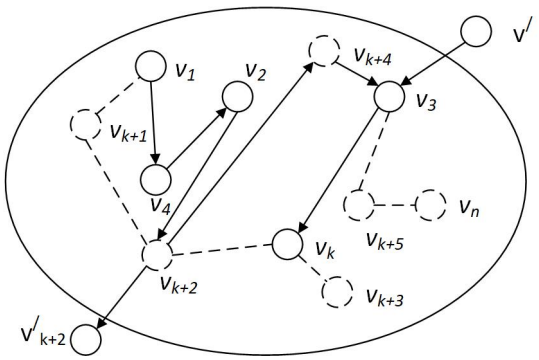

Fig.6 Interaction of the system within with the environment

It presents a system of interaction of certain data/information flows (in a narrow and wide sense) inside the system and with the environment. All real systems of this kind are open systems (Uemov, 1978), except in rare special cases when they're considered as closed. In fig.6, it's not just a transition from one vertex to another according to a formal representation, there can also be some data/information flows, for example, from v_1 to v_4

or from v_3 to v_k, when interacting with the external environment from v_{k+2} to v'_{k+2} or from v'_3 to v_3. Here you can apply the Shannon STI to evaluate the transfer of data/information, calculate the bandwidth, provide noise immunity, etc..

The STI fits perfectly with the four-level approach to the structure of knowledge (Cleveland, 1982; Ackoff, 1989; Zeleny, 2000) and people supporting this approach (Russel and Norvig, 2002; Tsvetkov, 2012; Zercal, 2014b), even more so in the advanced version (Bronfeld, 2012b; 2014b; 2016a; 2016b; 2017). There's no conflict here, and the semantics associated with connections and structures at the level of knowledge and wisdom have nothing to do with Shannon's approach.

Definitions of "information4" are among the main ones in our consideration. Firstly, the definition of information as a "data structure" which is the basis of the DIKW-structure of knowledge, discussed in section 3. The same view corresponds to a structural approach to information, supported explicitly or implicitly by very prominent specialists and scholars – J.Martin (Martin, 1977), S.Russel and P.Norvig (Russel and Norvig, 2002), academician A.Ershov (Ershov, 1988). The key point of the approach to the GDI information structure from L.Floridi fully consistent with the definition of information in paragraph 3.1 and graph G_I.

Here goes an idea of D.M.MacKay (from the 1950s) on the structural representation of units of information as a whole - sentences, and calling it logon (MacKay, 1969), and counting the amount of information in logons, each of which can carry its semantic content. Sadly, people didn't listen to him and almost forgot, while this proposal was perfectly aligned with the approach of linguists and semiotics, and later wouldn't contradict the direction of AI.

V.Ya.Tsvetkov's modern point of view considering "…the sentence of the text as a semantic information unit (SIU), which has indivisibility in the semantic union of related words and expresses a complete thought…" is also aligned with this view (Tsvetkov, 2012).

Already noted, data - corresponds to the vertices of a certain graph *G*. Information (in the narrow sense) is a graph G_I, with at least one edge (set of different graphs) with vertices from $G(G_I \subset G)$. Then knowledge (in the narrow sense) is a path/s in the graph $G(G_K \subset G)$, leading to some result. Wisdom – the clarification of why this particular route was chosen for specific knowledge – representing paths, differing than for knowledge. "Information4" is a set of subgraphs G_I in graph $G(G_I \subset G)$.

The legal definition of the "information" is very important (RF FL, 2006,Verevchenko et al., 2002), named by us "information5" (Bronfeld, 2012b; 2014b; 2016a; 2016b) - "Information (in the broad sense)". Per it - "...information is "data (messages, signals) regardless of the form of its presentation..." (RF FL, 2006). It's also obtained via the mathematical operation of combining the graphs of "data", "information (in the narrow sense)", "knowledge", "wisdom" in the form (1). As a result of (1), we obtain a very complex graph G_U – the graphical representation of "information5".

A way to do this not only mathematically, but practically, via the TDIK in the framework of AI and linguistics methods, is described in (Bronfeld, 2012a; 2014a; 2014b; 2017).

It's necessary to clarify that since in the general case the components of "information5" may initially not be interconnected, be very heterogeneous, and when superimposed, new relationships arise that completely distort the original ones (even for just two components), then collectively, this new entity hardly deserves a name other than "garbage" (fig.6). There's a gigantic difference between the original "information4", which may carry some kind of small semantic content and "information5". For STI this doesn't matter as anything can be sent via the transmission channel in any form, incl. encrypted.

But many don't share these concepts/states of the term "information", building it up, almost as "…foundation of the world…", for example, as I.Yuzvishin (Yuzvishin, 2000), T.Stonier (Stonier, 1990), M.Burgin (Burgin, 2011). Certainly, some subject areas can use their private terms for their purposes, which is connected with the well-known problem of the fuzziness of natural language, but in our opinion, it's not serious to substantiate and solve certain general scientific problems on this basis.

On this point, I.Kant wrote his famous work "Critique of Pure Reason" (1781), expressing the point-of-view that all our ideas are subjective, we can go far in our minds, but we need to verify this with theory and practice and gradually reveal the "thing-in-itself".

Now, about the what we called "information6" (Bronfeld, 2012b; 2016a; 2016b). It includes the most popular "philosophy of information" (Floridi, 2011; Burgin, 2016), as well as several others. One of its main promoters in the world is L.Floridi (Floridi, 2011; Grnkovic and Hofkirchner, 2011). It's interesting that he actively applies fairly complex mathematical methods. Among the minuses of his views from the point-of-view of philosophy is that he's trying to draw into the sphere "philosophy of information" (Kamp and Stokhof, 2008; Floridi, 2011; Grnkovic and Hofkirchner, 2011) epistemology (which philosophers have been doing successfully for more than 2000 years) and even the problems of the modern AI development. Other highly controversial philosophical concepts related to information are also known (Stonier, 1990; Yuzvishin, 2000; Burgin, 2011; Grnkovic and Hofkirchner, 2011). As already noted, these latter concepts can be considered the development of (relation of) some attributive approaches to information, wherein fantasy begins to overflow and the scientific approach along with the Occam's razor get completely forgotten.

In our opinion, people with these refinements and studies in physics and philosophy, and with disputes among themselves in the areas of "information1" and "information6" will probably spend millions of years, perhaps even with variable conclusions.

Now let's consider the ontological connections of the concepts of knowledge. As a rule, there're fewer discrepancies, firstly because philosophers have already slaved away discussing them for more than 2000 years. However, the 20th century brought new ideas.

The first of them, and one of the most discussed, is a four-level structure of knowledge (Cleveland, 1982; Ackoff, 1989; Zeleny, 2000), proposed by H.Cleveland, management specialist in 1982. Supplemented by us (Bronfeld, 2012b; 2016a; 2016b) and with mathematical justification, it turns out to be quite competitive with other concepts for mass practical use, fitting perfectly with some seemingly opposing (Kamp and Stokhof, 2008; Floridi, 2011).

From the very beginning, 2000 years ago, knowledge was considered on an *active basis* (Johannessen, 1988; Alexeyeva, 1993), which doesn't contradict the modern DIKW-structure of knowledge (Zeleny, 2000).

Even easier with unformalized knowledge (tacit knowledge) that's contained in a person's head, as M.Polani considered (Polanyi, 1974). It exists and many IT, in particular, of AI-development, are aimed at integrating it into useful activities.

In theory and practice, the concept of meaning is actively used (Averyanov, 1993; Kamp and Stokhof, 2008; Lukin, 2009). Since it's related to user perception (Lukin, 2009; Belousov, 2016), it can be ambiguous when read from texts, starting with individual sentences and individual words. This is even more emphasized in semiotics, where the important role of symbols is noted (Eco, 2016). In general (in our opinion) the concept of *meaning* contains both knowledge and wisdom, which differ in a four-level structure of knowledge (Zeleny, 2000). And the meaning is naturally contained in the texts, but linguistics, as a rule, doesn't distinguish them (knowledge and wisdom) (Lukin, 2009; Belousov, 2016), rarely even recalls information.

At last, *texts* (Kamp and Stokhof, 2008; Lukin, 2009; Belousov, 2016). It's precisely because of them about 70 years of heated discussion of the problems of "information" have unfolded. Indeed, it's their different content from individual characters to gigantic volumes, especially in an encrypted form, that will look to the outside observer like "garbage", for example, in case of a malfunction in the information transfer channel or very strong interference. It's the content of texts carried by the structures of "information" that can affect people, technologies, technical, natural objects, and phenomena. Why such confusion has arisen and has been maintained for 70 years and the severity of problems and fantasies centred on "information", is a different complicated question to answer.

5 Conclusion

As a result, the 70-year period of chaos in the problems of "information" and "knowledge" can end for practical application in many areas of science and human activity, and get a mathematically constructive basis via a four-level structure of knowledge for research in this area. This approach allows you to go from 500 different definitions to 6 small groups of definitions.

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Experimenting Design Thinking in RRI as a Model of Knowledge Exchange between Bottom-Up Initiatives and Policy Making

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Abstract

Responsible Research and Innovation (RRI) is characterized by a different attitude towards scientific research and development processes taking in account potential impacts on the society and ecosystem previously to the actual implementation. RRI has spread as a new approach towards the design of policies, services and products including the various actors not only in the final solution but also throughout the entire development. Even this perspective has been widely discussed in theory, it is facing issues in being transformed into practice.
This article discusses design thinking in RRI as an approach to stakeholder engagement aiming at operationalizing RRI while exploring its impacts.
This is done by means of ten real-life experimentations within the project SISCODE funded under the Horizon 2020 programme.
The experiments are conducted by 10 different innovation labs across Europe launching bottom-up initiatives to work on context-based challenges producing new forms of evidence for policy makers about the effectiveness of co-design in RRI and how co-design can contribute to shorten the distance between STI policy making and society.
This potential is explored concretely to feed theoretical studies on putting RRI into practice. At the same time, it is aimed to open the practices of policy making to evidence coming from real co-design: context-based initiatives shall trigger and reinforce the learning process of policy makers to become more open to experiment with policies.
This paper describes the design research for SISCODE that is mainly based on the notion of codesign experiment in real contexts as a playground for policy makers and its following

application to verify the assumption that: local design projects developed in response to specific societal challenges could work as living prototypes for the policy makers to observe directly how codesign work and to take advantage from the evidence produced during these experiments to develop and better define policies.
The paper reports the main results obtained during 1 (January 2019-January 2020) year of experimentation in the 10 labs with respect to the engagement of policy makers and the effectiveness of design thinking as an approach to make RRI into practice. Results discussed in the following are based on the triangulation of the data coming from a self assessment exercise conducted by the labs at the beginning of the project (co-creation knowledge baseline) and after 1 year of development, and the data from the labs case studies as developed by project researchers.

Keywords – Co-design, knowledge exchange, Responsible Research and Innovation (RRI), policy making, bottom-up initiatives

Paper type – Academic Research Paper

1 Introduction

Responsible Research and Innovation (RRI) has been upcoming and spreading as a new approach towards public engagement in STI (Science, Technology and Innovation) initiatives proposing a new attitude of anticipating and evaluating potential impact of initiatives including societal actors in the field of research and innovation rather than making effort to create accurate representations of former initiatives (Wouters, 2017).

Those initiatives can be traced back to a detected lack of consciousness regarding the needs and roles of actors in the development of STI initiatives (Rask et al, 2018). Therefore, new approaches are necessary to explore those needs and include those societal actors from the beginning into the process (Jacobsen et al, 2019).

The emergence of RRI practices therefore does not only determine project results, but mainly the way in which participants relate to each other and collaborate as well as the manners and methodologies of work. Including actors into the development to obtain a more holistic view and better predict impacts makes it a promising approach towards the development of STI initiatives raising the interest of both researchers and practitioners.

Despite the amount of attention RRI has received in the field of research and theory, it has been struggling to prove its potential in practice and its capacities to make an impact (Rowe and Frewer, 2005; Emery et al 2014).

This can be traced back on the lack of evidence of impact on policy, and lessons of what worked are still very limited (Deserti, Rizzo & Smallman, 2020). This appears to be because there has been little research into policy impact (Rowe and Frewer, 2005; Emery et al 2014) and because research has found little evidence of impact (Hansen & Allansdottir, 2011; Kurath & Gisler, 2009; Loeber et al., 2011). The reasons for the lack of impact focus on the reflexivity of the policymaking institutions – that the problems policy sets out to solve and the role of STI in that solution is pre-determined and not open for discussion. This leads to potential misunderstandings and frustrations as public

participants feel simply being asked to market-test the acceptability of technologies while institutions appear to see public participation as a way to gain trust for a predetermined approach, rather than to rethink policies and practices (Chilvers, 2012; Macnaghten & Chilvers, 2014; Stirling, 2007; Thorpe & Gregory, 2010; Wynne, 2006). Instead, scholars argue that it is vital that the problems to be solved and the kind of solutions sought are framed by public participants from the identification of the problem to then co-create solutions. The 'ScienceWise guiding principles for participation in science and technology policy' (Sciencewise, 2018) echo this, recommending that participation commences as early as possible in the policy/decision process. They also suggest that "where appropriate, we will work with participants to agree framings that focus on broad questions and a range of alternatives to encourage more in-depth discussion. For example, we might start by asking, "How do we provide for our energy needs in the future?" rather than by asking "should we build new nuclear power stations?" (Sciencewise, 2018).

The motivation to explore the potential that co-design may hold to operationalise RRI roots in the lack of investigation in practice and evidence of impact (Rowe and Frewer, 2005; Emery et al 2014).

2 Co-design as an opportunity to operationalise Responsible Research and Innovation (RRI)

The issues stated above demand a new and different approach to overcome the existing barriers in operationalizing RRI. While the theoretical concept reached wide interest and is in line with recent trends of tackling big societal challenges (Von Schomberg, 2013) there is still a lack of definition and methodology on how RRI could be turned from a theoretical concept into practice (Von Schomberg, 2013).

Co-design and design thinking have been identified as an approach that may hold the potential to overcome those barriers (Blomkamp, 2018) since it withholds promising aspects to tackle issues identified in the operationalization of RRI. On one hand, co-design is an approach to practice that, rooted in participatory processes, allows a wide range of actors to contribute to a solution starting from the analysis of the problem until the implementation of a solution (Brown, 2009).

The variety of actors involved with diverse concerns require mutual comprehension and collaboration to align the different interests. On the other hand the particularly practice-based approach of co-design could contribute to the definition of the role and impact of citizen engagement in research and innovation development and the formulation of STI policies.

Very few contributions in RRI literature have introduced the perspective of co-design and co-creation, borrowed from the literature previously mentioned, with the aim to evolve the concept of RRI from a model of two-way communication towards a process of research and innovation development. These contributions have introduced co-creation to overcome some of the current limits and weakness in RRI aiming to:

- fill the gap on how to introduce RRI into real solutions/implementations; deal with wicked problems often identifying societal challenges and that require a non-linear model of innovation (iterative design);
- introduce a mechanism for getting equal partnership between diverse stakeholders (including citizens).

Nathan (2018) discusses the shortcomings of linear innovation process models, especially technological innovation, and introduces design thinking (and co-design) as an improved, circular responsible innovation process model, especially for wicked problems, in order to embed ethical decision-making at the organizational level by taking into consideration both internal and external stakeholders and networks. Gudowsky and Peissl (2016) report the experience conducted within CIMULACT with co-design workshops led by expert designers who involved citizens in the prototyping of different research agendas to support the idea selection process and include citizen knowledge in a European research programme. The authors underline the role of co-design tools as fundamental and a common language among the participants that were co-designing prototypes of agendas to be further discussed and re-designed.

Within the frame of the FoTRRIS H2020 project, the partners carried out a "co-created RRI experiment". Bajmócy and Pataki (2018), synthesizing the results of one of these experiments, underlined the role of co-creation as a trans-disciplinary knowledge creation mechanism for getting equal partnership of diverse stakeholders (including citizens) in concretely addressing societal challenges. Co-creation also brought a different distribution of power into the process that resulted in changes regarding the aims, the process, the timetable and the success indicators.

However, until now co-creation and RRI have developed as two separated areas of knowledge with rare intersections and cross fertilisation among each other. Even if the EU research policy has conceived co-creation as a new and promising paradigm of innovation to be funded, it has been separated from RRI as an ethical perspective from which to face science and innovation development.

In principle, upstream citizen participation in science and technology implies mechanisms to enable two-way exchanges between different publics and powerholders about technology governance with its development still in an early stage aspiring to align the goals of the techno-scientific enterprise with societal values.

However, in practice many engagement processes still "fall short in terms of true citizen participation, as an evaluation of 70 international engagement initiatives on nanotechnology found. When evaluated against the 'Ladder of Citizen Participation' most fell in the lower categories of manipulation or tokenism" (Sutcliffe, 2011).

With respect to its practical viability, RRI has massively recurred to the use of tools to support user and stakeholder engagement producing toolboxes collecting tools and instructions for future uses. RRI has primarily focused on media, political and social sciences (Burns, O'Connor, and Stocklmayer 2003; Durant 1999; Schuurbiers and Fisher 2009) where there is a long tradition of research on two- and multiple-way

communication models and tools to support the democratisation of policy making processes political decision making.

However, the tools and toolkits developed in RRI present limits and controversies that seem to be in line with findings from literature:

- tools and toolkits in RRI are developed to support the integration of stakeholder knowledge, requests and needs in policy development. These are mainly linear upstream processes rarely including long-term experimentations or a trial-and-error approach
- tools in RRI are mainly used and manipulated by researchers;

RRI practice does not include prototypes, representing a specific category of tools in design thinking culture to co-design and test solutions

On the contrary, tools and toolkits for design thinking are developed for a process of innovation from ideation to prototyping and the delivery of a solution based on an iterative process (through experimentation) to reach a solution aligned with all needs and interests identified (Sanders and Stappers, 2014). Design Thinking tools are visual-based, meant to be directly manipulated by the stakeholders allowing discussions among participants until reaching a common representation (iteration). Finally, Design Thinking is based on massive use of prototypes as particular tools to represent a possible solution and support the phase of experimentation in the process of innovation.

Therefore, the aspect of actor involvement in Design Thinking and RRI is somewhat similar and the methodologies and techniques used in Design Thinking eventually hold the potential to be applied in RRI landscapes to overcome some of the limitations mentioned above. In particular, the practice-based approach of co-design could feed this lacking aspect in RRI initiatives translating tools, practical methodologies and suggested activities from the field of design thinking into a new context of application.

The creation of this interconnection to operationalize RRI is the core objective of the SISCODE project described in the following.

3 The SISCODE project, its methodology and model of knowledge exchange

SISCODE[1] (Society for Innovation and Science through CO-DEsign, n°788217) is a project funded within the European Union's Horizon2020 programme aiming to explore the use of co-creation in STI policies making to understand its potential and build up an evidence-based learning framework.

SISCODE's research develops around a reflective framework and knowledge repository and consists of extensive desk research including case studies, a co-creation experimentations conducted as pilot projects and a series of workshops with policy makers to emphasize the specific aspect of co-design in policy making (Figure 1).

[1] *https://siscodeproject.eu/*

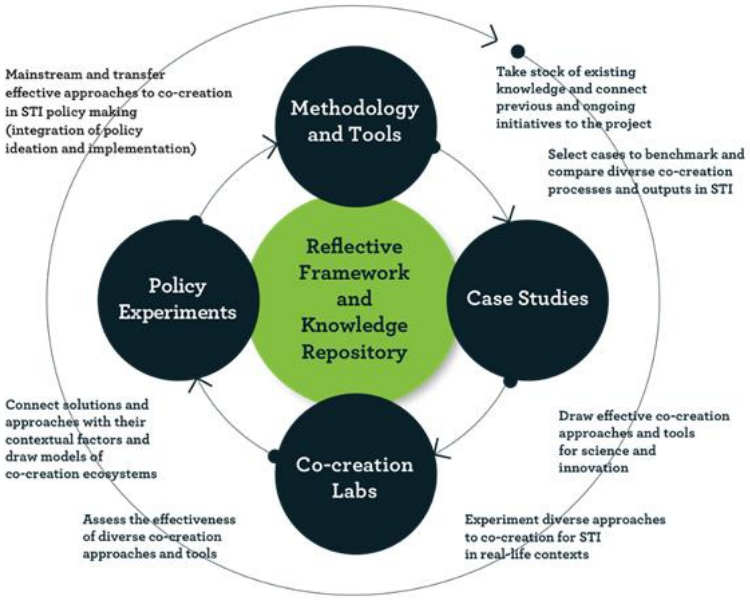

Figure 1 - SISCODE's learning model

The objectives of the SISCODE framework are on one hand to trigger reflection on a more practical and context-sensitive perspective in the actual application of RRI. On the other hand, the application of co-design could open new ways for participative and experimental policy making (Deserti & Rizzo, 2015; Brown, 2009).

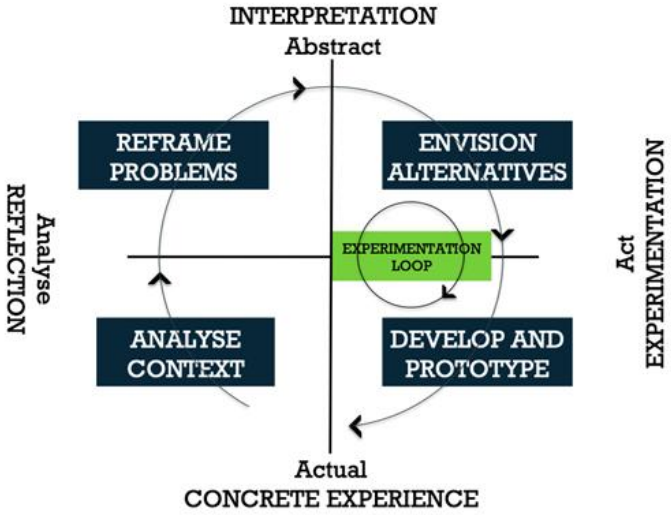

Figure 2 - SISCODE's experimentation model

The pilots' model is based on the adoption of co-design methodology for the conduction of real-life experimentations that have been carried out with local actors of each lab's ecosystem in a process of action research (Figure 2). The pilots' role in the overall project is to improve knowledge on design thinking in a learning-by-doing process that may fit to operationalise RRI as a long-term co-creation process in real contexts.

10 pilot projects set up in 10 European countries operating in various fields like healthcare, education or environment are creating solutions and influencing policies to actively involve society in innovation and science.

The pilots were developed bottom-up analyzing the context in terms of local challenges and policies, reframing the identified problem and envisioning alternatives. The idea has then been co-produced and prototyped to be evaluated leading to a new loop of co-design and prototyping in an iterative process (Figure 2).

Each lab identified a challenge particularly relevant in their specific context (Table 1) to consider its potential of being scaled up and transferred also to different contexts later on.

Table 1 table of all labs, their challenges and solutions developed

Lab	Location	Challenge	Solution
ThessAHALL	Thessaloniki (Greece)	Preventing **social exclusion** through life-long learning	**Partners of Experience,** a participatory research programme for older adults and chronic patients
Traces	Paris (France)	Raise awareness on **algorithmic decision making** in cultural activities	**Co-construction and culture for and by AI,** an informal learning show with artificial intelligences as the audience
KTP	Krakow (Poland)	Improve the **air quality in Krakow**	Preparation of the new **Air Protection Programme** for Malopolska
Underbroen	Copenhagen (Denmark)	Create a **circular plastic recycling system**	**PIPO,** a circular system for local sourcing, recycling and production of plastic
Polifactory	Milan (Italy)	Improve **movement** of children affected by **cerebral palsy**	**BODYSOUND**, a system of motor stimulation based on the transformation of movement into sound
Fab Lab BCN	Barcelona (Spain)	Synergise for **redistributing, upcycling and composting food waste**	**El Barri Circular**: a Symbiotic System for food surplus and bio waste valorisation
Ciencia Viva	Lisbon (Portugal)	**Rise interest in & improve accessibility** to the Lisbon **river**	**Build your own boat:** A yearlong workshop for the construction of usable watercrafts

PA4ALL	Novi Sad (Serbia)	Introduce **ICT in high-schools specialized in agriculture**	**ICT based education programme** in high-schools specialized in agriculture
Science Gallery Dublin	Dublin (Ireland)	Improve **mental health and well-being** management with young people	**Open Mind:** Empowering young people to understand the importance of mental health and creating clubs for them to support each other
Cube	Kerkrade (Netherlands)	**Improvement of life quality** for people of **all ages**	**Citizens Lab X Ransdaal:** Supporting bottom up social innovation

The pilots designed their project plan together with citizens, users, stakeholders and policy makers to provide an extensive overview of possible pathways taking all actors in consideration and therefore set up a more realistic and holistic journey.

The projects all applied the cyclical process of co-design (Fig 2), and using different co-design tools and methodologies.

The variety of parameters and kinds of data to be collected throughout the development of the 10 pilots journeys required the development of a framework going beyond one single tool for monitoring and assessing:

- the knowledge exchange and uptake in the pilot's organisations and ecosystems was to be assessed as a crucial point to be able to draw conclusions on the learning model and its functionality. Therefore, the diffusion of co-creation as a methodology and the identification of problems related to its application together with potential ways to overcome those issues has been investigated.
- the interactions with policy makers and activities related specifically to policy making needed to be monitored to produce insights on the effectiveness of tools and techniques and best practices to be further disseminated.

4 Monitoring and assessing (in) the SISCODE project

As stated previously, one of the difficulties in operationalizing RRI and spreading it in practice is its difficulty to be measured and assessed and the resulting issue in proving impact and success.

In order to cope with this issue the SISCODE project defined an assessment framework to keep together the general success of the pilots (including single methodologies and tools applied to validate their effectiveness and appropriateness in the different contexts) and the overall project capacity to cope with short and long terms expected impacts.

The framework has been created defining a set of indicators both taking the specific objectives of the project and the relevant factors of RRI in consideration.

The indicators on RRI initiatives have been extracted and adapted from the MoRRI project, a 4-year project with the aim to monitor and assess ongoing RRI initiatives and

their benefits. The project has produced a total of 36 indicators on 6 different dimensions to be measured in RRI initiatives (Meijer et al., 2016) SISCODE applied to develop its own indicators.

The elaboration of the SISCODE assessment framework led to the division in three different areas to be specifically explored during the assessment:

- **Stakeholder engagement**, as one of the core aspects of the project, explores how and which actors labs involve in their activities and their general strategies for actor identification and engagement.
- **Co-creation**, as the overall practice to be investigated in SISCODE draws a focus on the kind of activities related to co-creation that are carried out, the tools used and the ways and methods to reflect on these activities to evaluate their effectiveness and effects on the participants
- **Dissemination**, as the capacity to practice dissemination and contribute to knowledge exchange

Three different tools have been developed to assess the key themes on various levels (Figure 3):

- **An excel spreadsheet** as a continuously edited file with fixed parameters concentrated on objective observations and numbers;
- **A self-assessment questionnaire** periodically filled by the labs requesting a broader and more qualitative reflection on practices and methodologies rooted in the entire organization;
- **Scenarios** to illustrate potential situations for the near future, having an outlook on how the organization and the entire ecosystem could evolve and how they are influencing each other. The ongoing reflection and discussion on possible futures of the ecosystems, especially in the light of the current Covid-19 crisis, is to be concretely formulated and visualized for each pilot after the conclusion of the experimentation.

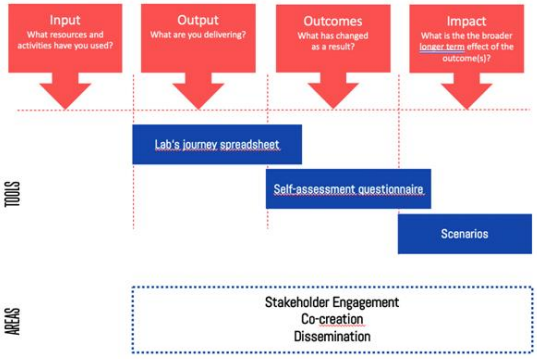

Figure 3 - SISCODE's kinds of results and the corresponding assessment tools and themes developed

The monitoring and assessing activity is being conducted in parallel to experimentation to then continue beyond with its results feeding a broader reflection on the effects of applying co-creation in RRI initiatives.

Concretely, the three tools described above are being applied throughout the experimentation by the members of the labs themselves either in a continuous way as for the spreadsheet or punctually at specific points in their journey as for the self-assessment questionnaire (Figure 4).

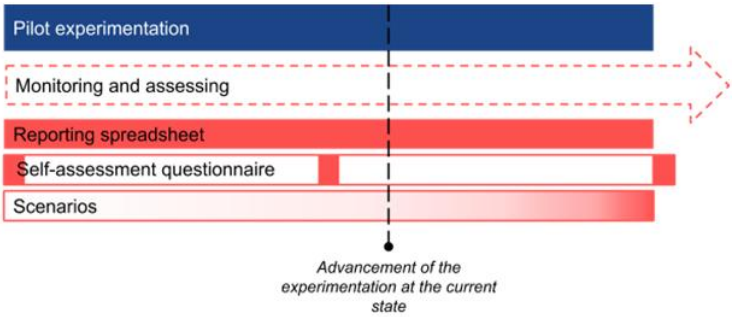

Figure 4 - Scheme of the monitoring and assessment activity throughout SISCODE

5 Evidences from the first cycle of assessment

In this section, the main insights gained from the assessment are reported, with a focus on the self-assessment providing insights and broader reflections on organizational change, capacity building and the implementation of co-creation. The activities conducted until May 2020 are taken into account with the experimentation ongoing until September 2020. Nevertheless, the collected data has been continuously evaluated and reflected on and already provides meaningful insights at present.

These have been organised under the three macro dimensions of the SISCODE assessment framework: stakeholder engagement, co-creation and dissemination.

In general, what emerges from the comparison of the baseline assessment with the one after the first year is the initial overestimation of the labs regarding their level of competences in all three areas.

The authors tend to interpret this as an effect tied to the notion of innovation journeys as a long term process based on four main phases: context analysis, ideation, prototyping and implementation. When co-creation moves from the stage of ideation to prototyping, testing and implementation it requires more complex capacities in respect to all three areas. The authors hypothesize that the labs initially estimated their competences as robust enough to govern co-creation with stakeholders to then realise the full extent (and therefore their lack) of capacities needed to adopt co-creation entirely.

This shows that knowledge about co-creation does not necessarily imply the capacity of an organisation to implement concrete co-design activities particularly relevant to go beyond sheer ideation.

On the basis of this assumption, in the following we discuss specific evidence found.

The direct results are mostly concentrated on smaller scales regarding the project-, organizational- or ecosystem level to then provide more extensive reflections on the application of co-creation in the final chapter.

5.1 Stakeholder Engagement

Generally speaking, the complexity of the process itself, scepticism towards co-creation and the need for constant engagement of stakeholders have been reported by the pilots as main reasons for difficulties.

One of the main barriers identified by the labs is related to the complexity in keeping the engagement constant throughout the process. While typically in co-design workshops the engagement is limited to single activities, the innovation journeys of the labs in SISCODE contemplated a constant network of interested stakeholders throughout the process until the real implementation of the solution. To reach this goal, specific knowledge was to be acquired and applied inside the labs' organisations (also testified by the request to use part of their budget to hire external competences to deal with this phase of their journeys). While this steadiness required effort it also functioned as an opportunity to motivate stakeholders fully including them into the process representing their interests and acquiring new capacities themselves.

The diverse stakeholder groups have been initially involved through co-design workshops where insights and ideas regarding the specific challenge have been generated to then lead to the acquisition of other engagement activities specific to the phases of prototyping and testing. As mentioned, here the support of the consortium was needed to learn about the notion of prototypes and their role in the process of engagement together with external support recruited at a local level.

In particular, the involvement of citizens in the process of co-design benefitted from the support of some level of tangibility and materialisation of the solutions/policies themselves resulting in a shortening of distance between policies and citizens with a prototype as a tangible object.

At a local scale, the importance of local characteristics and culture emerged with respect to the process of engagement requiring an adaptation of the methodology according to the local culture both related to the organization itself and the greater ecosystem.

Concerning the involvement of policy makers, both for single activities and constant engagement, the overarching difficulties met are rooted in their scepticism towards the new approach, the different mindset in terms of processes and implementation and their complex profiles and schedules.

The experiments show the difficulties in involving policy makers in the entire process and their preference to take part only in the light of concrete results or evidence fitting to their agenda. Also the need to convince policy makers of the value of co-creation

activities that involve lay people is confirmed by our experimentation. Different labs are facing the issue of how to improve the credibility of co-creation among policy makers, dealing with the problem of how to keep them involved in the process and how to produce concrete results for them to be used to inform policy.

At the same time, the challenge to convince citizens that participatory processes are not instrumental to predefined political goals and gaining consensus has emerged. This last observation is coherent with other results of our experimentation. IThe labs reported positive interactions with policy makers at a local level showing interest in the challenges being linked to their local context and concrete issues.

5.2 Co-creation

Co-designing and -producing all materials in the labs' processes, especially the introduction of prototyping as a principle to move from ideation to iterative testing revealed itself to be demanding on several levels.

A fear due to the uncertain nature of the prototyping process withholding the possibility to result in a failure and request a redefinition of the entire solution emerged from the side of the labs themselves while policy makers tended to be doubtful about the long process not providing immediate results or a clear evidence of impact.

This interference with traditional methods where the final solution is often immediately implemented has been detected as a point of insecurity and concern for organizations starting to be familiar with the practice. With an emphasis on long-term impacts rather than short-term outcomes this meets the general idea and goals of RRI to achieve stable and long-term solutions, but makes it often difficult in earlier stages.

The actor involvement in the prototype production strongly depended on the various cases, but all have been then involved in its testing and subsequent iterative phases. These iterated interactions are essential to the co-design process, ensuring user insight to influence the process not just in the early development phases, but also towards implementation, where ideas turn into solutions with concrete implementation plans.

The iterative involvement of users through feedback loops of insight, input and testing can help bridging the gap between ideation and implementation achieving higher levels of citizen & policy maker engagement, but requesting a certain amount of time.

The results from the labs show the importance of an overall vision of the co-creation process sharing it with actors and stakeholders involved. The engagement of citizens and 'non experts' appears easier in ideation, while implementation tends to remain in the hands of experts possibly leading to a feeling of losing ownership or mismatches between intentions and results requiring specific co-production strategies. In this, the role of prototyping is crucial, engaging all actors and stakeholders in different ways either in prototyping or experimenting the solutions. As a result, taking part in co-production helps all the involved stakeholders, including policy makers, to improve their understanding of

both opportunities for implementation and scaling up of the solution and constraints that may hamper its implementation, reflecting on those to produce implementable outcomes.

5.3 Dissemination

The findings and results, especially of the activities related to stakeholder engagement and co-creation shed light on the necessity of dissemination and exchange of practices beyond the project.

Sharing past experience has been found as an opportunity not only to motivate stakeholders to join similar activities and to stay informed about ongoing initiatives, but also potentially trigger new ones in similar ecosystems.

Furthermore, the dissemination of their experiences forced the labs to draw conclusions and functioned as a way of self-reflection, the results of these are outlined in the previous points due to the strong interconnection of the three themes.

6 Conclusion

The gap between ideation and implementation is a long-standing question in policy making. It is intrinsically bound to the complexity of problems, means that it is difficult to find causal links or to help multiple actors (possibly with diverging goals and mindsets) interact across different levels of governance (Matland, 1995; Hill & Hupe, 2002). In exploring ways to deal with this gap in the intermediate 'playground', SISCODE's experimentation identified a number of challenges establishing connections between bottom-up initiatives and top down policies.

Experiments show that sharing the challenge with policy makers and engaging them in co-creation activities from the beginning is important to obtain legitimation. Nevertheless, experiments also demonstrate that policy makers are difficult to be involved in the process from co-design to co-production and that they usually prefer to take part in the process when concrete results are already there and can be used if they fit with their agenda.

Also from the labs' journeys emerges that knowledge about co-creation does not necessarily imply the capacity of an organisation to conduct co-design activities. Co-design processes and competencies are particularly relevant to go beyond sheer ideation. To support capacity building in the labs, training before starting the co-creation journeys and learning-by-doing/learning-by-reflecting during the experimentation have been put in place. Experiments show that the engagement of citizens and 'non experts' is easier in ideation, while implementation tends to remain in the hands of experts. As this may lead to a feeling of losing ownership and to mismatches between intentions and results, it is important to put in place co-production strategies. In this, the role of prototyping is crucial.

Finally, all the 10 experiments show that taking part in co-production helps all the involved stakeholders, including policy makers, to better understand both opportunities

for the uptake or scaling up of the solution and constraints that may hamper its implementation, and reflect on enablers and obstacles to come out with implementable outcomes.

More in general, there is evidence from SISCODE that the outputs of participatory exercises still have little credibility within policymaking (compared to more traditional forms of expert advice) and when taken seriously, they struggle to be accommodated within the existing systems. A paradox emerges here to be addresses in future works and experimentations: on one hand, for co-creation to offer policy making a valid alternative to top down or expert based policy advice modes it needs to find legitimation by producing radically different and useful perspectives; on the other hand, if co-creation is too "alternative" the risk is being ignored or not fully adopted by policy makers that are eventually relegating it to peripheral applications that do not impact the core process and issues in policy formation.

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Open innovation Capability Maturity Model and Inside - In Innovation

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Abstract

Open Innovation (OI) is still a young phenomenon and its adoption by industry subject to a number of still poorly understood context factors and drivers. The development and implementation of the OI paradigm in business poses specific challenges not only to the management of the external environment but also to the development of organizational skills that would specifically prepare the organization to operate in OI networks and successfully integrate external knowledge flows into the innovation process and products. Each organization is at some level of maturity, but imperfect signalling and deliberate withholding of firm-internal information prevent the necessary alignment both among units of the same firm and between corporate entities as a whole necessary for external and innovative collaboration. This study applies the concept of the Capability Maturity Model (CMM)—which focuses on the quality of organizational processes—to the domain of intra- and interorganizational collaboration for innovation (open innovation). We propose the organizational-internal concept of inside-in innovation to complement boundary-spanning innovation flows such as inside-out and outside-in innovation. Based on research of three case companies, we outline an OI-CMM, identifying some of the key capabilities needed, and suggesting further avenues of research.

Keywords – open innovation, Capability Maturity Model, organizational collaboration

Paper type – Academic Research Paper

1 Introduction

„The smartest people in every field are never in your own company".
Bill Joy

Interest in Open Innovation (OI) has grown fast within the management field. For instance, since its first introduction by Chesbrough in 2003 more than 3,600 articles were published on this topic as per a review on Scopus. But Open Innovation is important both for academia and for practice. From a practice point of view, the importance of OI in today's business is growing for several reasons: broadening and deepening of technical

knowledge makes technology ownership impossible for individual companies, competition in the global marketplace forces collaborative behavior, product development cycles are shortening, and markets are becoming more complex. For instance, a comparison of Procter and Gamble's innovation projects showed that their OI projects outperformed closed innovation projects by achieving a 70 percent higher net present value (Enkel et al., 2011; Hosseini et al., 2017). According the Corporate Innovation Center and the Fraunhofer Society that examines OI activities in large organizations, most organizations fail in the change process from closed to open innovation, and more knowledge is needed about capabilities such as managing and organizing OI (Hosseini et al., 2017). Small and medium sized enterprises (SMEs) in particular face managerial, organizational and cultural challenges (van de Vrande et al., 2009; Enkel et al., 2009). Another challenge for organizations is how much they are able to maintain identity, adapt to a changing economy and adjust business models accordingly. These challenges can undermine the survival prospects of even successful firms. For instance, Fiskars Group, which was founded in 1649, continues to produce the best plastic handles scissors in the world, only in a different environment than when they were first developed in 1977. On the other hand, Xerox PARC, which was a very innovative company having developed important technologies such laser printing, the PDF file format, and the GUI, never managed to appropriate these inventions for its own innovation leadership. Kodak is another example of a company that was unable to recognise new opportunities in the photography market and lost to new and unexpected competitors (Tripas and Gavetti, 2000). It can be argued that organisations must transform in one way or another in order to achieve long-term competition (Schmitt et al., 2018; Enkel et al., 2020).

The original idea of the OI model was somewhat underestimated due to its rapid development and its diverse manifestations in different contexts (Teplov et al., 2018), resulting in a different understanding of what OI is in the scientific literature and how its definition has evolved. The flexibility and applicability of the concept of OI have been a source of its strength and success, but it has also prevented the adoption of a uniform, standardized theoretical framework for its management. Our paper aims at closing this gap by proposing such a framework, building on the established Capability Maturity Model (CMM) on the one hand, and empirical insights on both intra- and interorganizational practices of open innovation in industry.

The structure of the paper is the following: in the next sections we will review the OI and CMM literature. Then, we introduce the research methodology used in our survey and results of analyses. Finally, we will discuss future research opportunities.

2 Reviewing the Literature on Open Innovation and Organizational Maturity

2.1 Open Innovation

Open innovation is a multi-faceted complex phenomenon (Ahn, Lee, & Mortara, 2020; Bogers et al., 2017) that refers to unlimited access to inbound and outbound knowledge (Ahn et al., 2020; Enkel et al., 2020; Bacon et al., 2019; Roszkowska, 2017), addressing, but not limited to, the organisational level (Bogers et al., 2017; Enkel et al., 2020; Hilbolling et al., 2020). OI is focused on cost reduction for technology development, reducing risk for market entry, achievement economies of scale for production, reducing lead times for product or service development, and promotion to share learning. The fundamental principle of OI is to be ahead of the trend (Franke et al., 2006). Hence, organizations acting in OI are not limited to internal ideas, but also use those that rise outside the boundaries of the organization for product, service and technological development. OI has been likened to a combination of internal and external ideas system that enables the organization to enter new internal technologies into the market through external channels. Auch a system helps organizations open their boundaries for cooperation with external partners (e.g. universities, research institutes or competitors) and contribute to the internal technologies development and open new possibilities of profitable business (West & Bogers, 2014).

Chesbrough and Bogers (2014) defined OI as "a distributed innovation process based on purposively managed knowledge flows across organizational boundaries." Thus, knowledge inflow and outflow can be used for innovation development (Enkel et al., 2009). Gassmann and Enkel (2004) identified three processes of OI: *outside-in* or inbound OI when integrating external knowledge for innovation development for the organization; *inside-out* or outbound OI when ideas or new technologies of organization are taken to the market through the sale of intellectual property (IP) and *coupled* when is a combination of *outside-in* and *inside-out* (Chesbrough et al., 2006). For instance, Philips is engaged in two kinds of OI: through *inside-out* innovation (skills and are made recourses available to the outside world, e.g. contract research for external parties, providing technical facilities and support and assist with IP licensing) and through *outside-in* innovation (drawing on the capacities of individuals, organizations, and even small start-ups from around the globe, e.g. by providing a broader window on the world of health and wellbeing, strategic partners help us gain new insights and access to new technologies) (Philips, 2020).

Thus, the excess to external knowledge sources is very important for new insights and new technologies development. The Bogers & West (2012) model (Figure 1) shows that innovation does not take place in a single organization but is distributed around multiple stakeholders.

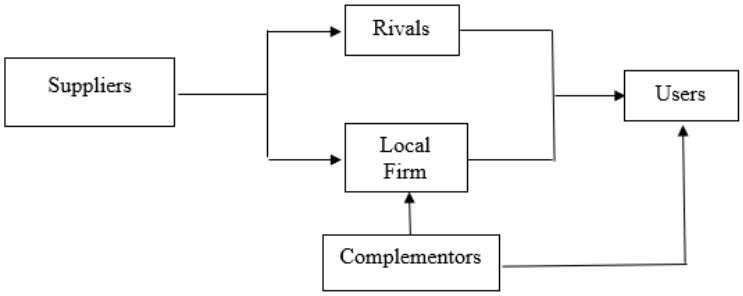

Figure 1. External Sources of innovation (Bogers & West, 2012)

Hence, even though OI concept is described as knowledge inflows and outflows (Chesbrough, 2003; Chesbrough et al., 2014; Dahlander and Gann, 2010), the understanding of OI concept remains underdeveloped (Bogers et al., 2017; West and Bogers, 2014, 2017). During the past three years trend in OI importance for organizations show that intellectual property protection, in-house R&D and open innovation should succeed only together (Bogers et al., 2019) and digital age for open innovation provides many opportunities for knowledge flows across organizational boundaries to support innovation process (Bogers et al., 2018; Enkel et al., 2020). While there is ample literature on cross-functional collaboration, the not-invented-here syndrome, and other conventional aspects of interdepartmental management, the intra-organizational dimension of collaborative innovation seems to be under researched in the context of open innovation. Internal open innovation, or *inside-in* innovation, in analogy to the Gassmann and Enkel (2004) terminology, should be prevalent in large multi-unit firms that often operate more like a collective of independent organizations than an integrated whole. But large SMEs may equally benefit from inward-oriented openness of innovation processes. In fact, technology exchange platforms (such as Yet2.com, and others) have noticed that much of the trade—anonymized initially to protect the integrity of the transaction—has been between different business units of the same firm (explained as a natural interest in technology of business units operating within the same general market). We conclude that Open Innovation is therefore important not only to coordinate innovation processes with external partners—inside-out and outside-in—but also among business units of the same firm, especially if the are managed at arm's length by the firm's headquarters, i.e. without an orchestrating decision center on innovation. Any reference model for Open Innovation must therefore also incorporate an inside-in perspective of Open Innovation.

2.2 Organizational Maturity

The Capability Maturity Model (CMM) was developed as a framework that reflected areas for improvement recommended for software organizations looking to increase the capabilities of their software processes (Humphrey, 1988). Although these definitions provide a basic understanding of this concept and the logic of how maturity models work, they do not explain either the meaning of maturity or the elements or content of such a model. In addition, they differ in terms of application and purpose, making it necessary to review one of the most important models of maturity in history.

Many scholars highlighted that organizations with high innovation capability are an important source of company performance (Aziz & Omar, 2013), innovation performance (Mir et al. 2016) and the opportunity to achieve a competitive advantage to pursue value creation (Battista et al. 2020). According Wendler (2012) innovation maturity models derived from dynamic capability maturity models can be used to measure the level of innovation maturity. The use of innovation maturity models allows assessing the level of innovation maturity of an organization and mapping areas that the organization can achieve a higher level of innovation maturity and competitive advantage.

The Capability Maturity Model (CMM) is the most well-known maturity framework for evaluating and improving the software development process within organizations. The model describes five levels of maturity (Humphrey, 1988):

1. The *Initial* level. Processes are chaotic, not documented with low communication. Success is based on individual skills
2. The *Repeatable* level. Basic project management established. The cost, schedules, and functionality are tracked.
3. The *Defined* level. Processes are standardised and documented.
4. The *Managed* level. Processes control through data collection and analysis.
5. The *Optimizing* level. Processes continue improved in order to innovate according the organization's particular needs

CMM has been applied to post-project management (von Zedtwitz, 2002), business process management (Röglinger et al., 2012), innovation (Essmann et al., 2009; Carnes et al., 2017; Arends, 2018), team collaboration (Boughzala et al., 2015), HR management (Curtis et al. 2009; Funchall et al. 2011) and other domains, but not yet to open innovation.

CMM are not the only capability frameworks possible: capability-based frameworks for OI have been proposed by Lichtenthaler and Lichtenthaler (2009) and Hosseini et al. (2017), and maturity-based models for OI by Habicht et al. (2012). Enkel et al. (2011) presented a CMM-inspired application to OI where organizational maturity was assessed in terms of partnership capability, innovation climate, and internal processes. However, their study had some limits, as only fifteen organizations were studied and were not included in the OI aspect, which has become quite important in recent management practices.

According to Chesbrough & Brunswicker (2013), organizations face challenges in adopting OI processes as they require changes in organizational structures, mechanisms, and practices at strategic and organizational levels, as well as the adjustment of the organizational learning for development, maturing and further improvement of OI. These organizational changes are related to capabilities for internal innovation with external ones (West & Bogers, 2014) and capabilities for collaboration with external partners (Niemelä, 2004). However, research on OI organizational capabilities is still limited (Enkel et al. 2011). Aiming at managing internal and external OI process in the firm, one of the first theoretical OI capability-based framework substituted the absorptive capacity concept with six "knowledge capacities" (inventive, absorptive, transformative, connective, innovative, and desorptive capacity) (Lichtenthaler and Lichtenthaler, 2009; Podmetina et al. 2019). Hosseini et al. (2017) presented and OI capabilities framework called OICF that describes 23 capability areas grouped in larger domains of "strategic alignment, governance, methods, information technology, people, and culture". Combining the three key elements of OI (ability to collaborate, innovation environment, and internal processes) with five levels of maturity (initial, repeatable, defined, managed and optimizing) provides a preliminary basis for OI maturity (Enkel et al., 2011).

One of the latest OI maturity framework was introduced by Enkel et al. (2020), delineating traditionalist, modernist, and visionary aspects of OI. Their model emphasized that these stages of transition do not have to be continuous. A company's culture may delay or prevent further development, or a company's strategic position may enhance OI performance. Thus, each organization needs to find a balance in its innovation management. At all stages, the traditionalist, the modernist, and the visionary need different options that must respond to external change. In slow industries, the transition from traditionalism to modernism may take time, and in fast-growing industries, these stages may be necessary to survive (Enkel et al., 2020).

We conclude that CMM is a well-established framework for organizational process maturity in at least several domains closely relevant to open innovation. However, no attempt has been made thus far to apply CMM to mapping and describing open innovation processes such that both intra- and interorganizational innovation process maturity is reflected.

3 Research methodology

We chose a qualitative research approach to examine OI capability in industrial multinational organizations. The data collection is performed through individual interviews to gain a deeper understanding of OI maturity in firms (Enkel et al., 2011). Between December 2019 and March 2020, we conducted 6 interviews with selected vice presidents of business management & innovations and director of new product development. Participants were from four different multinational organizations based in Europe and the USA. (This number is too low to warrant in-depth statistical evaluation, but it does allow some interesting observations about OI maturity in multinational

organizations. As this is research in progress, we are planning to continue with the empirical part and conduct at least 25-30 expert interviews in this phase.) The interviews lasted between 30 and 45 min and were transcribed verbatim and maintained anonymously. Our focus areas were climate for innovations, innovation processes, internal processes, collaboration, and partnership capacity.

The data was then interpreted, categorized and ranked according perceived levels of process maturity. We used the five generic CMM levels as a starting-point for classification and reference, populating the emerging OI-CMM from the bottom up and complementing generic definitions and properties from the OI literature. Two independent coders were used in this step, and any coding mismatch was addressed and either resolved or put into a backlog for eventual clarification and confirmation once more data is available. We are aware that this model has that status of a proposition until it has been fully verified and validated with additional companies not included in the research sample.

4 A Capability Maturity Model for Open Innovation

4.1 A High-Level Summary of the Results

All respondents agreed that organizations are applying external knowledge into a new product, service, and process development. But there are some limits with accepting and disseminating new external ideas as no formal guidelines on how to be done. Climate for innovation is on a quite good level, but there is a need for closer collaboration between employees and communication improvement. Some of the respondents indicated that there are no incentive systems for innovations. One of the most important aspects that defined OI is collaboration both inside the organization and outside. Respondents were divided into camps: two of them stated that the borders of the organization are not open for knowledge flow from outside-in and from inside-out and the other two answered the opposite: the borders of the organization are open for knowledge flow from outside-in and from inside-out. However, we also heard that "it might be that our organization doesn't have knowledge for such collaboration or there is a lack of trust."

4.2 A CMM Framework for Open Innovation OI-CMM

Based on the original CMM as presented by the Software Engineering Institute we defined a five-level capability maturity model for open innovation (Figure 2). The maturity model is organized into five levels: Initial; Repeatable; Defined; Managed; Optimizing.

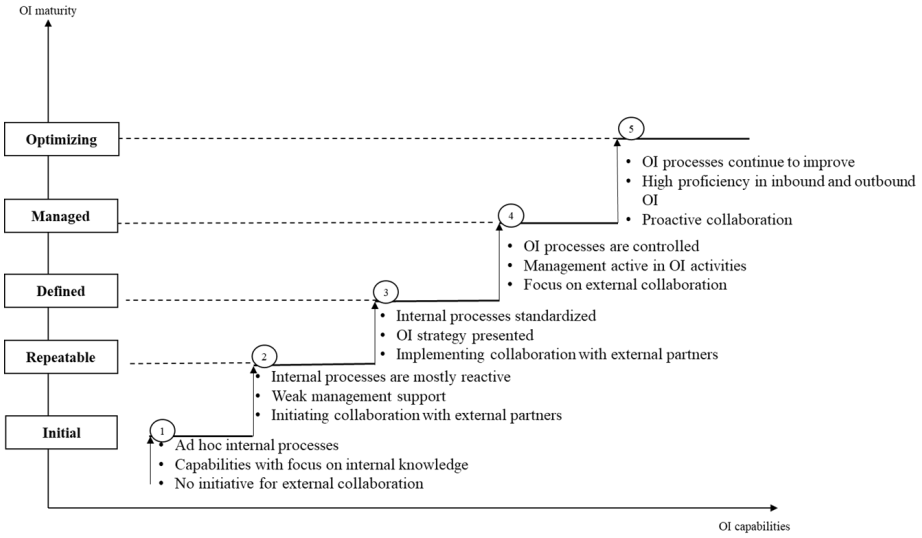

Figure 2. OI-CMM: A capability maturity model for Open Innovation (OI) maturity

Level 1: Initial. At this level of maturity organization's internal open innovation processes are unstructured or even chaotic. Internal knowledge sharing is weak und uncontrolled. Exertnal innovation collaborations occur ad hoc, but no guidelines as to how important aspects (e.g., IP ownership) are managed exist. Management in general does not support OI activities. Success of any collaborative innovation projects depend on the skills and performance of individual managers.

Level 2: Repeatable. At this maturity level organizations demonstrate some achievements in willingness to collaborate with external partners and to share knowledge. Still low level of internal information sharing and management support, although general appreciation for any benefits of OI is present. According to our survey results, OI projects are held by special teams. Basic templates for managing OI with external collaborators exist and are generally followed.

Level 3: Defined. Internal open innovation processes are documented and standardized. Definition and adherence to OI processes are owned by a dedicated unit (perhaps even just a single OI manager), which also follows up with implementation advice. Top management is committed to open innovation, presenting a clear strategy for OI, encouraging OI in core domains.

Level 4: Managed. Organizations at this maturity level have not only defined key open innovation processes at all levels—inside-out, outside-in, coupled, and inside-in—but also have developed metrics that permit them to motivate and support employees in OI activities. OI is a company-wide shared practice, with most processes, whether in R&D, product development or elsewhere, are by default considered for open, collaborative

execution. The OI unit provides relevant training for employees and increases skills for OI activities.

Level 5: Optimizing. In this final maturity level, the organization is proficient and proactive in proposing, designing, and executing collaborative inbound and outbound OI practices. OI supporting activities are integrated into corporate life and supported by a dedicated budget. Internal borders are open for knowledge sharing, and clear rules exist for interorganizational sharing. New ideas are welcome and tend to be easily accepted by management. Employees are rewarded for OI activities, and encouraged to improve existing OI practices and OI metrics.

5 Discussion and Conclusion

Given the limited empirical (but on-going) data collection, we are aware that the OI-CMM framework still has mostly propositional value. However, the application of CMM to a number of similar and related domains—we mentioned product development, post-project reviews, software development, team collaboration in the literature review—instils us with confidence that completing this template with solid data from multiple industries and sectors is just a matter of time.

Considering OI process maturity at the firm level, our interview respondents highlighted the fact that the culture of the organization and its employees are one of the keystones for successful open innovation. Interfaces with outside organizations are usually conservatively managed and dominated by legal, strategic and tactical considerations. Historically, the emergence of organization as a system of hierarchies and functional specialization has been driven by the need to limit information flow and focus on improving the quality of unit-internal work rather than cross-functional collaboration (Jensen & Meckling, 1976). Driving the development of an OI-CMM past the cultural acceptance levels of the host firm is likely leading to adoption failure, and we tentatively propose that OI-CMM success depends more heavily on overall corporate culture than more functionally limited or technical CMM implementations in e.g., software development or post-project reviews.

Our data has so far been too limited to support empirical extension of OI theory towards inside-in innovation. However, conceptually the view of a large organization to consist of multiple subunits with individual micro-cultures for openness for innovation and change permits to formulate inside-in innovation as an intra-organizational equivalent of coupled inside-out and outside-in innovation flows. Aggregated at the firm-level, these microcosms of innovation behaviors of individual units constitute not only a firm's inside-in open innovation but also its capability maturity to engage in open innovation with firm-external innovation partners. Inside-in innovation therefore plays a mediating role in firm-level OI-CMM and deserves more attention in future research (and, of course, by innovation management practitioners).

The preceding literature review in innovation management and OI revealed that there is no quantitative validation of CMM. Our future research focus is thus on solidifying our

qualitative model development before validating the OI-CMM framework in quantitative empirical studies. We also will develop an integrated perspective on outside-in, inside-out and inside-in processes of OI, including capabilities that relate to collaboration, strategic alignment, governance and culture conducive to collaborative innovation success.

However, we are aware of the limitations of our investigations due to restricted scope and scale of the survey and interviews, which need to extend both internal to our case firms as well as include other firms. As this study is part of a PhD project of one of the authors, we are lucky to have the time and resources to engage in this process.

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A Scientometric Analysis of Fourth-Generation KM Challenges: a Systematic Network Analysis of Last Decade (2009-2019)

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Abstract

Due to the important role of knowledge in the sustainable development of organizations, this topic still attracts several practitioners and researches. Therefore, knowledge management research area is considered as a young discipline that needs further exploration. The purpose of this study is to map the challenges in knowledge management by investigating the key themes and their relationship for the period 2009-2019. The study updates the previous study of Gaviria-Marin et al. et al. (2019) by specifically investigating the challenges in knowledge management to identify current research gaps and future research directions. This study utilizes the bibliometric analysis technique to identify the challenges in knowledge management. The dataset for this study was retrieved from the Scopus database. In total, 915 articles published between 2009 and 2019 were retrieved. These articles cover 2215 authors, 277 journals and 5400 keywords. The bibliometric analysis was conducted through the VOSviewer software. The study included activities like co-author and co-word analysis by mapping it to the theoretical foundations. The co-word analysis identified three broad themes of challenges in knowledge management: *Organizational learning, knowledge development and sharing; optimization through knowledge management; knowledge sourcing and planning.* This study helps researchers to understand the challenges in knowledge management studies in last decade and the direction that challenges research is taking in order to identify available avenues for future research.

Keywords – Knowledge management, challenges, bibliometric, Scopus, Co-occurrence analysis

Paper Type - Academic Research Paper

1 Introduction

The continuously challenging business environment is pushing companies to strive for forward-thinking solutions to remain competitive and grow sustainably. According to Lee et al. (2013), knowledge is an organizational resource that provides a competitive edge to companies if exploited effectively. Knowledge management (KM) is defined as a process/practice of creating, acquiring, capturing, sharing and using knowledge by firms to enhance their learning and performance (Gaviria-Marin et al., 2019). It is vital for firms to improve the efficiency of project delivery and gaining competitive advantage. According to Tzortzaki and Mihiotis (2014), the body of research on KM is classified into three generations (i.e. knowledge as tool (1960's); knowledge as process (1990's) and the role of knowledge to the success of organizations (2000's decade). Serenko (2013) further argued that the fourth generation of KM leads to new KM tools and paradigms and remains to be developed. Although, the fourth-generation approaches have predicted as offering a promising future for KM, unfortunately, organizations are having challenges in implementing fourth generation KM (Gaviria-Marin et al., 2019). Both the technological (i.e. hard) and human and organizational (soft) aspects are crucial for KM (Yap and Lock, 2017). Hard issues that generally arise from hardware problems like the breakdown of information technology tools can be solved straightforwardly. Soft issues underpin the capability of companies to successfully implement KM practices.

A firm relies on its employees to acquire experience, create knowledge from different learning situations and reuse the developed knowledge for continuous improvement. According to Tan et al. (2010), sharing of knowledge within or across firms is generally inhibited by management issues like organizational policies, confidentiality & security of knowledge, lack of rewards and incentives to encourage a knowledge sharing culture. Sharing of knowledge is also inhibited by cultural issues that are affected by the practices, values and norms within a company. In addition, the soft dimensions of KM facilitate a better understanding of organizational knowledge transfer and help in formulating guidelines for managerial actions.

Given the changes in the KM paradigms that have emerged in the last decade (i.e. fourth generation of KM) and have affected research, it is important for the KM field to trace the challenges scholars have discussed in literature. To address this research gap, and in continuity with the previous evaluation of KM (Gaviria-Marin et al., 2019), the objective of this systematic review is to understand the evolution direction of fourth generation KM challenges research in the period between 2009-2019 and to identify future avenues for research.

Bibliometric analysis offers a thorough evaluation of publications trends and patterns and helps in identifying established and emerging themes in the literature (van Eck and Waltman, 2017). Therefore, this study is designed to map the scientific literature of fourth generation KM challenges using the bibliometric analysis approach. The above-mentioned research objective is achieved by reviewing 915 articles published in the last decade in the area of fourth generation KM challenges literature (2009 – 2019). This study applied bibliometric techniques like co-citation and co-occurrence analysis to recognize challenges in the fourth generation KM and provide future research avenues. The next sections describe the research methodology and analysis, briefly followed by findings and discussion.

2 Methodology

A bibliometric study provides a broad analysis of a research field or the intersection of two or more fields through a combination of classification and visualization techniques (Verma, 2018). More specifically, a bibliometric study helps in understanding connections that exist in the corpus of a research field. It provides a macro picture of an area and its evolution to guide further meso and micro level investigations of the literature. The main bibliometric techniques are related to co-citation and co-word analysis. Co-citation analysis is used to measure similarity between documents, journals or authors through the frequency with which two units (i.e. documents, journals and authors) are cited together (also known as co-citation counts). Bibliometric methods to analyze citations have some limitations and, therefore, have been subject to criticism (Verma, 2018). Co-occurrence analysis is a bibliometric analysis technique that complements citation analysis. In co-occurrence analysis when keywords frequently co-occur in the document, the concepts related to those keywords are closely related (Bhattacharyya and Verma, 2019).

Bibliometric analysis helps in finding connections among the corpus of analyzed studies (van Eck and Waltman, 2017). Co-citation analysis was used to measure similarity between articles by using the frequency in which two articles are cited together content (van Eck and Waltman, 2017). This study also used co-occurrence analysis to investigate a semantic map to understand the conceptual structure of challenges in KM. Data for this study was extracted from Scopus database. Instead of other databases like Web of Science, Scopus was used because of its wide coverage of scholarly journals. The bibliographic records in the Scopus is searched using the following keywords as proposed by Gaviria-Marin et al. (2019): (‘‘knowledge management’’ or ‘‘organizational knowledge’’ or ‘‘knowledge acquisition’’ or ‘‘knowledge creation’’ or ‘‘knowledge integration’’ or ‘‘knowledge transfer’’ or ‘‘knowledge sharing or ‘‘knowledge diffusion’’ or ‘‘knowledge spillover’’ or ‘‘knowledge use’’ or ‘‘knowledge application’’) AND (‘‘challenge’’ or ‘‘risk’’ or ‘‘barrier’’). Only peer reviewed articles were retained and a total of 915 papers resulted in the final data set. This study analyzed the obtained datasets using the bibliometric tool VOSviewer 1.6.8, with co-citation analysis as the ratio to

aggregate the data. VOSviewer offers a different analysis of a large set of information through a single graphical map. The graphical map is a network of items built through text mining. The distance between items in a network is interpreted as an indication of the relatedness of the items. More specifically, the smaller the distance between the items (e.g. keywords), the stronger the items are related to each other. Further, the co-citation analysis highlights diversity in the knowledge base in an aggregate manner.

3. Results

3.1. Distribution of articles and most cited journals in challenges in KM (2009 – 2019)

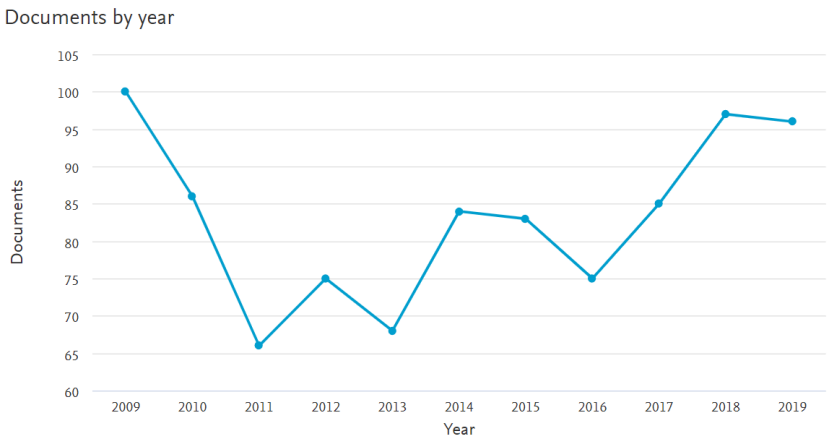

Figure 1: Distribution of challenges in KM (2009 – 2019) articles.

Figure 1 shows how the publication of challenges in KM studies has grown consistently in the investigated timeframe (2009-2019), with 2018 being the most prolific year. In total, the field produced more than 915 articles, published by 277 journals, confirming the growing trend in the field. Co-citation analysis was used to map and aggregate journals. Figure 2 shows that Cluster 1 (red) is more about general management journals, Cluster 2 (green) is KM and information systems journals and Cluster 3 (blue) is technology and innovation management journals.

The co-citation analysis of authors for the years 2009-2019 shows that authors in the field of challenges in KM tend to aggregate on three clusters (Figure 3). Figure 3 demonstrates that authors interested in challenges in KM in the last decade focus more on a managerial perspective of KM (red cluster).

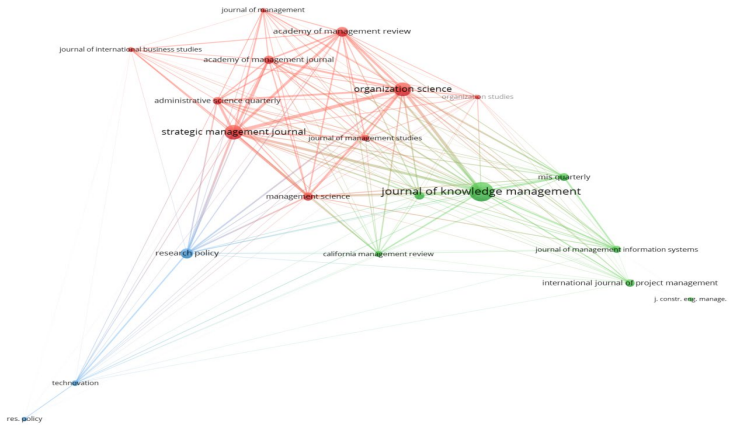

Figure 2: Visualisation of the social network of journals in challenges in KM literature (2009-2019)

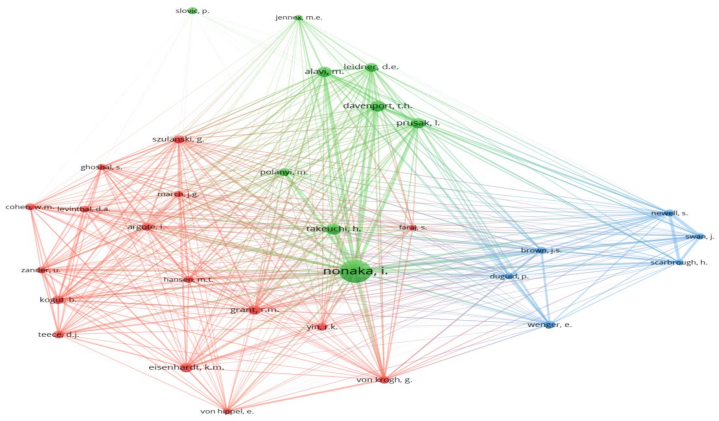

Figure 3: Visualization of the social network of scholars in challenges in KM literature (2009-2019)

3.2. Co-occurrence analysis

Figure 4 demonstrates that the co-occurrence analysis aggregated keywords in three cluster including: Organizational learning, knowledge development and sharing (red), optimization through KM (green) and Knowledge sourcing and planning (blue).

Cluster 1- Organizational learning, knowledge development and sharing:

Knowledge is a strategic resource and organizations should leverage their existing knowledge as well as create new knowledge for sustainable competitive advantage. Therefore, several researchers have tried to understand the challenges in knowledge

management processes and systems. According to Yap and Lock (2017), knowledge management is related to managing the created knowledge, while organizational learning (OL) manages the creation of a firm's knowledge. Between 2009 and 2019 researchers tried to investigate challenges of knowledge management by studying variables like organizational learning capability, organizational learning, effectiveness etc. Organization's learning culture is a continuous effort of an organization towards creating learning opportunities for its employees. The last decade articles in knowledge management literature mostly focused on understanding the challenges in organizational learning processes. An organization learns when the learning process is embedded among individuals. The knowledge sharing among individual is core of knowledge management (Feng and Shanthikumar, 2018).

Knowledge sharing (KS) is the process of getting the right knowledge to the right person at the right time to gain competitive advantage. Knowledge is developed and shared at the individual, group or the organizational level. KS describes how to share work related knowledge with other individuals in an organization. The main inhibitors of knowledge sharing behaviour include information acquisition and distribution, knowledge flow, knowledge claim formulation and evaluation. Finally, several researchers recommended that challenges related to OL should be reduced first in order to facilitate KS.

Cluster 2- Optimization through KM:

Several researchers have in last decade studied challenges related to knowledge development and sharing that inhibits optimization and reform of knowledge management. Organizational structure and management of firms in the modern world highly depend upon information system and innovation. The improvement in information acquisition, sharing, integration can therefore be promoted through process optimization and reforming knowledge management. Different researchers have developed their own unique perspective towards optimization through knowledge management. For example, according to Feng and Shanthikumar (2018), coordination and balancing of limited resources requires optimization of resource allocation as well as human resource capability in knowledge sharing. In addition, optimization through knowledge management leads to perfection of the quality of knowledge management circuits of the process, organizational structure and management methods. A platform for knowledge exchange and sharing helps optimization by building a flat organization of knowledge management processes that further facilitates joint efforts to innovate and enhance efficiency.

Cluster 3- Knowledge sourcing and planning:

According to Anderson et al. (2014), innovation is the combination of idea generation and implementation. New idea generation requires domain expertise and knowledge and it is nearly impossible for individuals to generate all the knowledge required for each task

(Huggins et al., 2010). Therefore, sourcing others' knowledge plays an important role in innovative performance and new ideas can be generated through knowledge sharing (Amayah, 2013). Knowledge sharing can maximise the use of existing knowledge and generate new knowledge. Knowledge exist either in tacit (implicit) or explicit forms in organization (Amayah, 2013). Knowledge sourcing includes both tacit and explicit knowledge. Individuals could source for tacit knowledge for domain knowledge, ideas and selection. Explicit knowledge sourcing includes the individual search for organization's knowledge management systems. Both tacit and explicit knowledge sourcing help individuals in companies to generate new ideas and induce innovation behaviour (ibid.).

3.3. Overlay Analysis

It is evident from Figure 5 that keywords like tacit and explicit knowledge, product development and culture appeared near 2012 and 2013. Most research in this timeframe focuses on using knowledge in projects in an effective and efficient manner. The keywords that were used towards 2014 and 2015 included knowledge sharing, knowledge transfer, innovation ecosystem, competition etc. Most research in this period focuses on organizational knowledge creation. Around/after 2015 challenges in KM literature focuses on knowledge and capacity development using technology.

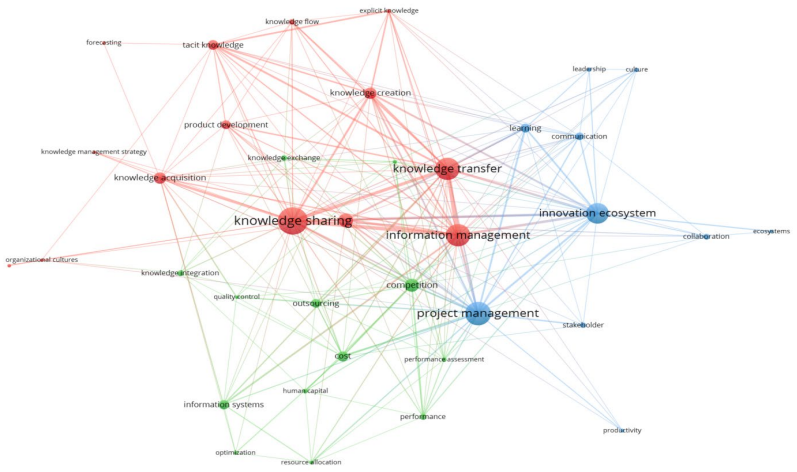

Figure 4: Visualization of the co-occurrence analysis in challenges in KM literature (2009-2019)

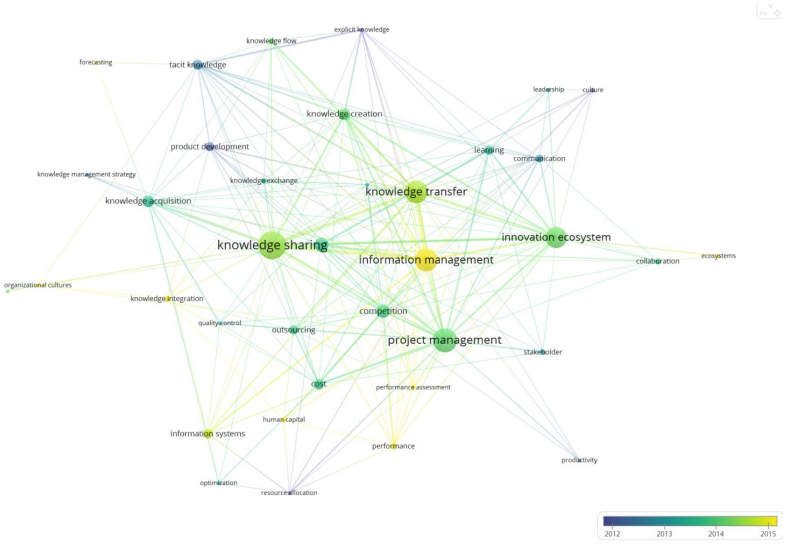

Figure 5: Overlay of keywords in challenges in KM literature (2009-2019) with timeframe

4 Limitations

The limitations of this study are related to the article inclusion and exclusion criteria based on the time period (i.e. 10 years), database selection and disciple (i.e. business, management and accounting). The results presented in this study are based on network analysis - in the future, in-depth content analysis of articles is required. This study has analysed academic publications obtained from the Scopus database. In the future, it is important to consider other databases along with the Scopus as they may contain excellent and relevant articles that are not indexed in Scopus. Future study should also consider relevant books e.g. Nonaka and Takeuchi (1995) or Polanyi (??add year) in the analysis to include perspectives from founders of knowledge management.

5 Conclusion

This study contributes to the area of KM research in multiple ways: First, the results present a viewpoint different from conventional literature reviews by visualizing the fourth generation KM challenges by using the bibliometric analysis. Second, the networks and clusters identified through co-citation and co-occurrence reveal interesting patterns and insights in the fourth generation KM challenges research. These insights can further lead to theoretical and empirical development and possibilities of relating different challenges of KM including the distribution of articles and most-cited journals and authors and finally keyword analysis. Third, this study provides an understanding of the influential forces that direct literature by identifying three main research streams in the challenges in fourth generation KM.

Based on these findings, this study proposes areas for future research that will advance the understanding of the challenges in the fourth generation KM. Also, future research can include articles from other databases like Web of Science, Google scholar etc. as this study only included scholarly articles from Scopus.

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Innovation Activities in Knowledge-Intensive Business Services (KIBS) and Manufacturing

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Abstract

Based on panel dataset of 33100 Italian firms collected by the MET company, this paper compares the differences in the innovation value chain of Knowledge-Intensive Business Services (KIBS), manufacturing and other services. The study demonstrates the relative importance attributed to different internal and external sources of information on innovation outcomes of KIBS in terms of product, process and organization, compared to manufacturing industries and to other services. Significant similarities exist between some aspects of firms' innovation behavior in these sectors: strong complementarities emerge between firms' internal and external knowledge. However, the outsourcing to Italian firms, to foreign partners or to other institutions and the local, domestic and international networking are valued differently across the three sectors. The findings shed new light on the innovation process of Italian firms and can be used in innovation management decisions.

Keywords – Knowledge-intensive business services; innovation; manufacturing; services.

Paper type – Academic Research Paper

1 Introduction

While analysis on innovation activities was mostly concerning the manufacturing sector, over the last 20 years the attention has raised for the service sector, and for KIBs, which after the revolution of Information and Communication Technologies have grown

in size and weight in the economic systems. While the less recent literature found that R&D activities are a much weaker competitive factor in services in general with respect to manufacturing (Hollenstein, 2003; Cainelli, Evangelista and Savona, 2006), and are an important innovation source only for a small number of science and technology-based service industries (Evangelista, 2000), more recently many studies on innovation in services, alone or in comparison with other sectors of activity, have reached different conclusions. Coombs and Miles (2000) propose that differences between the manufacturing and services have been blurred in recent years, a statement confirmed by a large ensuing evidence. In some studies the manufacturing industry has been compared to services in general (Álvarez at al., 2013; Sirilli and Evangelista, 1998), in other to KIBS (Cainelli, Marchi and Grandinetti, 2019; Teixeira and Santos, 2016; Asikainen 2015; Carlborg et al., 2014, Freel, 2006; Wong and He, 2005). From these recent studies, mostly on developed countries, the conclusion is that services firms and KIBS above all, are as innovative as firms in the manufacturing industry and appear no longer as "laggards" in terms of technology or dependent from the manufacturing industry, being the engine of the new knowledge-based economy. The role of KIBs emerges as crucial in the current global economy innovation process, where these firms act as fundamental providers, users, and intermediaries (Lafuente et al., 2018; Gallego et al., 2013; Cáceres and Guzmán, 2014; Gallouj and Savona, 2009; Czarnitzski & Spielkamp, 2003).

Despite the increased attention received by innovation in KIBS over recent years we argue that further research is still needed to gain a comparative view of manufacturing, other services and KIBs innovation patterns. The study of the determinants of the innovative performance of Knowledge Intensive Business Services (KIBS), as compared to manufacturing companies and to the sub-set of services companies, demand further exploration particularly in what concerns the relation between different sources of internal and external R&D.

We address these gaps of knowledge by considering firm's internal sources of information for innovation, taking into account many external sources (the impact on innovation of companies' outsourcing of R&D activities, the development of networking activities at domestic and international level) as innovation determinants.

Our empirical comparison proposes a comparative panel-data analysis developed in two steps.

Our aim is first to look at the complementarity between sources of knowledges that we detect by adopting a Multivariate probit analysis (Cappellari and Jenkins, 2003), and presenting the error correlations.

In the second step we try to answer a set of questions related to the innovation production function in which the effectiveness of firms' knowledge transformation activities is influenced by firms' internal and external knowledge resources in addition to other control variables. Firms' knowledge sourcing activities are used in the innovation value chain to study the transformation of knowledge into new products or processes or new organization of production.

There are several novelties of the analysis that are worth highlighting.

Firstly, we consider firm level data on a large sample of firms located in Italy (33100) including 4822 KIBS companies and 10153 other service companies drawn from the MET database, a wide firm level survey administrated in Italy. Secondly, a unique advantage of our analysis is the opportunity of using different types of innovation (product process, organizational) and many different proxies for knowledge activities. We have several determinant of innovation: 1) R&D dummy; and of external sources measured by 2) R&D outsourcing to Italian firms; 3) R&D outsourcing to other Italian organizations; 4) R&D outsourcing to foreign; 5) R&D networking local, domestic and international.

2 Data

We consider firm level data on Italian firms drawn from the MET database; this is the widest survey administrated in a single European country. We will use the dataset drawn from merging six waves of the Survey (2008, 2009, 2011, 2013, 2015, 2017) to which information from CRIBIS and ASIA ISTAT database had been added. Differently from other Italian and European datasets, the sample contains information on firms of all size classes, including firms with less than ten employees.

Each wave of the surveys contains about 25,000 observations belonging to the manufacturing (about 55%), KIBS (about 15%) and other (about 30%) services. The sampling design aims at having representativeness at the size, region, and industry levels.

For our analysis we have used a selected sample of 33.100 observations that includes only firms appearing at least in two consecutive waves from MET survey 2008, 2009, 2011, 2013, 2015, 2017. From the dataset we have extracted the following firms: 4822 KIBS firms, 18125 manufacturing firms and 10153 other services firms.

Table 1 contains the definition of the variables used for the analysis, and Table 2 their descriptive statistics for KIBS, manufacturing and other services.

Table 1. Variables definitions

Variables		Variables
Production innovation	Prod_inn	dummy = 1 if the firm has either introduced a new product on the market, radically changed an old one or a significantly improved product
Process innovation	Proc_inn	dummy=1 if the firm has changed its production process or introduce a significantly improved production process
Organizational innovation	Org_inn	dummy=1 if the firm has changed the organisation of its activity
R&D activity (dummy)	R&D	dummy=1 if the firm carries out R&D activity
R&D outsourcing with Italian firms	R&D_out_it_firms	dummy=1 if the firm have relations for Research and Development activities with Italian firms

R&D outsourcing with other Italian institutions	R&D_out_it_other	dummy=1 if the firm have relations for Research and Development activities with other Italian organizations
R&D outsourcing with foreign institutions	R&D_out_foreign	dummy=1 if the firm have relations for Research and Development activities with foreign organizations
Network local	Net_local	dummy if the firms have significant and ongoing relationships with other companies, organizations or institutions at local, international and domestic level
Network international	Net_internation	
Network domestic	Net_domestic	
Group (dummy)	Group	dummy=1 if the firm belongs to a group of enterprises at time t
Size	Size	ln(1 + number of employees)
Age	Age	natural logarithm of the age of the firm computed as the difference between time t and the date of its establishment
International (dummy)	International	dummy=1 if the firm participate in any international activities
Region (dummy)	Region	20 Regions of Italy
Investments (dummy)	Investments	dummy = 1 if the firm has made any type of investments

Table 2. Descriptive Statistics

	KIBS			**Manufacturing**			**Other services**		
	N	mean	sd	N	mean	sd	N	mean	sd
Prod_inn	4822	.21	.407	18125	.32	.466	10153	.163	.369
Proc_inn	4822	.171	.376	18125	.259	.438	10153	.133	.34
Org_nn	4822	.248	.432	18117	.245	.43	10152	.232	.422
R&D	3357	.212	.409	12442	.281	.449	6922	.111	.314
R&D_out_it_firms	3357	.049	.216	12450	.055	.228	6923	.022	.146
R&D_out_it_other	3357	.055	.223	12450	.063	.246	6923	.023	.148
R&D_out_foreign	3357	.013	.112	12450	.011	.103	6923	.003	.054
Net_local	1790	.321	.467	6974	.289	.453	3243	.358	.48
Net_domestic	1790	.196	.397	6974	.249	.433	3243	.199	.399
Net_internation	1790	.059	.236	6974	.119	.323	3243	.049	.216
Group	4822	.182	.386	18117	.209	.407	10152	.186	.389
Size	3357	2.398	1.347	12450	3.264	1.329	6923	2.914	1.481
Age	3325	2.667	.551	12292	2.941	.699	6851	2.728	.701
International	3357	.274	.446	12442	.558	.497	6922	.262	.44
Region	4822	10.10	5.611	18125	9.064	5.377	10153	10.22	5.487
Investment	3357	.465	.499	12442	.564	.496	6922	.487	.5

Interesting is also Figure 1 that shows the trend both for R&D and for Innovation from 2009 to 2017, considering KIBS, Manufacturing and the other services. The percentage of

enterprises that innovate is always greater than the percentage of firms that are involved in R&D. This is true in all the cases examined. At the same time, we observe in all the graphs the break around in 2013, in the sense that the percentage of firms that innovate and invest in R&D increases.

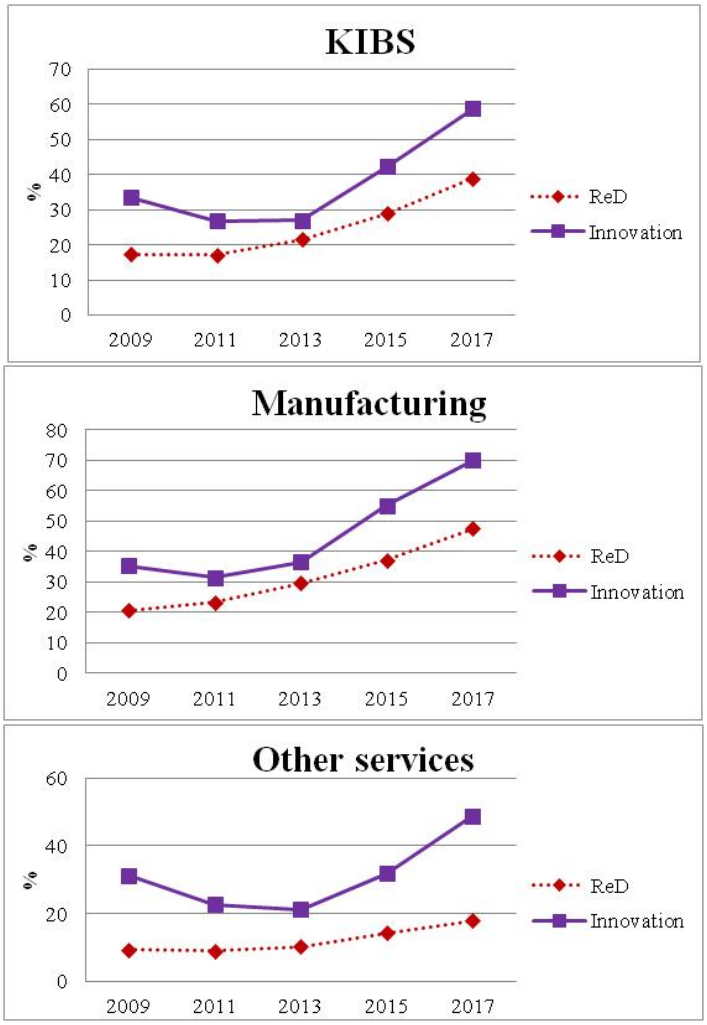

Figure. 1. Time series for innovation and R&D indicators

3 Methodology

We consider the knowledge inputs for innovation, that are the key variables. We identify seven alternative routes through which firms may source the knowledge inputs for innovation reflecting both internal knowledge creation and external sources of knowledge acquisition. We have in-house R&D measured by R&D and six external sources measured by R&D outsourcing to Italian firms; R&D outsourcing to other Italian organizations; R&D outsourcing to foreign; Networking activities to domestic firms; Networking activities to domestic firms; Networking activities at international level.(see Table 1 for additional details).

We summaries the probability that firm *i* will engage in each of the seven knowledge sourcing activities as follows:

$$RDN_{ijt} = \beta_0 + \beta_1 \mathcal{X}_{it} + + \varepsilon_{it} \qquad (1)$$

Where RDN_{it} represents the vector of Research and Development and Network variables i.e. its firm's knowledge sourcing activity j (j = 1, . . .7); $\mathcal{X}_{it}$ is the vector of explanatory variables, a set of indicators of the firms' resources such as size, age, international activities, shortage of finance; ε_{it} is an error term assumed to be independently and identically distributed with a mean of zero and a variance of σ^2.

We adopt an approach explored in Cassiman and Veugelers (2006) and also followed by Roper and Arvanitis (2012) estimating a Multivariate Probit model for firms' participation in the seven knowledge sourcing activities to catch the potential correlation. Positive error correlations then provide an indication of complementarities.

To keep building the innovation value chain, in the second step, we consider the process of knowledge transformation, in which knowledge sourced by the enterprise is translated into innovation outputs.

We check how key innovation determinants influence innovation outcomes in service (and, within it, in KIBS) and in manufacturing industries at three main levels: first, investigating the role of R&D; secondly, looking at companies' openness and at the relative importance attributed to distinct external sources of information for innovation via outsourcing (firm, market and other), and thirdly, considering the external local, domestic and foreign entities, with whom companies cooperate for innovation.

We first estimate a probit model for the innovation output, because the dependent variables are binary indicators. The baseline equation tests the effect of different drivers of innovation according to the following equation[1].

$$Y_{it} = \beta_0 + \beta_{1a} R\&D_{it-1} + \beta_{2a} R\&DOUTfirms_{it-1} + \beta_{2b} R\&DOUTother_{it-1} + \beta_{2c} OUTforeign_{it-1} + \beta_{3a} Networkdomestic_{it-1} + \beta_{3b} Networklocal_{it-1} + \beta_{3c} NetworkForeign_{it-1} + \beta_4 \mathcal{X}_{it-1} + \mu_i + \delta_t + \varepsilon_{it} \qquad (2)$$

[1] *The IV probit is estimated on the basis of equation 2 but considering the lagged (at time t-2) variables as instruments.*

Where:

Y_{it} is the dependent variable above described (product, process, organizational innovation), for firm i at time t ; All the $R\&D_{I,t-1}$ variables represents the vector of Research and Development variables for the alternative knowledge sources identified earlier; $\mathcal{X}_{it-1}$ is the vector of other explanatory variables: Region, Investment, Group, Size, International and Age; μ_i and δ_t denotes firm and time fixed effects; finally ε_{it} is an error term assumed to be independently and identically distributed with a mean of zero and a variance of σ^2 .

At this stage a potential issue is the endogeneity of the knowledge sourcing and network variables. Hence, we also estimate a model instrumenting the knowledge sourcing and network variables. More in detail, the IV strategy that we perform is related to the GMM in the sense that we consider the lagged values of the knowledge sourcing variables as instruments.

Basically with respect to the innovation production function we will test the following hypotheses:

H1: *R&D is positively and significantly associated with innovation.*

H2: *The power of the impact of R&D differs across KIBS, manufacturing and other service sector.*

H3: *Outsourcing relationship with different organizations are positively and significantly associated with innovation .*

H4: *The power of the impact of R&D outsourcing relationship with different organizations differs across KIBS, manufacturing and other service sector.*

H5: *The degree of openness to cooperation for innovation with different types of networking (local, domestic and international) is positively associated with innovation.*

H6: *The power of the impact of the degree of openness to cooperation for innovation with the entities differs across KIBS, manufacturing and other service sector.*

4 Empirical results

The initial link to innovation activity is firms' knowledge sourcing. Multivariate Probit models, employed for the reason above clarified, for firms' knowledge sourcing is shown in Table 3 with error correlation matrix in Table 4. The remarkable role of size, investment and credit access emerges as robust evidence across the different sources of knowledge. International activities are also a positive determinant of knowledge with the exception of the channel from local networking and from foreign R&D.

Complementarities between knowledge sourcing activities are numerically and statistically strong for all sectors of research interest with positive and statistically significant error correlations in all combinations (Table 4).

Table 3. Knowledge sourcing – Multivariate Probit models: KIBS, Manufacturing, Other services (1 – R&D, 2 - R&D_out_it_firms, 3- R&D_out_it_other, 4 – R&D_out_foreign, 5 - Net_local, 6 - Net_international, 7 - Net_domestic)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
KIBS							
Group	0.0822	0.0918	0.0763	0.129	-0.319***	0.270*	-0.0605
	(0.104)	(0.121)	(0.125)	(0.231)	(0.101)	(0.143)	(0.103)
Size	0.172***	0.128***	0.157***	0.114*	0.0597**	0.0127	0.0795***
	(0.0298)	(0.0369)	(0.0374)	(0.0686)	(0.0276)	(0.0442)	(0.0293)
Age	0.0536	0.0594	0.0945	0.205	0.243***	0.0205	0.164**
	(0.0754)	(0.0985)	(0.0990)	(0.234)	(0.0673)	(0.123)	(0.0752)
International	0.498***	0.497***	0.260**	3.464	-0.0195	1.539***	0.538***
	(0.0785)	(0.0987)	(0.101)	(54.27)	(0.0736)	(0.150)	(0.0768)
Investment	0.618***	0.706***	0.556***	0.429*	0.335***	0.277**	0.338***
	(0.0740)	(0.101)	(0.0992)	(0.228)	(0.0657)	(0.122)	(0.0722)
Credit_access	-0.0747	-0.106	-0.145*	-0.158	-0.127**	-0.230**	-0.131**
	(0.0585)	(0.0782)	(0.0812)	(0.177)	(0.0503)	(0.103)	(0.0574)
Constant	-1.506***	-2.193***	-2.362***	-5.908	-1.107***	-2.465***	-1.585***
	(0.257)	(0.338)	(0.342)	(54.28)	(0.227)	(0.427)	(0.254)
Observations	1,745	1,745	1,745	1,745	1,745	1,745	1,745
Manufacturing							
Group	0.0477	0.0374	-0.0289	0.155	0.0584	0.0855	0.0141
	(0.0482)	(0.0570)	(0.0593)	(0.0987)	(0.0465)	(0.0559)	(0.0461)
Size	0.249***	0.0886***	0.140***	0.114***	-0.0259*	0.0525***	0.0497***
	(0.0166)	(0.0204)	(0.0211)	(0.0364)	(0.0153)	(0.0196)	(0.0154)
Age	0.0107	0.0898**	-0.00529	-0.107*	0.0195	0.0523	0.0430
	(0.0296)	(0.0359)	(0.0368)	(0.0619)	(0.0265)	(0.0360)	(0.0270)
International	0.767***	0.513***	0.603***	0.716***	-0.160***	1.447***	0.361***
	(0.0434)	(0.0585)	(0.0650)	(0.151)	(0.0363)	(0.0938)	(0.0377)
Investment	0.633***	0.519***	0.497***	0.297***	0.260***	0.279***	0.238***
	(0.0390)	(0.0518)	(0.0548)	(0.0996)	(0.0347)	(0.0483)	(0.0355)
Credit_access	-0.0169	0.0217	-0.0102	-0.0180	-0.0507**	-0.142***	-0.0614**
	(0.0280)	(0.0339)	(0.0361)	(0.0648)	(0.0249)	(0.0356)	(0.0254)
Constant	-2.763***	-2.982***	-2.972***	-3.220***	-0.495***	-2.787***	-1.235***
	(0.120)	(0.148)	(0.155)	(0.285)	(0.100)	(0.163)	(0.104)
Observations	6,782	6,782	6,782	6,782	6,782	6,782	6,782
Other services							
Group	0.243***	0.201**	0.0612	-0.181	-0.0667	0.232**	0.136*
	(0.0833)	(0.102)	(0.122)	(0.309)	(0.0674)	(0.108)	(0.0722)

Size	0.0885***	0.0671***	0.0621**	0.161***	0.0589***	-0.0262	0.0215
	(0.0213)	(0.0254)	(0.0298)	(0.0622)	(0.0164)	(0.0309)	(0.0182)
Age	-0.155***	0.00306	0.0109	0.467**	0.0686*	0.0506	-0.0258
	(0.0497)	(0.0666)	(0.0774)	(0.204)	(0.0369)	(0.0699)	(0.0410)
International	0.616***	0.395***	0.518***	0.536**	-0.206***	1.289***	0.415***
	(0.0666)	(0.0846)	(0.0973)	(0.214)	(0.0530)	(0.0994)	(0.0559)
Investment	0.491***	0.608***	0.391***	0.132	0.303***	0.0901	0.383***
	(0.0676)	(0.0904)	(0.102)	(0.223)	(0.0476)	(0.0901)	(0.0535)
Credit_access	0.0340	-0.0231	-0.00959	0.122	-0.0718**	-0.127*	0.0524
	(0.0503)	(0.0649)	(0.0754)	(0.163)	(0.0361)	(0.0736)	(0.0397)
Constant	-1.699***	-2.536***	-2.634***	-5.177***	-0.707***	-2.343***	-1.269***
	(0.174)	(0.235)	(0.275)	(0.794)	(0.129)	(0.245)	(0.144)
Observations	3,122	3,122	3,122	3,122	3,122	3,122	3,122

Notes: All equations include constant terms, industry dummy variables at 2-digit level, region and time dummies

Table. 4. Complementarities between knowledge sources reflected in error correlations (1 – R&D, 2 - R&D_out_it_firms, 3- R&D_out_it_other, 4 – R&D_out_foreign, 5 - Net_local, 6 - Net_internation, 7 - Net_domestic)

	(1)		(2)		(3)		(4)		(5)		(6)	
	atrho	p	atrho	p	atrho	p	atrho	p	atrho	p	atrho	p
KIBS												
(1)												
(2)	1.179***	(0.0954)										
(3)	1.160***	(0.0958)	1.029***	(0.0863)								
(4)	0.788***	(0.170)	0.775***	(0.153)	0.627***	(0.136)						
(5)	0.151***	(0.0419)	0.0836*	(0.0464)	0.107**	(0.0452)	0.0996*	(0.0557)				
(6)	0.0908	(0.0710)	0.136*	(0.0817)	0.0507	(0.0770)	0.225***	(0.0858)	0.273***	(0.0719)		
(7)	0.197***	(0.0451)	0.187***	(0.0510)	0.114**	(0.0487)	0.226***	(0.0662)	0.373***	(0.0450)	0.373***	(0.0450)
MANUFACTURING												
(1)												
(2)	1.055***	(0.0450)										
(3)	0.969***	(0.0435)	0.743***	(0.0352)								
(4)	0.760***	(0.0703)	0.639***	(0.0601)	0.618***	(0.0585)						
(5)	0.104***	(0.0210)	0.118***	(0.0228)	0.0918***	(0.0229)	0.0824***	(0.0273)				
(6)	0.156***	(0.0267)	0.164***	(0.0283)	0.134***	(0.0283)	0.158***	(0.0350)	0.408***	(0.0268)		
(7)	0.174***	(0.0217)	0.182***	(0.0239)	0.174***	(0.0237)	0.147***	(0.0296)	0.477***	(0.0215)	0.718***	(0.0273)
OTHER SERVICES												

(1)												
(2)	1.657***	(0.142)										
(3)	1.204***	(0.0995)	1.007***	(0.0842)								
(4)	1.063***	(0.237)	1.018***	(0.198)	1.215***	(0.238)						
(5)	0.143***	(0.0348)	0.168***	(0.0362)	0.118***	(0.0381)	0.148***	(0.0423)				
(6)	0.0798	(0.0583)	0.148**	(0.0621)	0.125*	(0.0666)	0.0959	(0.0768)	0.288***	(0.0527)		
(7)	0.103***	(0.0381)	0.161***	(0.0410)	0.113***	(0.0427)	0.112**	(0.0510)	0.390***	(0.0331)	0.406***	(0.0454)

*** p<0.01, ** p<0.05, * p<0.1
Note: Derived from Multivariate Probit models in Table 3.

The key econometric results for the innovation production function are reported in Tables 5 and 6. Tables 5 shows the main results of the RE probit for KIBS, manufacturing and other services in three different types of innovation: product, process and organizational. Table 6 shows the results of the IV strategy.

Regarding the RE probit (H1) the result for the R&D activity is positively and significantly associated with all types of innovation in manufacturing, other and all firms, while in KIBS, R&D activity is positively significant only for product innovation. In summary, H1 is only partially approved. Moreover, we can also emphasize that there is a sort of complementarity with the accumulation of physical capital given that also the probability to innovate increases with the firm size in all the estimations made (see Accetturo et al 2013 for a discussion). Besides, R&D activities have greater positive effects in the manufacturing sector on all types of innovation, therefore H2 is approved (Table 5).

As to the R&D outsourcing with Italian firms, the effect is positive on product and process innovation when the whole sample is taken into account, and on product innovation in manufacturing, but the estimation doesn't present remarkable results for the KIBs and for other services.

We underline similar effects when the R&D outsourcing with other Italian organization is consideredbut. in addition we also note that the impact on process and organizational innovation is also positive for the KIBS.

As to the Research and Development activities with foreign organizations, this does not exhibit interesting value. So the H3 and H4 are not confirmed (Table 5).

As to the H5, it is approved at margins as the networking activities are more important for some sectors in particular innovation types. The local networking is significant for organizational innovation in Other sectors, while international networking is positively significant for organizational innovation in Manufacturing, but negative for process innovation in other and for product innovation in KIBS. The domestic networking is important for process innovation in KIBS and in other services.

Table 5. XT Probit – Impact on Innovation

	KIBS			MANUFACTURING			OTHER			ALL SAMPLE		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	Product_inn	Process_inn	Org_inn	Product_inn	Process_inn	Org_inn	Product_inn	Process_inn	Org_inn	Product_inn	Process_inn	Org_inn
LReD	0.536***	0.141	-0.0494	0.558***	0.291***	0.198***	0.702***	0.404**	0.328*	0.600***	0.300***	0.193***
	(0.188)	(0.177)	(0.179)	(0.0797)	(0.0751)	(0.0730)	(0.182)	(0.184)	(0.195)	(0.0661)	(0.0632)	(0.0622)
LReD_out_it_firms	0.342	0.327	0.0591	0.285***	0.106	0.0682	0.228	0.204	0.0137	0.267***	0.155*	0.0468
	(0.265)	(0.240)	(0.248)	(0.108)	(0.0969)	(0.0934)	(0.238)	(0.234)	(0.246)	(0.0902)	(0.0827)	(0.0814)
LReD_out_it_other	0.163	0.405*	0.680***	0.220**	0.140	-0.00376	0.113	0.231	0.104	0.197**	0.169**	0.0683
	(0.249)	(0.230)	(0.243)	(0.110)	(0.100)	(0.0973)	(0.257)	(0.254)	(0.267)	(0.0921)	(0.0851)	(0.0842)
LReD_out_foreign	0.429	0.341	0.436	-0.0714	0.175	0.340*	0.267	0.221	0.0548	0.0115	0.194	0.326*
	(0.514)	(0.456)	(0.480)	(0.216)	(0.196)	(0.188)	(0.619)	(0.597)	(0.609)	(0.186)	(0.169)	(0.167)
LNetwork_local	-0.0427	-0.0311	-0.0898	-0.0591	-0.00300	-0.0557	-0.0242	0.0889	0.127*	-0.0508	0.0153	-0.00574
	(0.112)	(0.106)	(0.102)	(0.0533)	(0.0513)	(0.0500)	(0.0754)	(0.0786)	(0.0725)	(0.0407)	(0.0397)	(0.0377)
LNetwork_international	-0.465*	-0.185	-0.306	0.00871	0.0748	0.133*	-0.0919	-0.442**	-0.115	-0.0497	-0.0315	0.0328
	(0.241)	(0.211)	(0.215)	(0.0829)	(0.0785)	(0.0767)	(0.165)	(0.185)	(0.159)	(0.0693)	(0.0665)	(0.0645)
LNetwork_domestic	0.0598	0.244*	0.137	0.0175	-0.0246	-0.0319	0.0829	0.166*	0.145	0.0490	0.0558	0.0371
	(0.138)	(0.126)	(0.124)	(0.0623)	(0.0600)	(0.0585)	(0.0905)	(0.0928)	(0.0881)	(0.0479)	(0.0466)	(0.0448)
Group	0.0836	0.106	0.131	0.0434	-0.00371	0.187***	0.165*	0.102	0.235**	0.0952*	0.0360	0.185***
	(0.153)	(0.141)	(0.137)	(0.0670)	(0.0637)	(0.0614)	(0.0982)	(0.101)	(0.0957)	(0.0516)	(0.0497)	(0.0473)
Lln_size	0.142***	0.151***	0.185***	0.110***	0.149***	0.131***	-0.00668	0.112***	0.135***	0.0758***	0.139***	0.137***
	(0.0473)	(0.0436)	(0.0414)	(0.0243)	(0.0233)	(0.0222)	(0.0258)	(0.0273)	(0.0262)	(0.0166)	(0.0163)	(0.0152)
Lln_age	-0.0329	-0.0526	-0.157	-0.0363	-0.0464	-0.0891**	-0.0504	-0.0332	-0.159***	-0.0373	-0.0455	-0.118***
	(0.121)	(0.109)	(0.105)	(0.0418)	(0.0397)	(0.0384)	(0.0600)	(0.0629)	(0.0597)	(0.0331)	(0.0318)	(0.0304)
LInternational	0.397***	0.186	0.294***	0.342***	0.113**	0.0834	0.267***	0.269***	0.318***	0.343***	0.169***	0.170***
	(0.120)	(0.113)	(0.108)	(0.0551)	(0.0532)	(0.0518)	(0.0828)	(0.0866)	(0.0810)	(0.0423)	(0.0416)	(0.0396)
LInvestment	0.270**	0.248**	0.272***	0.272***	0.464***	0.266***	0.291***	0.299***	0.204***	0.273***	0.401***	0.249***
	(0.107)	(0.100)	(0.0954)	(0.0499)	(0.0488)	(0.0473)	(0.0739)	(0.0782)	(0.0716)	(0.0386)	(0.0382)	(0.0361)
LCredit_access_lim_inv	0.00240	0.0877	0.0356	-0.0297	-0.104***	-0.0293	-0.0168	-0.0525	-0.0553	-0.0219	-0.0661**	-0.0239
	(0.0799)	(0.0744)	(0.0711)	(0.0352)	(0.0348)	(0.0334)	(0.0547)	(0.0587)	(0.0538)	(0.0278)	(0.0277)	(0.0261)
Constant	-1.769***	-1.948***	1.255***	-1.565***	-1.440***	1.451***	-1.462***	-1.764***	1.215***	-1.658***	-1.762***	1.268***
	(0.430)	(0.394)	(0.367)	(0.180)	(0.171)	(0.166)	(0.259)	(0.272)	(0.252)	(0.141)	(0.137)	(0.128)
Observations	1,593	1,593	1,593	6,102	6,102	6,102	3,015	3,015	3,015	10,710	10,710	10,710
Number of id	1,047	1,047	1,047	3,780	3,780	3,780	1,913	1,913	1,913	6,683	6,683	6,683

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The robustness check carried out in Table 6 conducts to very similar results to those obtained with the probit regressions, but some novel results can be pointed out. Looking at R&D as to KIBS sector the effect is positive also on process innovation. Moreover as to the R&D outsourcing with Italian firms the effect in IV probit is stronger and this is verified especially in all the sample and in manufacturing sector and for process innovation in KIBS and product and organizational ones in other services. Moreover, differently from before when the R&D outsourcing with other Italian organization is considered, we observe only the organizational innovation in KIBS improves with that.

In addition, it seems that the importance of network is increasing more than before, especially if we measure the relevance of network domestic; this drives the innovation in

all the forms, and this is true in the total sample and in the other sectors. But the process and organizational innovation in the KIBS sector also exhibits a significant value, even if at low level such as the product innovation in manufacturing.

Table 6. IV Probit – Impact on Innovation

	KIBS			MANUFACTURING			OTHER			ALL SAMPLE		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
VARIABLES	Product_inn	Process_inn	Org_inn	Product_inn	Process_inn	Org_inn	Product_inn	Process_inn	Org_inn	Product_inn	Process_inn	Org_inn
LReD	0.653***	0.222**	0.0888	0.506***	0.230***	0.247***	0.549***	0.545***	0.369***	0.550***	0.289***	0.239***
	(0.0977)	(0.109)	(0.101)	(0.0446)	(0.0455)	(0.0457)	(0.102)	(0.106)	(0.101)	(0.0372)	(0.0385)	(0.0379)
LReD_out_it_firms	0.108	0.367**	0.0367	0.334***	0.203***	0.198***	0.254*	0.227	0.329**	0.276***	0.226***	0.212***
	(0.145)	(0.150)	(0.148)	(0.0656)	(0.0636)	(0.0635)	(0.152)	(0.156)	(0.152)	(0.0550)	(0.0545)	(0.0540)
LReD_out_it_other	0.0230	0.163	0.467***	0.106	0.0142	-0.0650	0.0749	0.0108	-0.181	0.0848	0.0248	-0.0122
	(0.148)	(0.156)	(0.151)	(0.0672)	(0.0659)	(0.0663)	(0.176)	(0.183)	(0.179)	(0.0573)	(0.0573)	(0.0570)
LReD_out_foreign	0.192	0.134	0.0955	-0.00381	0.239*	0.304**	-0.143	-0.0291	0.490	0.00777	0.193	0.259**
	(0.302)	(0.303)	(0.310)	(0.143)	(0.141)	(0.138)	(0.474)	(0.486)	(0.448)	(0.124)	(0.122)	(0.120)
LNetwork_local	0.0241	0.00789	-0.0363	0.0180	0.0596	0.0358	0.0489	0.154**	0.186***	0.0108	0.0574*	0.0778***
	(0.0783)	(0.0862)	(0.0775)	(0.0382)	(0.0389)	(0.0392)	(0.0599)	(0.0643)	(0.0558)	(0.0295)	(0.0307)	(0.0294)
LNetwork_international	-0.105	0.0470	-0.211	-0.0364	0.0334	0.0570	-0.0949	-0.405***	-0.108	-0.0434	-0.0221	-0.0191
	(0.159)	(0.162)	(0.158)	(0.0576)	(0.0580)	(0.0583)	(0.131)	(0.151)	(0.124)	(0.0491)	(0.0501)	(0.0493)
LNetwork_domestic	0.135	0.231**	0.175*	0.104**	0.0487	0.0423	0.119*	0.197***	0.159**	0.111***	0.0984***	0.0903***
	(0.0951)	(0.101)	(0.0940)	(0.0438)	(0.0447)	(0.0450)	(0.0720)	(0.0761)	(0.0677)	(0.0346)	(0.0358)	(0.0347)
Group	0.0273	0.137	0.00651	0.0448	0.0115	0.124***	0.120	0.0833	0.157**	0.0401	0.0178	0.115***
	(0.105)	(0.110)	(0.103)	(0.0458)	(0.0465)	(0.0463)	(0.0769)	(0.0820)	(0.0721)	(0.0362)	(0.0372)	(0.0358)
Lln_size	0.0918***	0.127***	0.151***	0.0508***	0.0979***	0.0850***	0.00528	0.100***	0.109***	0.0596***	0.117***	0.0988***
	(0.0296)	(0.0315)	(0.0289)	(0.0157)	(0.0161)	(0.0161)	(0.0195)	(0.0207)	(0.0181)	(0.0110)	(0.0114)	(0.0109)
Lln_age	0.0481	0.000121	-0.0642	0.0239	0.00684	-0.0351	0.0241	0.0191	-0.0708*	0.0531**	0.0343	-0.0581***
	(0.0764)	(0.0824)	(0.0739)	(0.0272)	(0.0278)	(0.0279)	(0.0448)	(0.0487)	(0.0419)	(0.0220)	(0.0229)	(0.0218)
LInternational	0.274***	0.163*	0.268***	0.347***	0.170***	0.130***	0.243***	0.233***	0.244***	0.381***	0.263***	0.155***
	(0.0826)	(0.0908)	(0.0812)	(0.0391)	(0.0407)	(0.0409)	(0.0642)	(0.0695)	(0.0609)	(0.0297)	(0.0313)	(0.0301)
LInvestment	0.277***	0.326***	0.273***	0.261***	0.450***	0.297***	0.282***	0.281***	0.222***	0.269***	0.399***	0.271***
	(0.0745)	(0.0819)	(0.0731)	(0.0355)	(0.0369)	(0.0370)	(0.0581)	(0.0633)	(0.0544)	(0.0279)	(0.0294)	(0.0281)
LCredit_access_lim_inv	0.00575	0.0856	0.0446	-0.0265	-0.0672**	-0.0279	-0.0231	-0.0296	-0.0269	-0.0128	-0.0319	-0.0192
	(0.0560)	(0.0604)	(0.0541)	(0.0253)	(0.0264)	(0.0263)	(0.0437)	(0.0484)	(0.0414)	(0.0203)	(0.0215)	(0.0205)
REG_def	-0.0146**	-0.00755	0.0189***	0.00942***	0.00892***	-0.00283	-0.00115	-0.000115	-0.00234	0.00856***	-0.00639**	0.00498**
	(0.00654)	(0.00719)	(0.00641)	(0.00324)	(0.00334)	(0.00335)	(0.00507)	(0.00547)	(0.00476)	(0.00250)	(0.00262)	(0.00251)
Constant	-1.423***	-1.799***	-1.079***	-1.074***	-1.254***	-1.158***	-1.395***	-1.887***	1.223***	-1.086***	-1.391***	-1.056***
	(0.260)	(0.283)	(0.252)	(0.111)	(0.114)	(0.115)	(0.170)	(0.186)	(0.158)	(0.0945)	(0.0994)	(0.0944)
Observations	1,745	1,745	1,745	6,782	6,782	6,782	3,122	3,122	3,122	11,649	11,649	11,649

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

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Enterprise Social Media Users' Typology: a Bi-Dimensional Classification

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Abstract

The use of Enterprise Social Media (ESM) platforms is rapidly diffusing in the business context, as they are increasingly considered crucial for the future competition. In particular, as commonly underlined by scholars, ESM can bring substantial benefits to companies and especially to their knowledge management (KM) processes. However, such benefits can materialize only if the active use and contribution by individual employees to ESM are ensured. Therefore, it is crucial to better understand how and how much an ESM platform is used by a company's employees. This explains why the literature is devoting particular attention to the analysis of the level of participation and the type of activity performed by the users of such platforms. While "frequency of use" is the most considered dimension to classify different users' groups, scholars also resort to other dimensions, as the distinction between passive and active users, sometimes called as "posters" and "lurkers". The paper proposes a new typology of ESM users based on the results of a survey, which involved 262 employees of an international engineering project-based service company that has adopted an ESM platform. What emerged from the analysis of the survey data confirmed the existence of different types of ESM users and provided the empirical basis to develop a users' typology based on two dimensions: frequency (high vs. low) of use and kind (active vs. passive) of use. This allowed identifying four different users' groups (of different size but all populated), that were denoted as: "frequent contributors", "sporadic contributors", "frequent lurkers" and "sporadic lurkers".

Furthermore, applying descriptive statistics and variance analysis on the survey data allowed to verify the reasonableness of the proposed new typology and identify the main aspects that characterise the different users' groups such as: position in the company, role inside the community, specific types of relevant knowledge sources, perceived usefulness, information novelty and satisfaction with the platform and the Community of Practice. The findings of the study have both academic and managerial implications. As regards the latter, managers should consider that different employees might behave differently with respect to new media, so that an undifferentiated approach to different behaviours may be ineffective. The main limitation of the study is that only one company was analysed belonging to a particular sector with specific knowledge needs and capabilities.

Keywords – Knowledge Management, Enterprise Social Media, Users' behaviour, Survey

Paper type – Academic Research Paper

1 Introduction

Enterprise Social Media (ESM) are social media platforms arranged for being used by company's employees (Leonardi et al., 2013; Hacker, 2017). Their application is rapidly becoming common in the business context, as this technology is increasingly considered important for the future competition. Many scholars underline that ESM can bring substantial benefits to companies and especially to their knowledge management (KM) processes (Nisar et al., 2019). However, such benefits can materialize only if the active use and contribution by individual employees to ESM are ensured (Guinan et al., 2014; Mäntymäki and Riemer, 2016). Hence, it is crucial to understand how companies adopt an ESM platform and how employees get support regarding their knowledge-related activities. This explains why the literature is devoting particular attention to the analysis of the level of participation and the type of activity performed by the users of such platforms (Schwade and Schubert, 2019). While "frequency of use" is the most considered dimension to classify different users' groups, scholars also take into account other dimensions, as the distinction between passive and active users, sometimes called as "posters" and "lurkers" (Engler and Alpar, 2018; Chin et al., 2020). Even if it is plausible that active users are also frequent users (or vice versa passive users are sporadic users), the relationship between the two dimensions deserves to be further investigated, not only to find confirmations, but also to understand if a new typology can be constructed based on these two dimensions.

This is what the present paper aims to do, by illustrating the findings of a study concerning the use of an ESM platform as a tool to support the knowledge management activities of the employees of an international project-based service company. Specifically, based on the results of a survey, which involved 262 company's employees, a new ESM users typology was first proposed, and then by means of a statistical analysis the main aspects that distinguishes the different kinds of user were identified and examined.

The paper is organised as follows. Section 2 illustrates the conceptual background of the study, while section 3 presents the research goals and method. Section 4 is devoted to the findings of the study that are discussed in the next section 5. The last section contains some conclusions, together with academic and managerial implications and the limitations of the study.

2 Background: ESM users typology

There is wide consensus in the literature on the fact the failure of many ESM platforms is due to (as well as testified by) they are underused by the workforce (Guinan et al., 2014; Alarifi et al., 2015; Giermindl et al., 2018). Hence, there is the need to understand how companies can act in order to motivate and induce employees to use ESM platforms more intensively. This can be effectively done only by taking into account that there exist different forms of usage. Indeed, empirical evidence shows that ESM participants perform various activities (from simple consumption to content production and contribution) and with different frequency. This is why scholars have devoted specific attention to analyse and classify the different behaviours adopted by ESM users.

It is worth noting that the spreading of online communities, spurred by the availability of the new social media applications, has brought about the introduction of new terms to indicate possible user behaviours, as, e.g., posters and lurkers. The former term is used to indicate users who assume an active behaviour by posting new contents, replying or commenting content posted by others, etc. On the contrary, the term lurker denotes users who observe the community activity but do not actively participate.

The research about Enterprise Collaboration Systems (as ESM are) users typology is very fragmented and offers a lot of classifications that are based on different aspects and dimensions, as e.g. type of use, frequency of use, variety of use. This is confirmed by the findings of a recent literature review made by Schwade and Schubert (2019) that identified 102 definitions of user types, that they summarised in 6 typologies, as follows: creators, contributors, lurkers, inactives, non-users, users without an account. The review also revealed that scholars deserved particular attention to the role and characteristics of lurkers, while the discussion about other user types results to be comparably limited. Furthermore, scholars do not even agree on the definition of the single types, so that e.g., they found 22 different definition for lurkers, as well as the distinction between contributors and creators is all but clear.

The strong interest of scholars about lurkers is probably due to the fact that in most online communities the 90-9-1 rule applies (Nielsen, 2006): 90% of users are lurkers who read or observe, but do not contribute; 9% of users contribute from time to time, but they have other priorities. Only 1% of users are very active and account for most contributions. Such rule, originally defined for Internet users, seems to be applicable also in the business context, even if with different percentages, as revealed by empirical evidence (Oettl et al., 2018; Schwade and Schubert, 2019).

In general, typologies employed by ESM scholars to differentiate and analyse users' behaviours focus on a single dimension. In particular, ESM scholars tend to distinguish between content contributors (posters) and content consumers (lurkers) and investigate the factors that drive the behaviours of the two groups (Alarafi et al., 2015; Engel and Alpar, 2018; Chin et al., 2020). However, two interesting exceptions deserve to be mentioned here.

The first one is the study by Oettl et al. (2018) that, on the basis of the findings of 28 interviews with experts of a company that introduced an ESM platform, distinguishes the different user types resorting two dimensions: individual openness to ESM and perceived task-fit, where the latter is derived from the technology acceptance theories (Ngai et al., 2015). Accordingly, the authors identify four user archetypes, i.e. power users (denoted by high openness and high task fit), limited users (denoted by high openness and low task fit), reluctant users (denoted by low openness and high task fit) and repudiators (denoted by low openness and low task fit). They also identify two mixed user types, i.e. hidden champions (placed halfway between limited and power users) and question marks (placed halfway between repudiators and limited user. The results of the study suggest that the different groups have different perceptions about the value added by the platform as well as the obstacles to its use, which has relevant implications for managers who want to promote the use of the platform.

The second one is the work of Giermindl et al. (2018) that proposes a classification than can be regarded as bi-dimensional. The authors examine why posters and lurkers differ in their motivations for participating in ESM by referring to the social exchange theory. This theoretical approach considers that in ESM, individuals exchange socioemotional resources, and hence their participation is affected by the motivational factors that are central to the characteristics of a social exchange, such as: reputation, common identity, common bond, social interaction and community commitment. The authors further split the two groups based on the frequency of their activity as follows: super frequent posters, frequent posters, infrequent posters, frequent lurkers, infrequent lurkers. The general findings of their study indicate that posters show significant higher mean values for all the five motivational aspects when compared to lurkers.

To sum up, studies that analyse the factors that distinguishes the different kinds of ESM users are still scarce and offer fragmented results. Furthermore, since most of the proposed typologies are unidimensional, it would be appropriate to try to use a bi-dimensional classification.

At this point, an aspect deserves to be recalled that concerns the role played by lurkers for the success of an ESM platform. While initially lurkers were negatively connoted, recently they role was revaluated since they provide the audience for posters (Cranefield et al., 2015; Ridings et al., 2006). Furthermore, even consumption alone helps the whole users' community to increase its knowledge, transfer it and apply where it is need (Engler and Alpar, 2018; Pohjola and Puusa, 2016). In this regard, Havakhor et al. (2018) suggest

naming the individuals who only consume content as “seekers”, term that has not a negative connotation.

3 Research goals and method

3.1 Research questions

What emerged from the previous discussion suggested us formulating the following two research questions:

RQ1. Can a bi-dimensional classification based on kind of activity and frequency of use allow to better identify different types of ESM users?

RQ2. Which factors characterize the different user types?

3.2 Research method

In order to answer the above-formulated research questions, we investigated how the members of internal communities of practice in a global engineering company are using an ESM platform to access and interact inside their communities. At this aim, we developed a questionnaire with 22 questions. In addition to demographic questions, we asked which knowledge sources and need for information the employees have, what the activities they perform by means of the platform are, the difficulties they perceived in using the platform to interact with the other members, and their satisfaction with their communities. In particular, we asked them to indicate how frequently they access their communities by means of the platform and which kind of use they make. Questions either used a 5-point-Likert scale or were multiple-choice questions. Additionally, we used open-answer questions to collect more opinions about their community. The survey was administered online between September and October 2018.

In order to analyse the data, we used descriptive statistics, content analysis to analyse open answers and one-factorial ANOVA and Tukey-B tests to detect differences between the identified user groups.

4 Findings

4.1 Case company

The investigated enterprise is a global engineering company specialized in the pharmaceutical industry, with around 2,000 employees in 15 offices dispersed in Europe, China, India, and USA. Communities of practices, that they call Communities of Interest (CoI), as a central part of the strategy to become a world leading pharma engineering company, that has a local presence and use the knowledge of experts around the world.

Since 2008, the company has organized 20 global CoIs, whose size ranges from 67 to 373 members and approximately 1,400 project execution employees are members of at least one CoI. Participation is voluntary continuously, and the CoIs define their own task, are responsible for stewarding knowledge within the enterprise, and have a long-term focus. CoIs are responsible for writing the global engineering standards and implementing best engineering practice derived from projects throughout the world. CoIs are supported by several ICT tools including the ESM platform Connect. Each CoI has a Chairman who is overall responsible for the community and key members' engagement. He/she is also responsible for the mainly administrative tasks of inviting to meetings, reporting on CoI performance, maintaining the dialogue with the CoI board, and following up on budget. A CoI has several Key members that are voluntarily appointed to the position because they are recognized experts within their field, and these are central to developing knowledge, sharing knowledge and answering questions. Usual members have no responsibility but contribute to the knowledge sharing and development.

4.2 Deriving User Groups

We received 262 valid answers from the employees of the case company. We defined a frequent user as a person that uses Connect for accessing his/her CoI at least on a weekly basis, while a sporadic user is only active on a monthly basis or even more seldom. Furthermore, we asked employees whether they are rather passive users, or actively involved, e.g., by answering questions or motivate colleagues to contribute. Based on the two dimensions, users' frequency and kind of activity, we have derived four user groups, as indicate in table 1, that are named according to the definition typically employed in the literature (see section 2), i.e. frequent contributors, sporadic contributors, frequent lurkers and sporadic lurkers.

Table 1**:** User groups according to frequency and activity of users

	Active user	**Passive user**
Frequent user	46.9% frequent contributors	9.2% frequent lurkers
Sporadic user	21.4% sporadic contributors	22.5% sporadic lurkers

The group of frequent users is with 56.1% slightly bigger than the group of sporadic users, which can be mainly explained by the fact that the survey was administered online by means of Connect. Furthermore, 68.3% of respondents are active users. The high share of active contributors, much higher than that usually characterises a social media platform, may be linked to the fact that the platform is used inside a favourable organisational context as that of communities of practices. The biggest group, according to table 1, is the group of frequent contributors. However, as previously underlined, "lurkers" are important for the CoI functioning (they could be people who find within the

CoI the knowledge they need for their job). In the following, we analyse these user groups if they show some specific characteristics.

4.3 Characterizing user groups

Table 2 provides an overview of the demographic information. Half of the engineers and more than half of the managers consider themselves as frequent contributors. For project and engineering managers, we do not have a clear picture between frequent contributors and sporadic lurkers. The different behaviour of project and engineering managers can be ascribed to the fact that they may also use other tools to coordinate their teams. Chairmen and key members are fulfilling their role well, because their majority considers themselves as frequent contributors. It is worth noting that all the Chairmen declare to be contributors, even if with different frequency. Regarding the duration of being a member of a CoI or the length of working in the company, no patterns could be found.

Table 2: Demography of user groups

	Frequent contributor (N=123)	**Frequent lurker (N=24)**	**Sporadic contributor (N=56)**	**Sporadic lurker (N=59)**
Position in the company	**50% engineer/ specialist** 31.4% project/ engineering manager **55.6% manager**	10.9% engineer/ specialist 5.9% project/ engineering manager 0% manager	20.8% engineer/ specialist 23.5% project/ engineering manager 22.2% manager	18.2% engineer/ specialist **39.2% project/ engineering manager** 22.2% manager
User role in primary CoI	**89.5% Chairman** **77.4% Key Member** 34.4% Member	0% Chairman 1.9% Key Member 12.2% Member	10.5% Chairman 17% Key Member 23.3% Member	0% Chairman 3.8% Key Member 30.2% Member

We used an ANOVA analysis in order to identify differences between the four different groups. Table 3 lists the mean values of Likert-scaled variables that showed a significant F-Test (p=0.05). The first four variables concern the management of knowledge needed for the own daily job, the second five how much CoIs help in satisfying such needs.

Table 3: Mean values of significant dependent variables in ANOVA analysis

Variable	**F-value (sig.)**	**Frequent contributor**	**Frequent lurker**	**Sporadic contributor**	**Sporadic lurker**
Relevance of external knowledge sources for own job (magazines, conferences)	F=6.047 Sig .001	3.37	2.83	2.96	2.64
Relevance of Connect as knowledge source for own job	F=8.818 Sig .000	3.58	3.09	3.05	2.84
Relevance of formal meetings for own job	F=2.698 Sig .046	3.88	3.92	3.61	3.53
Importance of information	F=7.304	4.07	3.50	3.51	3.51

about new tech solutions for job	Sig .000				
CoI fulfils own needs	F=15.99 Sig .000	3.55	3.17	3.11	2.71
Satisfied with level of collaboration in CoI	F=6.629 Sig .000	3.40	3.21	3.02	2.79
Find often answers to questions in CoI	F=15.514 Sig .000	3.44	3.04	2.89	2.49
Satisfied with CoIs ability to receive own ideas	F=8.019 Sig .000	3.63	3.33	3.20	2.95
CoI keeping up with industry	F=5.968 Sig .001	3.58	3.58	3.14	3.09

Looking at data in table 3, sporadic lurkers have indicated the lowest values while frequent contributors have higher values (apart from the relevance of formal meeting whose value, however, is very close to the higher one): hence it seems reasonable to presume that these two groups are very different. Furthermore, the level of satisfaction with all the benefits linked with the CoI decreases passing from frequent contributors, to frequent lurkers, to sporadic contributors and, lastly, to sporadic lurkers.

We employed the Tukey-B Test to show in case of significant F-Tests possible homogeneous subsets in the data (significance level 0.05). The Tukey-B tests revealed that we have not four different groups for all the significant variables, but sometimes the frequent contributors build one group and the others build a second group (like in the case of the relevance of external knowledge sources). Sometimes, three homogeneous subgroups where found - (1) frequent contributors, (2) frequent lurkers and sporadic contributors and (3) sporadic lurkers (e.g., variable: CoI fulfil own needs).

We furthermore asked the participants what they miss in their primary CoI. The results were analysed via a content analysis. We identified six different problem areas. Table 4 lists the most frequent answers and the number of people in parentheses that mentioned this issue. Two problem areas were indicated by all the groups and concern the need having more active participants and making the search of useful content easier. Frequent contributors recall the need to find more (and in a different format) topics; they also would even like to contribute more, if they would have time. Sporadic contributors totally agree with frequent ones but ask for more support from upper management and clearer strategy for all CoIs. Frequent lurkers get disappointed with old information and dead links, while sporadic lurkers are not motivated to use their CoI, because they find it easier to ask colleagues directly. They also complain about the limited time to participate in the CoI and, as similarly to sporadic contributors, the missing support from the management to integrate such activity in daily work.

Table 4: Missing issues in the primary CoIs (open answers analysis)

Problem area	Frequent contributors	Frequent lurkers	Sporadic contributors	Sporadic lurkers
User activity	• More active participants (18)	• More activity (2)	• Missing active people (2)	• Missing activity of other people (2)
Content issues	• More topics, not only questions and answers (7)	• More and more updated content (4)	• Missing updated content and links (3)	
Missing time	• More time to contribute (6)		• Missing time to use CoI (3)	• No time (3)
Finding relevant information	• Better search possibilities (6) • Access from outside the company (2)	• Easier overview about content that allows to follow a topic (2)	• Better ways to search for and filter relevant information (4) • Useful rating of articles (2)	• Miss focus on relevant information (2)
No motiva-tion		• Do not need CoIs for own work (1)		• Lack of motivation / better to ask colleagues directly (4)
Missing support from management			• Support from upper management / strategy for all CoIs, rewards for higher quality (2)	• Need more support from management to integrate in daily work (2)

5 Discussion

What illustrated in the previous sections provides some food for thought that deserves to be further discussed.

5.1 Characteristics of the user groups

The study was based on the assumption that it is possible, and better, to use a bi-dimensional taxonomy to classify ESM users, where the two dimensions are: frequency of use and kind of use. The results of the analysis seem to confirm such an assumption (all the four types include a not insignificant number of respondents); however, findings show that sporadic users and frequent lurkers are very similar in terms of cognitive needs and satisfaction with CoI, so that the statistical analysis sometimes indicated them as a single group. Rather, the latter ones are more satisfied that the former ones, which induces to think that frequency plays a more relevant role in explaining the different users' perceptions than the active or passive kind of use.

Furthermore, the study shows that different user types have different motivations for using the platform, that are connected to the need of information for their job (depending on which of this information can also be found in the CoIs), to how much the community, that is supported by the platform, fulfils their needs for finding useful and updated information and for collaborating with other colleagues. In general, it can be assumed that

the higher are the knowledge needs and the capability to find answers inside the community the more frequent is the use of the ESM platform.

5.2 Changing sporadic contributors and lurkers to frequent contributors

Taken for granted that is difficult to change a passive into an active user, the question is if and how to induce infrequent contributors to contribute more frequently, as well as infrequent lurkers to resort to CoIs more frequently. Our study shows that sporadic users do not find enough useful information in the ESM and miss the support of the management.

To face the first point, chairmen and key members should not only contribute new knowledge, but also take care that outdated knowledge is archived, and dead links are removed. In general, a better organised information allows its easier and faster retrieval, thus involving a more intense use of the platform as well as the community.

To address the second issue, managers should integrate the work with CoIs into daily work routines of employees, that means to encourage them to contribute and give them time to read information and provide answers. In doing this, they should consider the organisational position of the single employee. For instance, in the case company there are some factors that make project/engineering managers less frequent and active users of the platform, which need to be identified if project/engineering managers' participation is to be fostered.

6 Conclusions

Our study employed a bi-dimensional typology to classify and analyse how the employees of an engineering services company are using an ESM platform to access and interact inside their communities. Findings allow to answer the two research questions we posed; however, the answers are partially unexpected and provide thought-provoking indications.

6.1 Implications of the study

The paper has both academic and practical implications. Concerning the former ones, it confirms that such a bi-dimensional classification can help better identifying the different ESM user groups as well as understanding the factors that affect their behaviour. Furthermore, it allows highlighting more clearly differences and similarities that denote the various groups. For instance, in the analysed case, the study revealed that frequent lurkers and sporadic contributors share some common traits that distinguish them from the other two groups. The above paves the way for further empirical research aimed at employing the proposed classification in other contexts and verifying if the characteristics of the different groups might be linked to the organisational environment where the ESM platform is implemented. As regards the practical implications, the study provides some

useful indications to managers who intend to promote the use of an ESM platform inside their company. In particular, the analysis not only confirms the ineffectiveness of an undifferentiated approach, but it also suggests that mangers' efforts should be primarily directed to frequent lurkers and sporadic contributors whose participation can be more easily stimulated.

6.2 Limitations

The study is not without limitations. The most important is that results cannot be generalised, since only one company was analysed that belongs to an industry with specific knowledge needs and capabilities. An aspect that must be taken into account concerns the fact that the ESM platform operates inside a community-based context, which clearly influences its use. Furthermore, for the sake of quickness and simplicity, the survey was distributed through the ESM and not via email, thus reducing the reach. Thus, it is likely that the sample includes a larger share of more frequent users than the actual percentage in the company is. Lastly, the study is based on a self-assessment of respondents about the frequency and the kind of use they are making of the platform, and not on an analysis of log data and activity performed on the platform. However, researchers on this topic frequently use this method.

Despite the previous limitations, the findings of the study provide interesting insights that can be a basis for further studies aimed to better understand how the new social tools are employed in a business context.

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Designing the Knowledge Base of University Research: Ontology for Practical Navigation

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Abstract

Nowadays information flow overload is typical for most of the companies, universities as knowledge organizations are not the exception. Little emphasis is placed on knowledge transfer efforts made by universities in passing knowledge to internal stakeholders (Chugh, 2013). The paper describes a sketch of a knowledge base for university research. The case of Graduate School of Management St. Petersburg State University is taken into consideration. The knowledge base in the form of ontology helps to create a big picture view of the different information pieces involved into research and improve understanding of research in general as well as its various research aspects (Gruber, 1993; Hahn, Chang, Kim & Kittur, 2016; Hammar, 2017).

This paper is consistent with design science research and systems thinking applied for generalization of the selected research domain (Dresch, Lacerda & Antunes, 2015). It is based on literature review, the systemic analysis of knowledge portals of several universities as well as semantic analysis and in-depth interviews. The paper is focused on the ontology development for research domain so methods of ontological engineering are used. The study considers knowledge base and ontology from knowledge management perspective. According to Ameen et al. (2012) the university ontology generally portrays an institution, representing the local reality of the entire educational process. The knowledge base in the form of ontology is designed considering various aspects: organizational structure, research activities and workflow processes, including administrative structures, research results and their dissemination.

The analysis of knowledge bases and literature review showed that existing university knowledge bases serve more like digital repositories (Koperwas, Skonieczny, Rybiński & Struk, 2013). But there is no survey devoted to university research domain. This research fills the gap.Proposed knowledge base is linked to the existing Pure Cloud Information System developed for a very specific application being a digital repository. The sketch of ontology of a knowledge base creates a big picture of decomposed comprehensive research aspects and tasks and their relationships; and allows the research data to be aggregated, filtered and delivered in a user-friendly way to the faculty and administrative staff.

Presented sketch of ontology of a knowledge base for university research may help researchers, managers and knowledge analysts to develop a big picture view, improve the navigation among different knowledge assets. The paper considers the feasibility of using the ontology for research data integration from relational databases and other information sources.

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Keywords – research ontology, university knowledge base, visualization technique, domain-specific KM, case study.

Paper type – Academic Research Paper

1 Introduction

Nowadays information flow overload is typical for most of the companies and universities where organization of knowledge and information flows are decentralized, desynchronized in time and space. Universities take a lot of effort in knowledge transfer through commercialization of research and expert activities of the faculty but little emphasis is placed on the knowledge transfer efforts made by universities in passing knowledge to internal stakeholders (students, faculty and administrative staff) (Chugh, 2013).

It is an increasingly common practice within universities to use departments and schools as units of a big picture of research (Bourke & Butler, 1998). However the organisation of information flows among the information clusters and agents in the university is often hidden and invisible. Ontology-based approach can help to reveal the tacit knowledge structure of the university research landscape.

2 Research methodology

The paper describes a sketch of a knowledge base for university research. The case of Graduate School of Management St. Petersburg State University is taken into consideration. The knowledge base in the form of ontology is based on the use of modern visual knowledge codification (diagramming) techniques which helps with data integration and systemizing and managing knowledge on research (Banks, 2001; Sosnovsky, Gavrilova, 2006). The presented ontology of research (conceptual model) is based on competency questions including planning questions and temporal projections; and helps to create a big picture view of the different information pieces involved into research and improve understanding of research in general as well as its various research aspects and decisions (Gruber, 1993; Gruninger & Fox, 1995; Hammar, 2017; Hahn, Chang, Kim & Kittur, 2016; Wheeldon & Ahlberg, 2012). Systems thinking and visual metaphors are applied for generalization of the selected research domain. The conceptualization of university knowledge through visualization techniques serves to depict the results of research and to provide communicative tools for further discussions of the presented data.

The proposed ontology UNIVERRA (UNIVERsity Research Activity) is based on the extension of BIBO approach (Surla, Segedinac & Ivanović, 2012). The BIBO ontology (Bibliographic Ontology) is a conceptual structure to describe information defining the bibliographic things like papers, articles, or books (D'Arcus, Giasson, 2009). It uses RDF and is widely operated as a citation ontology or as a document classification ontology.

BIBO also semantically models publication review statuses, enabling to make a request for all items in the knowledgebase in a much simpler manner (Hammar, Lin, & Tarasov, 2010). Sometimes it is employed as a way to describe any kind of document. It has been originated from many modern document definition metadata formats and is widely employed as a common ground for converting other bibliographic data sources (Dimić, Segedinac & Ivanović, 2012). Figure 1 illustrates a piece of BIBO ontology.

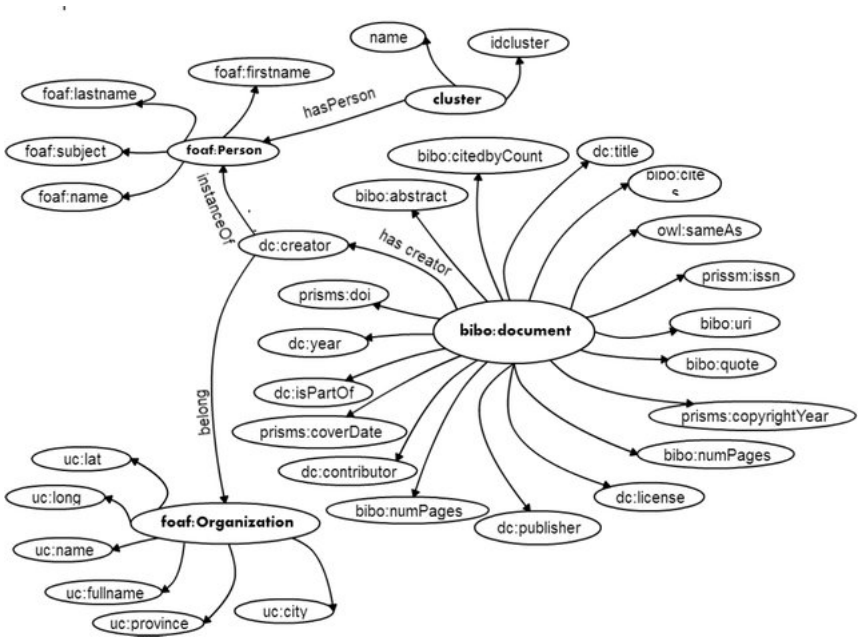

Figure 1 Fragment of BIBO ontology (Sumba et al., 2016)

There are a number of other ontologies describing the research activity, e.g. DoCO, the Document Components Ontology, most widely used for the description of document components (Constantin et al., 2016), FRAPO (Peroni & Shotton, 2018), SCoRO, the Scholarly Contributions and Roles Ontology(Shotton & Peroni, 2017), VIVO (Conlon et al., 2019). The basic concepts within the FRAPO and SCoRO models are shown in the following figures 2 and 3.

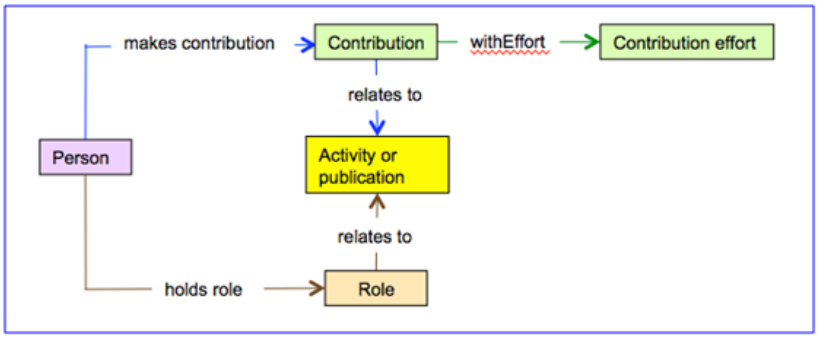

Figure 2 SCoRO ontology for Research Output concept

SCoRO ontology describes the contributions and roles of researchers, and the organizations of which they are members, concerning all types of academic activities depicted using FRAPO, and to the scholarly journal articles and other outputs that result from them.

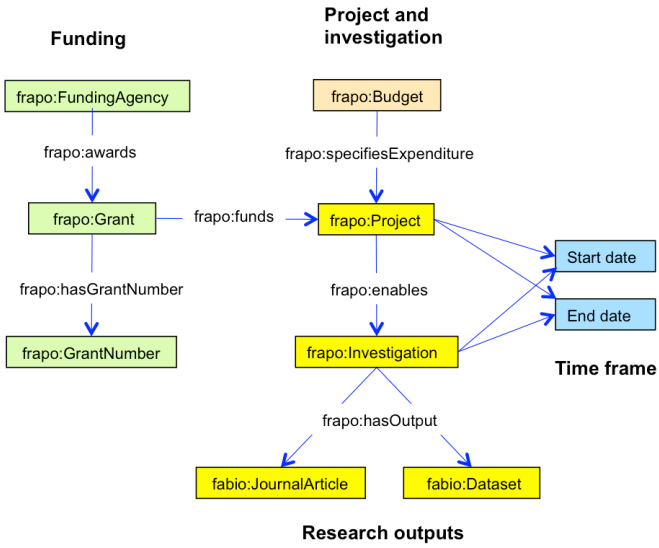

Figure 3 FRAPO ontology for PROJECT concept

FRAPO ontology also permits descriptions of various types of applications, funding programs, infrastructure entities (e.g. services and research facilities), and a wide range of financial entities (e.g. accounts, contracts, quotations, purchases, invoices and payments), and the relationships between them not shown in the diagram above.

Recent VIVO ontology supports recording, editing, searching, browsing, and visualizing different scholarly activities (Conlon et al. 2019). VIVO is member-supported,

company open source software and an ontology for representing scholarship. VIVO It encourages research discovery, expert finding, network analysis and assessment of research impact. It also may be easily extended to support additional domains of scholarly activity.

Our approach is consistent with design science research and systems thinking (Dresch, Lacerda & Antunes, 2015). It is based on literature review and the systemic analysis of knowledge portals of several universities as well as semantic analysis and in-depth interviews on the case of Graduate School of Management St. Petersburg State University. The paper is focused on the ontology development for research domain, so methods of ontological engineering are used. The study considers knowledge base and ontology from knowledge management perspective.

The analysis of knowledge bases and literature review showed that existing university knowledge bases serve more like digital repositories (Koperwas, Skonieczny, Rybiński & Struk, 2013). There are some works in this area devoted to information system of university and its problems discussing university ontologies for archives, studying process, human resource and financial issues as well as general management and administration processes (Bawany, Nouman, 2013; Malik, Prakash & Rizvi, 2010; Kyriaki-Manessi, Dendrinos, 2014). But there is no survey devoted to university research domain. The presented paper and the proposed design make an attempt to fill this gap. We use the visual approach in the ontology development that demonstrated its feasibility for several decades of deployment (Gavrilova, Voinov, 1996).

3 Ontology Design and Development

This research puts in evidence on the issue of development of knowledge base for research using ontology-based approach. The ontology in general can be defined as the "specification of the conceptualisation" (Gruber, 1993). According to Ameen et al. (2012) the university ontology generally portrays an institution, representing the local reality of the entire educational process.

However, we are interested in providing a big picture view of the research activity. So UNIVERRA ontology is put as a skeleton of a knowledge base aiming at collecting, organising and sharing each researcher's knowledge base. It allows to create self-service customer support content around recurring topics, issues, and themes. The knowledge base in the form of ontology is designed considering various aspects: organizational structure, research activities and workflow processes, including administrative structures, research results and their dissemination. This network of ontologies allows the creation of concepts independently or could be integrated for a specific application. We used the visual approach to the design as the most comprehensive one (Gavrilova, Voinov, 1996).

Designed knowledge base reuses another ontology (Read, Demetriou, Nenadic, et al. 2016). It is linked to the existing Pure Cloud Information System which was developed for a very specific application being a digital repository. It collects the information about

the published research results of the faculty and conference papers as well as the information on applications for grants and grants themselves.

Proposed knowledge base in the form of ontology creates a big picture of decomposed comprehensive research aspects and tasks and their relationships, friendly for navigation and search; and allows the research data to be aggregated, filtered and delivered in a user-friendly way to the faculty and administrative staff.

Knowledge base includes logical structure of the domain concepts and their relationships to one another. It was based on data sources that were made available: annual research reports, regulating documents and existing datasets.

Figure 4 illustrates the first version of the skeleton of the designed ontology UNIVERRA which describes the main actors and concepts of the modelled domain.

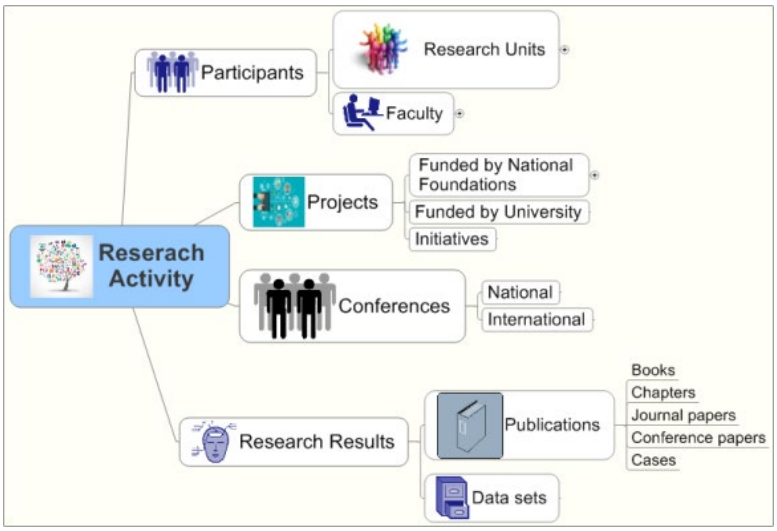

Figure 4 The sketch of the UNIVERRA ontology (upper levels)

Each of the concepts of this ontology can be presented as a set of more detailed pieces. We tried to develop the systems view of different research aspects at different scales and ensuring they all fit together. For example, the figures below show the conceptual structures of the research management domain as a whole and the aims of research activities.

Figure 5 presents the idea of management research on the case of Graduate School of Management, St.Petersburg University, with the most important concepts (key principles and objects, key activities) that radiate from the central idea of research management.

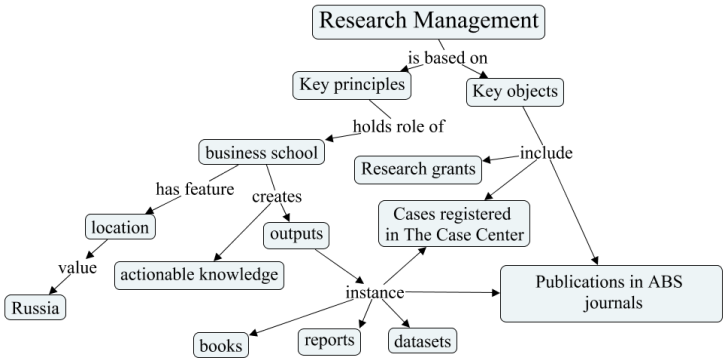

Figure 5 Concept map for principles and objects in management research at Graduate School of Management, St.Petersburg University (GSOM SPbU)

Figure 6 depicts the aspect of the aims of research activities.

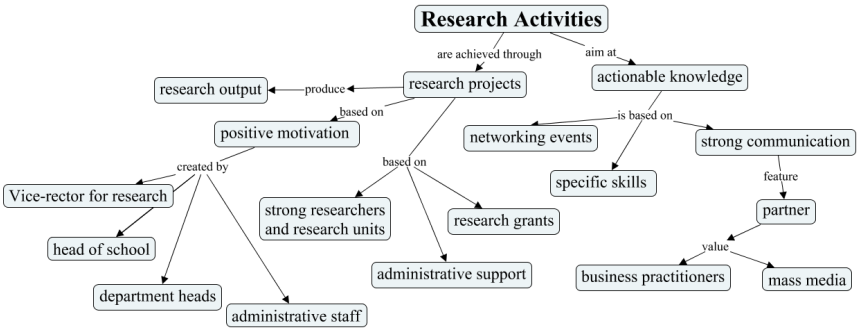

Figure 6 Concept map for the aims of research activities

The aims of research activities are closely connected with the faculty member profile, which concept is presented in figure 7 below.

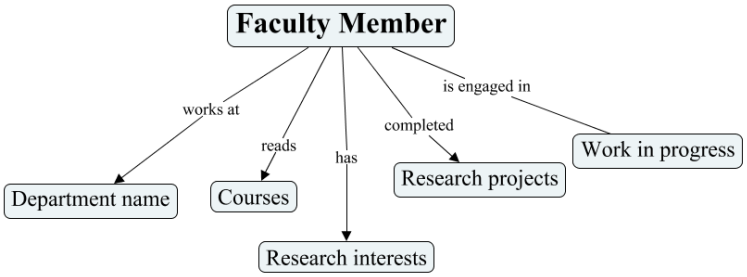

Figure 7 Concept map of the faculty member profile.

Figure 8 shows the conceptual structure of the information within "project" concept.

The designed knowledge base comprises not only classical domain ontology but also the knowledge management scaffolding information – rejected applications, failed projects, etc.

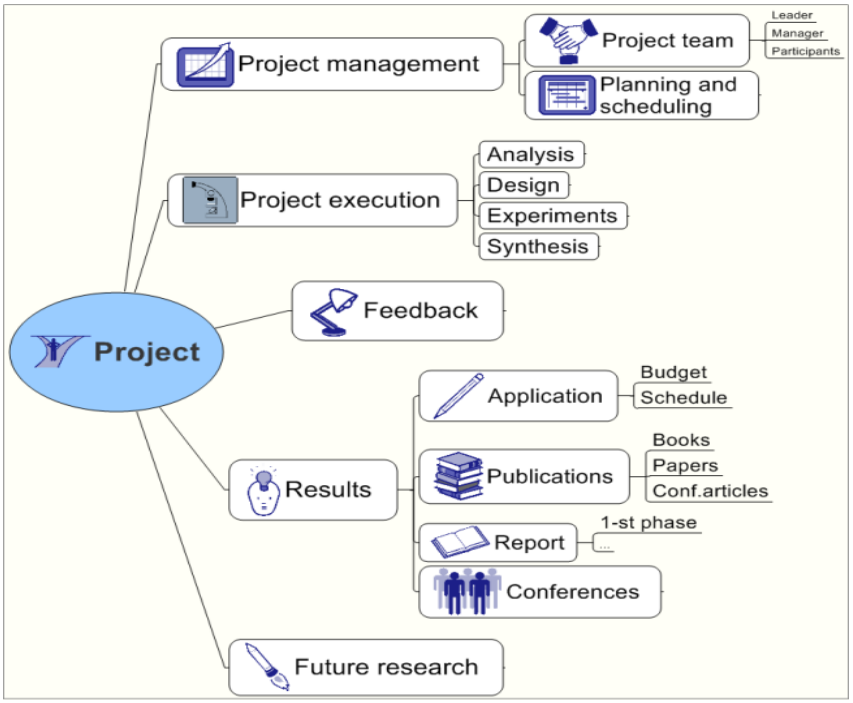

Figure 9 The sketch of the PROJECT ontology (upper levels)

4 Conclusions

In the era of Big Data the interest to generalising information is increasing dramatically. The researchers and educationalists look at ontologies with hope, trying to structure the increasing volumes of information mostly stored in computable form.

Presented sketch of ontology of a knowledge base for university research may help researchers, managers, and knowledge analysts to develop a big picture view and improve the navigation among different knowledge assets. We hope it becomes a sufficient model to represent the concepts of university research and the semantics.

Our UNIVERRA ontology is more modest than other ontologies describing research activities. The presented knowledge base for university research facilitates understanding of various research aspects and aims to serve as a self-service tool. It is developed for the purpose of enabling research knowledge sharing and reuse.

The paper considers the feasibility of using this ontology for research data integration from relational databases and other information sources. Now the UNIVERRA project is on the design stage.

Acknowledgements

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The Source of Productivity Heterogeneity in the Italian Knowledge-Intensive Business Services (KIBS) Industry

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Abstract

This paper investigates heterogeneity in Total Factor Productivity (TFP) of a sample of Knowledge-Intensive Business Services (KIBS) firms actively operating in Italy over the period 2012-2018. Business service industries can be defined as KIBS if they are private sector organizations that offer specialist professional, consultancy, and outsourcing services to other organization relying heavily on professional knowledge. On the basis of an ample literature, KIBS firms support the innovation process of organizations in different industry market, including, in particular, small and medium-sized ones, and of those operating in the public sector, through knowledge generation and diffusion. Starting from the underlying idea that KIBS firms differ from each other in several ways, whatever their location, and such heterogeneity in firm-specific characteristics is supposed to translate into heterogeneity in business performance, the main object of the present contribution is to analyze KIBS productivity heterogeneity on the basis of their localization and business sector. The empirical analysis is conducted at firm-level using a large sample of KIBS firms, obtained, as primary source, from the AIDA- Bureau van Dick database, which contains all Italian firms' disaggregated balance sheet and profit and loss statement information for the period 2012-2018. In particular, we consider the following Eurostat NACE Rev. 2 statistical sectors: 62-63 (information technology and communication sectors), 69-70-71-72-73-74 (professional, scientific and technical sectors). Based on the efficiency scores obtained from DEA (Data Envelopment Analysis), we

estimate the Malmquist Productivity Index for the period under investigation (2012-2018) to measure the variation of firms TFP. Moreover, in order to investigate if the source of productivity heterogeneity among the firm can be explained by firm specific features (geographic location, activity sector), a multilevel statistical modelling approach is used.

Keywords – Knowledge Intensive Business Services, Total Factor Productivity Heterogenity, Multilevel Model.

Paper type – Academic Research Paper

1 Introduction

Business service industries can be defined as KIBS (Knowledge-Intensive Business Services) if they are private sector organizations that offer specialist professional, consultancy, and outsourcing services to other organization relying heavily on professional knowledge (Wood, 2009; Hertog, 2000; Miles et al., 1995).

On the basis of an ample literature, KIBS firms support the innovation process of organizations in different industry market, including, in particular, small and medium-sized ones, and of those operating in the public sector (Windrum, 2013), through knowledge generation and diffusion (Ciriaci et al., 2015; Muller and Doloreux, 2009; Muller and Zenker, 2001; Hertog, 2000).

The process of "knowledge re-engineering" operated by KIBS, when interacting with other enterprises, causes KIBS to be identified as an important object for both innovation, regional policies (Brenner, 2018; Savic, 2016; Corrocher et al., 2012; Muller and Zenker, 2001) and regional development (Pino et al., 2016).

In recent years, there has been growing interest in the geography of KIBS (Brunow et al., 2019). Doloreux and Shearmur (2012) examine on the one hand the role of their location behavior in shaping the performance of the localities in which they operate, stimulating regional economic growth and potentially supporting regional structural change, and on the other hand highlight as their innovativeness, indirectly and more generally in determining enterprises' outcomes, is strongly associated with highly qualified socio-economic local environment, that play an active role in facilitating access to inputs (e.g. qualified employees and knowledge resources) and output market (e.g. interactions and collaboration with external partners).

Starting from the underlying idea that KIBS firms differ from each other in several ways, whatever their location, and such heterogeneity in firm-specific characteristics is supposed to translate into heterogeneity in business performance, the main object of the present contribution is to analyze KIBS productivity heterogeneity on the basis of their localization and business sector.

In particular, the paper investigates heterogeneity in Total Factor Productivity (TFP) of a sample of Knowledge-Intensive Business Services (KIBS) firms actively operating in Italy over the period 2012-2018.

The empirical analysis is conducted at firm-level using a large sample of KIBS firms, obtained, as primary source, from the AIDA- Bureau van Dick database, which contains all Italian firms' disaggregated balance sheet and profit and loss statement information for the period 2012-2018.

In particular, following the papers by Brenner (2018) and Skórska (2015), we consider the following Eurostat NACE Rev. 2 statistical sectors: 62-63 (information technology and communication sectors), 69-70-71-72-73-74 (professional, scientific and technical sectors).

Based on the efficiency scores obtained from DEA (Data Envelopment Analysis), we estimate the Malmquist Productivity Index (Färe et al. 1995; Caves et al. 1982) for the period under investigation (2012-2018) to measure the variation of firms TFP.

Moreover, in order to investigate if the source of productivity heterogeneity among the firm can be explained by firm specific features (geographic location, activity sector), a multilevel statistical modelling approach is used (Aiello et al., 2014; Fazio and Piacentino, 2010; Raspe and van Oort, 2007).

The next Section (2) describes the dataset and discusses the methodology. Finally, Section 3 points out the results and conclusions.

2 Materials and Methods

2.1 Analytical framework

Extending an our previous work (Campisi et al., 2019), the present analysis adopts a two-stage procedure to find answers to the following two questions.

RQ1: Does financial productivity of KIBS firms present different productivity pattern over time (2012-2018)?

RQ2: Is there or not a link or relationship among productivity behaviours over time and some firms' specific variables?

At the first stage, to assess and benchmark a large sample of knowledge-intensive business service organizations, a Constant Return to Scale (CRS) DEA based Malmquist Index Model (Färe et al., 1992) is developed. The productivity analysis is then used to characterize KIBS firms' financial performance through the definition of productivity patterns based on the Italian geographical region. In the second stage of our analysis, in order to evaluate the differentials in firms' productivity, we investigate the influence of specific firms' attributes (geographic location, and business activity sector) on the overall performance changes over time (i.e. Malmquist Productivity Index) adopting a multilevel statistical analysis.

2.2 Sample description

The quantitative proposed approach uses firm-level information about financial variables and some specific attributes.

The AIDA (Analisi Infomatizzata delle Aziende - Bureau van Dijk) database is used to carry out the analysis of this work. AIDA is a dataset that contains information filed at the Italian Chambers of Commerce by companies with at least one registered office in Italy and regarding comprehensive data about financial statements, activity, location, and ownership of small, medium, and large Italian firms.

A period of about 8 years, from 2012 to 2018, has been selected.

The sample extracted from the AIDA database is composed of 18.459 firms representative of the KIBS sectors, and defined on the basis of the next search strategy (applied for all the time frame used, 2012-2018): companies with legal status classified as active (i.e. actively operating during the period of analysis), firms with the complete availability of financial statements data, firms with a value of revenues from sales and services of 100 thousand euro or more, companies that employed between 2 and 250 persons, firms defined at the level of the NACE Rev. 2 Classification System representative of KIBS economics activities.

As private sector firms that offer specialist professional, consultancy, and outsourcing services with high intellectual value-added (Muller and Zenker, 2001) to other organizations (Wood, 2009), KIBS companies typically operate in the following sectors (Cabigiosu, 2020): software and computer services (ICT), strategy and management consultancy, auditing, accountancy, tax and legal service, marketing services, opinion pooling, technical services, engineering personnel training and headhunting.

According to a broader classification framework of KIBS firms proposed in some recent works (Hernandez et al., 2018; Skórska, 2015; Schnabl and Zenker, 2013) the next 2-digit NACE Rev. 2 branches were selected, comprising the following service industry segments: 62 (activity associated with software development and consultancy in the sphere of information technology and related activity); 63 (service activity in the sphere of information technology); 69 (law-related activity, accounting and book-keeping activity as well as tax consulting); 70 (activity of head offices; consulting associated with management); 71 (activity in the sphere of architecture and engineering; technical research and analyses); 72 (scientific research and development works); 73 (advertising, market and public opinion research); 74 (other professional, scientific and technical activity).

Table 1 provides a summary of the distribution of firms among Italian regional geographical areas and their relative grouping based on the adopted NACE Rev.2 activity codes.

Table 1 – Distribution of firms among Italian regional geographical areas and their relative grouping based on the adopted NACE Rev.2 activity codes

			NACE rev.2 CODE															
			62		63		69		70		71		72		73		74	
Region	n. of KIBS	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)	n	(%)
Abruzzo	**217**	1.2%	**52**	1.2%	**32**	0.9%	**19**	1.3%	**34**	1.2%	**45**	1.7%	**5**	1.2%	**10**	0.7%	**20**	1.1%
Basilicata	**70**	0.4%	**14**	0.3%	**13**	0.4%	**3**	0.2%	**15**	0.5%	**12**	0.5%	**3**	0.7%	**2**	0.1%	**8**	0.4%
Calabria	**145**	0.8%	**42**	1.0%	**31**	0.9%	**4**	0.3%	**24**	0.9%	**29**	1.1%	**4**	0.9%	**3**	0.2%	**8**	0.4%
Campania	**646**	3.5%	**187**	4.3%	**106**	3.0%	**36**	2.4%	**97**	3.5%	**109**	4.2%	**18**	4.2%	**32**	2.3%	**61**	3.2%
Emilia Romagna	**2035**	11.0%	**479**	10.9%	**321**	9.2%	**234**	15.8%	**282**	10.2%	**276**	10.6%	**52**	12.2%	**127**	9.2%	**264**	14.0%
Friuli Venezia Giulia	**475**	2.6%	**103**	2.3%	**100**	2.9%	**52**	3.5%	**59**	2.1%	**68**	2.6%	**15**	3.5%	**24**	1.7%	**54**	2.9%
Lazio	**1871**	10.1%	**513**	11.7%	**298**	8.5%	**114**	7.7%	**257**	9.3%	**296**	11.4%	**61**	14.3%	**156**	11.3%	**176**	9.3%
Liguria	**453**	2.5%	**106**	2.4%	**73**	2.1%	**46**	3.1%	**61**	2.2%	**91**	3.5%	**15**	3.5%	**19**	1.4%	**42**	2.2%
Lombardia	**5502**	29.8%	**1228**	27.9%	**1073**	30.6%	**337**	22.7%	**1011**	36.4%	**606**	23.3%	**94**	22.0%	**572**	41.5%	**581**	30.8%
Marche	**429**	2.3%	**82**	1.9%	**87**	2.5%	**53**	3.6%	**60**	2.2%	**54**	2.1%	**6**	1.4%	**27**	2.0%	**60**	3.2%
Molise	**32**	0.2%	**5**	0.1%	**10**	0.3%	**1**	0.1%	**4**	0.1%	**7**	0.3%	**1**	0.2%	**0**	0.0%	**4**	0.2%
Piemonte	**1579**	8.6%	**409**	9.3%	**252**	7.2%	**154**	10.4%	**233**	8.4%	**225**	8.6%	**39**	9.1%	**119**	8.6%	**148**	7.9%
Puglia	**490**	2.7%	**126**	2.9%	**89**	2.5%	**27**	1.8%	**59**	2.1%	**98**	3.8%	**23**	5.4%	**29**	2.1%	**39**	2.1%
Sardegna	**227**	1.2%	**50**	1.1%	**60**	1.7%	**28**	1.9%	**22**	0.8%	**36**	1.4%	**3**	0.7%	**11**	0.8%	**17**	0.9%
Sicilia	**434**	2.4%	**97**	2.2%	**86**	2.5%	**36**	2.4%	**67**	2.4%	**79**	3.0%	**5**	1.2%	**21**	1.5%	**43**	2.3%
Toscana	**1192**	6.5%	**316**	7.2%	**241**	6.9%	**105**	7.1%	**140**	5.0%	**194**	7.4%	**32**	7.5%	**57**	4.1%	**107**	5.7%
Trentino Alto Adige	**441**	2.4%	**82**	1.9%	**107**	3.1%	**43**	2.9%	**62**	2.2%	**66**	2.5%	**13**	3.0%	**30**	2.2%	**38**	2.0%
Umbria	**226**	1.2%	**44**	1.0%	**43**	1.2%	**19**	1.3%	**32**	1.2%	**38**	1.5%	**8**	1.9%	**19**	1.4%	**23**	1.2%
Valle d'Aosta	**45**	0.2%	**6**	0.1%	**14**	0.4%	**5**	0.3%	**11**	0.4%	**5**	0.2%	**2**	0.5%	**1**	0.1%	**1**	0.1%
Veneto	**1950**	10.6%	**455**	10.4%	**470**	13.4%	**168**	11.3%	**247**	8.9%	**272**	10.4%	**28**	6.6%	**119**	8.6%	**191**	10.1%
ITALY - total	**18459**	100.0%	**4396**	100.0%	**3506**	100.0%	**1484**	100.0%	**2777**	100.0%	**2606**	100.0%	**427**	100.0%	**1378**	100.0%	**1885**	100.0%
% of KIBS per sector			**23.8%**		**19.0%**		**8.0%**		**15.0%**		**14.1%**		**2.3%**		**7.5%**		**10.2%**	

2.3 Methodology

First, we calculate the Malmquist Productivity Index as a measure of firms' performance changes over time. The Malmquist Productivity Index is constructed as ratios of distance functions, which are estimated by DEA as a comparison tool. Then, the estimated value of overall productivity progress (or regress) and its components (technical efficiency change and technological progress) are mapped based on Italian geographic territorial units (region and/or province). Secondly, we carry out a regression of the estimated productivity patterns on various regressors, which are considered in this study as determinants of financial performance dynamics.

DEA is a mathematical programming methodology (non-parametric linear programming) that can be applied to measure the relative efficiency of a homogeneous set of Decision-Making Units (DMU) that produces outputs by combining inputs. The term relative is rather important since a particular DMU, identified as efficient in a given data set, may be deemed inefficient when compared to a different set of data.

With the objective to compare a selected sample of peer entities, such in our case KIBS firms, the DEA analysis allows to construct an efficient frontier, named best production frontier (or envelopment), which consists of DMUs with the highest ratio of output to input. The frontier surface is defined by the solution of a sequence of linear programming problems, one for each DMU. A DMU is said to be efficient if the ratio of its weighted outputs to its weighted input is larger than similar ratio for every other unit in the sample. DMUs located in the frontier are called "efficient units". For all other units, DEA measures the distance of the unit to the best practice frontier. The distance between this envelopment and the observed data point (representative of each DMUs) measures the

relative technical efficiency. Relative efficiency scores are defined in a range of [0,1] for each decision-making unit, allowing to rank the organizations on the basis of an increasing efficiency order (i.e. a score of 1 identify an efficient unit).

Since its introduction, by Charnes et al. (1978) adapting Farrell's proposal (1957), a variety of DEA-related literature has been published and applications of DEA models have been extensively used in performance appraisal in a wide range of business context and industrial sectors, becoming one of the most popular techniques for benchmarking analysis and a powerful quantitative approach to estimating and ranking a given decision making relative to other similar units subject to operation under similar input and output processes. In particular, the DEA has also been proposed as a model to evaluate the overall efficiency of small and medium-sized enterprises business (Fernandes et al., 2018; Marjanovic et al., 2014; Park, 2014; Chancharat and Chancharat, 2013; Mohamad and Said, 2012; Yang, 2006) and professional service firms (Hsiao et al., 2017; Hsiao et al., 2014; Wang et al., 2014) .

In our work, we applied DEA-based global Malmquist productivity analysis in order to develop a multi-period efficiency analysis model (Jianguo and Qamruzzaman, 2017; Majumdar and Asgari, 2017) and evaluate the productivity changes of each unit between two periods of time (t; t+1).

The concept of Malmquist Productivity Index (MPI) was first introduced by Malmquist (1953) and has further been studied and developed in the non-parametric framework by several authors. Caves et al. (1982) applied from a theoretical point of view the Malmquist's Index extending it as a productivity measure in a multi-input multi-output setting. Färe et al. (1992) made use of the connection between Farrel's basic measurement of technical efficiency (1957), DEA by Charnes et al. (1978) and MPI by Caves et al. (1982) to introduce the DEA estimation method for the MPI. In other words, the MPI is constructed as ratios of distance functions, which are estimated by the data envelopment analysis approach. Färe et al. (1992) further decomposed the index into two mutually exclusive and exhaustive components: changes in productivity over time (or efficiency changes - *Effch*) and shifts in technology over time (or technology changes - *Techch*). In general terms, the relative efficiency of a decision-making unit over time, defined by a relative distance using DEA, will depend on both its position relative to the corresponding frontier (technical efficiency) and the position of the frontier itself (technological change). The MPI compute firms' deviation of productivity in two different time periods, assuming common technological involvement.

Using an output-orientated model (i.e. to measure the maximal proportional expansion of the outputs given a set of inputs), the MPI between periods *t* and *t + 1*, can be defined as (Färe et al., 1995; Färe et al.,1992):

$$MPI\ {}^{t}_{t+1}(y_{t+1}, y_t, x_t) = \frac{D_{t+1}(y_{t+1}, x_{t+1})}{D_t(y_t, x_t)} \times \left[\frac{D_t(y_{t+1}, x_{t+1})}{D_{t+1}(y_{t+1}, x_{t+1})} \times \frac{D_t(y_t, x_t)}{D_{t+1}(y_t, x_t)}\right]^{1/2}$$

Where *D* represents the distance, *x* and *y* respectively inputs and outputs, and MPI is the Malmquist productivity index in time *t + 1* using the *t + 1* technology relative to the production in *t* using the *t* technology. The overall equation represents the Malmquist productivity growth of a firm between two periods. A value of MPI greater than 1 denote productivity growth from period *t* to period *t + 1*, while a value less than 1 indicate a decrease in efficiency relative to the previous year (i.e. productivity decline). An MPI equal to 1 represents no change in productivity over the periods.

The first term of the equation defines changes in technical efficiency (*Effch*) from period *t* and *t + 1* and the second expression, inside the brackets, indicates changes in technology (*Techch*). If a firm fails to achieve an output combination on its production possibility frontier and fails beneath this frontier, it can be said to be inefficient (or technological inefficient). Over time the level of output an organization is capable of producing will increase due to technological changes. These variations cause the production possibility frontier to shift upward, as more output are obtainable from the same level of inputs. Thus, for any firm in a specific industry, productivity improvement over time may be either technical efficiency improvement or technological improvement or both.

After estimating the MPI for each KIBS firm and in order to take into account differences in productivity across both geographic regions and business sector, we make use of multilevel statistical models to disentangle firm-specific effect from region-specific and sector-specific ones, that define the economic environment playing an important role in shaping productivity's heterogeneity observed at firm-level or instance, firms' performance may be affected by both the territorial conditions of the regions where they are located and the specific characteristics of the sector in which they operate. On the other side, firms from different sectors may be located in the same region and firms in different regions may operate in one given sector. From this point of view, sector and regions are not nested reciprocally but rather, the geographic areas in which firms are registered and the business sectors in which companies belong have a cross-classified structure (Aiello et al., 2015).

According to some relevant previous studies on firm productivity using multilevel methods (Aiello and Ricotta, 2016; Aiello et al., 2015; Aiello et al., 2014; Fazio and Piacentino, 2010; Raspe and van Oort, 2007) we apply a two-level cross-classified model (Mahlberg et al., 2013) where firms constitute the first level, and regions, sector or sector-by-regions (i.e. the interaction of region and KIBS industry) constitute the second level. A general specification of a simple cross-classified model can be expressed as follows:

$$y_{i(sj)} = \gamma_{000} + u_s + u_j + u_{sj} + e_{i(sj)}$$

Where the dependent variable, $y_{i(sj)}$, refers to the i-th firm from the (sj)th sector/region combination and that is equal to the overall mean γ_{000}, plus a random component u_s due to sector s, a random departure u_j due to region j, an interaction term

u_{sj} (interaction among regions and sectors), and an individual-level random departure $e_{i(sj)}$ (Aiello and Ricotta, 2016; Aiello et al., 2015; Aiello et al., 2014).

In order to interpret how much each different components (i.e. region, sector, region/sector) influence variance of the overall performance of each KIBS firm ($y_{i(sj)}$) is to compute the Variance Partition Coefficient (VPC). VPC statistics, computed as the ratio of each component variance (firm-specific attribute, region, sector, region/sector) to the total variance, report the proportion of the response variance that can be related to each level of the model hierarchical structure.

On the basis of the quantitative approach previously described, for each KIBS firm, operating in a specific Italian geographic area and belonging to a determined business sector, we first compute the MPI to define a total productivity measures and then try to evaluate of much of the difference in firms performance can be attributed to individual heterogeneity, how much of this difference reflects specific territorial conditions or business sector context.

2.4 Variables selection and data processing

According to the choice of inputs and outputs adopted, in some empirical studies that attempt to estimate firms financial performance on the basis of a combination of accounting-based income statement and balance sheet data (Oberholzer, 2014; Oberholzer, 2013; Ho et al., 2009; Lo and Lu, 2006; Tsai et al., 2006; Luo, 2003; Zhu, 2000; Seinford and Zhu, 1999), we collected for each KIBS company from 2012 to 2018 the following general and financial item: company name, CCIAA number (ID code registered at the Italian Chamber of Commerce), related two-digit NACE rev.2 branches, geographical region and province in which the firms are located (registered office address), number of employees (size), total assets, and value of revenues from sales and service.

To measure efficiency and productivity growth over time it is fundamental to choose a set of measures to use as inputs and outputs. In line with previously cited work, two inputs are thus identified, namely the number of employees and total assets, and one output, the value of revenues from sales and service. Total assets are defined as the year-end total amount from the balance sheet; the value of revenues from sales and service are computed as the year-end total amount of revenues income from the income statement.

Table 2 exhibits some descriptive statistics of data collected (inputs, outputs).

Table 2 – Some descriptive statistics of data collected (inputs, outputs)

ITEM OBSERVED	YEARS			
	2012		2018	
	mean	*sd*	*mean*	*sd*
Number of employees	11.9	19.4	15.4	25.3
Total assets (th EUR)	5,448.7	158,200.1	6,179.8	139,331.6
Revenues from sales and services (th EUR)	1,642.7	3,244.0	2,121.6	4,265.5

As previously stated, the linear programming model used assumed constant returns to scale and, because firms observed have a given amount of resources (employees and assets value) and have to maximize the final results (revenues), we adopt an output orientation (i.e. pursuing output maximization under given input). The results of DEA based Malmquist Productivity Analysis are obtained with FEAR (Wilson, 2008), a software package for frontier efficiency analysis that can be linked to the general-purpose statistical package R.

In order to validate the result of the overall DEA-based Malmquist Productivity Analysis to discover determinants of differentials in firms' productivity, we select the next two level for the application of the multi-level statistical model: level 1 (firms level variables: *Effch* and *Techch*), level 2 (geographic location defined by region-based groups and business activity sector groups represented by the selected NACE Rev. 2 codes).

3 Results and conclusions

We conducted the DEA-based Malmquist Productivity approach to address two primary issues in our computation over the sample period. The first is the financial productivity change measurement over the time frame selected; the second is to decompose changes in financial performance in what is generally referred to as a "catching-up" effect (*Effch* - efficiency change,) and a "innovation or frontier shift" component (*Techch* - technological change).

The former is generally defined as the diffusion of management and organization best-practices, and attributed to more focused investment planning, technical experience, and capacity utilization; the technological change is the consequence of innovation, that is, the investment and adoption of new technologies and methodologies, procedures, and techniques related to them, by best practice KIBS firms.

The values obtained for each KIBS companies are summarized for the period under investigation (2012-2018) and presented in Table 3 in the form of KIBS regional aggregation, and in Table 4 considering KIBS grouped into different business activities branches. Each summary presents the mean, median, Coefficient of Variation (CV%),

minimum, and maximum values for the MPI computed for the two grouping context, and its components scores.

According to the mean value, we can understand the average behavior in terms of productivity. The Coefficient of Variation and total range values (minimum and maximum) let us evaluate the fluctuations in terms of financial efficiency over time among alternatives.

Table 3 – Malmquist Productivity Index values in the form of KIBS regional aggregation

Region	n. of KIBS	(%)	*mean*	*median*	*CV%*	*min*	*max*	*EFFch avg*	*EFFch median*	*TECHch avg*	*TECHch median*
Abruzzo	**217**	1.2%	0.986	0.924	60.49%	0.194	6.583	1.308	1.137	0.766	0.793
Basilicata	**69**	0.4%	1.053	0.997	39.58%	0.022	2.639	1.470	1.266	0.747	0.751
Calabria	**145**	0.8%	0.956	0.865	41.74%	0.294	2.818	1.324	1.165	0.750	0.763
Campania	**646**	3.5%	0.961	0.904	43.94%	0.064	4.047	1.330	1.189	0.751	0.763
Emilia Romagna	**2,035**	11.0%	1.001	0.957	37.94%	0.085	5.317	1.368	1.242	0.756	0.785
Friuli Venezia Giulia	**475**	2.6%	1.038	0.986	47.07%	0.138	6.701	1.430	1.279	0.758	0.785
Lazio	**1,870**	10.1%	1.003	0.912	56.69%	0.123	7.328	1.421	1.214	0.734	0.747
Liguria	**453**	2.5%	0.985	0.946	40.88%	0.099	6.162	1.311	1.192	0.771	0.794
Lombardia	**5,500**	29.8%	1.000	0.945	42.54%	0.009	8.223	1.402	1.257	0.736	0.751
Marche	**429**	2.3%	1.005	0.960	35.46%	0.077	3.213	1.311	1.196	0.788	0.819
Molise	**32**	0.2%	1.152	1.014	48.49%	0.428	3.471	1.645	1.545	0.752	0.808
Piemonte	**1,578**	8.6%	1.009	0.939	48.12%	0.027	8.613	1.368	1.227	0.759	0.786
Puglia	**490**	2.7%	1.012	0.919	47.84%	0.107	5.151	1.373	1.206	0.761	0.785
Sardegna	**227**	1.2%	0.957	0.941	33.10%	0.301	2.156	1.275	1.158	0.780	0.823
Sicilia	**434**	2.4%	1.029	0.916	60.20%	0.005	6.990	1.429	1.166	0.758	0.778
Toscana	**1,191**	6.5%	1.006	0.950	42.01%	0.097	5.678	1.355	1.219	0.766	0.792
Trentino Alto Adige	**441**	2.4%	1.041	0.963	45.67%	0.109	5.630	1.418	1.252	0.753	0.785
Umbria	**226**	1.2%	0.979	0.944	41.13%	0.028	3.405	1.340	1.205	0.753	0.777
Valle d'Aosta	**45**	0.2%	1.011	0.965	35.74%	0.463	2.197	1.379	1.169	0.764	0.800
Veneto	**1,949**	10.6%	1.027	0.973	40.36%	0.088	8.418	1.371	1.251	0.768	0.795
Italy - total	**18,452**	100.0%	**1.005**	**0.945**	**44.80%**	**0.005**	**8.613**	**1.382**	**1.234**	**0.751**	**0.775**

Table 4 – Malmquist Productivity Index values considering KIBS grouped into different business activities branches

NACE Rev. 2 - branches	n. of KIBS	(%)	MPI - 2018/2012								
			mean	*median*	*CV%*	*min*	*max*	*EFFch avg*	*EFFch median*	*TECHch avg*	*TECHch median*
Computer programming, consultancy and related activities - 62.01 - Computer programming activities - 62.02 - Computer consultancy activities - 62.03 - Computer facilities management activities - 62.09 - Other information technology and computer service activities	**4,393**	23.8%	0.991	0.927	0.446	0.072	8.418	1.323	1.195	0.767	0.789
Information service activities - 63.11 - Data processing, hosting and related activities - 63.12 - Web portals - 63.91 - News agency activities - 63.99 - Other information service activities	**3,506**	19.0%	0.994	0.945	0.365	0.005	5.630	1.291	1.185	0.790	0.816
Legal and accounting activities - 69.10 - Legal activities - 69.20 - Accounting, bookkeeping and auditing activities; tax consultancy	**1,484**	8.0%	0.986	0.951	0.321	0.168	4.611	1.284	1.190	0.789	0.823
Activities of head offices; management consultancy activities - 70.10 - Activities of head offices - 70.21 - Public relations and communication activities - 70.22 - Business and other management consultancy activities	**2,773**	15.0%	1.017	0.945	0.559	0.009	8.613	1.486	1.275	0.713	0.724
Architectural and engineering activities; technical testing and analysis - 71.11 - Architectural activities - 71.12 - Engineering activities and related technical consultancy - 71.20 - Technical testing and analysis	**2,606**	14.1%	1.032	0.963	0.497	0.028	7.017	1.478	1.325	0.721	0.731
Scientific research and development - 72.11 - Research and experimental development on biotechnology - 72.19 - Other research and experimental development on natural sciences and engineering - 72.20 - Research and experimental development on social sciences and humanities	**427**	2.3%	1.051	0.951	0.622	0.099	5.678	1.610	1.364	0.688	0.686

Advertising and market research - 73.11 - Advertising agencies - 73.12 - Media representation - 73.20 - Market research and public opinion polling	**1,378**	7.5%	1.030	0.969	0.394	0.113	4.277	1.483	1.348	0.720	0.724
Other professional, scientific and technical activities - 74.10 - Specialised design activities - 74.20 - Photographic activities - 74.30 - Translation and interpretation activities - 74.90 - Other professional, scientific and technical activities	**1,885**	10.2%	0.987	0.944	0.387	0.027	3.770	1.353	1.239	0.749	0.774
Italy - total	**18,452**	100.0%	**1.005**	**0.945**	**0.448**	**0.005**	**8.613**	**1.382**	**1.234**	**0.751**	**0.775**

The information in Table 3 can be used to compare the average performance of KIBS firms grouped in geographic regions (20 geographic areas), independently of the kind of KIBS activity that characterize firms' own core business. On the other side, Table 4 can be adopted to evaluate the productivity of KIBS companies based on their specific business activity and classified in eight business branches (defined by NACE rev. 2 codes) not depending on their geographic distribution.

According to the average values of the MPI, Table 3 shows the total productivity change score (the MPI presented in column 6) is higher than one for thirteen Italian regions, each one characterized by different percentage gains in total financial performance over time: Molise (+15,2%), Basilicata (+5,3%), Trentino Alto Adige (+4,1%), Friuli Venezia Giulia (+3,8%), Sicilia (+2,9%), Veneto (2,7%), Puglia (+1,2%), Valle d' Aosta (+1,1%), Piemonte (+0,9%), Toscana (+0,6%), Marche (+0,5%), Lazio (0,3%), Emilia-Romagna (+0,1%). These geographic areas contribute to 59,8 percent of the total KIBS sample (11.038 firms). With the exception of Lombardia (MPI equal to one, indicating stability or no change), the remaining regional territories suffer a decline in the financial productivity growth over the time period, with the worst financial performance scores obtained from Calabria (-4,4%) and Sardegna (-4,3%). It is also interesting to note that, for each region, the growth or decline behavior in terms of overall productivity appears to be driven by the role of the efficiency change component (column 6). In fact, every geographic area is characterized by an *Effch* score greater than one, which improvement is able to offset the generalized rate of the regress of the technological efficient component (column 8 - *Techch*) only in the thirteen regions mentioned above.

Looking at the average scores listed in Table 4, the only KIBS business sector that presents a growth in the total productivity index (column 5) are: 72 (+5,1% - scientific research and development), 71 (+ 3,2% - architectural and engineering activities; technical testing and analysis), 73 (+3,0% - advertising and market research), 70 (+1,7% - activities of head offices; management consultancy activities).

These four NACE Rev.2 branches represent only 38,9 percent of the whole firms' sample. The remaining industries show a decline in overall financial performance over time and, in line with the previous considerations and with regard of the NACE business branches aggregation form, the overall financial productivity behavior of the different KIBS business classes is related to the balance between the efficiency changes score (column 10) and the technological change one (column 12). In particular, the first is greater than one for all business branches, and the second presents a negative rate of growth (decline or regress) for every business context.

The final results of the multi-level model computation are displayed in Table 5 and obtained when running different regressions.

Table 5 – Final results of the multi-level model computation

	(1)	(2)	(3)	(4)
Intercept	-0.861131***	-0.89466***	-0.91187***	-0.95709***
Random Effect				
Variance				
Regions	0.02055		0.016182	0.0007027
NACE		0.024078	0.022911	0.0079993
NACE*Region				0.0278549
tech_biasc	0.007105	0.026337	0.031659	0.0408428
eff_biasc	0.004068	0.004193	0.007347	0.0068505
tot	0.031723	0.054608	0.061917	0.0842502
VPC				
Regions	0.647794975		0.261349872	0.008340633
NACE		0.440924407	0.370027618	0.094946956
NACE*Regions				0.330621174
tech_biasch	0.22396999	0.482291972	0.511313533	0.484779858
eff_biasc	0.128235035	0.076783621	0.11865885	0.08131138
LR test	107.2***	163.34***	108.41***	187.98***
Observation	18452	18452	18452	18452
Regions	20		20	20
Sectors		36	36	36

In the first column, we consider the second level of the hierarchical structure composed by the 20 Italian regions. In column 2, regions are replaced by KIBS NACE sectors (n.

36). Column 3 presents estimations scores considering simultaneously regions and sector (n. 56 groups units) as components that may influence the overall productivity measures. Finally, column 4 takes into account the interaction among regions and sectors (n. 56 units). Using the VPC as a tool to interpret the magnitude of the variance component in each stage of analysis, the first one (firms-level variables plus regions) region-specific factors capture 64,8% of the total MPI variance, while the remaining is explained by firms MPI components. Introducing in the second level of the hierarchical structure the business sectors (firms-level variables plus NACE sectors), the variability of the productivity index for each firm is explained at 44,1% by the sectoral membership (column 2). When using the cross-classified specification (i.e. region and sector) we find that 26,1% the MPI variation lies at the regional level and 37,0% is related to the sectoral one (column 3). Finally, column 4 displays that the introduction of the interaction component "regions/sectors" captures 33,1% of the individual of MPI variability. Moreover, the explaining power of other components of the second level (region and NACE sector) decline respectively to 0,8% and 9,5%. These results show that MPI heterogeneity in the KIBS firms' sample analysed to present an important sensitive to the regional context in which firms operate, to the specific KIBS branches to which they belong and, in particular, to the interactions the arise from the economic environment defined from the coupling of regions and sectors. Giving this and in order to evaluate more deeply the role played from both the geographic context and the business sector-level characteristics, our analysis could be extended and complemented in two ways. First, in order to better estimate KIBS firms' changes in productivity over time, evaluate the use of other meaningful accounting-based income statement and balance sheet data; secondly, in order to better explain the measure to which the effect of the different components explains firm performance, augmenting the multilevel model application through a set of specific attribute defined at firm, region and sector levels.

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Finding and Filling Lacunas in Linguistic Typologies

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Abstract

Our study arose from a need to find and fill lacunas in knowledge systems supporting machine translation. The paper focuses on the challenge of developing a model that describes processes of goal-oriented enrichment of linguistic typologies as dynamic knowledge systems about language units and their translations. To describe the processes, we have developed a model of knowledge discovery for filling lacunas. The model is based on the idea of the spiral of knowledge creation and describes a process of populating a typology. The population process is based on conceptualizing potential sources of new meanings. In our projects, the potential sources are parallel texts. The conceptualization provides an opportunity to discover and describe new meanings of language units in question. The goal of the paper is to present the proposed model and scrutinize iterative stages of the discovery of new meanings of language units for filling lacunas in a typology. We develop a computer system to represent discovery outcomes and populate the typology. We give an example showing that new meanings could be discovered and used to enrich the typology.

Keywords – Conceptualization, Typology lacunas, Knowledge discovery, Individual meanings, Knowledge base.

Paper type – Academic Research Paper

1 Introduction

There is a large corpus of literature investigating the impact of artificial intelligence (AI) on the definition and solution of problems related to knowledge management (KM). The literature review by A. Zbuchea et al. (2019) provides a multi-faceted analysis of relationships between AI and KM, including:

- Applications of AI techniques advance KM (Liebowitz, 2001)
- Assuming the inability to formalize tacit knowledge as it exists in the minds of people does not exclude the possibility that computer systems might perform the same tasks using alternative representations; a richer model of cognition and knowledge representation is needed to study and build KM-systems (Fenstermacher, 2005)
- A strategic approach for solving the emerging challenges in KM (Anum, et al., 2018)

The goal of the paper is to present a model as a theoretical basis for AI-based creating new knowledge to fill lacunas in linguistic typologies. At present the spiral model of knowledge creation is one of the most popular (Nonaka, 1991; Nonaka and Takeuchi, 1995). The model is very often mentioned in discussions about knowledge discovery. 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:

- individual tacit knowledge
- group tacit knowledge
- individual explicit knowledge
- group explicit knowledge

In the model, besides these four types of knowledge, the following four transition processes are defined: socialization, externalization, combination, internalization (SECI). By definition, each of the spiral turns of knowledge creation includes a sequence of processes: socialization → externalization → combination → internalization → socialization (as the beginning of the next spiral turn). According to 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 the SECI model, one can already see three dimensions of knowledge creation:

- The socialization dimension has two nominative categories (individual and group)
- The temporal dimension is implied in the spiral turns of knowledge creation
- The explicitness dimension has also two nominative categories (tacit and explicit)

There are models that describe the dynamics of knowledge with a larger number of nominative categories in the socialization dimension, as well as with one or two explicit temporal dimensions. M. Nissen (2006) extended the SECI model to integrate two temporal dimensions: life cycle and flow time. Life cycle with nominative categories 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 socialization dimension identifies three nominative categories (individual, group, and organization). All four dimensions (socialization, two temporal, and explicitness) for characterizing knowledge flows can be employed collectively to visualize the spiral turns of knowledge creation. One name is changed here for clarity (i.e., Nissen uses the term *reach* instead of *socialization*).

Another model with a larger number of nominative categories in the socialization dimension was proposed by Wierzbicki and Nakamori (2006, 2007). Like Nissen (2006), they also offer three nominative categories, but instead of organization knowledge, their

model (hereafter, the WN-model) includes conventional knowledge. They also subdivide each category into tacit and explicit knowledge, thus obtaining six types of knowledge, and define nine transition processes that contribute to knowledge creation, including socialization, externalization, combination and internalization.

Before describing our model for filling lacunas in a typology (hereafter, the filling model), we list here the principal features of the models briefly discussed above. All models explicitly or implicitly use three or four dimensions to describe the dynamics of knowledge. In the socialization dimension, two or three nominative categories are defined. 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 socialization dimension we get four nominative categories (individual, group, organization, and conventional). In all the models considered, the potential sources of emerging meanings are not defined.

2 The initial conditions

The initial conditions of the development of the filling model were obtained in the process of observing the work of linguists. They annotate language units along with their translations and simultaneously enrich a linguistic typology by new headings and their definitions if they discover new meanings of units or new semantic aspects of units in parallel text sentences (Tabl. 1). Linguists discover new meanings or aspects and describe each of them as an entirely new heading of the typology or add it to an existing heading. At the same time, they create a definition of the new heading or change the existing definition. Let's list the initial conditions obtained as a result of observing the work of linguists:

- Parallel text sentences which are stored in a database are potential sources of new knowledge discovered
- The discovery of new knowledge is a goal-oriented iterative process of annotating sentences
- To discover and describe new knowledge, a linguist conceptualizes sentences during their annotating and simultaneously changes a typology
- Annotations, including sentences and headings of the typology that linguists enrich, are stored in a database

Table 1. Sentence-aligned German-Russian parallel texts

German sentence	*Russian translation*
Don Quijotes sollen wir wohl alle sein, wenn wir nur ein wenig das Herz auf dem rechten Fleck haben und ein Körnchen Verstand unter der Schädeldecke.	Мы все Дон-Кихоты, если у нас честное сердце и под черепной коробкой крупица разума.

So sollen wir die Welt nicht zu retten suchen, sondern zu bestehen, das einzige wahrhafte Abenteuer, das uns in dieser späten Zeit noch bleibt.	В силу нашей ограниченности мы можем помочь только в отдельных случаях.

Note that any heading added to the typology represents a new concept of knowledge of only one linguist, that is, this concept and its heading are individual. In the general case, different linguists may create unlike individual headings that they formed during the conceptualization (=semantic analysis) of the same sentence.

A group heading concept is formed in the process of discussing individual headings and their definitions by the group of linguists who enrich the typology. The purpose of the discussion is to form a consensual definition within the group for the heading concept corresponding to the new meaning of the studied language unit or the new semantic aspect of the unit in parallel text sentences. Therefore, the proposed filling model covers two processes of typology enrichment:

- Discovering and representing individual concepts of new knowledge using headings and their definitions
- Forming and representing consensual new concepts

3 Two procedures and the filling model

The filling model allows to fix a time point of discovering each new meaning of studied language units in parallel text sentences. Suppose that at time t_1 one linguist discovers a new meaning of a language unit in an analyzed sentence, for which there is no corresponding heading concept in the typology. At time t_2, he/she externalizes this new meaning, defines a new heading concept and creates an annotation which includes a heading for this new meaning and a sentence as its source. At time t_3, another linguist also discovers a new meaning of the same language unit in the sentence and at time t_4, he/she externalizes this new meaning, defines a new heading concept and creates an annotation (Fig. 1). If these two linguists interpret the same language unit in the sentence differently, then these two heading concepts do not coincide in the typology. In this case, it becomes necessary to discuss them. Suppose that they have consensual concept of the new heading at time t_5 and its definition at time t_6.

In Fig. 1, which shows all three dimensions of the filling model: two quantitative ones (socialization and temporal) and the nominative one (explicitness), a consensual heading concept was agreed between two linguists. The process of agreeing on group concepts between any number of linguists is discussed below. For the example with two linguists, the time axis shows the first six time points (t_1 - t_6) in which six states of heading concepts are fixed for two group (tacit and explicit) and four individual (two tacit and two explicit) ones.

On the socialization axis, the number 1 indicates any of the two linguists who discovered new meanings of a language unit in question, and the number 2 corresponds to the two linguists which agree on a group heading concept and its definition. The

explicitness axis shows two nominative categories: “Tacit knowledge” for implicit concepts and “Explicit knowledge” for definitions of heading concepts.

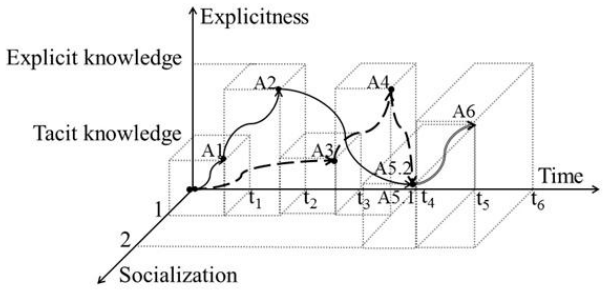

Figure 1. Three dimensions of the filling model and seven processes

In the Fig. 1, three solid, three dashed lines and one double line with arrows indicate seven following transition processes between the states of concepts at time points t_1 - t_6:

- A1 – analysis of a sentence by the first linguist and discovery of a new individual meaning of a studied language unit
- A2 – creation of an annotation with a typology heading of the new concept corresponding to the new meaning by the first linguist
- A3 – analysis of the sentence by the second linguist and discovery of a new individual meaning of the same unit
- A4 – creation of an annotation with a typology heading of the new concept corresponding to the new meaning by the second linguist
- A5.1 and A5.2 – agreeing on a group tacit concept of a typology heading between two linguists
- A6 – externalizing the group tacit concept and creating its definition

In order to describe the filling model, we consider these seven processes in more detail on the example of discovering new meanings of studied language units. The example shows how to determine the time points t_1 - t_6 of the completion of processes A1 – A6, respectively. In this example, two iteratively repeated procedures implemented in a computer system by our team are used. These computer-based procedures are designed to populate the annotation database and enrich a typology of a knowledge base. The first procedure covers four transition processes A1 – A4, supports discovering new meanings and defining new individual heading concepts. The second procedure covers three transition processes A5.1, A5.2 and A6 (Fig. 1) and supports linguists agreeing on a group concept of the typology heading and creating its definition.

3.1 The first procedure

The computer system supporting the first procedure consists of three parts (Fig. 2):

- The annotation database
- The knowledge base (hereafter KB) including the linguistic typology (KB typology) which describes the knowledge system about meanings of studied linguistic units
- The parallel sentence database (PSDB), which contains potential sources of new knowledge

The first procedure assumes that the initial state of the KB has been previously formed. Prior to the first procedure, the KB typology contains the description of the state-of-the-art conventional knowledge in the subject area under study. In addition, the PSDB was also populated in advance with the potential sources of new knowledge according to a linguists' goal. Linkages between sources and annotations, which include sentences and headings of the typology, are formed during the first procedure. Linkages are designated by dotted double-headed arrows in Fig. 2.

The first procedure is iterative and includes two transition processes A1 – A2 in Fig. 2 (the analogous processes A3 and A4 are neither shown in Fig. 2 nor described below). We are going to show that in the example of discovering new meanings of studied language units and defining new individual heading concepts, the process A1 can continue for several iterations, and the process A2 belongs to the same iteration where the process A1 is completed.

Each iteration includes the following steps

- Retrieving the digital data of a sentence containing the language unit in question from the PSDB (only one sentence is processed at each iteration; iterations and sentences are numbered from 1 to N in Fig. 2; it is assumed that at the iteration N the first new meaning was discovered)

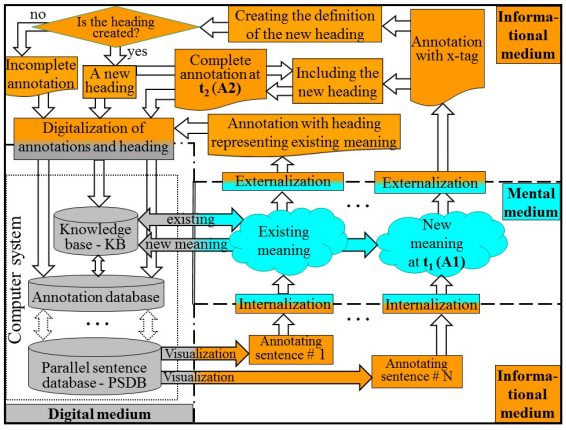

Figure 2. The first procedure supporting visualization, internalization, externalization, and digitalization

- Visualizing the digital data of the sentence, i.e., its transformation from a digital form to a perceptual one (this transformation is indicated in Fig. 2 by arrows “Visualization”), semantic analysis and annotating a meaning of the language unit by a linguist (if the linguist cannot interpret and analyze the sentence, then this iteration is terminated without generating any meaning)
- Internalizing an individual meaning of the language unit in the sentence
- If a meaning was generated, then the linguist compares it with each heading concept described in the KB typology
- If the generated meaning corresponds to any of heading concepts, it is not new (this case is indicated by the double-headed arrow "existing"); then the linguist adds the corresponding heading to the annotation (it is indicated by the left rectangle "Externalization" in Fig. 2); the annotation with the heading is digitalized and loaded into the annotation database
- If the generated meaning does not correspond to heading concepts, it is new (this case is indicated by the double-headed arrow "new meaning"); the time point when the new meaning was discovered is indicated in Fig. 1&2 as t_1; at this time point, the transition process A1 is completed (the new meaning notify that there is a lacuna in the KB typology)
- Then the linguist adds the incompleteness tag (=x-tag) to the annotation because the KB typology is incomplete (it is indicated by the right rectangle "Externalization" and the text "Annotation with x-tag" in Fig. 2)
- The linguist tries to create a definition of the new heading representing the new meaning of the linguistic unit in question
- If the linguist can create a heading and its definition representing the new meaning, the heading with its definition adds to the typology (this case is indicated in Fig. 2 by the rectangle "New heading"); then he/she can replace the x-tag with the heading in the annotation; the completed annotation is digitalized and added to the database (the time point when annotation is completed is indicated in Fig. 1&2 as t_2; at this time point, the transition process A2 is completed)
- There may be a case when the linguist cannot create a definition; in this case, he/she retains the x-tag in the annotation (the case indicated in Fig. 2 by the rectangle "Incomplete annotation"), then the incomplete annotation is digitalized and added to the database
- Linkages are established between loaded the complete and incomplete annotations and the sentences, on the basis of which the meanings were generated (these linkages are designated in Fig. 2 by dotted double-headed arrows)

Incomplete annotations require deeper investigation of the corresponding sentences by expert-linguists, which is beyond the scope of the filling model, but in any case, these annotations fix unfilled lacunas in the KB typology. To conclude the description of the first procedure, we note that the second linguist completes the analogous processes A3 and A4 at the time points t_3 and t_4.

The analysis of the listed steps makes it possible to formulate the key difference between the filling model and the spiral model. In the proposed model, the knowledge base is first iteratively filled with the headings for individual concepts of linguist's knowledge (the first procedure). Then on the basis of them, the consensual headings for group concepts are formed in the knowledge base (the second procedure). In the spiral model, each iteration (in the form of a spiral turn) includes the creation of both individual and group knowledge.

3.2 The second procedure

The description of the first procedure helped to reveal the content of processes A1-A4 and determine the time points t_1 – t_4 of their completion. Consider the second procedure, which includes the transition processes A5.1, A5.2 and so on, to reveal the content of these processes, which begin at time points t_2, t_4 and so on, respectively, and to determine the time points of their completion.

It is assumed that before the beginning of the second procedure, the first procedure has been performed by two or more linguists separately. There are cases when they generate new different individual meanings corresponding to the same sentence containing a language unit in question. In these cases, the second procedure is iteratively performed, which includes the following steps (Fig. 3):

- Retrieving the digital data of individual headings and their definitions from the KB typology which were created by different linguists but correspond to the same sentence # N containing a studied language unit with a new meaning (these headings and their concepts are numbered from # N.1 to # N.M in Fig. 3; it is assumed that M is the number of different individual headings created by M linguists which annotated the sentence # N; note, that M=2 in Fig. 1)
- Visualizing the digital data, i.e., transformation of the individual headings and their definitions from digital forms to perceptual ones
- Internalizing the individual headings and their definition
- Agreeing on a group heading concept # N between M linguists based on the individual heading concepts # N.1, …, # N.M (if it is not possible to agree on a group heading concept, then the second procedure is terminated for these individual headings)
- If they can agree on a group heading concept # N, then the processes A5.1, …, A5.M are completed at t_5
- Then the group concept # N is externalized and its definition is formed (the time point of its externalization is indicated in Fig. 1&3 as t_6)
- Changing individual headings # N.1, …, # N.M to the group heading #N in corresponding annotations (=reclassifying annotations)
- A digital form of the group heading and its definition are generated and loaded into the KB with the typology

- Linkages are established between the reclassified annotations and the group heading in the typology (these linkages are designated by dotted double-headed arrows in Fig. 3)
- The second procedure is repeated for a next group of individual headings until they are exhausted

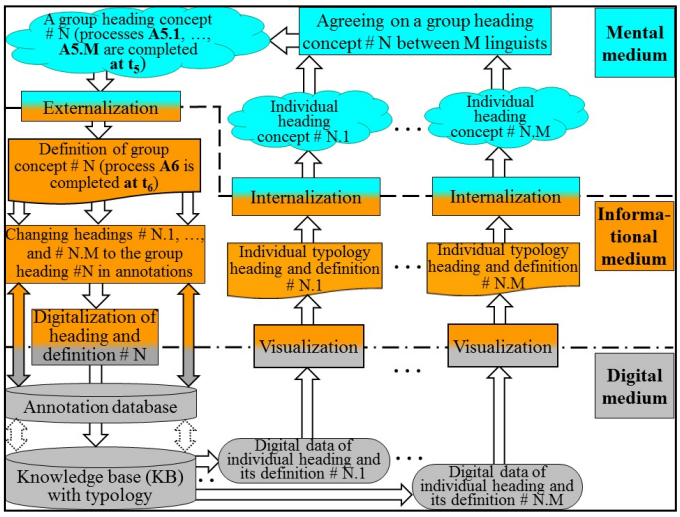

Figure 3. The second procedure supporting visualization, internalization, agreement on group concepts, externalization, and digitalization

3.3 The filling model

The first procedure of the filling model includes two transition processes (two out of the four transition processes that make up each turn of the spiral model): internalization and externalization, as well as two new processes: visualization and digitalization (Fig. 2). The second procedure includes three of the four spiral model transition processes (internalization, agreement on group concepts, externalization) and the same two new processes (Fig. 3). One name is changed here for clarity, i.e., Nonaka (1991) uses the term *socialization* instead of *agreement*.

Both procedures do not use the *combination* transition process, since individual concepts are outcomes of *semantic analysis* and *annotation* of sentences as potential sources of concepts of new knowledge. After considering two procedures of discovering and filling lacunas in linguistic typologies, we will describe the filling model in a generalized way using following hypernyms: *expert* rather than *linguist*, *ontology* instead of *typology*, *conceptualization* in place of *semantic analysis and annotating*, *semantic description* in lieu of *annotation*, and *knowledge source* rather than *sentence*. The filling model in a generalized way is based on the three following principal ideas.

First, the filling model covers three media of different nature: mental, informational, and digital (Zatsman and Buntman, 2015) and includes six transition processes: visualization, conceptualization, internalization, agreement (socialization), externalization, and digitalization (Fig. 4).

Second, three dimensions are defined for describing the outcomes of discovering and filling lacunas: two quantitative (socialization and temporal) and one nominative (explicitness) (Fig. 1).

Third, several different individual concepts of new knowledge can be created based on the same knowledge source. The Fig. 1 shows an example of creating two concepts, Fig. 3&4 illustrate the case of creating M different concepts.

Now we give a brief depiction of all the six processes of the filling model in a generalized way, which consists of two submodels. The first submodel describes the work of one expert discovering new individual concepts during conceptualization (see the left part of Fig. 4):

- The first found object for conceptualization is extracted from the database of knowledge sources which is converted into a perceptual form (the "Visualization" process)
- The extracted object is conceptualized, including putting existing ontology headings that characterize its semantics; if there is no relevant heading to reflect some semantic aspect of the object, then a lacuna in the ontology is fixed by the incompleteness tag (the "Conceptualization" process)
- An individual concept for the non-reflected semantic aspect is formed (the "Internalization" process) and an attempt is made to create a new heading of ontology, the concept of which would correspond to the non-reflected aspect
- If a new concept cannot be created, the semantic description of the object is marked as incomplete and a lacuna in the ontology is fixed; otherwise, the concept is created and its heading is added to the ontology and inserted in the description (the "Externalization" process) which is recorded in the description database (the "Digitalization" process)

Then the listed processes of the first submodel are performed for each knowledge source found. If these processes were repeated M times for the same source by different experts, then up to M different individual headings can be formed.

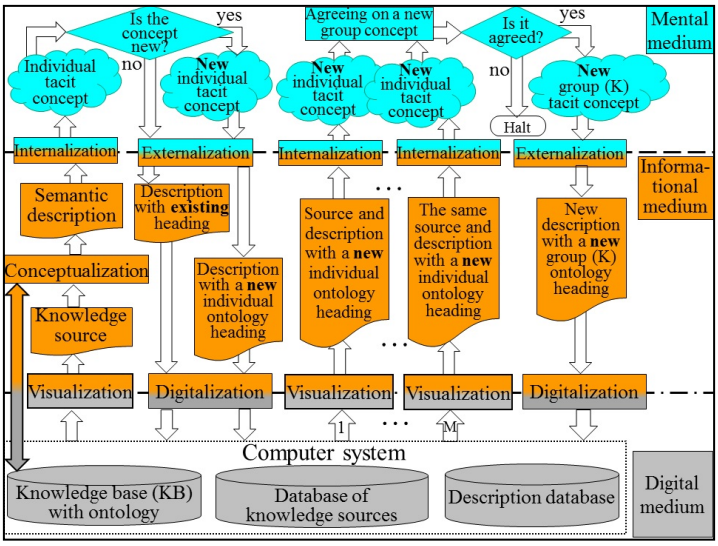

Figure 4. The filling model

The second submodel describes the work of L experts to form a single consensual concept based on M individual ones (see the right part of Fig. 4), created on the base of the same knowledge source:

- M descriptions with individual headings created by M different experts together with their source are extracted from the description database and converted into perceptual forms (M "Visualization" processes)
- Based on this source and M descriptions with individual headings, each of L experts creates their own individual heading concept for the non-reflected semantic aspect (the "Internalization" process) and an attempt is made to create a new group heading of typology, the concept of which would correspond to this aspect
- If experts cannot agree on a new group heading, the agreement process stops for these M individual headings (see the terminal «Halt» on Fig. 4)
- If a new group heading is created by K from L ($1 < K \leq L$) experts, then it is added to the ontology with a socialization index equal to K, and putted in a new description (the "Externalization" process), which is recorded in the database (the "Digitalization" process)

Then the listed processes of the second submodel are performed for series of individual headings formed for other knowledge sources.

4 Filling model implementation

On the basis of the filling model, our team has developed a computer system that allows to enrich the linguistic ontology about meanings of German modal constructions and their exemplary translations into Russian. For applying the computer system, a German-Russian dictionary that reflects the state-of-the-art level of knowledge about these studied linguistic units was selected. To show the feasibility of goal-oriented enrichment of the linguistic ontology, our team has designed a knowledge base with the initial version of the typology based on the dictionary.

The PSDB has been loaded with parallel texts of several dozen books totaling 2.6 million words. The downloaded texts of the books have been aligned so that one original sentence corresponds to its translation. Sometimes several sentences of the original text were put in correspondence with their translation, which may include one or more sentences. Thus, downloaded texts are divided into potential sources of new knowledge as shown in the example of the two pairs in Tabl. 1. For all books downloaded to the PSDB, 83190 pairs as potential sources have been formed by a computerized way.

As noted above, the subject of the study is the translations of German modal constructions. They include the verbs dürfen, können, mögen, lassen, müssen, sollen and wollen. Out of 83190 pairs, 16268 contain these verbs, and in 2041 of them the verb sollen is used. Tabl. 1 shows two examples of potential sources from 2041 pairs which contain the verb. The initial state of the ontology contained 12 meanings of the modal verb sollen, which correspond to the following headings: sollen-01, ..., sollen-12. The initial state of the typology includes headings only for those meanings that are described in the dictionary in a paper form. If the meaning of the verb in a studied source coincides with one of these 12 meanings, then, therefore, the source does not contain a new meaning and the typology heading with the corresponding number is written in the annotation with the source. If the meaning of the verb does not coincide with any of these 12 meanings, then the source contains a new meaning. Then a new heading representing the new meaning and its definition are added to the typology.

Up to 31.05.2020, 780 out of 2041 pairs containing sollen had been analyzed. During the analysis, two new meanings of sollen were discovered and their definitions were agreed between five linguists. The definitions of two group meanings with their headings were added to the typology.

5 Conclusions

Let's list the main differences between the proposed model (as a theoretical basis for computer-based discovering and filling lacunas in ontologies) and the spiral model (Nonaka, 1991):

- Two dimensions of the filling model are quantitative
- The lacuna filling process covers three media (the digital medium was added)

- The potential sources of new knowledge are added to the model, which correspond to the goal of the process of discovering and filling lacunas (it makes this process goal-oriented)
- The process "Combination" has been replaced by the process “Conceptualization"
- Two new processes on the border between the informational and digital media are added (visualization and digitalization)

The feasibility of the filling model was tested by adding new headings to the linguistic typology. However, there may be more complex types of changes, such as increasing or decreasing the meaning volume (=the semantic content) of existing headings of the typology. The current version of the model does not take into account such cases.

The filling model is planned to be developed by including the process of semantic analysis of incomplete descriptions of conceptualization objects (one of the main reasons of their incompleteness is the need to change the semantic content of existing headings rather than to add new ones to the ontology), as well as more complex cases of changing ontology headings and their definitions.

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Knowledge Advantage through Social Software "Slack"? Opportunities and Challenges for Knowledge Management in Enterprise 2.0

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Abstract

Social software is becoming increasingly important in companies and has long since been used in organizations not only as an instant messenger but also as a collaboration tool. Therefore, this paper deals with the potentials and challenges for knowledge management (KM) in Enterprise 2.0 using the example of the social software Slack. Based on episodic interviews, new challenges such as "blurring of the boundaries between work and leisure" and "misunderstandings due to text-based communication" are identified. The implications derived from this should help companies to deal with the challenges of social software like Slack in Enterprise 2.0.

Keywords – Knowledge Management, Social Software, Enterprise 2.0, Slack, regulatory framework

Paper type – Academic Research Paper

1 Introduction

In order to deal with the challenges of a dynamic environment, well-conceived management processes of organizational knowledge are becoming increasingly important and make a systematic dealing with knowledge resources a core competency for organizations to enhance individual and organizational performance and to generate a sustainable competitive advantage (Mao, Liu, Zhang, and Deng, 2016). In addition to these changes towards knowledge-intensive processes, today's knowledge society is characterized by the emergence of numerous web-based technologies and Web 2.0, affecting people's interactions (Sarka and Ipsen, 2017). The rise of remote work and home office also contributes to the increasing importance of tools and applications for knowledge processing. Social Software itself can be described as "tools and

environments that support activities in digital social networks" (Klamma et al., 2006) and, thus, facilitate social connections and exchange of information (Chatti et al., 2007). In order to describe the usage and application of emergent social software within and between companies, the term Enterprise 2.0 was developed (McAfee, 2006). As previously mentioned, knowledge management in general is subject to major changes nowadays. Through the increasing use of social software, KM can be designed more cost-effective, cloud-based, ubiquitous, and standardized, but still contributing to meet individual needs and in this way fulfilling the purpose of social practice (von Krogh, 2012). The interaction and exchange of the group is promoted by allowing communities to form on the basis of the social software application. There are options for creating, exchanging, archiving, and organizing content (Haefliger et al., 2011). Thus, organizations can benefit from social software as it enables the development of many types of content through a variety of collaborative processes (von Krogh, 2012).

Especially, the instant messaging (IM) tool Slack enjoys great popularity. Slack represents the most frequently used IM tool worldwide and registers over 12 million active users per day. Slack itself serves not only as a pure means of communication in the classical sense, but also enables the integration of various applications and the sharing of documents within groups or between two individuals (Slack Technologies, 2020). To figure out to what extent this social software can represent a knowledge-promoting space and support a systematic KM, it is essential to understand and analyze the knowledge processes taking place within the organization and the integration of IM into these processes. Lin et al. (2011) describe the conceptual problems of proven knowledge management models in dealing with KM in Enterprise 2.0. For this reason, a framework model for a systematic knowledge management in Enterprise 2.0 has been developed, which will be hereafter examined and applied in the concrete context of the gaming industry. The aim of this paper is to analyze the application of Slack within the phases of the KM process and to identify potential challenges by means of a qualitative approach and by taking the IDEA framework (Lin et al., 2011) into account. The theoretical contribution of this paper is to review the theoretical model of Lin et al. (2011) in the context of the gaming industry, whereas the practical implications consist in the evaluation of the benefits as well as the challenges that social software can provide in dealing with knowledge.

Based on the factors discussed above, the following research questions will be considered: *How does the use of social software "Slack" affects knowledge management in Enterprise 2.0? Which challenges can be derived by using "Slack" for KM? Which interrelationships exist between people, technology, and organization?*

2 Social Software and KM

The rapid growth of IM in the workplace has attracted increasing attention from researchers around different aspects of IM. Previous studies have already dealt with the influence of instant messaging tools on the performance of organizations. Ou et al. (2010) concluded that IM tools support social networks, which in turn contribute to organizational agility. Furthermore, several studies investigate the negative effects of IM on performance, which may result from its interrupting nature (e.g. Isaacs et al., 2002; Rennecker and Godwin, 2003; Fox et al., 2009; Ou and Davison, 2011; Mansi and Levy, 2013). For example, Mansi and Levy (2013) investigated the role of IM and its impact on the task performance of knowledge workers. The results indicated that tasks with higher complexity may be performed more slowly, but simultaneously stimulate the exchange of information and thus can also contribute to time savings. The study of Ou and Davison (2011) on work interruptions caused by IM has shown that IM leads to more work interruptions, but does not negatively affect work results. However, other researchers found that IM can improve communication and productivity by supporting spontaneous reactions (Hersleb et al., 2002; Shaw et al., 2007; Saavedra et al., 2011) or by helping to build trust and facilitate cooperation between colleagues (Pazos et al., 2013). Further studies have investigated the direct link between IM and knowledge management processes. Ou et al. (2014) have examined to which extent IM tools are conducive to knowledge transfer in the workplace and in the course of this have an influence on team performance. The results showed that IM tools not only promote knowledge sharing but also knowledge creation among employees. Furthermore, Ajjan et al. (2014) found that the continuous application of enterprise instant messaging has a positive effect on the KM results (creation, retention and transfer of knowledge).

3 IDEA regulatory framework

Especially noteworthy is the study according to Lin et al. (2011), which explicitly deals with social software and the SECI model after Nonaka and Takeuchi (1994). Considering KM in the context of Enterprise 2.0 concept, Lin et al. (2011) have found that it is difficult to systematize knowledge-oriented activities in Enterprise 2.0 with the help of established knowledge management models. The study identified conceptual problems regarding implicit knowledge within the SECI model, which makes the SECI model appear unsuitable as a knowledge management model in the Enterprise 2.0 concept. This was followed by the construction of a framework for the systemic handling of knowledge in Enterprise 2.0, the IDEA regulatory framework. IDEA refers to processes which can have four characteristic moments: *interaction, documentation, evolution,* and *adoption.* These can be identified along work processes and facilitate the creation of a knowledge-promoting space, which in turn fosters the knowledge processes described by Lin et al. (2011): knowledge multiplication and knowledge innovation. In this way, value-creating work processes can be improved.

In this context, the IDEA moments are not to be understood as successive accomplished sub-processes. An analysis of the knowledge-intensive work procedures, taking into account the four IDEA moments, can help to identify the causes of possible knowledge problems and uncover optimization potential in order to initiate measures in the fields of technology, organization, and people. The moment of interaction describes the degree of mutual reference in the communication process, i.e. focuses the tailoring of the sent messages to the specific context or situation of the recipient. The process can be passive or active (Lin et al., 2011). The documentation describes the moment, which makes the knowledge-intensive work processes accessible for further use by active or passive mapping and recording of their course and results. Evolution is the moment that measures the extent to which the development of the organizational knowledge base is supported. The gathering of new experiences in work processes can lead to the further development of individual and collective knowledge. Depending on an organization's ability to learn, the new knowledge can be anchored in the organizational knowledge base. Adoption describes the moment that enables individuals to (re-)construct knowledge from existing data. The moment includes the steps of perception and interpretation of relevant data. The application and (re-)contextualization provides the opportunity to embed the new knowledge into the existing knowledge structure, and, thus to enhance it (Lin et al., 2011).

4 Methodology

4.1 Data sources

Research Setting. In order to answer the questions adequately a qualitative research approach is used. Semi-structured in-depth episodic interviews (Flick, 2000) were conducted, transcribed (Davidson, 2009), and analyzed using qualitative content analysis (Mayring, 2014). The data-collection was carried out at one of Germany's leading providers of online games. Nine interviews with a total amount of 477 minutes have been conducted with employees of different hierarchical levels in the IT, business, and product divisions.

Research Participants. Interview questions were based on the underlying research questions of the study. For example, the interview partners were asked about their individual user behavior with regard to social software as well as the consequent potentials and challenges. Of course, every participant was guaranteed that the interview is anonymous as well as voluntary. All nine interviewees have been working in the organization at least since the implementation of the Slack software. Participants from different business areas and hierarchical levels of the gaming company were deliberately selected (IT, business, and product areas). Every participant also shows a high level of user activity.

Semi-structured episodic in-depth interviews. According to Flick (2000), episodic interviews are based on the assumption that experiences of individuals are stored in the form of narrative-episodic knowledge on the one hand and semantic knowledge on the others. The procedure of episodic interviews can be outlined in nine phases, each represents a step towards the goal of analyzing the everyday knowledge of the interviewee about a certain topic or area in a way that enables the interviewer to compare the knowledge of respondents from different social groups - i.e. as social representation (Flick, 2000). Thus, we were helped to understand the experiences and perceptions as related to dealing with knowledge and Slack itself. All interviews were conducted between January to April 2019 exclusively face-to-face. They took between 39 and 75 minutes, they were recorded, and denaturalized transcribed (Oliver et al., 2005).

4.2 Data analysis

Qualitative content analysis. We started data analysis with an iterative coding of the interview transcripts based on the suggested procedures for qualitative content analysis (Mayring, 2014) using MAXQDA (Kuckartz and Rädiker, 2019), a software for qualitative research. First a deductive category finding was carried out by using the theoretical preliminary considerations to the IDEA moments as a starting point for the definition of the first-order themes (Mayring, 2014). The categories were briefly defined and for the purpose of illustration, anchor examples were given. To avoid delimitation problems between the categories, contingency rules were formulated. Subsequently, a first trial run was carried out in which the first interviews were analyzed with regard to relevant text passages in relation to the previously defined first-order themes and assigned accordingly. In this step, the category system was tested and revised in order to ensure the final unambiguous assignment of relevant text passages (Mayring, 2014).

5 Findings

Based on the conducted interviews, it can be concluded that using Slack can have positive and negative effects on KM within the examined context and supports knowledge multiplication as well as innovation according to IDEA regulatory framework (Lin et al., 2011). Nevertheless, the interviews also examined the success factors identified by Lin et al. (2011), which can contribute to the fulfilment of the respective moments. However, this analysis also identified challenges that arise when using social software Slack. The intentions of the actors and the interrelationships between people, technology and organization play a key role in this context.

Interaction: The results have shown that the moment of interaction is strongly emphasized.

> *"Slack is interaction. You use it to interact with people and give them information or ask them anything." (I.B)*

The moment of interaction can be divided into different second-order themes, which on the one hand can have a positive effect as success factors, but on the other hand can also cause challenges. One category describes the *cultivation of communities*. In the interviews, for example, topic-related communities were described which have a positive effect on the interaction through their dynamics, informal communication or the 'we-feeling'. At the same time, however, these can also bring challenges, such as the blurring of the boundaries between leisure and work or the increasing potential for conflicts.

> *"It can happen that I send various messages around Slack an hour before I go to work, just to answer people's questions or to look for information myself." (I.A.)*

Another factor that influences the outcome of the interaction is *relationship and collaboration management*. Slack simplifies the active establishment and search for contacts or a collaborative creation process through shared work or discussions. However, respondents have also highlighted negative aspects, such as the flood of information that can result from the simplified inclusion in various chats and discussions. A further success factor, the *robust knowledge networks* can promote interaction through the exchange of knowledge over large spatial distances or the development of communication across hierarchies and departments.

Documentation: The documentation of knowledge is largely supported by the use of slack.

> *"Documentation works too, you have a chat history. [...] Nothing gets lost or anything. [...] You can also search in Slack, that works great. You can even search in documents you once shared, as long as they are text documents. Insofar, Slack also covers documentation. However, it is sometimes difficult because many people can't use the search function properly. And I think in many people's minds it hasn't gotten to the point where it could serve as a knowledge base." (I.A.)*

According to Lin et al. (2011), the success factor *motivation of knowledge workers* is influenced both positively and negatively by the use of Slack. Active users describe that motivation is increased by the user-friendly interface and the added value gained through its use. Less active users criticize the lack of introduction and education concerning the use of Slack as a documentation tool on the part of the organization. Another subcategory *flexible wiki application modes* describes the active preparation or passive archiving of work processes or results. Work processes can be stored in the cloud of the organization or can be displayed in a processed form by integrated bots. However, the complexity, caused by hundreds of groups and conversation, can proved to be problematic, as the documentation is not archived in a structured way.

Evolution: The moment of evolution of knowledge was partially addressed in the context of social software. The subcategory *perpetual beta knowledge culture* describes the ongoing discussion and development of data, which can be fostered, for example, by threads or the possibility to comment, share or evaluate contributions.

> *"Especially in developer channels, there are also some posts where you say: 'Gee, that's really interesting. [...] I'll have a look on that.' I actually click on the link or*

I really look at it, which later broadens my horizon or teaches me something new." (I.A.)

However, the large number of groups and conversations can at the same time make the further development of the knowledge base more difficult. One respondent describes *creativity in the network*, which can be fostered by collaborative idea generation processes. The *collective objectification*, which depicts the objectification of the relevance of data, cannot be covered by Slack.

Adoption: According to the interviewees, the adoption of knowledge was encouraged by *contextualization*. Threads, commentary functions and specific naming of groups can support the contextualization and interpretation of comments according to some respondents. Challenges can arise within the category *contextualization* if discussions are not held in the designated threads:

"When people have arguments, it rarely happens in the threads, but in the main line, and that really wastes time and bothers me." (I.E.)

In addition, text-based communication itself is often a problem, as it is not possible to convey voice, feelings or emotion-based interactions, which in turn makes contextualization difficult. The subcategory *holistic awareness* describes the group perception or the perception of results and is especially promoted by the Slack notification system. Furthermore, Slack covers browsing, search and tagging functions, which are used by the majority of respondents and belong to the subcategory *navigation concepts*. This simplifies the search for information and documentation of past work processes or results. However, some interviewees describe the search function as suboptimal, since only their own communication processes are searched for keywords and it is more difficult to find specific content.

6 Discussion

Our findings show that the social software Slack represents a knowledge-promoting tool within the examined company and, due to the partially weaker or stronger support of the individual IDEA moments, provides a knowledge-promoting space that enables knowledge multiplication and innovation. Furthermore, different challenges could be identified, which result from the respective success factors and run along the IDEA moments. Whether Slack has a positive or negative effect on KM also depends on the extent to which the particular organization is able to deal with the various challenges and has a supportive effect on the employees. In this respect, the interrelationships between people, technology and organization were considered, which will be discussed in more detail in this chapter.

First, we will again take a closer look at the individual moments, the promoting, and hindering factors. The moment of interaction is supported in a concrete context by the social software Slack and its extensive functionalities. Slack enables a fast, easy, flexible, and broad exchange between employees and supports the creation of robust knowledge networks. However, the success factors outlined by Lin et al. (2011) also bring challenges

that have already been identified in the results. It can be confirmed that the moment of documentation is supported by using slack. Slack enables the documentation of various work processes and results through the existing chat history and the exchange in topic-related groups. The user friendly interface, the possibility to create specific or general groups, and the influence of the Slackbot as an assistance for the presentation and archiving of results are to be positively evaluated. However, challenges still appear, which are manifested in the flood of information by a confusing and unstructured documentation and the limited documentation ability of Slack itself. The moment of evolution is supported by the use of Slack. The open spaces created in various topic-related groups, the expandability of these groups, and the inclusion of several integrations and functionalities of Slack promote the further development of the organizational knowledge base. At the same time, the large number of existing groups and the lack of functionality on the part of the Slack software makes the collective objectification of relevant content more difficult. The last moment of adoption is also supported by the use of social software Slack. The use of threads, profile, and group information, together with a very individually adjustable notification system and various navigation concepts, enables a targeted and effective perception as well as interpretation of relevant data. Nevertheless, Slack is not fully capable of ensuring this, since the mere fact that text-based communication is used does not allow for the targeted communication of vocalizations or feelings. Furthermore, the contextualization of content is made more difficult by ignoring group information and by not perceiving or correctly using various features (e.g. threads), which can lead to unclear communication structures.

As already mentioned at the beginning, the interaction between people, technology, and organization plays a major role (Lin et al., 2011). The results have shown that people, technology, and organization are highly dependent on each other and that the interdependencies have a major impact on the way Slack is used. These interdependencies lead to both positive and negative effects. The interrelation between people and organizations can be of great importance when it comes to the handling and targeted use of Slack. The mutual interdependencies are expressed partly in company guidelines, but also in a lack of influence, which can lead to Slack not being used in a targeted manner and a lack of knowledge about the functions. A good balance of mutual influences, which lead to the goal-oriented use of the software, but also allow the employees sufficient freedom, seems to be especially important here. Considering the interrelation between people and technology, it becomes clear that the functional scope of social software is not or only partially known. In addition, many of the interview partners missed a mandatory and detailed introduction. Nevertheless, the interviewees also repeatedly mentioned the friendly user interface of Slack and presented the software as self-explanatory. The Slackbot or information material in form of blogs and videos were also used as an assistance in dealing with the social software. In this second-order theme, the usability of Slack is presented very clearly and positively, but concrete support from the company is missing. Considering the interrelation between organization and technology it becomes

clear that Slack is a very flexible, fast and versatile tool with the help of its extensive functions. Nevertheless, concerns are also expressed about data protection, as Slack is not an internal solution but a third party that has access to important company data. Furthermore, the organization's dependence on Slack is presented as both a strength and a weakness. Slack is able to create *"a kind of augmented reality" (I.F)* for an organization and its employees, which could make certain work processes even more effective. On the other hand, this dependency could also be negative if the boundaries between leisure and work become blurred, work processes and results are made dependent on others and sensitive data is transferred to third parties.

7 Conclusion

In the last years, the management literature has largely stressed the importance of knowledge assets for company's competitiveness. Grounded in the knowledge-based view of the firm, this paper, by means of nine episodic interviews, stresses the importance of a holistic view of a systematic KM through social software, taking into account the obstacles as well as the success factors. In summary, the IDEA framework offers a suitable basis for the evaluation of knowledge management in Enterprise 2.0. The interactions between people, technology, and organization play an important role, but must be considered separately in each specific context. In principle, Slack is able to support a systematic knowledge management in Enterprise 2.0. The challenges identified can help to improve the use of the software and, as a consequence, increase the perceived benefits. Especially, the transparent implementation and instruction of employees can contribute to a successful use. The steps taken to meet these challenges could be the design of concrete workshops for the company's employees and the creation of teaching materials for the correct use of social software. In order to promote the acceptance and use of the software, individual and organizational requirements must always be considered and included.

This study has several limitations. First of all, the number of interviews conducted is still very limited. The theoretical saturation has not yet been reached based on the interviews conducted, for this reason, this should be expanded in the future to get an even more comprehensive insight into the advantages and disadvantages of using Slack. Furthermore, the interviews were conducted exclusively in one company within the gaming industry, future research should investigate whether the results are comparable in other industries and contexts. The study refers to the concrete functionalities of Slack, in the context of other studies the transferability of the raised challenges and success factors to other tools could be examined. Furthermore, our investigation was conducted in the German context, the consideration of using slack within different cultures is required.

In conclusion, Slack has proven to be a suitable tool for knowledge transfer, generation and documentation. A prerequisite for generating positive effects of Slack, however, is the consideration of obstacles in implementing and using the social software.

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Communicating the Customer Perceived Value of a Preventive Maintenance Solution: Implications for Management Accounting Capabilities Development

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Abstract

This paper aims to examine the value communication capabilities required in service development by proposing a way for value communication of a preventive maintenance solution. The research questions the paper aims to answer are, therefore, (1) how customer value of preventive maintenance services can be quantified, visualized and communicated and (2) what the implications of this value quantification and communication development to the wider MA capabilities development are.

The study is based on an interventionist case study in a manufacturing company and its hose assembly supplier. The researchers have worked with the case companies on development of a new production innovation eventually providing value potential also for the OEM's end users. In addition to supporting the service development, the MA researchers have worked on creating models for value quantification and visualization of this potential new aftersales service concept.

Customer value of preventive maintenance services can be communicated by quantifying and visualizing the cost behaviour of direct and downtime costs. The required capabilities can be accessed from the financial department requiring also effective knowledge management practices.

Value quantification and communication capabilities are in crucial role in also in the early stages of the servitization process and may warrant the help of the financial department. Value quantification and communication is needed early in development of a service offering in order to push the idea forward. Thus, these capabilities need to be developed to a sufficient level even before the development starts. The financial department can have a role in this as the value analysis requires certain skills and information to provide reliable estimations. The framework provided may also help manufacturers understand the value created by preventive maintenance solutions.

The paper answers the call for more practical tools for servitization. Moreover, the paper adds to the discussion about the role of MA in the servitization process and provides insights in the capabilities required in this process, especially in value quantification and communication.

Keywords – servitization, customer value, value quantification, value communication, MA capabilities

Paper type – Academic Research Paper

1 Introduction

For decades now, manufacturers have been engaging in the process of becoming a service provider, though with varying degrees of success. After Vandermerwe and Rada (1988) introduced the term servitization to describe this process, there has been extensive academic inquiry on the subject (see, e.g., Baines et al., 2009). Different drivers, such as competitive advantage, have been recognized as motivators for this change process (Vandermerwe and Rada, 1988). However, success in servitization is not given and manufacturers still face challenges (Brax, 2005) and, hence, the subject remains far from being mature (Baines et al., 2017).

Value communication is one of the recognized challenges in servitization in which management accounting (MA) capabilities could be utilized. Value communication is needed both in sales and internally to push the new service development (Kindström et al, 2012). However, in practice manufacturers find value communication challenging (Hinterhuber, 2008) and, thus, value communication has been recognized as a challenge in the servitization process (see e.g. Brax, 2005; Kindström et al., 2012; Parida et al., 2014). MA capabilities could aid in value communication especially in value quantification (Wouters and Kirchberger, 2015) which is needed in effective value communication (Eggert and Ulaga, 2018).

Therefore, the objective of this paper is to examine the value communication capabilities required in service development by proposing a way for value communication of a preventive maintenance solution. The research questions the paper aims to answer are, therefore, (1) how customer value of preventive maintenance services can be quantified, visualized and communicated and (2) what the implications of this value quantification and communication development to the wider MA capabilities development are?

To answer the research questions, this article takes advantage of a unique access to an industrial case on developing new technology that embeds customer value potential for preventive maintenance. The case companies are a mining equipment manufacturer and its hose assembly manufacturer who have jointly developed a production innovation which provides value also to the end customers as an aftersales concept. The case is based on an interventionist research project (see, e.g. Jönsson and Lukka, 2006; Suomala and Lyly-Yrjänäinen, 2012; Suomala et al., 2014; Lyly-Yrjänäinen et al., 2017) and the researchers have worked with the case companies in the development of the production innovation as well as polishing the same innovation into a new service concept. As interventionist MA researchers, they have also worked on creating models for value quantification and visualization at the early stages of the service development process.

The paper, therefore, provides a practical tool for value communication and adds to the discussion about the knowledge management aspects of the servitization process. First, the cost model and the framework created answer to the call for new tools and techniques to aid practitioners in the servitization process by Baines et al. (2009). Second, by

examining the capabilities required from the research team in the development of this model the paper provides more insights on the role of MA capabilities in servitization and more broadly on the knowledge management aspect of servitization. Both these concepts have gotten less attention in the literature (see e.g. Laine et al, 2012; Leoni, 2015), thus more inquiry on these subjects is warranted.

2 Literature Review

2.1 Customer Perceived Value of Preventive Maintenance Service

The customer's incentive to purchase the offering can be calculated as the difference of the total customer value and the price of the offering (Anderson and Narus, 1998). This difference between the total customer value and to total costs is also known as the customer perceived value (Eggert and Ulaga, 2002). As summarized by Eggert et al. (2018), over the decades our academic understanding has evolved from the exchange view on value to the current understanding of value-in-use and service dominant logic, in which customer is always a co-creator of value (Vargo and Lusch, 2004). However, the idea of customer perceived value as the difference of benefits and sacrifices has persisted. In one of the earliest instances Zeithaml (1988) defined customer value as: (1) a low price, (2) whatever the customer wanted from the offering, (3) the trade-off between the quality received for the price paid and (4) the difference between all the benefits received and all the sacrifices incurred. The fourth definition refers to the currently widely accepted and used benefits/costs model of customer perceived value (see e.g. Eggert and Ulaga, 2002; Khalifa, 2004, Kumar and Reinartz, 2016, Lyly-Yrjänäinen et al., 2019) shown in Figure 1.

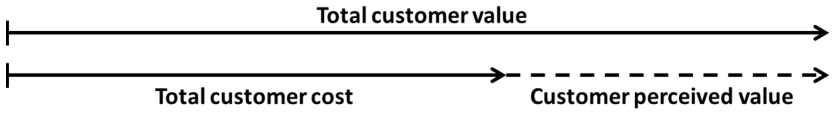

Figure 1. Customer perceived value

When evaluating the value of preventive maintenance, though in many cases increasing the direct maintenance costs, it usually lowers the total maintenance costs. Preventive maintenance has been used since the 1940's to avoid unplanned downtime (Garg and Deshmukh, 2006) and authors like Barlow and Hunter (1960) presented the first mathematical models for time-based preventive maintenance policies. Thus, the benefits of avoiding unplanned downtime has been understood for decades. However, when moving from corrective maintenance to more frequent preventive maintenance, the direct

maintenance costs and downtime costs have an inverse relationship, where the direct costs rise and downtime costs decrease (Woodward, 1997). Figure 2 shows this inverse relationship.

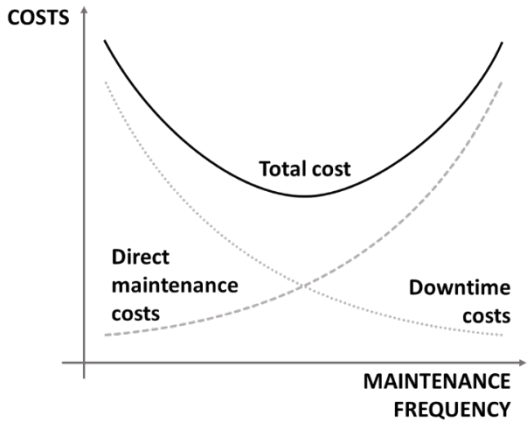

Figure 2. The relationship between the direct maintenance and downtime costs (adapted from Tempest 1976, p. 459).

Thus, the value of preventive maintenance is composed of lower total maintenance cost consisting of increased direct maintenance but substantially lower downtime costs. Direct maintenance costs include costs like labor and materials that are caused directly by the maintenance intervention (Pascual, 2008). Therefore, they are quite easy to measure and control (Vorster and De La Garza, 1990). On the other hand, the downtime costs are harder to quantify because they depend on different factors such as the production rate of the equipment (Pascual, 2008). If the downtime costs come down more than the direct maintenance costs rise, customer value is created from cost reduction in total maintenance costs.

2.2 Value Communication Capabilities in Servitization

Value communication capabilities are required in service development. It is well known that servitization process requires new capabilities for manufacturers to be successful (see e.g. Oliva and Kallenberg, 2003). This is also evident in the fact that not all manufacturers are able to provide profitable services (Malleret, 2006) or gain revenue growth but with lower profit margins (Neely, 2008). Value communication capabilities are important as to sell services, customers need to be made aware of their value (Malleret, 2006). Furthermore, value communication is needed also internally to push the development project (Kindstörm and Kowalkowski, 2014).

Effective service value communication necessitates value quantification and visualization capabilities. As concluded by Eggert et al. (2018) *"…value proposition quantification in business markets is a key consideration in effective value communication."*. Furthermore, value visualization capabilities are needed in service sales (Kindstöm and Kowalkowski, 2014) as customers struggle to understand the value of services in advance (Kindström et al., 2012). Thus, to market the service offerings, manufactures first need to quantify the value and then communicate it effectively.

However, these essential value communication capabilities seem to be underdeveloped in many organizations. Rapaccini et al. (2013) noted that tools and skills developed for service development were at the lowest stage of maturity compared to other aspects. Furthermore, in practice manufactures find value quantification and communication challenging (Hinterhuber, 2008). Lastly, manufactures struggle in value visualization when moving away from their traditional products to more intangible services (Kindström et al., 2012). Thus, the current struggles with value communication can be aggravated when a manufacturer moves to more intangible services where these capabilities are especially needed but not developed sufficiently.

2.3 Communicating the Value of Preventive Maintenance

Communicating the value of preventive maintenance is challenging as the benefits are not visible. When preventive maintenance is utilized, the maintenance is done proactively to avoid breakdowns and downtime (Ahmad and Kamaruddin, 2012). This increases the direct maintenance costs, but the total maintenance costs usually decrease, thanks to the reduced downtime (Woodward, 1997). However, these downtime costs are more intangible (Vorster and De La Garza, 1990) and, therefore, not so easy to quantify. Furthermore, the value is created in the long run, thus requiring understanding of the total life-cycle costs (Brax, 2005).

Thus, to successfully communicate the value, not only the quantification of the customer's direct maintenance costs but also a credible estimation regarding the downtime costs is required. In other words, in order to determine the customer perceived value when moving from corrective to preventive maintenance, the behavior of the two value components (the total customer value and total customer cost) needs to be known well. The preventive maintenance, however, does not change the value-creation logic of the customer and, therefore, it is possible to simply compare the costs with and without the preventive maintenance approach, taking into account these two cost components. Thus, the value quantification is focused only on the points of difference in value (Wouters and Kirchberger, 2015). Therefore, the increase in customer perceived value is created by decrease in total maintenance cost. In addition, as the decrease is created by a reduce in intangible downtime costs, effective value communication is also required.

The framework in Figure 3 explains the customer perceived value of preventive maintenance. As visible in the figure, the framework makes connection between (1) the

expected cost behavior of preventive maintenance compared to corrective maintenance (Figure 2) and (2) the definition of customer perceived value (Figure 1) explicit. In this framework, the 'cost lines', normally represented horizontally, are only rotated to vertical to illustrate how the graph showing the total cost of preventive maintenance can be used to communicate customer perceived value, too. In other words, the framework therefore explains and visualizes the increase in customer perceived value resulting from the reduced total costs enabled by investments in preventive maintenance.

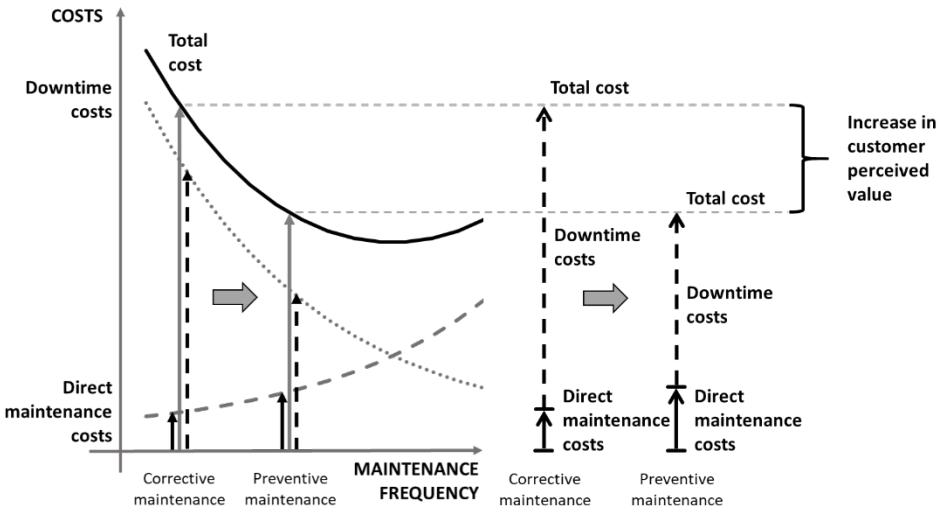

Figure 3. Customer perceived value of preventive maintenance framework

Therefore, to communicate the value of their preventive maintenance, service organizations need capabilities to (1) quantify their customers' maintenance costs and (2) visualize the cost reduction. Cost quantification requires knowledge about the customers processes (Wouters and Kirchberger, 2015) as well as cost calculation capabilities. Furthermore, to eventually communicate the cost reduction, visualization/communication capabilities are needed as the customer's understanding of these intangible costs might be limited.

Interestingly, MA function could be used to gain access to these required capabilities**.** Wouters and Kirchberger (2015) bring up the idea that especially customer value quantification can be very close to MA activities with the idea to show the benefits of the offering in monetary terms. The MA's role in servitization is also conceptualized by Laine et al. (2012). In their paper they discuss the different roles of MA in supporting the servitization process. Therefore, manufacturers could utilize the MA function's capabilities and resources, especially in value quantification as a part of the servitization process.

Thus, the servitization process requires also effective management of the manufacturer's current knowledge assets. The knowledge assets of an organization include intangible resources such as employee know-how (Moustaghfir, 2008) but also more tangible assets that enable the diffusion of knowledge (Linzalone, 2008). In the servitization process, knowledge management systems that support knowledge sharing should be in place (Leoni, 2015). Thus, from knowledge management perspective, effective service value quantification requires the development of both intangible knowledge assets (MA know-how) as well as more tangible assets (organizational routines for sharing knowledge).

3 CASE: Communicating Value of Preventive Maintenance Service

3.1 Hose Harness as a Production Innovation – Knowledge Transfer Emphasized

This paper is based on an interventionist case study with a company manufacturing mining equipment (OEM) and its hose assembly supplier. The mining equipment are powered with hydraulics and, therefore, hose assemblies are needed to transmit the power. A hose assembly consists of a piece of hose with fittings crimped (i.e. squeezed) at both ends.

The research collaboration started already 2011 with the development of a new digital production concept for manufacturing machine-specific hose assembly kits (Lyly-Yrjänäinen et al., 2016). However, as soon as the new hose assembly factory was up and running, the sourcing management of the OEM started to ask for a solution to reduce the installation time of hose assemblies.

A mining machine can have more than one kilometre of hydraulic hose or over 400 hose assemblies. When such mining machines have telescopic booms, the hoses going to the front end are built into thick bundles, bound together with plastic safety spiral. Especially these bundles are time consuming to build and, more importantly, work ergonomics are poor causing sick leaves. Figure 4 shows a worker building the bundle hose by hose and a finished, spiralled bundle on the other boom of a mining machine.

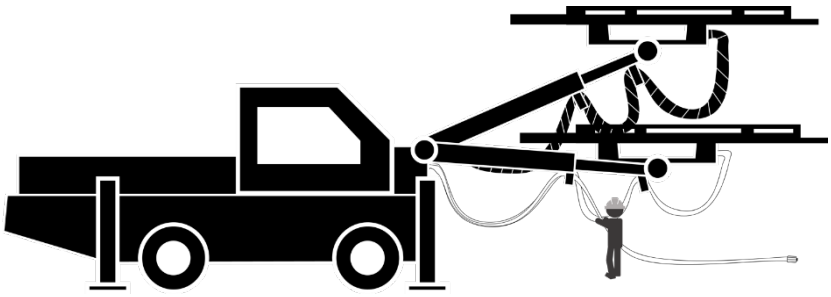

Figure 4. OEM assembly worker installing hoses into a 'bundle' on the machine boom

The sourcing manager wanted to purchase the boom hose assemblies as a ready-made, plug-and-play module similar to the wire harnesses used in the automotive industry. With wire harnesses, wires and cables are flexible; as long as they are all long enough, they can be connected. However, high-pressure hoses have several layers of steel wire in them, making the bending radius large and, as result, the hose ending points must be within a tight tolerance.

When the hoses were previously cut manually, the length tolerance was not that tight and, as a result, the OEM's assembly workers had to change hose routings inside the bundles to ensure that the hose end points are appropriate. Interestingly, the new digital manufacturing technology embedded in the new digital production concept improved the hose length tolerance, hence providing the starting point for the development of plug-and-play hose harnesses.

Because of the variation in the hose length, each hose bundle was somewhat unique and, hence, there were not much documentation on the assembly process either. Hose routing is difficult to document even with modern 3D solutions; instead, ideas for the knowledge transfer were tested using waste hoses and cheap plywood mock-ups. Eventually, after two years of development with the help of the research team, the supplier eventually invented a solution to handle the knowledge transfer needed to build the necessary jigs for both assembling the harnesses ergonomically at the supplier (left in Figure 5) and transporting them to the OEM assembly line for easy and fast installation (right in Figure 5).

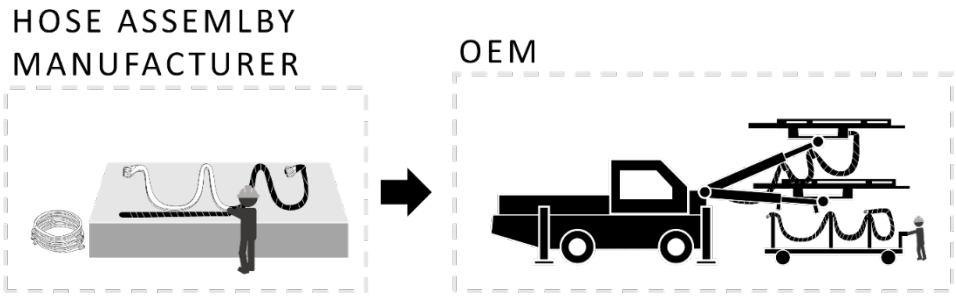

Figure 5. Supplier builds the bundle and the OEM installs it

Buses and trucks use preassembled hose harnesses for, e.g., brake hoses, though hose harness concept has never been applied to large, high-pressure hose bundles. As pointed out by the OEM Plant Manager:

> *"I have never seen nor heard about any manufacturer using preassembled harnesses similar to ours."*

Thus, new ideas were needed to manage the knowledge transfer and also how to build the assembly jigs and tool fast and with low costs; mining equipment volumes are measured in hundreds per year and such volumes simply do not justify high investments

in assembly tools. At the same time, many experienced professionals were convinced that outsourcing of the bundle assembly would never be possible. The development process, therefore, included both technology uncertainties and 'knowledge-management-related uncertainties' eventually solved.

When the uncertainties related to the process were solved, these ready-made, plug-and-play hose harnesses provided clear value in the OEM's final assembly. As stated by Sourcing Manager:

> *"Previously it took one worker three shifts to build the bundle for one boom. With this plug-and-play hose harness, the assembly time has dropped to three hours."*

Factory throughput time and asset turnover are important KPIs for the OEM. The hose harness concept impacts both these measures, appreciated by the top management. The core competence of the supplier is the fast and low-cost knowledge transfer process needed for ramping up new harnesses with limited amount of documentation available, a knowledge asset hard to copy. Furthermore, the innovative ways of knowledge transfer burden the over-burdened R&D and production engineering resources very little.

3.2 The Hose Harness Evolves in a Spare-Part Solution

Interestingly, the implication of the hose harness concept on the OEM final assembly sparked another potential application for it. As mentioned by Sourcing Manager:

> *"If the harness speeds up the assembly process in the factory, it has potential to reduce the maintenance downtime of our mining customers as well."*

When looking at the mining machines, the hose assemblies in drilling and tunnelling equipment are wear parts; pressure hammering and falling rocks eat hoses up fast; the replacement hose assemblies create a lubricative aftersales market for the OEM. At the same time, drilling and tunnelling machines are bottleneck resources, hence calling for new solutions for fast hose replacement. The comment of one of the OEM's engineers verifies the shared value potential:

> *"When I was younger and working on a tunnelling site, whenever a tunnelling machine had a broken hose, everyone was running. It is evident that customers would appreciate solutions that reduce the downtime of their bottleneck assets."*

Despite the shared value potential of services related to hose assemblies of mining and tunnelling machines, few OEMs have been able to successfully monetize it. As pointed out by the OEM's manager:

> *"We have not been able to compete with the local hose assembly suppliers. This is because the delivery time is of essence when selling replacement hose assemblies."*

With the hose failures in bottleneck machines, the impact of downtime on the mine productivity creates a need for fast replacement and, to shorten the lead time, a local hose assembly manufacturer typically operates inside the mine, illustrated in Figure 6. Typically, the same local supplier is then used for the scheduled, regular maintenance, too, hence keeping the OEM out.

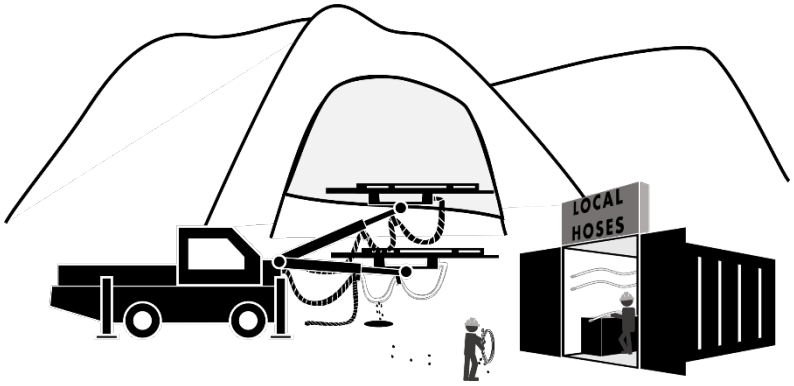

Figure 6. Replacement hoses.

The hose harness, however, may provide a solution that would help the OEM compete with the local hose assembly manufacturers. Since the drilling machines typically are bottle-neck resources in the mining operations, fast preventive maintenance solution on wear parts adds value to the customers. In the best scenarios, the hose harnesses can be changed down in the mining tunnels without driving the machine to the workshop, again saving valuable drilling time. Thanks to the hard-to-copy knowledge assets of the OEM's hose assembly supplier, it is not so easy for the local hose assembly manufacturer to offer similar value.

3.3 Modelling the Total Cost of the Proposed Preventive Maintenance Solution

The evaluation of the aftersales concept was initiated based on the value potential identified in the OEM production. The focus first was on building the sales argument for the cost reduction enabled by the complete hose bundle changeover with the plug-and-play harness concept. However, the MA research team built more complex cost analysis taking into account also the corrective maintenance. Table 1 shows the inputs used in the cost analysis with example figures.

Table 1. Inputs for cost analysis needed to evaluate customer value potential

	Hoses from a local manufacturer	**the OEM's hose bundle**
Cost of a single hose	€ 150	-
Cost of hoses for a complete changeover	€ 7 500	€ 6 000
Downtime when a single hose is replaced	1 hour	-
Downtime when complete changeover is made	15 hours	7 hours
Complete changeover interval	6 months	2 moths
Downtime cost per hour	€ 3 000	€ 3 000

First, when a hose breaks down, the hose is taken to the workshop inside the mine and, based on the sample, a similar one is manufactured. The wear-down hose assembly is used as a sample and depending on its condition, the new locally-made hose assembly does not always follow the factory spec.

Thanks to the local monopoly, the hose assemblies manufactured in the mine cost ten times more (150 Euros in the table above) than what the OEM pays for the hose assemblies Interestingly, as shown on the second row, the price of a complete pre-assembled, OEM-specified hose harness can be even less compared to the 'pirate' hose assemblies purchased locally.

Third, when a hose assembly breaks down, with the hose assembly workshop operating in the mine, the downtime is about one hour. Fourth, when comparing the time needed for building a new harness from loose hose assemblies or installing a plug-and-play hose harness, the time reduction was estimated about 60%:

> *"In a mine, the old bundle has to be disassembled before the new harness can be installed. In addition, there is usually a team of three to four people doing the work."*

Fifth, the hose assemblies in the boom of a new machine usually work for about two months without any breaks. After the two months, first hose failure occurs, and the hose failure frequency grows until it is time to rebuild the entire bundle. In the cost analysis, the boom hoses are completely changed in every six months while, to ensure error-free drilling, the hose harness should be changed every two months.

Finally, the bottleneck role of the drilling and tunnelling equipment makes the opportunity cost of lost sales the most important cost element. In this case, the opportunity cost is the gross profit the lost hour of drilling capacity. As pointed out by one of the managers:

> *"Depending on the mine, the cost of downtime per hour can be anything from 3 000 to 50 000 Euros."*

However, in order to make to make a conservative cost estimation, a downtime cost of 3 000 Euros per hour was used. Figure 7 visualizes the cost analysis for both the corrective and preventive maintenance policies based on the information discussed above. First, the graph on the top illustrates the cost behaviour with the hoses replaced at failure. The magnifying glass shows the 150 Euros of the replacement hose purchased locally and the downtime cost of one hour. As the graph illustrates, the hoses in the bundle start to fail after about two months with the failure frequency increasing until, after about six months, all the hoses are changed, and the bundle rebuilt in a workshop. The dashed line shows the accumulated costs, summarized in the pillar on the right. Second, the graph at the bottom illustrates the cost behaviour when the preassembled hose harness is changed in every two months to ensure failure-free drilling. Though the cost of hoses is a bit higher, the significant reduction in the downtime brings the costs down almost 50%.

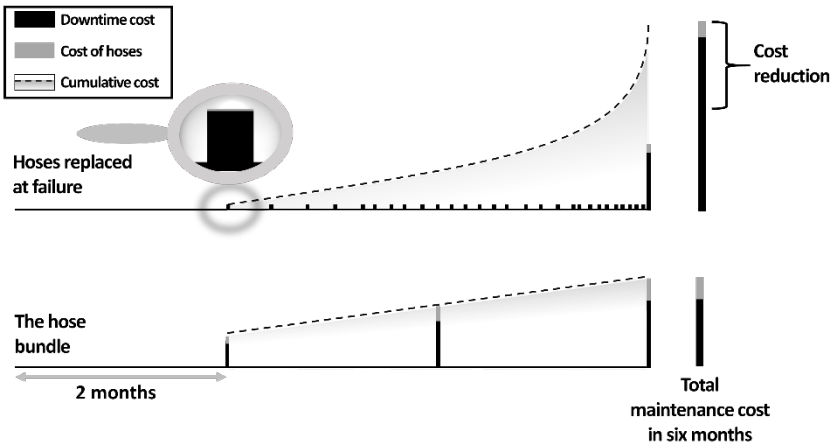

Figure 7. Total costs of hose maintenance in six months.

The figure aims to (1) visualize the significance of single hose failures to total maintenance costs, (2) highlight the predictability of costs with the hose harness, (3) show the amount of direct maintenance and downtime costs in both maintenance policies and (4) show the total cost reduction over the time period. The figure above provides a simple illustration of the key variables used for communicating the value potential within the organization. Naturally, in case the company wishes to push this service concept in the market, the figure can be used for communicating the value potential and the value drivers to the customers, too.

The figure above showed the cash-flow perspective of the two service approaches, with the total impact summarized on the right. However, the same summary can be shown using the illustration typical for preventive maintenance, as shown in Figure 8. The two arrows on the right show the total costs of the two service approaches, both split into the direct costs and downtime costs. When placed parallel, these two arrows make the total cost impact explicit. As the figure shows, the perceived customer value (i.e. 59 700 difference in the total costs) is shown in the same way typical to the benefits-sacrifices frameworks, though this time only vertically. However, Figure 8 makes it very explicit how the customer perceived value analysis follows the well-accepted idea of preventive maintenance, with the cost components coming from the framework illustrating the inverse relationship between direct costs and downtime costs.

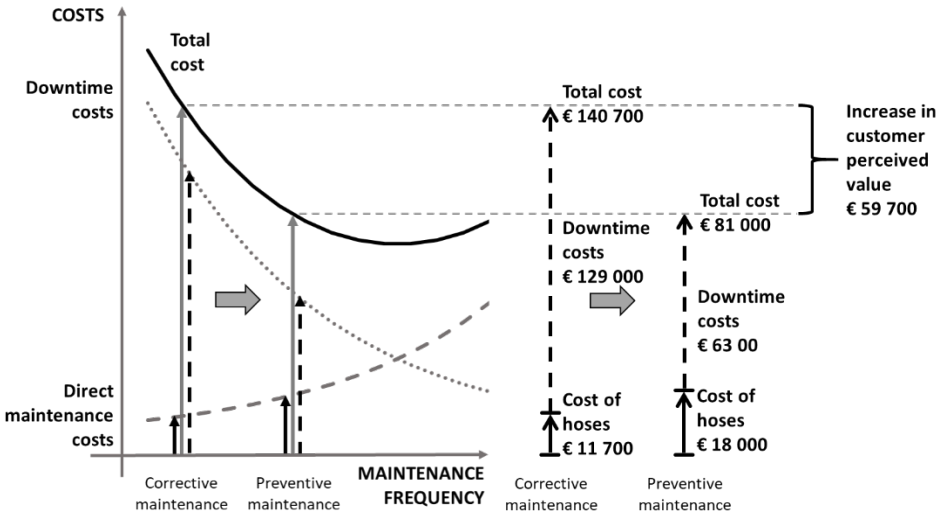

Figure 8. Increase in customer perceived value with the hose bundle in six months.

The cost analysis and the visualisations can, then, be used for building different scenarios educating both internal and external stakeholders. For example, to save on the direct costs, a mining company may be interested in accepting three to four hose failures during the third month to reduce the number of complete hose harness changeovers. However, with such a costing tool the sales organization can prepare an analysis showing that more than two hoses failures during the third month makes the customer's idea unprofitable. Such analyses introduce a totally new costing capability also for the OEM's front-line after-sales organization; value often is context specific (the downtime cost, for example, depends on the mineral customer is mining) and, therefore, it is important to use organization's MA knowledge to build MA competencies also in the front end.

4 Conclusion

The paper examined the value analysis and communication capabilities required in service development. Such capabilities are clearly required for building a shared understanding about the desired business development (Laine et al. 2012), and for identifying more detailed development activities based on such shared (continuously refined) understanding.

The first research question was how customer value of preventive maintenance services can be quantified, visualized and communicated. In response, Figure 8 shows a more detailed analysis of the customer perceived value using the framework introduced in this paper. The framework that was introduced and utilized in this paper holds several implications. First, it provides a promising basis for understanding and analyzing the longitudinal value of preventive maintenance activities. Second, it represents an example of an approach enabling a company interested in service development develop a

framework through which central value elements can be identified, further examined and communicated within and across organizational boundaries. As such, the framework represents a rare example of the tools and techniques that has been already a decade been called for in the servitization literature (Baines et al. 2009)

Regarding the second research question focusing on the capabilities required for these processes of customer value quantification, visualization and communication, one should note that external interventionist researchers are not always available. Instead, the company personnel need to hold those capabilities by themselves, within finance, services, R&D and other operations. MA (or finance function) should typically be there for actively supporting decision-making for business development. However, the information about the value and profitability embedded to servitization has been discussed so far in rather exploratory terms, and a more detailed, supportive role of MA in servitization could deserve substantial further examination (Neely 2008, Laine et al. 2012, Tenucci and Supino 2019). The development process around the case of this paper could be largely supported by the MA function of the company, which provides nice avenues for MA to truly become a business partner as discussed in the literature (see e.g. Järvenpää, 2007). However, MA is not working in isolation. Instead, cross-functional activities are desired in order to identify, further develop and manage the service business development.

The process, similar to the case presented in this paper, for developing the capabilities for quantifying, visualizing and communicating the customer value, is desired in companies aiming at service business development in a solid, knowledgeable basis. The process presented in this paper is related to increasing understanding about the value and business impacts of proactive maintenance services. However, there are several other avenues for developing new service businesses that could benefit from extended such MA capabilities. Thus, our paper holds implications for revisiting the role of the finance function and other experts in developing and utilizing their capabilities of MA supporting service business development and decision-making.

The study presented in this paper is not without limitations. The case represents an empirical illustration on for quantifying, visualizing and communicating the customer value, and has contribution in itself. However, wider implications presented in this paper regarding MA capability development in this context require further examination. Further research is encouraged to provide additional cases for extending the similar idea to different service business development contexts and for examining the need for and use of MA capabilities extensively in the servitization context. This would represent a major contribution in the research area, by providing new means for identifying and managing value of servitization.

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Knowledge Management and Factors Influencing its Implementation in Small KIBS firms – Evidence from Poland

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Abstract

Even if the notion of knowledge management (KM) has been introduced more than three decades ago, the application of this concept in the context of small firms has still not been sufficiently explored. The relatively few contributions, however, agree on the fact that small companies do not manage knowledge the same way as their larger counterparts. In order to fill this gap, the present paper aims to the investigate the if and how different aspects of knowledge management in small enterprises offering knowledge-intensive business services (KIBS) – such as: type of adopted KM practices, barriers to KM implementation and use – are related with some characteristics of the companies such as: their size, the business sector they belong, the kind of adopted strategic knowledge approach followed. Specifically, paper examines some features of KM in companies belonging to various KIBS sectors (ICT, architectural and engineering services, professional services, R&D services and marketing and communication services) in Poland. The findings are based on a quantitative survey conducted among 104 small companies of this type. Investigated KM-related aspects were: the role played by knowledge and KM, the KM practices adopted, the factors that have hindered the adoption of such practices, the way they are used. KIBS companies were investigated because knowledge and its management are vital for their operations and they are perceived as intensive users of KM tools and practices. The findings of the survey show that the approaches to KM followed by small KIBS companies results to be rather differentiated. Concerning the factors that influence the KM approach adopted by the individual company, the size and the kind of followed strategy help in explaining the differences between companies more than the sector of belonging. In particular, the size seems to act as a constraint (in terms of number of adopted practice and of role of promoters) while the kind of strategy as an enabler (a more reflected strategy is connected with a greater number of adopted practices). The study offers food for thought about KM features in the KIBS sector and moreover, it contributes to a better understanding of KM in small enterprises. The knowledge presented in the paper may be of use to managers and owners wishing to better understand their KM practices and implement more suitable solutions.

Keywords – Knowledge Management, KIBS, SMEs, Poland

Paper type – Academic Research Paper

1 Introduction

Although the notion of knowledge management (KM) has been introduced more than three decades ago (Schwartz, 2007), the application of this concept has still not been sufficiently explored with relation to small- sized enterprises (Centobelli et al., 2017; Durst and Edvardsson, 2012; Massaro et al., 2016); furthermore the scarce research currently available on this topic offers rather fragmented results. The relatively few contributions, however, agree on the fact that SMEs do not manage knowledge the same way as their larger counterparts (Chan and Chao, 2008; Wee and Chua, 2013). With the aim to contribute filling this gap, the present paper intends to analyse if and how different aspects of knowledge management in small-sized enterprises are related with some characteristics of the companies such as: the business sector they belong, their size, the kind of strategic approach to managing knowledge they adopt. In particular the paper analyses some aspects related to the way small companies offering knowledge-intensive business services (KIBS) manage their cognitive assets, as follows: the degree of consideration that companies place to their knowledge and its management, the number and kind of implemented KM practices, the barriers they encountered when introducing the practices, the factors that facilitated their adoption, how such practices are used. KIBS companies where selected for a twofold reason. First, as their name recalls, such companies base their competitiveness on knowledge and therefore they must manage it at their best. Second, KIBS companies are very heterogeneous as far as their knowledge bases are concerned (Pina and Tether, 2016), which offers the opportunity to investigate if and how the sector to which the company belongs influences its KM approach.

The paper articulates as follows. Section two briefly summarises extant research about KM approaches and practices with a specific focus on small companies. Section three describes the research methodology and the sample used for the survey, while empirical findings are illustrated and discussed in section four. The last section is devoted to discussion, conclusions, suggestions for future research and limitations of the study.

2 Knowledge management approaches and practices

For some companies, KM can be a deliberate and planned activity; for others, it may *emerge* and develop progressively from the day-by-day practice. It is, therefore, possible to distinguish between two opposite approaches to KM: a *deliberate* or planned approach, and an *emergent* approach. To clarify this distinction, we can refer to the literature of *strategic management*, where we find a similar contrast between a deliberate vs. emergent approach to strategic planning (Mintzberg and Waters, 1985). Deliberate strategic planning refers to an explicit and rational formulation of goals, plans and means that

originates from precise intentions of the company. All is generally decided by the central management, progressively articulated in tasks for different parts of the organization, and backed up by formal controls, in a top-down logic. Conversely, a purely emergent approach to strategic planning is one where actions result to be consistent only over time, but in the absence of clear intentions, leadership, and rational predefinition of goals and plans. In other words, in an emergent approach, goals and plans of a company may even be established initially, but in the end, it is only the results of emerging actions and decisions that lead to an ex-post formalization and co-ordination of those actions and decisions that have proven to be more effective and beneficial to the organization. Maybe, as Mintzberg and Waters (1985) highlight, a purely emergent approach is impossible in real life, but there are situations that are (more or less) close to that abstract definition.

In accordance with the mentioned literature, we can introduce the two different definitions of deliberate and emergent KM approach (Zieba et al., 2016):

A deliberate or planned KM approach is an approach where practices, tools and methods of managing knowledge are linked to the general strategic orientation of the company and are deliberately designed at a top management level. KM goals are based on a rational analysis of company's needs, objectives and resources, and are later implemented and spread across the company with deliberate efforts and investments.

An emergent KM approach is an approach where practices, tools and methods of managing knowledge originate from the daily practices and learning processes of company's employees. Employees develop their own methods of learning, storing, retrieving and sharing knowledge in relation to their actual needs and practical problems to solve. The methods and tools that prove to be effective, useful and/or compatible with the daily business practice are later developed and become established practices, and later can be recognized as "the KM approach" of the company.

According to Zieba et al. (2016), companies of small size may especially follow the emergent approach towards KM. As a matter of fact, these companies have less resources to invest systematically in KM plans and appropriate organizational structures for a deliberate KM. Also, their management style is more oriented to flexibility and "entrepreneurial instinct". However, even if we limit the analysis to small companies, their approach is not standardized, and can develop in different forms, depending on the particular condition where they operate. The set of practices, tools, methods, and KM processes can vary from a company to another. This point still deserves to be researched. In particular, there is the need to characterize the possible content of the KM approaches followed by small companies, and to investigate why some companies introduce a certain KM approach. This is the goal of the present study, that aims to contribute filling such research gap by analysing the different KM approaches adopted by a group of small Polish companies.

3 Research methodology and sample

On the basis of what has been presented above, it can be stated that little is still known about the practices related to KM introduced by small companies and the factors potentially influencing their implementation. In order to fill this gap in, the authors of this paper have tried to answer the following research questions:

- Do KM practices implemented by small firms differ in accordance with the sector of the companies? If so, in which way?
- Do KM practices implemented by small firms differ in accordance with the size of the companies? If so, in which way?
- Do KM practices implemented by small firms differ in accordance with the strategic analysis performed before their implementation by the companies? If so, in which way?

In order to answer these questions, it was necessary to conduct a quantitative study among small firms in Poland. Companies from the KIBS sector were selected as they are knowledge-intensive and knowledge is their crucial resource (Miles, 2005; Miles et al., 1995; Zieba, 2013). Therefore, they naturally need to manage it properly, in accordance with their needs. The companies for the study were selected from the database containing such firms and purchased from a professional company offering data. The survey was distributed among the respondents via two means: a link to an on-line survey and a paper version of the survey sent via traditional post, together with the letter inviting to take part in the survey. In total, the survey was sent to 1000 firms via e-mail and 2000 firms via traditional post. The response rate from the e-mail survey was very low, so it was necessary to choose a different approach (traditional post). In total, 104 replied to the survey, which gives the return rate at the level of 3,5%. The study was conducted in two waves: the first one in 2018 and the second one – in 2019. The whole survey was devoted to KM approaches and practices, factors and barriers influencing their implementation, people responsible for KM, etc. In the next section, selected empirical findings (due to paper limits) will be presented, together with the discussion.

4 Empirical findings and discussion

We collected usable questionnaires from 104 small KIBS companies (i.e. with 50 or less employees), whose composition is shown in table 1. The sample is rather balanced in terms of sectoral and size composition, with the exception of professional services companies that are the 40% of the observed companies.

Table 1**:** Sample composition by company size and sector of belonging

	0 - 4	5-10	>10	Total
ICT	7	2	6	15
R&D	0	5	7	12
Technical	9	6	8	23
Professional	15	16	11	42
Marketing	8	1	3	12
Total	40	29	35	104

The surveyed companies have a relevant business history: only 11 have been active from 5 years or less (Table 2), and the average age of the sample is about 19 years. Hence, they have a consolidated experience which contributes to increase the significance of their responses.

Table 2: Sample composition by company age

Age	# companies
0 – 5	11
5 – 10	12
11 - 20	30
> 20	50
n. a.	1

The role played by the respondents further contribute such a significant: indeed, most of them are company owners or people occupying an executive/managerial position (table 3).

Table 3: Sample composition by role of respondent

Role	# companies
Owner	65
Board member	17
Manager	13
Specialist	9
Total	104

Coming to the analysis of the collected data, it must be recalled that for reason of space in the following pages only data concerning the KM-related practices applied by companies are analysed, linking them to the sector of belonging, the size and the fact that the introduction of the practices was preceded or not by a strategic analysis of the knowledge-related problems of the company. At this regard, we have subdivided

companies in three groups as follows: the first group includes companies that definitely (or almost definitely) did not make such analysis (and are indicated with "N") and represents around 23% of the sample; the second group includes companies that made some analysis but only partially (indicated with "I") and represents around 32% of the sample; and the third group contains companies that that definitely (or almost definitely) made such analysis (indicated with "Y") and represents around 45% of the sample. With reference to the literature about KM strategies, it can be said that companies of the first and the second group follow an emergent KM strategy and those of the third group a deliberate KM strategy. The composition of the sample confirms that among small companies, emergent strategies are more diffused than deliberate, also in the case of KIBS firms (Coyte et al., 2012; Wee and Chua, 2013). This implies that in most companies the introduction of K-related practices is the result of the necessity of satisfying working needs.

To begin with, it is worth noting that the sampled companies on the whole agree on considering knowledge as their most important competitive resources, which confirms previous studies about the role that such asset play for the competitiveness of the KIBS sector (Palacios-Marques et al., 2011; Lara et al., 2012; Mangiarotti, 2012). Furthermore, as it was logical to expect, responses indicate that companies with a deliberate KM strategy assign to knowledge a bigger competitive relevance in comparison with companies following an emergent KM strategy.

Table 4: KM-related practices applied by the company (average % by sector)

	ICT	R&D	Tech.	Prof.	Mktg	Total
Capturing and storing K in repositories or written documents	66.7	66.7	65.2	78.6	58.3	70.2
Email to share and transfer K	86.7	91.7	73.9	83.3	91.7	83.7
Social media to publish and access information	40.0	66.7	30.4	47.6	91.7	50.0
Building and maintaining employees' expertise and skills	60.0	66.7	82.6	85.7	75.0	77.9
Identifying and disseminating best practices	60.0	58.3	60.9	57.1	66.7	59.6
Creating a supportive environment for K sharing	66.7	66.7	34.8	50.0	58.3	51.9
Rewarding employees who share K	53.3	58.3	43.5	40.5	50.0	46.2
Organizing regular meetings to exchange information	53.3	83.3	52.2	61.9	75.0	62.5
Using ERP or CRM software as learning tools	40.0	50.0	26.1	21.4	33.3	29.8
Using communities of practitioners to share K	26.7	25.0	39.1	57.1	25.0	41.3
TOTAL (average number of adopted practices)	**5.53**	**6.33**	**5.09**	**5.83**	**6.25**	**5.73**

One of the survey's question asked respondents to indicate which KM-related practices (among ten listed) the company are using. As it can be seen in table 4, the surveyed companies on average use less than 6 practices each one. Some practices are widely diffused (particularly email that is used to share and transfer technical and market

knowledge by 83.7% of the companies), while others are rarely used (as ERP and CRM). Furthermore, table 4 groups the answer by sector: each value represents the percentage of the companies of the sector that are using the individual practice; the last row shows the average number of practices employed by a sector. Data denote the existence of significant differences between sectors: R&D companies are the most intense users of the practices, while ICT the least intense ones. This fact is quite surprising (there is a general opinion that ICT companies are at the forefront in managing knowledge assets) but it can be partially explained by looking at the single practices and taking into account that the use of a specific practice can be affected by the kind of knowledge base that denote each sector. For instance, marketing services companies make relatively little use of repositories, and this is congruent with the symbolic/cultural nature of their knowledge base; completely different is the case of professional service companies, that make use of administrative (document-based) knowledge. Similarly, the intense use of communities of practitioners by professional services companies can find reason in that they are more used to resort to professional associations (Hinings et al., 2016).

Table 5: KM-related practices applied by the company (% by size)

	0 - 4	5-10	>10	Total
Capturing and storing K in repositories or written documents	62.5	65.5	82.9	70.2
Email to share and transfer K	80.0	82.8	88.6	83.7
Social media to publish and access information	45.0	55.2	51.4	50.0
Building and maintaining employees' expertise and skills	70.0	86.2	80.0	77.9
Identifying and disseminating best practices	50.0	62.1	68.6	59.6
Creating a supportive environment for K sharing	37.5	51.7	68.6	51.9
Rewarding employees who share K	37.5	48.3	54.3	46.2
Organizing regular meetings to exchange information	52.5	62.1	74.3	62.5
Using ERP or CRM software as learning tools	22.5	20.7	45.7	29.8
Using communities of practitioners to share K	37.5	55.2	34.3	41.3
Total (average number of adopted practices)	**4.95**	**5.90**	**6.49**	**5.73**

As regards the number of applied practices, size results to be a very good explanatory factor: micro companies use less practices than the biggest ones (table 5). Only the use of communities of practitioners of practices diverges from this trend, but this is due to the fact that professional services firms (which make intense use of such communities) represent more than half of the "medium-sized" companies.

Table 6: KM-related practices applied by the company (% by strategic approach)*

	N	I	Y	Total
Capturing and storing K in repositories or written documents	68.2	56.7	79.1	69.5
Email to share and transfer K	81.8	80.0	86.0	83.2
Social media to publish and access information	40.9	43.3	62.8	51.6
Building and maintaining employees' expertise and skills	54.5	86.7	81.4	76.8
Identifying and disseminating best practices	27.3	60.0	72.1	57.9
Creating a supportive environment for K sharing	36.4	50.0	55.8	49.5
Rewarding employees who share K	18.2	60.0	51.2	46.3
Organizing regular meetings to exchange information	45.5	60.0	69.8	61.1
Using ERP or CRM software as learning tools	18.2	33.3	32.6	29.5
Using communities of practitioners to share K	27.3	36.7	51.2	41.1
Total (average number of adopted practices)	**4.18**	**5.67**	**6.42**	**5.62**

* Only 95 respondents

The results of table 6 confirm that the kind of KM strategic approach followed by a company is strictly connected with the effort it makes in managing knowledge. Actually, companies that have made a strategic analysis before introducing a KM-related practice are those that are applying more practices.

The last two aspects presented in this paper regard how the practices were introduces and who were the key promoters of the introduction.

Table 7: Introduction of practice (average by size)

	0 - 4	5 - 10	>10	Total
Practices were introduced after a strategic analysis of k needs (1 = definitely no – 5 = definitely yes)	2.87	3.77	3.35	3.27
Key promoters (1 = only employees – 5 = only managers/owners)	4.28	4.21	3.52	4.01

Findings of table 7 are as expected. Given the limited size of the sampled companies the key promoters could be especially executive/owners. It is also obvious that the role of employees increases with the dimension. Similarly, it is quite obvious that micro firms are those that more frequently adopt an emergent KM strategy. Furthermore, they are especially micro companies that follow an emergent strategy.

Table 8: Introduction of practice (average by sector)

	ICT	R&D	Tech.	Prof.	Mktg	Total
Practices were introduced after a strategic analysis of k needs (1 = definitely no – 5 = definitely yes)	2.69	2.90	3.99	3.73	3.33	3.27
Key promoters (1 = only employees – 5 = only managers/ owners)	3.79	4.00	4.05	4.12	3.83	4.01

Table 8 shows that there are some differences between sectors, that seems to be in line with what previously said about the different cognitive context that denote the various sectors. In particular ICT and Marketing services companies are those where employees play a more active role in promoting the introduction of the practices, which can be ascribed to the fact that in these sectors employees are more familiar with the information-related technologies.

5 Discussion and conclusions

The results of the analysis of the answers given to the questionnaires by the investigated firms allow to answer the research questions posed in section 3. First of all, the findings of the survey show that the approaches to KM followed by small KIBS companies results to be rather differentiated, which confirms previous studies about the fact that a single common way to implement KM cannot be identified (Alexandru et al., 2020). Concerning the factors that influence the KM approach adopted by the individual company, the size and the kind of followed strategy help in explaining the differences between companies more than the sector of belonging. In particular, the size seems to act as a constraint (in terms of number of adopted practice and of role of promoters) while the kind of strategy as an enabler (a more reflected strategy is connected with a greater number of adopted practices). Hence, it is possible to say that a deliberate approach towards KM can promote a more thoughtful and intense use of related practices and tools. An interesting result is that the sector of belonging does not seem to be a factor that helps in differentiating the firms' approach, even if it is logical to assume that different knowledge bases imply different ways of managing them. A possible explanation is that knowledge is such a complex matter and there are so many various practices that is difficult to bring everything back to a simple sectorial classification.

5.1 Academic and managerial implications

The study has both academic and managerial implications. As regard the former ones, it confirms the role played by having a deliberate strategy in the shaping the KM activities of a company, also in the case of the smaller ones. This paves the way to further studies aimed at deepening our knowledge about the factors and the conditions that favour the adoption of a deliberate KM strategy by companies of such a very limited size. Concerning the latter ones, our findings suggest that the adoption of KM-related practices

should be preceded by a careful reflection about their effective use, which can be really changing for smaller firms, where also owners or managers usually are directly involved in daily business activities.

5.2 Limitations of the study

The study presents some limitations. The first one concerns the sample that is not representative and regards only Polish small KIBS companies: hence the findings of the analysis cannot be generalised to small firms as such. Second, given the preliminary nature of the study, only a very limited part of the questionnaire was analysed, and the responses were not processed by means of specific statistical methods. However, this limitation can be overcome by the performing of a more sophisticated analysis in the future papers. Third, a greater number of factors could be identified and examined in the survey. All these limitations can set the field for the future research avenues and the forthcoming publications.

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Business Model Innovation in the Space Industry

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Abstract

The Copernicus Programme leaded by ESA (European Space Agency) has/is released/ing a huge amount of Earth Observation data and therefore firms operating in the Space Industry aim at getting most out of them. However, this is not straightforward in that, to be exploited, data need to be processed and interpreted and this, on its turn, requires to build on new digital technologies, and particularly Artificial Intelligence (AI). In this perspective, AI, while allowing data processing, can change the way firms create, deliver and capture value, and hence can be interpreted as a trigger igniting Business Model Innovation (BMI).
While understanding BM as a set of different components, our objective is investigating i) whether AI initially modifies a specific component of the BM, to be considered as epicentre of BMI, or if any of the BM components can be the epicentre of innovation, and ii) whether the innovation process spreads from the epicentre to other BM components and if this happens according to a common path.

Keywords –Artificial Intelligence, European Space Agency, Copernicus Program, Case study

Paper type – Academic research paper

1 Introduction

Nowadays, the European Space Agency (ESA), through the Copernicus Programme, has opened a vast amount of Earth Observation (EO) daily data to the world. Specifically, because of the increasing number of drones, satellites constellations and high-altitude platforms, Earth imaging is becoming increasingly affordable and available at higher resolutions.

Within this scenario, Artificial Intelligence (AI) is expected to play a pivotal role. Indeed, AI, through the availability of mature machine learning tools and the emergence of methods such as deep learning and appropriate hardware units for parallel processing (e.g. Graphic Processing Units - GPUs, Tensor Processing Units), allows processing these data and hence taking full advantage of them through the development of a vast array of new commercial downstream services related to climate, safety, security, surveillance, etc.

As a result, AI for EO large data volumes made available through the Copernicus Programme has changed considerably the Space Industry, where firms are reconsidering their Business Models (BMs) (Saebi and Foss, 2017) and searching for new ways for creating, delivering and capturing value (Parida et al., 2019; Warner and Wäger, 2019). In other words, AI for EO can be interpreted as a trigger for Business Model Innovation (BMI) in the Space Industry.

Given these premises, this paper aims at contributing to the research stream that investigates the role of AI in BMI with a specific focus on the possible paths of BMI through AI by looking at the component(s) BMI starts from and how changes spread to other components.

In the following section a general overview of the literature on AI and BMIs is provided. The third section outlines the methodology. The fourth and fifth sections present the results and their discussion, respectively.

2 Theoretical background: BMI and AI

The concept of BMI, despite the increasing attention received in the last years, is considered "a slippery construct to study" (Casadesus-Masanell and Zhu; 2013: 480) due to the associated proliferation of definitions (e.g. Mueller, 2014; Foss and Saebi, 2017).

Despite with different approaches and extents, BMI implies a change in business model (BM) components, according to the definition of BMI as the "designed, novel, nontrivial changes to the key elements of a firm's business model and/or the architecture linking these elements" put forward by Foss and Saebi (2017: 201).

Some authors look at BMI taking a process perspective and unveiling its dynamic, whereas others describe it as an outcome of an innovation initiative that renews company's existing BM (Mitchell and Coles, 2003; Foss and Saebi, 2017) or completely introduces a new one (Lindgardt et al., 2009). Considering what is being innovated, the transformation might involve one or more components of the BM (e.g. the channel, the

value proposition, the key relationships) or all of the components, thus modifying the entire architecture and the links among the activities underlying them. Moreover, BMI can stem from a single epicentre or several epicentres (Osterwalder and Pigneur, 2010). Overall, the debate on the "dimensionalization of BMI" (Foss and Saebi, 2017) is still open and further studies are needed to better investigate the interdependence among the different components.

The possibilities of adapting or innovating the different components of the BM or even introducing an entire new and disruptive BM have dramatically increased thanks to the opportunities offered by the digitalization (Kiel et al., 2016; Rachinger et al., 2019), leading off the development of a young stream of literature. The new digital technologies, such as (AI, big data, or internet of things (IoT), allow changing the processes of creating, delivering and capturing value and the relationship with customers and other actors as well (Parida et al., 2019; Warner and Wäger, 2019). At the same time, new service and product offerings might be developed, using digital solutions for satisfying unmet customers' needs. Even though it is evident that digitalization enables BMI, contributions are still dispersed (Parida et al., 2019); in particular, while there are some papers that investigate the impact of IoT and cloud computing on BMI (Coyle and Nguyen, 2019), there are very scant contributions that examine the role that other digital technologies, have in BMI.

Considered the recent estimates forecasting that 75% of business applications in various sectors will employ AI by 2021 (Crews, 2019), as well as the evidence of well-known top companies (e.g. Airbnb, Uber, Tesla, Google, Alibaba and UPS) having introduced completely new business models thanks to the use of AI, this study focuses on this specific technology.

The concept of AI, which was coined in 1956 by John McCarthy and his group, is defined as a set of "theories and techniques used to create machines capable of simulating intelligence. AI is a general term that involves the use of a computer to model intelligent behaviour with minimal human intervention" (Wamba-Taguimdje et al., 2020). As said above, AI allows rebuilding, revising and completely changing companies' BM, to the point that Valter et al. (2018) sustain that, in the future, BMs will be a result of an interaction of humans and machines with the latter taking over more and more tasks. Despite the tremendous impact that AI might have on businesses, which have started attracting the attention of scholars, there are only few studies that explore the connection between AI and BMI (Lee et al., 2019).

So far, on the one hand, some articles investigate the influence that AI capabilities might have on organizations performance improvement (Wamba-Taguimdje et al, 2020). On the other hand, some others focus on how AI applications might modify the different components of BM or create an entirely new BMs (Garbuio and Lin, 2019), or how an organization might be able to exploit the potentialities offered by AI. In the latter stream, the article by Garbuio and Lin (2019) distinguishes three main ways through which businesses can or will use AI: assisted intelligence, that allows improving what is

currently in place by increasing the value of the current activities, augmented intelligence, which makes available new capabilities and thus requires modifications in the company's business model, and finally autonomous intelligence, which is the advanced stage of AI that acts on its own and chooses its action on the basis of business goals.

In order to have an organization ready for the AI challenges, Lee et al. (2019) and Reim et al. (2020) present a set of recommendations managers might follow to prepare their company to catch the multiplicity of possibilities offered by the AI (Lee et al., 2019). In particular, both contributions insist on the need to develop internal AI competences, as well as an adequate culture that is also open to collaborations since multiple companies are part of digital ecosystems.

Based on these premises, considering the paucity of research on the role of AI in BMI and the need to further investigate the interdependence among the different components of BM through the BMI process, the aim of this article is to explore possible paths of BMI through AI by looking at the component(s) BMI starts from and how changes spread to other components.

3 Methodology

The research methodology adopted in this paper is multiple case studies. We relied on a multiple case study approach analysing three cases (case A, B and C) operating in the Space Industry and engaged in changing their BM for tapping into the opportunities AI offers.

We followed Osterwalder and Pigneur (2010)'s BM framework which allowed the definition of the variables at play (Eisenhardt, 1989): respondents were asked to describe how AI impacted the company's four areas of the BM over time (the description of the areas/components is provided in section 3.3).

Data were collected in a four-month period and included primary (the CEO of the firms) and secondary sources (firms' websites and documents provided by the informants) according to a multiple data collection method (Eisenhardt, 1989). In carrying out the three case studies, we followed several steps (Barczak, 2015): case selection, identification of the unit of analysis, definition of the reference research framework, data collection, data elaboration, and data analysis.

3.1 Case selection

We selected three case studies of firms operating in the Space Industry, which engaged in changing their BM with the aim of tapping into the opportunities offered by AI technologies.

Table 1. Main characteristics of the firms

Firm	Founded	Country	Size	Industry	Products/Services	Funding	Type
A	2014	IT	~ 10, spin-off	Computer Hardware (mainly aerospace)	Design, development and commercialisation of Electronics Systems, Informatics Systems and innovative services	Private and Public	Privately held
B	1994	IT	~ 50 employees, SME	Defense & Space	Private Geographical Information Services (GIS) and Earth Observation consultancy company, which focuses on information land management	Private and Public	Privately held
C	2008	SL	~ 50 employees, start-up	Computer Software (mainly aerospace)	Enterprise-level solutions for managing spatial data, especially for support in land administration and agriculture processes	Private and Public	Privately held

Firms A, B and C (whose names will not be revealed for sake of anonymity) are European Small and Medium Enterprises (SMEs) operating in the Space Industry. Their main characteristics are reported in table 1.

3.2 Identification of the unit of analysis

As unit of analysis, we address the process the firm followed to change its BM, either explicitly defined or emergent.

3.3 Definition of the reference research framework

We relied on the BM framework provided by Osterwalder and Pigneur (2010), composed of four main areas, each encompassing different components: Offer (Value Proposition), Customers (Customer Segments, Customer Relationship and Channels), Infrastructure (Key Resources, Key Activities and Key Partners) and Financial Viability (Revenue Stream and Cost Structure) because it is a widely accepted conceptualisation of a BM.

The above research framework served as a starting point to conduct interviews as it allowed the definition of the variables at play (Eisenhardt, 1989). Indeed, respondents were asked to describe how the BM was conceived before and after it was innovated. However, according to an exploratory approach, we avoided thinking about specific

relationships between the constructs, so striving to maintain a neutral position when asking firms to explain how the BMI took place.

3.4 Data collection

Table 2: Topics, information sources and supporting tools

Investigated topics	Primary sources	Supporting secondary sources	Supporting Tools
Description of firms; identification of key informants for the case studies	CEOs, Marketing Officers, AI experts of firms A, B and C	Firms' website; slides presented at conferences	Interview guide, part I
Detailed description of the BM components and architecture for the analysed firms before AI was used to			Interview guide, part I
New BMs configuration, in terms of components and architecture, aimed at taking advantage of AI			Interview guide, part II
Final verification of the case studies validity		—	—

Data were collected in a four-months period and included several primary and secondary sources (Table 2) according to a multiple data collection method (Eisenhardt, 1989) in order to enhance the validity and reliability of the data provided by the informants.

As primary sources, the first contact point was the CEO, who allowed us to access two sets of information: i) the detailed description of the initial BM(s) and ii) the detailed description of the new BM(s) configuration. Semi-open questions were used for direct interviews. Semi-open questions allowed gathering all the necessary data, at the same time leaving interviewed people the opportunity to enrich the context description and to enlarge the set of variables investigated. The interviews lasted about one hour and a half each.

As secondary internal sources, we analyzed the firms' website. Other secondary sources were provided by the interviewee and used to triangulate information gathered during the interview (e.g. slides presented at International Congresses and Conferences, company presentations).

3.5 Data elaboration

The interviews were recorded and transcribed my means of a software tool (Dragon Professional v.15). All the information gathered by means of interviews and secondary sources were elaborated with data categorization, using the categories/variables suggested by the literature on BMI. For each variable, information collected by the different sources was compared. For each investigated variable, the triangulation of data was guaranteed: data from the direct interviews were integrated with the secondary sources in order to ensure construct validity and to limit post hoc rationalization.

3.6 Data analysis

Data collected and categorized were used according to the reference models on BMI in order to answer the research questions. Specifically, we analysed possible paths of BMI through AI by looking at the component(s) BMI starts from and how changes spread to other components by means of tables and schemes to facilitate the emergence of evidences from the cases.

4 Results

In the following we first analyse each case separately, and secondly, through the cross-case analysis.

4.2 Within-case findings

Firm A's Case study shows that the epicentre of the BMI process is the Infrastructure: Firm A is indeed striving to increase its knowledge and competences to take full advantage of AI and hence to be acknowledged by ESA (which is showing an ever increasing interest towards AI for the elaboration of Copernicus data) as capable to design electronic systems endowed with AI algorithms which can work on board of satellites. The final aim is that of offering ESA a Value Proposition consisting in the possibility of using AI for selecting images directly on board, getting rid of those images that, while being of low quality, are useless. This, on its turn, will allow resources optimisation, which indeed is one of the main concerns for space missions.

For strengthening its own human resources on AI algorithms, Firm A is implementing two strategies: on the one hand, training qualified personnel to be in the next future at the forefront of AI space applications, and, on the other hand, tapping into the knowledge of Key Partners such as ESA Labs and universities, by means of part-time contracts, collaborative contracts, and contracts by projects with academics. In addition, the path between Firm A Infrastructure (Key Resources and Key Partners) and the Value Proposition is not direct: providing ESA with the above Value Proposition, entails Firm A to build strong Customer Relationship with ESA, by growing in credibility at ESA's eyes and being recognised by ESA among the first companies to be qualified for such a use of AI. This is being achieved by participating to i) a pilot project funded by ESA, intended to provide an in-orbit demonstration of AI algorithms on a CubeSat, and ii) workshops/conferences organised by ESA on the topic. If being a credible partner at the customer's eyes is a key factor in general, in the space industry this is essential: in a niche market as the space one is, being credible and reliable on edge technologies creates loyalty from customers which is much more important than in other sectors. In the words of the CEO "Customer loyalty in the space sector is essential". The Financial Viability of the new BM will be impacted too. In fact, the new Value Proposition offered to ESA

requires investments for training human resources (also supported by means of EU projects) but will grant Firm A a new Revenue Stream deriving from consultancy activities addressed to both ESA and national agencies, as well as participation as expert contractor in open calls etc.

Figure 1 depicts the BMI path.

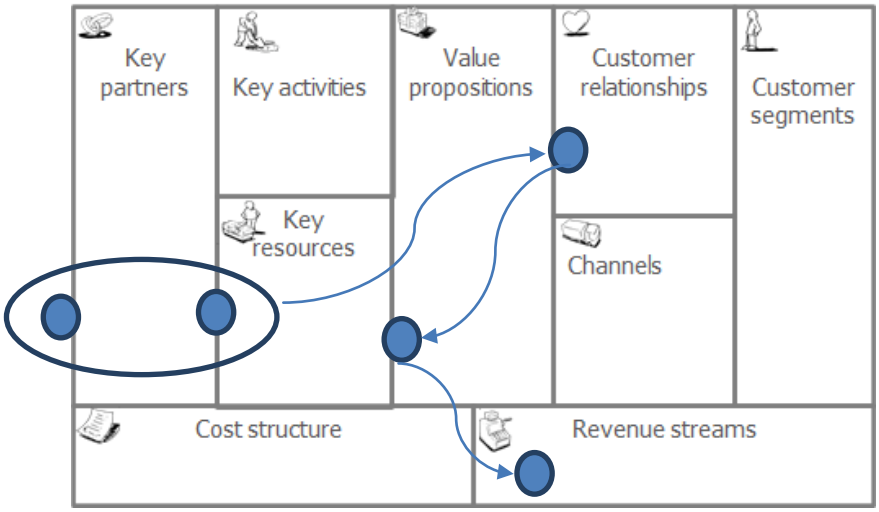

Figure 1: BMI path in Firm A

Firm B has recently innovated its business model in order to offer its Customer Segments (firms in the transportation/oil&gas industries), previously addressed with geo-information, a new Value Proposition in terms of ready-to-use knowledge (geo-analytics) obtained through joining together many diverse data sources (e.g. social media, satellite imagery, mobile phone telemetry, and weather sensors) into a single, unified model able to expose the relationships between apparently unrelated data elements. In other words, the new Value Proposition consists of offering geo-analytics, i.e. info-as-a-service software that, while being scalable in both time and space, is able to provide Customers with the very knowledge they need. This new Value Proposition entails catering to two customers' needs: not only customers can access relevant knowledge to perform their business as a continuous service, but also they can change their cost structure, from CAPEX (capital expenditure) to OPEX (Operating expense), i.e. from an investment in a desktop software to an operating cost connected with software subscription. Such shift determined, from Firm B point of view, a change in its Revenue Stream - from sales revenues to revenues from subscriptions – which, in turn, required an innovation in the Customer Relationship for enforcing customer retention and hence sustaining annual cash flows connected with subscriptions. Firm B underpins the Customer Relationship by continuously improving the offered products and applying the pre-commercial

procurement approach that entails the engagement of the customer in the design of new and innovative applications. The viability of Firm B Value Proposition builds on a bundle of enabling Key Resources in terms of data and technologies, Key Activities in terms of managerial approaches to design, and Key Partners. This bundle allows keeping Firm B Cost Structure affordable; in the words of the CEO: "*info-as-a-service to be sustainable must be scalable, must have from 90 to 70% of gross operating margin, small influence of direct costs on the application*". Despite its BM is not classifiable as purely cost-driven, for Firm B, which is an SMEs, succeeding in creating and maintaining the leanest possible Cost Structure is crucial. Key Resources, Key Activities and Key Partners are of paramount importance for overcoming cost issues connected with the liability of smallness. Key Resources are represented by the huge volume of EO data unleashed for free by ESA on a daily basis through the Copernicus Programme, according to free open data policy. Key Resources are also the enabling technologies supporting the Value Proposition at affordable costs such as: the cloud computing and the consequent possibility of distributing scalable software-based services to customers via a single server, the HPC (High Performance Computing), and the AI. More in particular, Info-as-a-Service, as one of the main applications of cloud computing, is used by Firm B to distribute software-based services to customers via a single server, owned by external partners. Specifically, concentrating the provision of software on a centralised server saves time and money, and eases the problems of scalability (capacity of the software system of scaling up or down application resources to only consume for the resources that are really required at some point in time) that instead occur when software is distributed via physical media. The words of the CEO underpin this point: "*If you consider a large part of traditional services, it has this scalability problem; so you cannot increase production without increasing costs, and since we are essentially talking about value-added activities, they are personnel costs – besides, it is not personnel who you find on the street corner, because you have to train these people. Our answer to this problem is to try to have the ability to make applications and services as scalable as possible with a large automation contribution within the processes*". When introducing the concept of automation, the CEO explains the prominent role of AI, on which Firm B has been working for four years. Specifically, in order to keep costs affordable, it is essential to employ AI for automating the interpretation of satellites images, avoiding to "*enrol the services of a multitude of image interpreters.* […]. *The same need arises if you start doing things on board, for example starting with the constellations of thousands of satellites and thinking that this can be done by a human operator like coordinating their acquisitions or using the resources on board in a smart way. In addition, there is a bottleneck in all missions which is the data transmission channel, you can improve it by using laser communications and systems of this type but in essence there is a great way of transforming things by transmitting to the ground not all the acquired data but only the information you need and therefore having activities on board and therefore these activities must be automated. That is, we cannot send a photo interpreter on space to*

work on things". Examples of managerial approaches aimed at developing the new Value Proposition (Key Activities) at affordable costs are dev-ops methodologies, adopted in the development of the software applications for facilitating communication and fostering flexibility in the context of evolving requirements. Key Partners are ESA which has offered for free the data from the Copernicus Program and the supplier of the servers enabling cloud computing.

Figure 2 depicts Firm B BMI path.

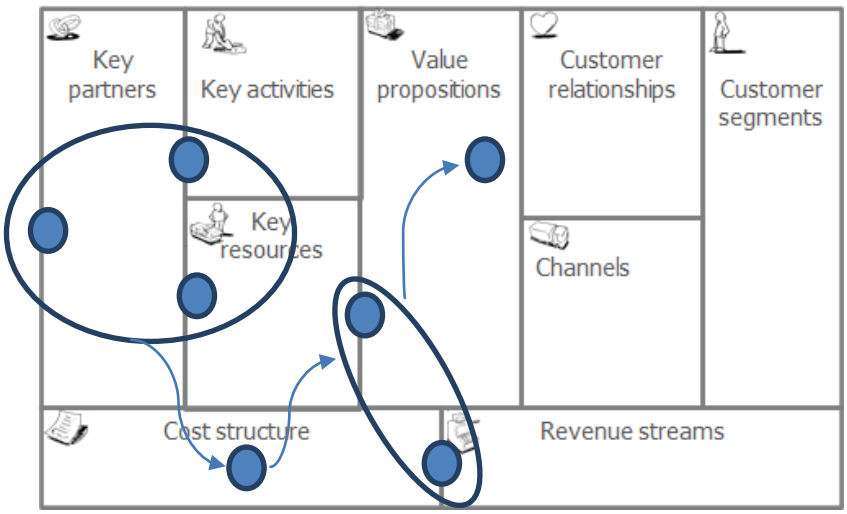

Figure 2: BMI path in Firm B

Firm C case study shows that the Copernicus Programme and the AI have dramatically affected its BM. Specifically, the availability of good quality, consistent and globally available data and, at the same time, the development of the capability of extracting meaningful information thanks to machine learning AI show that the epicenter of the BMI process is on the Infrastructure and in particular on the Key Resources. Firm C has in fact created a new organizational unit, called 'machine learning R&D team' in order to introduce AI machine learning in the company. This allowed enlarging the Value Proposition to products based on machine learning: an example is Sentinel 2 (S2) Cloudless, a cloud detection algorithm for satellite data. These products are addressed to new Customer Segments especially in the agricultural sector where clouds create most of the problems. In addition, Firm C is now working on the development of completely new products that, while mapping natural phenomenon such as floods, earthquakes, and hurricanes, are addressed to a range of Customers Segments: from agriculture to real-estate, from water resources monitoring to insurance industries. In order to improve customer retention, Firm C had to innovate the Customer Relationship, supporting the

customers, helping them, answering their questions, solving their problems in a timely manner.

Figure 3 depicts Firm C BMI path.

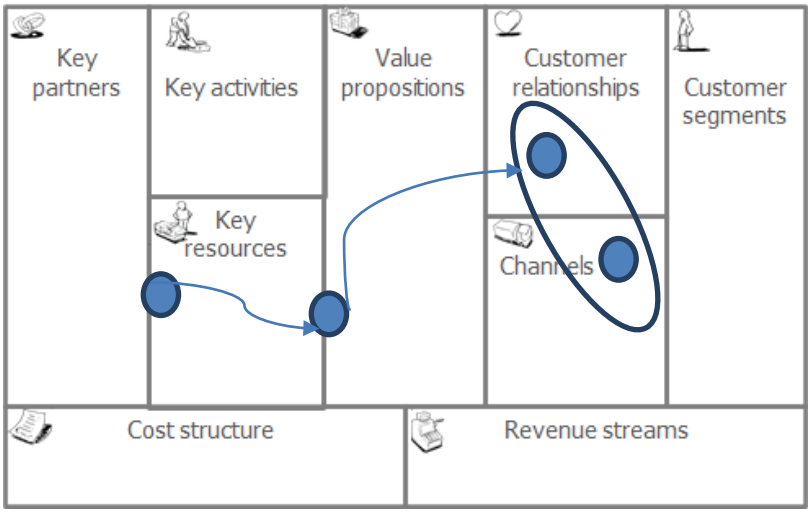

Figure 3: BMI path in Firm B

4.3 Cross-case findings

Following Eisenhardt (1989), we conducted the cross-case analysis selecting categories or dimensions, and then looking for within-group similarities coupled with intergroup differences.

Preliminary evidence suggests that BM changes have found the innovation trigger in 4.0 technologies such as AI, cloud computing, becoming largely available at affordable costs. Specifically, AI is a trigger that in case A acted singularly, while in cases B and C in combination with other 4.0 technologies.

As an addition, the innovation wave seems to affect all the components BM with dynamic patterns that share some common aspects, but also present differences.

As regards the common aspects, it is interesting to note that in all the cases, and prominently in firm A, AI is interpreted not only as a technology enabling new Value Propositions, but a value in itself to be offered to customers, which indeed in the Space Industry are attributing increasing importance to AI. In addition, the paths followed by the three companies show that technology (and particularly AI) is the trigger of the BMI process. Specifically, firms aiming at taking full advantage of AI need to acquire this technology as a Key Resource. Hence, Key Resources and assets play as the epicentre of the BMI process, with Key Partners (although different: universities and ESA's Labs for firm A, and technology providers for firm B) having a supporting role.

As for the differences, the epicentre of the BMI evolved into different paths. Concerning Firm A, the path evolved towards Customer Relationship that enabled the possibility to offer ESA a Valuable Proposition. Such new Proposition in its turn seems to affect also the Revenue Streams, the Customer Channels and Relationship.

While for firm B a new Cost Structure for the company can emerge thus making alternative Value Proposition possible. Finally, for firm C the BMI path evolved towards a new Value Proposition to be offered to new customer segments, thus impacting the revenue streams.

5 Discussion and conclusions

This paper aims at adding to the nascent and growing debate in the extant literature which investigates if and how digital technologies, and particularly AI, impact the processes of creating, delivering and capturing value (Parida et al., 2019; Warner and Wäger, 2019). Specifically, we aimed at investigating if AI triggers similar paths in the BMI process. Open scientific issues are: i) whether AI initially modifies a specific component/area of the BM, to be considered as epicentre of BMI, or if any of the BM components/areas can be the epicentre of innovation, and ii) whether the innovation process spreads from the epicentre to other BM components/area and if this happens according to a common path.

As regards i), our preliminary results confirm the recommendations provided by Lee et al. (2019) and Reim et al. (2020): to take full advantage of AI, firms are firstly required to prepare the ground, developing internal AI competences (Key Resources and Key Activities), as well as an adequate culture that is also open to collaborations with external Key Partners. This means that the Infrastructural area seems to ignite the BMI.

We add to the literature a couple of results that concern ii). As a first result, case studies seem to indicate that the innovation process, initially stemming from the infrastructural BM area, spreads in other parts of the BM, involving all/most of the components of the BM. This means that AI-driven BMI is not modular, but rather is architectural (Foss and Saebi, 2017) in that it regards the general structure and the interactions between the components. As a second result, it emerges that the path stemming from the Infrastructure is dissimilar in the case studies. This seems to be due to the different objectives the firms have: if AI is to be interpreted for instance as a technology enabling the reduction of costs (Firm B), or a mean to strengthen the Customer Relationship with important Customer Segments (Firm A) who attribute AI a pivotal role.

This evidence suggests that innovation drivers and perhaps also other contextual factors to be identified might have a role in the innovation diffusion within the BM.

This research is not exempt from limitations that also point out directions for future improvements. The most important are related to its explorative nature and the initial stage of the work. Drawing on few case studies, results might be affected by the specific application context. This is a common issue that limits the generalization of results.

Further evidence going more in depth into the investigated cases and extending the research to new ones, should be collected.

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Business Models in Digital Age: a Proposal of Framework for the Cultural Heritage Sector

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Abstract

The present research aims at providing an overview on the new approaches adopted in the definition of a business model, paying particular attention to the role of new technologies. In detail, we investigate the business models configuration in the cultural sector starting from the model provided by Osterwalder and colleagues (2005) and proposing a new framework defined on the basis of the most significant evidences emerged from the scientific publication and the practical experiences.
As it concerns the contribution, the research outlines how the business models are being transformed by new technologies and provide a framework within which to understand how digital business models can be built onto concepts and practices of cultural heritage service.

Keywords – Business models, digitalization, digital tools, cultural heritage

Paper type: Academic Research Paper

1 Introduction

In recent years, considerable research has been conducted into "business model" in the age of digital transformation (Berman, 2012) As the technology evolves, both researchers and policymakers are forced in dealing with rapid changes in daily operations, as well as in the development and restructuring of business models (Giones and Brem, 2017; Langley et al., 2020). The digital business transformation involves new processes of integrating the growing body of digital technologies and the resulting customer, product, and operational data (insights) into an organization with results of increasing the value creation capabilities (Normann, 2001). Businesses are undertaking their own digital transformations, rethinking what customers value most and creating operating models that take advantage of what's newly possible for competitive differentiation. Additionally, these new ways of framing business models is permeating several industries, especially service-based ones, since digital transformation affects value perception (Adrodegari and Saccani, 2017), therefore digital instruments may increase the value promise addressed from businesses to their customers (Algar, 2007, Hamari et al., 2016; Fadda et al., 2019).

However, when it comes to business models in cultural heritage, the academic literature and applied empirical research is less developed, if not scarce and this paucity is stressed by scholars (e.g., Li, 2018) calling for further research. Indeed, few contributions dealt with the changing business models in cultural industries, since due to the novelty of the ongoing digital transformation, some authors focused on how the governance of cultural-based firms should take care of the impacts on business models (e.g., Baraldi and Ferri, 2019), while others stressed the suitability of the traditional business models in a context with new entities emerging and changing the design and provision of cultural services. (Adie, 2017).

Due to the aforementioned debate, this paper aims at addressing the calls for research and at shedding some light on the novelties affecting business models in cultural heritage in digital age.

This paper contributes to literature by framing a digital business model in the cultural heritage. The model is depicted through a set of assumptions about how a cultural-based organization, by relying on new technologies create value in a new way, deliver it to a customer – namely a visitor – and other stakeholders, and how value is framed in terms of economic, social and cultural outcomes. Consequently, the remainder of this paper is structured as follows: First the theoretical session presents literature on business models and recent contributions on digital business models; then, the methodology section introduces our research process, the section on findings presents the framework and details and empirically illustrates the key elements of the framework, while the last section presents the main conclusion and discusses the further research.

2 Literature review

2.1 The evolution of the business model

In the last two decades considerable research has been conducted into "business model"; the attention paid by scholars led to the provision of multiple definitions, determining significant challenges for understanding its essential components.

In general, literature contributions focus on economic aspects depicting the business model as a tool to describe the rationale of how an organization creates, delivers, and captures value (Amit and Zott, 2001; Osterwalder and Pigneur, 2010; Mandrella et al., 2020). According to other perspectives, the business model is the representation of a firm's strategy; in line with this, a terminological confusion is detected as *''business model, strategy, business concept, revenue model and economic model are often used interchangeably"* (Sharma et al., 2012) as Shafer et al. (2005) outlines, stating that *"business model is a representation of a firm's underlying core logic and strategic choices for creating and capturing value within a value network"* (2005: 204). The business model has also been referred to *"as architecture, design, pattern, plan, method, assumption and statement*'' (Morris et al. 2005: 726) that make the strategic choices explicit, through an ecosystem approach (Foa, 2019).

More general approaches (Johnson et al. 2008; Frank et al., 2019; Zhao et al., 2020) stress the relevance of shaping a business model to keep a competitive position on the market, as it is considered especially useful when new opportunities and threats indicate a need for reinvention. In this regard, Dudin et al. state that "*the management concept business model canvas is designed for managing the strategic sustainable and competitive development of the enterprise structures in the context of the turbulent and unpredictable changes in the market environment*" (2015: 887);

However, most of scholars describe the business model as a set of interrelated activities that transcends the boundaries of the firm into its wider environment (Zott and Amit, 2017), highlighting its multi-sided nature (Rumble & Mangematin, 2015; Parmentier and Gandia, 2017; Zhao et al.,2019). To express the new multi-sided approach, some scholars talk about the "crowd actor" (Bigham et al., 2015; Raj and Kar, 2015) tracing a path from customer to community to crowd, an evolution mainly due to the new technologies interventions and the new methods to favour participation (Yoo et al., 2019; Siquiera et al., 2020). Bigham et al. (2015) describe the crowd as *"a dynamic group of individuals* (that) *collectively form a single actor that responds to real-time performance tasks, e.g., controlling an on-screen character, driving a robot, or operating an existing desktop interface"* (p. 101).

As it concerns the application of the model, Osterwalder et al. (2005) provide a framework known as business model canvas (BMC) for practitioners, and in their more recent value proposition canvas, Osterwalder and colleagues (Osterwalder and Pigneur,

2014) take a feature-based approach, suggesting the importance of infrastructure, offering, customers, finances, and resources.

The canvas outlines the value exchange between the company and the actors, as well as its network of partners for creating, marketing, and delivering this value to generate profitable and sustainable revenue streams (Osterwalder et al., 2005; Osterwalder and Pigneur, 2014). As suggested by Dudin and colleagues (2015), to achieve an efficient and effective performance, an entity should set its own customer priorities, in particular, allocate a pool of the key customers, as the most important customers, namely those allowing the generation of the basic enterprise income, and a common pool of customers, the ones that generate the residual enterprise revenue. The costs and revenues streams are fundamental in the structure of the business model canvas, as, when shaping the canvas, the authors aimed at stressing the fact that *"the cost streams generate the product value for the enterprise entity itself, in turn, the revenue streams determine the product value for the consumer"* (Dudin et al., 2015: 893).

The BMC consists of nine building blocks to be perceived as an ontological framework for define relationships between the components of the company; in the right-hand side the canvas emphasizes the role of actors grouping the 'customer' in three blocks (customer relationships, customer segments and the channels) that result in a revenue stream for the company; in the left-hand side the elements that are necessary to actually create the product (or service) are grouped (partners; activities to be undertaken and resources to make a product or create a service).

2.2 Digital business model in cultural heritage

More recently, a new perspective has been adopted, as scholars started to talk about "digital business model" in line with the increasing embeddedness of digital technologies in products and services highlighted by scholars (Bharadwaj et al. 2013; Markovich et al., 2019). One of the first contributions stressing the way new technologies can favour the emerging of new business models was proposed by Demestichas et al. (2013), who framed new technology-based business models, more focused on the management of relationships as a way to create and share value (Gati et al., 2019).

Technologies as IoT are changing companies daily activities (Hussain, 2017; Belli et al., 2019) and the effects are self-evident in several industries; one of the most all-embedding approaches is the service-bases business model (Kindstrom, 2010), since customers and firms are expected to cooperate towards the achievement of value creation and IoT is something to elaborate on in order to lever on all the assets available (Trabucchi et al., 2018; Casais et al., 2020); data are one of these assets and they can favour a better service provision. For example, business models based on Artificial Intelligence (Corea 2017) take the focus of the mutual influence between these two elements, as business models are changed because of Artificial Intelligence, as well as Artificial Intelligence is affected by business models. This mutual impact depends on the

differences emerging along time, since, actors' behavior is even more affected by Artificial Intelligence and new technologies in general (Bostrom 2016).

According to the reshaping of the global market through new technologies, and how the digitalization process affected also the cultural sector, it has to be noted that new technologies have also favoured and allowed the configuration of new kinds of services starting from the target segmentation process (). Scholars show that digitization of cultural heritage is growing up together with the improvement of the quality of digital tools, creating new and more personalized kinds of services and experiences (Lanzaretti & Sartori, 2016; Rantala et al., 2019; Fissi et al., 2020). Anyway, companies in this kind of industry are still far from reaching a standard in business models (Schiuma & Lerro, 2017; Zhao et al., 2020), as a purely economic logic cannot be applied in cultural heritage industry (Klamer et al., 2013; Towse & Hernández, 2020). Nevertheless, many cultural organizations are currently reframing both their language and behavior, tracing paths towards new business models.

3 Methodology

To address the aim of this paper we adopted an abductive research approach (Dubois and Gadde 2002) as it seemed most suitable, given the nature of the research objective. Unlike inductive and deductive reasoning, abductive research can explain, develop or change the theoretical framework before, during or after the research process. Accordingly, abductive reasoning consists of a pragmatic approach to advancing the social sciences through a process of "systematic combining" in academic research as depicted in Dubois and Gadde's approach. Thus, we moved back and forth between inductive and open-ended research settings to more hypothetical and deductive theories attempt.

The main components of the proposed conceptual framework were defined by an iterative process that enriched theoretical arguments via a context-specific empirical analysis (Flyvbjerg 2006).

To collect data we considered some of the most innovative evidences in cultural heritage domain reacting to the new digital era. Google search and institutional web site (i.e. NEMo) were used to scrutinize among cases; the selection of the seven cases considered included those that have implemented – or are about to implement – innovative way to transform their service settings, both in situ and online. The data collection took place by combining different sources on museums, namely information from the official websites, messages posted by the organization on social media, as well as the content of specialized magazines and reports issued by supranational institutions dealing with arts; this combination of data is in line with the methodological suggestions by Smith et al. (2006). Indeed, this process favoured an understanding of the phenomenon from different angles, namely based on what curators, IT firms, end-users, as well as local institutions state about the new cultural services offerings. All in all, empirical evidence supported the analysis of the recent literature depicting the ongoing changes in business

models. In conclusion, theoretical and practical evidences let us to interpret business model canvas pillars through a wider perspective and in a view based on digital technologies as elements of disruption with the past, leading towards the proposal of a conceptual framework.

4 Findings

The key findings of this research observed from a new angle the elements of business models as observed in the canvas (Osterwalder and Pigneur, 2010) and theorized by several scholars (e.g., Zott and Amit, 2010). Indeed, collaboration can now be seen as integration, in line with how partners are parts of digital ecosystems instead of being just related one another. Consequently, resources are not just owned but the notions of density and liquidity (Normann, 2001) make them available in the entire ecosystem, thus content better represents what digital transformation can offer to the actors integrating their efforts in digital business models. This content is offered through multiple interactions taking place in various context, thus there is not a single channel that can frame the whole process, but an omnichannel approach is needed; therefore, an omnichannel strategy is properly representing firms' approach in a digital ecosystem domain.

Due to the change above the value proposition too changes, since it depends on additional elements shaping the entire set of activities actors perform, shaping an experience for customers with multiple consequences. These consequences are framed in different ways, since the wide context is affected by the new interactions, thus the outcomes are social, apart from economic and cultural.

The evolution of market dynamics changed the role of all the actors that is now more active and pivotal; new forms of interaction have been developed, moving from collaboration, or cooperation, to integration of sources of knowledge and resources in line with Osterwalder's key partners definition (Osterwalder & Pigneur, 2010). More complex ecosystems are emerging, and the need for partnerships is further amplified and made possible thanks to new technologies and consumers' behavior leading to a demand for highly customized experiences (Kastelan, et a., 2017; Rantala et al, 2019). Innovation is indeed a key issue in the integration of resources to shape more valuable services; for example, processes based on resources/capabilities and new technology are often the result of the involvement of research institutes as universities or scientific institutions, with the aim to develop new businesses through technology and knowledge transfer.

However, has to be underlined that capabilities/resources integration produces positive results only if the consequences are beneficial for all participants leading to continuous value creation and delivering (Fuchs et al., 2000; Mandrella et al., 2020).

In this regard, an example is the Europeana Network Association (ENA), an association grouping experts and practitioners involved in the field of digital cultural heritage. Europeana provide cultural heritage institutions with value by sharing and promoting the collections of museums taking part of the initiatives providing people of all the world with an extensive experience that they can personalize As stated in the official

website *"Europeana supports all cultural heritage institutions to create good quality digital assets in standardized formats, allowing them to share, explore, interrogate and use their collections in ways that fulfil their institutions' own 21st century missions", and adopting strategies* in line with EU policies operating in areas such as inclusiveness, online accessibility, reuse of public information, promotion of EU research, in order to develop cultural sector and create more emphasized experiences.

In a technology-driven perspective resources are still crucial, but what is being exchanged among parties through digital technologies is content. Content is a resource itself and also the result of resources and knowledge combination; indeed, Yoo et al., (2019) referred to user innovation as a key feature of new business models and users' participation as the activity leading to user-generated content. The advantage of favouring new content generation stands on creativity and on the emerging of a unique mix in the combination of efforts performed by multiple actors, as claimed by Trabucchi et al. (2018); indeed, new sources of information are relevant, particularly in traditional businesses to move from the well-established activities to new ones. Additionally, Casais et al. (2020) stressed some more the role of a multitude of actors contributing to the creation of new content with a focus on sharing economy, as it is already evident in the changed business models in tourism industry. Therefore, not only resources are changing, but activities too, since the combination of knowledge and resources and the content generation are the new ways towards digital business models.

An example featuring the considerations above is offered by one of the most famous museums in Europe, namely the Tate Gallery in London (United Kingdom). Tate proposed a digital strategy in 2013 to get the most from the digital transformation; the interactive comment walls are one of the key changes brought to Tate Museum, since customers are allowed to contribute to the museum activities through social media. Additionally, the digital activity and skills developed at Tate favour the creation and nurturing of an arts community, namely a huge community consisting of online actors to offer new and enriched content to visitors. In this way, a virtuous cycle is activated, since new visit experience will lead to further chances to reshape the content and create new one with effects on the upcoming service experience.

In a digital-oriented vision, the service context has become more competitive and customers are more demanding, since elements as memorability, emotions, and feelings are now at the centre of marketing activities. As a consequence, customers look for something new compared to traditional value promises and firms aim at offering experience, due to the cognitive and emotional involvement of consumers, with wider effects in terms of value creation and future purchases. For instance, Foà (2019) opted for ecosystem as the most suitable way to describe service contexts; the perspective on ecosystems is more appropriate since it involves also the activities and outcomes before the visit and after the visit itself. This shift is supported by digital technologies as proposed by Ruhl and Zurdo (2020), with customers at the centres of all activities a firm performs, not only the ones strictly related to service provision. In the same vein, Fissi et

al. (2020) stated that the experience offered to a customer is a crucial element in the business models, since it drives value and all its related dynamics, in terms of benefits for the firm, satisfaction for the consumer, and the improvement of the image as a competitive lever to challenge the increasing competitiveness of market.

The British Music Experience offered a concrete example of such an approach. A great variety of content and music is offered to offer the best from the global scene in last sixty years. Some attractions are physical resources offered by singers and bands, while others have been created on purpose to recreate an era or to track back the history on one of the world-famous artists. The British Music Experience is offered in Liverpool and includes galleries, zones for interactive services, audio and visual experiences and even holograms. The experience may be further enriched with the participation – both on-site and offline – to educational workshops and guided tours, as well as film screenings and private events.

Customer experiences are even more participation-based, with special reference to the involvement of various categories of actors, including other customers. However, to provide satisfying services, customer segmentation is still remaining the starting point in shaping and implementing marketing strategies. Thanks to new technologies companies are now able to study the target more in-depth, to identify in the best and most efficient way possible customers preferences and expectations.

Furthermore, through the digital tools and the so-called multi-sided platforms, customers' engagement is amplified as companies are now able to satisfy several categories of consumers leading to the concept of community. Customers are now able, thanks to new technology and digital tools, to occupy their own "persona segment", adopting the most suitable technology (An et al., 2018), participating also to the target segmentation process.

Obviously, the involvement of a larger number of actors requires the adoption of techniques to make them interact and contribute to service shaping and value creation through online and offline activities.

A fitting example is represented by the #FutureMuseum Project an "experience-Driven and People-Centered" initiative aiming at promoting the idea that *"the future museum will assume the role of an intermediary between local communities, the state and the international community",* namely based on the concept that cultural organizations are even more community oriented, as also stated by La Plata Museum of Buenos Aires' managers talking about democratising museums. Indeed, *"through their capacity to network museums will be in a position to translate the grim realities of their communities into international platforms",* bridging the between the local context and the international context particularly on cultural and social issues.

Taking care of customers is a not-to-be-missed task for a firm, even more when competitive arenas become more complex due to the presence of several actors; technologies represent both the cause and the solution to the problem of interacting with customers in more competitive markets. Indeed, technology has opened the doors to new players on the market, but it offers also new solutions to describe what firms can do to

take a proper care of their customers. Consequently, the literature on business models offer some recent advances addressing this vision.

New media favour additional opportunities to take care of customers and manage relationships with them; in this vein, Gati et al. (2019), while recognizing the advantages in taking care of customers in an almost ubiquitous way with no time and space constraints, stressed the negative effect of an excess of communication, since customers may be soon tired of too much of communication.

The online interaction may turn in something hard to be managed for firms too; indeed, a recent study (The Art Newspaper, 2020) calculated the number of total followers of the Museum of Modern Art in New York and an astonishing number emerged: 12.4 million followers, namely almost the same as the inhabitants of Los Angeles or Moscow. The relevance of this number is confirmed even by the number of followers of the second-ranked museum in this special standing, namely Metropolitan Museum of Art – again in New York – with 9.8 million followers. The online communication activities of the Museum of Modern Art are several, since everyday there are pictures of artworks, inspirational messages, contests stimulating visitors attention, as well as the interpretation of arts in line with society events and news, as it was recently with the pandemic and the anti-racism manifestations.

The above mentioned development of new communication channels as well as the chance to experience cultural heritage in multiple contexts led to the emerging of the so-called omnichannel strategy; indeed, authors focused on this topic even with reference to business models, as Siquiera et al. (2020) described as hard to be separated the on-site and online markets since they are mutually influent; additionally, they state one of the markets may increase the popularity of a firm, while the other may perform more operational tasks. Anyhow, they agree with previous studies describing the markets as featured by an increasing complexity and with demanding consumers, since the availability of information makes consumers more aware of what they can get from an offering and increases the chances they have to compare offerings in the decision-making process previous to an offer.

An example of omnichannel service offerings is given by a museum in the United Kingdom, namely “The Hastings Contemporary”, situated in East Sussex. This museum is mainly centered on modern and contemporary art created by local artists; the gallery is known in the United Kingdom for the focus on paintings and on Modern British art. The gallery was awarded a prize in two contests. The board of administration of the museum decided to borrow a robot from a laboratory and unleash it into the empty rooms of the museum during the pandemic. The robots moved among the artworks and filmed the inner of each room, broadcasting a visit to people at home through an online channel. The success of this idea, named as “robotours”, has been so wide that the museum had to limit the number of online visitors in order to ensure quality in streaming the content; sessions were limited to half an hour and took place frequently during the day to offer the same chance to a wide number of visitors.

In summary, the role of companies in society is greatly changed in the last decades due to the new technologies and the new and pivotal role acquired by actors – especially customers and partners (Osterwalder et al., 2005). New technologies and the multi-actor (or multi-sided) approach amplify the impact of companies' businesses as no more only economic but also social and cultural; for example, scholars as Algar, 2007, Hamari et al. (2016) and Fadda et al. (2019) outlines the new goals of cultural organizations, namely creating, sharing and delivering value both for the society and the company itself.

The evolution of the role of customers from single actors to crowd actors, as previously mentioned, turned customers into co-designers of service, going beyond economic goals and taking into account the social and cultural role of companies and of all the actors interacting with it.

For example, the Western Australian Museum, together with Morris Hargreaves McIntyre, developed a community engagement tool called the 'Spectrum', useful "*to analyze, plan and evaluate how people engage with the Museum and its programs. This is seen as vital to the ongoing development of the Museum, especially in the context of the development of the New Museum in Perth and its impact on the whole of Western Australia".*

The significant number of initiatives and programs co-created and co-curated with community partners is also determining changes in the ordinary activities of the museum, with special reference to the introduction of new Aboriginal trainee programs for the members of the staff.

The WAM approach influence the business model in terms of making the value proposition realistic and relevant to a range different actors and categories of customers, also because the organization "*has reprioritised its expenditure to make more investment into community and education work, regional engagement and into its work with Aboriginal and Torres Strait Islander people".*

Building on insights and categories from the existing literature and based on empirical evidences led as to propose a new framework that captures the challenges of new business models within the contemporary landscape of cultural heritage digital transformation. In the following figure, the 9 blocks identified by Osterwalder have been adapted to the cultural context on the basis of the theoretical and practical evidences.

source: authors' elaboration

Fig. 1 – Osterwalder and colleagues' business model in the cultural heritage;

5 Conclusion

This research effort of the present work is devoted to captures the challenges of new digital transformation within the contemporary landscape of cultural heritage business. The research interest is twofold: (1) to understand conceptually how the business models are being transformed by new challenging of digital transformation (2) to provide a framework within which to understand how digital business models can be built onto concepts and practices of cultural heritage service. Building on insights and categories from the existing literature and exploiting them empirically, the paper identifies some issues that are integral to the proposal of new framework addresses the opportunity for cultural heritage to furthering research discussion and practical implications on digital business models.

The proposed framework aims to add to the efforts of scholars in developing new ideas, concepts and tools that more deeply explicate the complex and multifaceted nature, structure and processes of business models in a digital era.

First our research contributes to studies on business models, by advancing the understanding of the ongoing changes due to the implementation of digital tools (Giones and Brem, 2017) and offer a detailed analysis of how each of the element of a business model ay change when digital transformation affects the choice of a firm and the ecosystem it is part of. Additionally, this research contributes to research in cultural heritage, as called for by Li (2018), by combining empirical evidence with theorizing, leading to understand how digital business models are changing in cultural services. Consequently, this contribution may support the activities performed by curators and museum managers in challenging digital transformation as a way to further enhance their offering.

Further research may involve practitioners in order to better understand which are the issues affecting the implementation of digitalization in these firms, and how they are concretely reacting to the main features of a digital-driven context.

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The Video Assistant Referees (VAR) for Decision Supporting in Soccer Match

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Abstract

Decision Supports Systems (DSS) are computer-based systems which are characterized as interactive systems, used to help decision makers to utilize data and models to solve problems and support activities linked to their decision making process by enhancing it (Ali, et.al, 2017). Until now most of DSS are developed and implemented for business sector depending on the company/organization perspectives, still there are few done within the area of sport. With those premises, the objective of this paper is to assess the current state of art implementation of new technologies - in the specific the Video Assistant Referees (VAR) - and the impact that it has in supporting the referees in their decision making process during soccer matches. In this paper, we propose a review of literature, starting with the online database through specific keywords in order to assume the current state of analysis.

Keywords – V.A.R., Decision Support Making, Referee, Football Match, ICT; Literature review.

Paper type – Academic research paper

1 Introduction

In today's digital age the technological advances have further pushed the need for knowledge management to the forefront, and XXI century organisations are facing and exploiting the data "explosion", by navigating into an ocean of information coming from different sources, sites and stakeholders (Gavrilova et al., 2017).

Indeed, the proliferation of data and the development of advanced technologies are transforming the way organisations manage, integrate and deploy their competences, take strategic decisions, operate their businesses models, drive value creation mechanisms to meet diversified stakeholders' wants and needs.

Nowadays, people are getting more and more involved in adopting new technologies, which provides them with new ways to communicate, investigate and support decisions. Information and Communication Technology (ICT) has gone through innovations and every aspect in every day's life of people around the world has changed as a coincidence to the changes of society.

The required harmonization of information and communication technologies (ICTs) with operational decision-making demands new alignment software techniques. The subject of using modern technologies as a support to decisions becomes an interesting topic for a large number of researchers in organization studies. Decision Supports Systems (DSS) are computer-based systems which are characterized as interactive systems, used to help decision makers to utilize data and models to solve problems and support activities linked to their decision making process by enhancing it (Ali, et.al, 2017). Until now most of DSS are developed and implemented for business sector depending on the company/organization perspectives, still there are few done within the area of sport.

With those premises, the objective of this paper is to assess the current state of art implementation of new technologies - in the specific the Video Assistant Referees (VAR) - and the impact that it has in supporting the referees in their decision making process during soccer matches. The VAR team is located in a centralised video operation room.

The VAR team can access to all relevant broadcast cameras and two dedicated offside cameras. The VAR does not take any decisions, but it supports the referee in the decision-making process and the final decision can only be taken by the referee.

In this paper, we propose a review of literature, starting with the online database through specific keywords in order to assume the current state of analysis.

The contribution of the document will be to develop a greater awareness of the contribution of the VAR in supporting sport decisions.

2 Methodology

The International federation of football took the approval on the use of video in order to provide support to football refereeing. The federation a claimed this technology as an effective aid in decision making. The Use of Video Technologies in Refereeing Football

and Other Sports analyses the capacity of audio-visual technology from different perspectives to help understand the best implementation of the Video Assistant Referee (VAR) system in football. This paper addresses the opportunity of the implementation procedures regarding how to use it, considering that it could lead to important changes. For this reason, a review of literature was conducted in April 2020 by the author. The systematic review was completed in accordance with the Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) guidelines (PRISMA, 2009). However, this protocol was modified by incorporating the article screening process as each article was identified, rather than as a single solitary stage later on in its process. The search strategy used a series of specific keywords. A primary keyword (I.C.T. n° 1). was used in direct combination with a second (Decision Support Making n°2) and third keyword (V.A.R. n°3), and Keyword n° 4 Sport. In the paper considered the system football.

Four inclusion criteria were established to exist as a specification for relevance once any sources were identified. The four criteria were:

1. The years considered must be a through 2009 and 2020.
2. Must be peer reviewed based literature.
3. English language.
4. Open access.

Four relevant bibliographic databases were used for this purpose. These included the Scopus, Sport discus, Science Direct, and Medline bibliographic databases. Furthermore, as per the PRISMA protocol, additional records were identified through other sources. These sources included the use of article reference lists identified through the primary search stage and use of Google Scholar. Once the duplicates had been removed, the remaining publications were then filtered using the inclusion criteria.

Table n°1:

Number of articles from first search	8.725
Number of articles removed due to article duplication/application of eligibility criteria	7.592
Number of eligible articles from first search	1.133
Number of eligible after the reading the abstract	362
Number of eligible after the reading the full paper	36
Number of articles identified by other means	2
Total number of eligible articles	38

Subsequently, 38 publications met these conditions and were included in this review.

3 ICT and Decision Making

Managers are saddled with the responsibility of leading their organizations to achieve objectives and stated goals. This does not only require versatility and prowess, but more adequate knowledge management with excellent decision-making. Knowledge management is a meticulous approach toward the optimization of a organization's knowledge economy. It involves several elements like human resources practices,

technology, culture and organizational structures (Du Plessis, 2007). Several knowledge management models propose that knowledge management framework should include knowledge management enablers and processes. Knowledge management framework should have a basic understanding of knowledge operations and infrastructures to support the organizational operations. In Lee and Choi's (2003) opinion, knowledge management enablers are mechanisms employed by organizations to foster consistent knowledge usage. The Information Technology plays a central role in eliminating the communication barriers in organizations. Enabling collaborative learning, knowledge seeking, and communication are the important role of information technology (Ngoc, 2005). According to Davenport and Prusak (1998), information technology is a crucial enabling factor and has a dynamic role in knowledge management. Gold and Arvind Malhotra (2001) opined that there must be comprehensive investment in technological infrastructures to aid various systematic activities within the organization and that to increase the success of knowledge management projects and applications, investing in information technology is unavoidable.

The implementation of technology has a significant impact (Haake, 2009; Balmer et al. 2011; Dyer 2015; Foster et al. 2012; Stefani 2012) on the performance, this require adequate knowledge management with excellent decision-making.

Scott and Bruce (1995) defined decision-making style as the habitual, learned response pattern an individual exhibit when tackled with a problem or situation.

The central nature of the decision-making process in economic-business studies has been highlighted by broad and influential doctrines. The decision can be defined as an answer to a situation characterised by three elements: the possibility of assessing more than one course of action (alternative); the presence of expectations that results connected with each course of action can truly create; the presence of consequences associated with possible results that can be assessed according to the personal values and objectives of the decision maker (Hastie & Dawes, 2001). Decisions are the result of a complex decision making process, including several subsequent yet logically-connected phases: 1 identification of the problem to be solved or specification of the objectives to be achieved 2 collection of information regarding the external and internal environment in order to establish and define the problem or clearly highlight the objective 3 development of alternative courses of action 4 identification and assessment of consequences associated with alternatives according to the assessment system of the person making the decisions 5 choice of the very best alternative. This process has not been included in a univocal interpretation within a doctrine, but it has generated heated debate that has resulted in the creation of two different schools. Behling, Gifford and Tolliver (1980) associated decision-making style with cognitive style, because it is believed that those who gather information intuitively are more likely to be “feeling as information evaluators” while those who gather information systematically are more likely to be “thinking as information evaluators”. A classification scheme for decision-making style proposed by Harren (1979) includes two opposing

categories in regard to information gathering and evaluation: intuitive and rational. Intuitive Decision-Making Style is also referred as "holistic thinking, immediate insight, seeing the answer without knowing how it was reached" (Thorne, 1990).

Decision-makers might sense patterns, feelings and objects in seemingly unconnected facts. Intuition is often perceived by people as a sudden awareness of information (Ritter & Dijskterhuis, 2014, Sauter, 1999). Intuition also provides the decision-makers with relationships and facts without understanding why such relationship or facts existed. Thus, resulting to higher individual and organizational performance (Zander et.al., 2016). Sauter (1999), Hodgetts et al. (2017), have been hypothesized the role of intuition in decision-making as a two-step process: (1) explicit decision – made by the use of emotions; (2) implicit decision – made by referencing previous decisions (Bierman, Destrebecqz, & Cleeremans, 2005). Patton (2003) identified three sources of intuition used by decision makers: (1) general experience – the learning that occurs during the normal process of accumulating and aging of experience (2) innate response – the instinct that brings subconscious but appropriate reactions to situations. It is usually inborn not learned; and (3) focused learning – the learning that originates from deliberate efforts to cultivate habits and attain intuitive responses. A study by Açıkgöz, et.al (2014) found that intuition enhance project success and corporate performance. Different is the rational Decision-Making Style – causes decision makers be obliged to consider a number of alternative scenarios and probabilities for each alternative before making decision (Busari & Spicer, 2015, Oliveira, 2007). According to Dean and Sharfman (1993), rationality is "the extent to which the decision-making process involves the collection of information relevant to the decision, and the reliance upon analysis of this information in making the choice." Rational procedures help decision makers establish relevant decision criteria, identify a comprehensive set of alternatives, and evaluate the individual alternatives objectively (Kaufmann, et.al., 2012). In contrast to intuitive decision-making style, rational decision-making style encompass cautious and methodical thoughtfulness of all conceivable decision choices (Baird, 1989). Scrutinizing the available options by means of rational decision-making style necessitates the decision maker to deliberately appraise options and their relevant probable consequences. Through this approaches, the managers, seen as expert decision makers, are not immune to systematic errors that can generate a poor level of accuracy in assessments, instability in predictions (Smith & Kida, 1991) and a lack of logic in estimates (Frederick and Libby, 1986), connected, among other things, by an indiscriminate use of intuition to the detriment of careful and rational thought (Isenberg, 1988). On the other hand, managerial doctrine has for years highlighted that the myth of the thoughtful and systematic programmer-manager is destined to crumble due to a reality that sees high level managers characterised by short-term, varied and discontinuous activities, with a decisive inclination towards action and poor inclination to thought (Mintzberg, 1991).

4 Decision support making and Sport

Some authors focus on how to implement decision making in the sports world, in this regard, Tur-Porcar, et al. (2020) have as main objective to create a hierarchy of emotional and motivational factors that sports organizations can use to increase commitment athletes. The analysis in this study was performed using the Analytical Hierarchy Process (AHP). This structured decision-making process has made it possible to demonstrate that motivation and the regulation of emotions are the most important criteria for generating this commitment within sports organizations. In addition, the work of Defruyt, et al. (2020) was set up as a perspective to study, investigate athletes' perceptions before they begin a double career (DC) in Higher Education (HE). An optimal dual career balance (DC) - defined as a "combination of sports and studies that help student-athletes achieve their educational and athletic goals, live satisfying private lives and maintain their health. A qualitative methodology was used, with the two relevant theoretical models that guide data collection (i.e. semi-structured interviews) and data analysis (i.e. thematic analyzes). The results showed that many different considerations related to different levels of development (e.g. athletic, psychological, psychosocial, academic / professional, financial), can influence the decision-making process of athletes to start a DC in HE.

Finally, Collins, and Collins (2019) examine the coping strategies used by sports professionals to manage their cognitive loads of decision-making. A mixed approach based on a quantitative questionnaire and a structured qualitative interview was employed. The study found that coaches' knowledge and behavior focus on their ability to set goals. First, it's about self-regulation, driven by the goal. Coaches have clearly established goals that focus and prioritize their actions and therefore their cognitive load. Male coaches focused their goals on the outcome, while female coaches focused their goals on the process. According to the authors, an intermediate position seems optimal. The experience of the coaches grows and the ability to move between the process and achieving results also becomes optimal.

Secondly, there are the authors who focus their studies on how to adopt decision support tools, including technological ones, within the various sports organizations.

In this context, we recall Calder, and Durbach, (2015) who developed a decision support tool, called stochastic multicriteria acceptability analysis (SMAA), to assist the evaluation of rugby performance. The method considers the player's performance on a number of attributes and resolves uncertainty in both performance evaluation and preferences for some aspects of the game over others. This system addresses the uncertainty that exists both in evaluating player performance and in preferences for some aspects of the game over others. It emerged from the study that the SMAA model cannot replace the decision-making process itself but aims to support the process by helping coaches better understand the players available to them and the preferences that favor each player.

Furthermore, Nasiri, et al. (2019) present an integrated approach that combines multi-criteria decision analysis and mathematical programming to support the decision maker

through the selection process of a football team's players. First, the analytical network process is applied to assess the meaning of the different performance criteria for each position in the field. An integer programming model was designed to assess the transfer status of players. Finally, data envelope analysis is used to identify the most efficient solution that determines the status of each player.

Instead, Marquez's research, et al. (2020) provides information on consumer behavior regarding the use of technology that can assist the decision-making process of sports managers. Through a survey on paper and pencil of American high school football spectators (N = 523) on 12 games, the study examined the perceived ease of use, the perceived usefulness, the trust of the digital ticket, the willingness to pay convenience the fees and their effects on the intention of the spectators to use the digital ticket. The results show that confidence in the issue of digital tickets, the willingness to pay a convenience fee and the perceived ease of use have influenced the perceived usefulness of the technology. The willingness to pay taxes also had a direct effect on the intention.

Also, Petrović's study, et al. (2015) aims to review the type of decision support offered by emerging information and communication technologies (ICT) in sport. The research used an exploratory approach to data collection due to the fact that the topic is new, and that the data is difficult to collect. The topic is analyzed using the case study method. Research has found that an emerging market exists to extend the reach of digital technologies adapted for the sports industry and sporting events. Increasingly, developers are exploring and exploiting the vast potential of ICT to create value in the field of sporting events. The development of emerging technologies creates new opportunities that the sports industry requires a growing range of innovative solutions for decision making to be tested and accepted in the near future.

Thirdly, other authors focus on the supports in the decision-making process of the referees in soccer or rugby.

In this regard, the main focus of the work of Samuel, et al. (2019) was to test the usefulness of a new decision simulator designed for qualified soccer referees. The challenge was to create a simulator that, on the one hand, simulated the referee's task (i.e. numerous sequential episodes of decision-making under physical effort) and, on the other hand, verified the convenience of the simulator (i.e., it can be easily applied by referees on a regular basis). Expert soccer referees (N = 22, age = 27) were tested on a new simulator decision making during the active part of the season. They ran on a treadmill for 60 minutes at different rates while watching two video sections describing real matches, in context and in mixed order, and calling out their match decisions aloud. Decision accuracy levels were higher for simple decisions, such as offside than for careless fouls or yellow / red cards. The results support the use of simulator as a potentially innovative method for referee training in sequential decision making.

In contrast, Dawson, et al. (2019) analyze the impact of technology support and the subsequent role extended by the referee of the TV match in the decision-making process and on the assignment of sanctionable offenses for players in games played in the group

stages of the European Rugby Cup (ERC) and European Rugby Champions Cup (ERCC) in 15 seasons from 2000/01 to 2015/16. The main finding and contribution of the research is that the introduction of the official of the television match influenced the impact of the sanctions issued for both teams. However, the increase in the number of yellow cards awarded to away teams implies that home injury has increased since the official's introduction to the TV game. This suggests that the referees may have consciously or unconsciously tried to avoid contributing to internal bias before the introduction of an additional official who is remote from the effects of the crowd. Recognizing that this adjustment is based on circumstances is important information for the training of officials; in particular because an official of a TV match may not be present in all the matches he will referee.

Instead, Harding, at al., (2016) focus on the concept of attitudes (e.g. referees, athletes and coaches) towards a proposal for technological innovation that calculates the transmission time and rotation of each athlete. In-depth cross-sectional qualitative data were used to explore the assessments of the components of the assessment protocol. Email correspondence and an online survey platform were used to collect data. The participants assessed the freedom, individuality and progression of the performances approved by the current subjective evaluation protocol. The attitudes of the participants towards the proposed innovation varied based on whether it was used to calculate the final scores of the athletes or to assist the referees in the decision-making process.

Another interesting topic in this area is that studied by Van Quaquebeke, and Giessner, (2010). The authors aim to investigate whether the cognitive association of height and dominance of people and, specifically, of players influenced sports judgments by football referees. In particular, the authors hypothesized a distortion of attribution in the "foul" calls, since respectively taller people are more likely to be perceived as perpetrators and their smaller opponents respectively as victims of foul. This is the phenomenon known as "attribution bias", understood as an asymmetric cognitive association that systematically influences bad decisions about players. As a demonstrator, this association was acquired data on professional football arbitrage (i.e. all fouls recorded in the last seven years of the German Bundesliga, in the last seven years of the Champions League of the Union of European Football Federations (UEFA) and in the last three cups of the FIFA world). The investigation shows that the referees are not processors of objective and perfect information, but human and therefore also subject to cognitive associations learned socially and evolutionarily trained that sometimes influence their decision-making process.

Finally, Schnyder, et al. (2017) aim to reconstruct subjective theories on the decision-making process of football referees in offside situations. 16 Swiss male referees were interviewed using a combination of semi-structured interviews. Contrary to the hypothesis, the results identify the need for further research, in particular as regards the determination of the moment of the decisive passage and the psychological basis for judging offside situations.

5 First result: The V.A.R. in the football match

In recent years, there has been an increasing use of technology in a number of areas of sport to support the referee's decision making; this also happens in football. A football match lasts 90 minutes and is equally divided into 2 45-minute periods separated by a 15-minute half-time recovery in which both competing teams change sides. At the end of each half, the referee can allow extra time to recover any time lost during the play. The referee represents the maximum authority in the field, and his main objective is to guarantee that the Laws of the Game are respected (Mallo et al, 2008). In making decisions the referee is supported by VAR technology (Sabag et al, 2020). VAR is a kind of technology that helps the referee through assistant referees, who watches the live streaming of the game. VAR watches the match in the video operation room (VOR) assisted by an assistant VAR (AVAR) and replay operator (RO).

VAR follows the progress of the action on a series of screens. When he realizes that the referee on the pitch has made a wrong decision, he communicates it via radio so that he can correct it. VAR can intervene, only in 4 categories defined as game-changing situations (Mather et al, 2020; Kapil, 2018); they are:

1. Establish the regularity of a goal
2. Awarding of a penalty kick
3. Expulsions that require the direct extraction of the red card
4. Identity error (exchange of the player to be warned or expelled with another)

Analysing the literature concerning the VAR, it has been noted that the experiments conducted on video technologies have led to several advantages for the decision-making process of the referees:

- videos from different angles allow you to capture the physical and tactical information of different players (Meng et al, 2020);
- the use of instant replay allows the referees to make more accurate decisions (Salomon et al, 2011). V.A.R. have access to the replays of the videos in real time and in slow motion. The impact of the speed of the video on the decision-making process of the referees showed that the slow-motion footage increases the accuracy for the referee's technical decisions (no foul, indirect free kick, direct free kick or penalty kick), in particular for corner situations. However, the impact of video speed depends on the type of decision and the type of situation that need to be assessed (Spitz, 2017; Spitz et al, 2018).

According Pina et al (2018), V.A.R would allow certain refereeing decisions made on the field (goal, penalty, red cards and incorrect identity in assigning a card) to be examined by an individual located in a video operating room where the referee can analyze multiple angles of the camera provide input on those decisions.

In their study, Carlos et al (2019) showed how the introduction of the VAR system influenced the play in soccer. They used a generalized linear model and a pairwise z-tests

to compare seasons before and after the implementation of the VAR. They found that there was a significant decrease in the number of offsides, fouls and yellow cards after the implementation of the VAR and there was an increase in number of minutes added to the playing time in the first half and the full game. VAR plays an important role in enhancing the quality of the refereeing. These findings may help coaches, players and managers to better understand the effects of the VAR system on professional soccer and to identify strategies to improve refereeing during matches.

Undoubtedly, video technology allows the referees to assist in their decision-making process, on decisions such as establishing whether a goal has been scored or which player has actually committed a foul. Video technology can provide more objective information and be valuable for decision making. It was introduced precisely to assist the referee's decision-making process and avoid wrong decisions. The hope is that they can reduce or eliminate the errors that can occur during the game. The main criticism of real-time video-replay devices like VAR is the possible disruption to the flow and pace of the game due to the stopping and starting, which might be especially disruptive in matches played in cool weather (Dyer,2015;Svantesson,2014). Several studies have shown that referees 'decisions can be influenced by several factors such as crowd noise, social pressure, match status or the strength of the teams (Boyko, Boyko, & Boyko,2007; Dohmen,2008; Garicano, Palacios-Huerta, & Prendergast,2005;Riedl, Strauss, Heuer, & Rubner,2015; Sutter & Kocher,2004; Unkelbach & Memmert,2010).

6 Conclusion

A professional referee must have excellent decision-making ability, excellent making ability to problem solving, he must be an excellent broker and have excellent skills communicative with both own colleagues who with players on the field. He Needs to have good anxiety and stress management skills trying to above all, keep his confidence, self-esteem and high charisma after a possible mistake; he must not be too conditioned by external situations to himself as criticism, protests, insults or screams. It is therefore important not be conditioned by the surrounding environment but seek however to increase its capacity of internal "locus of control". The role of the referee is certainly not simple, his decisions are always under the eyes of everyone, from the fans, to the players, to the coaches and just for this subject to many criticisms. The VAR system wants facilitate the work of the referee and ensure that his decisions are consistent with what is seen objectively on the pitch and not conditioned by external situations. In addition to this, it allows the referees to be more confident and allows you to put them in the best conditions to make the most decisions corrected during the game (Ugondo et al, 2019; Nerboldi E., 2018).

But in many ways trying to use VAR to make the game fairer has led to difficulties. Using technology one problem is that the interpretation of the rules of the game has highlighted the fact that these rules are often too subjective. There are also limitations: even with a video replay, it is not always clear whether a player has stumbled or dived.

Therefore, while VAR has improved the accuracy of many decisions, on the other hand the technology has also highlighted the difficulties of being a neutral referee of a football game, apparently increasing people's expectations without always satisfying them. Additionally, decision making can be time consuming and cumbersome. This is almost bearable in a stop-start game like cricket, but not in a sport that should be in an almost constant flow like football.

By analysing the reference literature, an attempt was made to verify how the scholars of the case have addressed the contribution that the Video assistant referee technology (known as VAR) can make to supporting sports decisions in football match. The soccer referees are required to keep up with play at all times to ensure optimal positioning in making key decisions, and VAR intended to correct egregious mistakes, has taken close calls to a place beyond the abilities of humans to perceive them, a matter of centimetres measured by a computer. Despite the potential benefits of VAR, the implementation of this technology faces with barriers and restrictions, technical limitations, standardization limits, attitudinal constraints-behaviour of individuals, and organizational constraints.

The second step will be the interviews at the professionals by the understanding the role of the VAR in the decision making. Trying to understand if the VAR is a decision support tool or a tool to be endured because it is envisaged at governance level.

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How Smartphone Apps can Provide Value to the Cultural Tourist

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Abstract

Cultural tourism constitutes an interesting business opportunity for many companies. Recent advances in mobile-based technologies open new ways in offering value to cultural tourists, driving some tech companies to enter the cultural tourism market at full steam. These companies offer the opportunity to exploit benefits new technologies, providing users with a set of services that are more responsive to their new expectations and information needs, supporting them along all the tourism experience lifecycle. Although there are countless mobile apps aimed to assist tourists with their everyday practices, little research has been devoted to investigate the impact of these technologies on the management cultural tourism services. This research constitutes a first attempt to fill this gap. We reviewed a set of 80 mobile apps providing services for cultural tourists, in order to design a bi-dimensional framework to position the offering of app based cultural tourism services.

Keywords – cultural tourism, app-based services, value proposition, tourism experience lifecycle,

Paper type – Academic Research Paper

1 Introduction

Cultural tourism is widely recognized as a major element of international tourism consumption. Cultural tourism is characterized by a set of emerging niches (such as gastronomic tourism, arts tourism, heritage tourism, film tourism and creative tourism) giving a significant boost to the growth of this industry (Richards, 2018).

Information and Communication Technology (ICT) has been the backbone for innovating many processes in cultural tourism industry, both on demand and supply side.

From a tourist perspective, ICT based solutions are able to help the decision-making process along the tourism experience lifecycle, can support the performing of travel related activities, and enrich the cultural experience of the travel. The chance to taste in advance a trip (thanks to virtual reality, videos, photos, opinions and storytelling of other users), the opportunity to compare offers through fare aggregators and meta search engines, the immediate delivery of a set of tourism services (e.g., reservation or booking) and the possibility to enjoy availability of contextualized services (location-based services, context-aware mobile tourism guides, augmented reality) are among the features that make technologies and cultural tourism an absolutely winning combination (Ammirato, Felicetti, & Della Gala, 2015). Digital technologies can support the cultural tourist with plenty of functionalities also to respond to specific and contingent constraints, like epidemic risk (i.e. Covid-19), thus becoming a strategic asset for global tourism relaunch.

Recent advances in the convergence of ICTs (e.g. "internet of things) led to the development of new services for tourists. By leveraging on context-awareness, ubiquity, pervasiveness, and mobility features, mobile-based services are suitable for an effective and efficient service provision, providing value to the tourist.

Tourists contribute to the creation of a massive flow of data generated by sensors, devices and cameras distributed on cultural tourism destinations. All these data represent promising basis for enhancing the tourism firms' capability to personalize their offering of products and services (Ardito, Cerchione, Del Vecchio, & Raguseo, 2019).

In this sense, the increasing role of technologies in *prosumption* of cultural services paved the way towards new ways in offering value to tourists, enabling new business models and driving some tech companies to enter the cultural tourism services market at full steam. These companies offer the opportunity to exploit benefits new technologies, providing consumers to manage cultural tourism services that are more responsive to new tourists' expectations and needs. In particular, these emerging trends make possible to conceive new business models where stakeholders of cultural tourism industries interact to create value for tourists.

In fact, from a business oriented perspective, web and app-based solutions enrich the value proposition of cultural tourism companies, acting not only as a support for traditional businesses in tourism sector but also as core business enabler for marketplaces and other tech companies interested in providing tourism information based services (Schneider et al., 2019).

If, on the one side, cultural tourism can be boosted by digital technologies, on the other side, there are countless mobile-based services aimed to assist tourists along the tourism experience lifecycle. Little research has been devoted to investigate the characterization of such services business models and their value proposition to consumers of cultural tourism services. Our work tries to fill this gap by proposing a framework to characterize, classify and assess, the extant offer of mobile app for cultural tourism. Namely we provide an answer to the question: how current smartphone apps can support the cultural tourist? That is, what functions do smartphone app provide to the cultural tourist to best perform a travel?

Based on a review of smartphone apps, this paper intercepts and evaluates the functionalities available to a hypothetic cultural tourist, and highlights where the next major developments lie. This framework can be used as marketing tool to position the offering of the above-mentioned services in the cultural tourism market.

2 Theoretical Background

2.1 Cultural tourism

Cultural tourism is becoming a major source of business and employment in today's economy. Internet and the digital technologies have radically changed the approaches and processes to managing and experiencing a cultural travel.

Cultural tourism is nowadays recognized as one of the most important forms of tourist traffic in the world (Niemczyk, 2013).

Cultural tourism can be viewed in a narrow and traditional definition, or according to a wider and modern one. According to this latter, cultural tourism entails the consumption of a cultural past and historical product, but also those contemporary, like cultural way of life of the people and/or region (Richards, 2001).

Cultural tourism can be defined as a form of travel, characterized by the voluntary departure from one's place of residence, during one's time off work, for a continuous period of not more than 12 months without any break (Niemczyk, 2013), for at least 24 hours (Ercole, 2008), with the intention to gather new information and experiences to satisfy their cultural needs (Richards, 1999).

Cultural tourism involves the participant being aware of the place where he or she is visiting, in which culture becomes the core element of the tourist product, and is key driver of planning of the journey (Niemczyk 2013). Cultural tourism is not just visiting and knowing, but also and overall becoming "*acquainted with new places, their*

communities, cultures, their interest in art, architecture and history, participation in cultural and artistic events, a "return to one's routes", and contact with the sacrum; during which a tourist experiences the reception and cultural wealth of a given location" (Niemczyk 2013) (p. 24). Cultural tourism is not just about visiting sites and monuments, which has tended to be the 'traditional' view of cultural tourism, but it also involves consuming the way of life of the areas visited. Both of these activities involve the collection of new knowledge and experiences.

Actually, the narrow and wider perspective on cultural tourism, appears to reflect not just the traditional and modern view, but also the distinction between the so-called "high" culture and "popular" culture (Williams, 1983). "High" culture refers to artistic expressions such as literature, poetry, painting, sculpture, music, while "popular" culture is understood in a sociological and anthropological sense, with its intangible component (values, norms, models of behavior) and material (customs, traditions, lifestyles) of a people or a social group (Ercole 2008).

All-in-all cultural tourism covers not just the consumption of the cultural products of the past, but also of contemporary culture or the 'way of life' of a people or region (Richards 1999).

Managing a cultural travel to maximize the traveler's satisfaction, from its inception to the ex-post consumption, is not as easy. This basically requires to integrate knowledge, information, travel products, pertaining to two dimensions: the travel (transportations, accommodations, subsistence) and the cultural experience (monuments, exhibits, gastronomy, etc.).

(Ammirato et al., 2019) effectively modelled a travel as a complex integration (travel package) of travel products. An effective integration of travel-logistic products and touristic experiences provide the traveler a satisfying (cultural) travel. In fact, a good integration of transportation and accommodation result into an efficient travelling, while a good integration of touristic offers (i.e. cultural goods) results into a coherent experience. A successful cultural travel can be seen as a fitting integration of travel-logistic products ('horizontal integration'), and of cultural touristic ('vertical integration') (Ammirato et al., 2019).

Cultural tourism products can be identified in: a) cultural heritage tourism, b) museum tourism, c) industrial tourism, d) cultural events tourism, e) historical-military tourism, f) religious-pilgrimage tourism and g) culinary tourism (Niemczyk 2013).

As much as the traveler is a 'digital enabled' traveler, the success of cultural tourism and of cultural touristic products depends strategically by the capacity of the digital technology to integrate complex travel information, in any place and time, to the needs of the traveler. Thus, smartphone apps rise as strategic for the success of a cultural travel, and in general for cultural tourism. It can be seen as a cluster of usability, creating a set of goods and services and thus facilitating travel taken for cultural purposes (Ammirato et al. 2019; Niemczyk 2013).

2.2 The Cultural tourist.

Bearing in mind the importance of culture in the decision to visit a destination and the experience sought, (McKercher and Du Cros, 2002) distinguishes five types of cultural tourists according to the 'experience sought (shallow or deep), and the importance of culture in the decision to visit a destination (low or high): purposeful, serendipitous, sightseeing, casual, incidental.

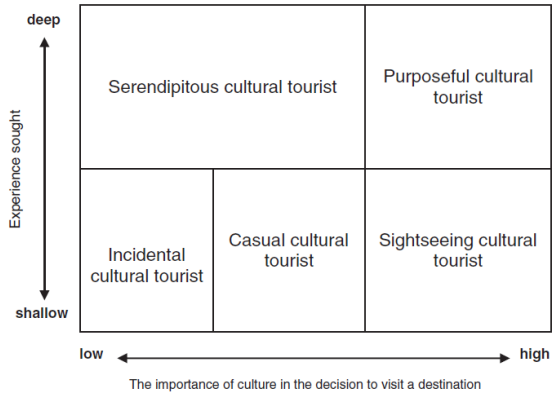

Fig. 1 – The five typologies of cultural tourist according to (McKercher and Du Cros, 2002)

A widespread approach in the definition of tourist experience consists in the adaptation to the tourism sector of some generic models to describe consumer behavior in the purchase of products or services. In Ammirato et al. (2015), a model characterized by the following phases is proposed:

- *Dreaming*: the process begins with the emergence of a need, a desire to travel. In this phase, tourists look for inspiration for their vacation. While in the past, most of the ideas came from photos, stories and memories of friends' past experiences, or brochures of travel agencies (TAs), or tour operators (TOs), today the internet greatly simplifies this step. The dream of holiday is fed by an overabundance of photos, videos, or maps on the web, allowing users to gain virtual previews of the holiday, explore places, identify the location, refer to opinions and recommendations published by travellers who already had an experience and then prospected tourists begin to 'dream' their vacation.
- *Planning and booking*: once the tourist identifies the potential destination and the type of holiday he intends to do, he proceeds with the detailed planning of the trip. After establishing the details of the whole holiday, all that remains before travel is to make reservations of transportation, accommodation and any additional services (car rental, excursions, events, etc.) that will complete the tourism package. Until a few years ago, planning and booking activities were generally carried out by TAs and TOs, who had to book transportation,

accommodations, and activities or to create complete packages for the customer whose only concern was to pay the broker. Nowadays the availability of web services based on comparison, recommendation systems, and booking services, leads consumers to make self-service reservations with increasing frequency, allowing them to enjoy lower costs related to the absence of intermediaries, to book at any time from everywhere.

- *Experiencing*: this phase is mainly related with the in-place tourism activities: the tourist overnight stays in hotels, make excursions, enjoy meals, visit local attractions etc.. The main difference with the past at this stage is the availability of contextualised information and additional services (maps, location-based services, context-aware mobile tourism guides, augmented reality etc.) offered to the 2.0 tourist through mobile devices as well as the opportunity to share location-based multimedia contents. Based on location, user profile (preferences), time, and pre-stored trip information, a user get recommendations about points of interest, plan personalised tours, get informed on open nearby restaurant according to his time, be advised where to eat on the basis of his food preferences, get public transport information, etc. (Karanasios et al., 2011)
- *Recollecting*: After experiencing the holiday, the tourist comes back home and remembers the experience through photo albums, souvenirs and storytelling. At this phase of the tourism 2.0 lifecycle, the main ICT tools are those based on sharing services, as in the dreaming phase. The meaning of using specialised portals to share photos, videos, stories and opinions on visited places is to collect some snapshot of the vacation in order to recall its memory and to give tips and advices on the experienced Tourism Destination.

Fig. 2 The tourism experience lifecycle

As much as the traveller is a 'digital enabled' traveller, the success of cultural tourism and of cultural touristic products depends strategically by the capacity of the digital technology to integrate complex travel information, in any place and time, to the needs of the traveller. Thus, smartphone apps rise as strategic for the success of a cultural travel, and in general for cultural tourism. It can be seen as a cluster of usability, creating a set of goods and services and thus facilitating travel taken for cultural purposes (Ammirato et al. 2019; Niemczyk 2013)

2.3 Cultural tourism and smartphone apps

In order to best meet this challenging requirements of the cultural travel management, cultural tourist adopt and self-support with Information and/or Digital technologies, namely web-based services (Akoumianakis et al., 2011; Ammirato et al., 2019; Runfola et al., 2013) and smartphone apps (Dickinson et al., 2014; Gupta et al., 2018).

Based on its advanced computing capabilities and ubiquity, the smartphone has rapidly been adopted as a tourism travel tool. With a growing number of users and a wide variety of applications emerging, the smartphone is fundamentally altering our current use and understanding of the transport network and tourism travel (Dickinson et al. 2014).

A wide variety of smartphone apps are available to the contemporary traveller able to provide a wide spectrum of services like transport planning (Uber, Skyscanner), travel planning (TripIT, Tripadvisor), accommodation planning (Booking.com, Expedia), tour guide (DETOUR, NY Travel guides) and directional services (Google maps) (Gupta, Dogra, and George 2018).

The value proposition of tourist and in particular of the cultural tourist, becomes crucial for positioning a touristic strategy and make competitive a destination or a travel product, by developing smartphone travel apps around their value proposition (Samy, 2012) or simply marketing a travel product, or a destination, through the most value-added and used apps.

Smartphones are defined by (Verkasalo et al., 2010) (p. 243) as "*devices that can be used both as a mobile telephone and as a handheld computer*". Thus, what separate smartphones from mobile phones are the features of a computer, such as the applications (apps) (Andersson and Frost, 2013). Smartphone apps can be defined as small programs that run on a mobile device and perform tasks ranging from banking to gaming and web browsing (Taylor et al., 2011) which make smartphones possible to use for as many purposes as possible, even included plan, manage, and archive cultural travels and related experiences.

With regard to value for cultural traveller, the utility gained from an app is a crucial concept. Then, before considering what the user perceives of an app, one should consider the utility an app provides.

(Dickinson et al. 2014) analysed the App functions in the tourism travel domain. They identified 5 basic functions, and several uses: information (information only or

information plus search function), two-way sharing (two way implicit and/or explicit sharing, that is users specifically provide information back to the app.

This may build on social networking capabilities to share information with selected friends, a social network of users embedded in the app, the wider Internet community (eg blogs) or the app provider), context awareness (services based on the smartphone's contextual sensors; the most prominent of these are current temporal and spatial location), internet of things (ability to communicate with everyday objects such as vehicles and parcels), tagging (ability to leave messages on places and objects for future visitors) (Dickinson et al. 2014).

2.4 The role of smartphone apps in the cultural tourist lifecycle

Over recent years, the rise of mobile app-based service allowed to consumers the opportunity to access to in-time, in-place and in-context information services.

The term mobile app-based service refers to services that can be accessed by means of mobile devices (e.g. tablet, smartphone, PDA,). Today's smartphones and tablets have acquired richer functionalities (embedded sensors enabling augmented and situated information, internet connection and easy portability), developing a huge potential to provide personalized, in-time and in-place information services. Mobile applications (or apps) are downloadable programs designed to run on mobile operating system (e.g. iOS, Android O.S.). They require installation on a device and run locally on it. An app-based service interacts with a consumer and his/her surrounding environment thanks to some user's mobile device resources, such as built-in device sensors and local databases, or may be connected to external sensor systems (Volpentesta, 2015), they can access also remote databases and API to extend their functionalities and dynamically update their content.

Based on the above-mentioned issues and theoretical concepts, we are interested in understanding what services do smartphone apps provide to the cultural tourist along the whole phases of a cultural travel. In other words, our research question is: what functions do smartphone apps address to a cultural tourist to improve cultural travel performance (both from cultural and logistic-operational point of view)?

App-based services offer to cultural tourists the opportunity to access complete and detailed information when and where they make their tourism related choices, but their information provisioning has limited chances of success as it is not affected by changes in tourist's situation (unless the consumer is explicitly involved in service demand and configuration).

Some characteristics of mobile app-based services have a major impact on the characterization of mobile-based information offerings, since they play an important role in providing tailored, high-quality and contextualized information and, thus, in satisfying cultural tourism information needs. Extending the concept of "fitness for use", related to information value and information quality (Eppler et al., 2004; Borek et al., 2014), we

consider the value of an app-based service as the overall utility that the user receives when using the information service. In the case of app-based services for cultural tourism, the user is a tourist who requires some information necessary for his/her decision-making or learning process, as he/she is involved in cultural tourism activities in some situations.

Value proposition is defined as the implicit promise a company makes to its customers to deliver a particular combination of values (Sweeney and Soutar, 2001). Several authors (Walters and Lancaster, 1999) agree that business value proposition of an information service leverage on three main components: content (i.e. the product or service to be purchased), context (i.e. the environment in which content is offered) and infrastructure (i.e. the way content is delivered). From the supply side perspective, the value proposition refers to the ability to facilitate a better tourism experience for users and it reflects service performances influencing the consumer's judgement about the utility the user receives when using the service. From a user perspective, the service value is the ultimate trade-off between benefits and costs a tourist perceives as the result of his/her interaction with the app-based service. Benefit/cost assessment varies from a consumer to another as it is affected by consumer's attributes (knowledge, cultural related values, experiences, attitudes). In what follows, we present a set of components affecting tourist perceived value:

Utility benefits. They refer to the overall utility of the information that a user acquires when interacting with an app-based service. Here, we refer to this utility as a measure of the impact on tourism-related decision-making. Two entities play a crucial role in determining utility benefits:

a) *Content*: a set of information 'cues' that are exchanged between the consumer and the service. The main value factor is the **content relevance** that establishes how much impact the "what" is exchanged has on a decision process. Content relevance sub factors are topicality, accuracy, depth, scope, clarity, organization, and format of the information exchanged (Nocella et al., 2014).
b) *External Context:* a set of characteristics of the situation (place, time, activity, social relations, etc.) in which the user interacts with the service. The main value factor is **situation relevance** that establishes how much impact the "how", "when", and "where" of the interaction has on a decision process (Volpentesta et al., 2017). It may be defined as the extent to which information content is required to be specified to practical matters of the current situation.

Sociocultural benefits. They concern with the satisfaction of consumer's sociocultural needs through the user participation in a community. Participation at the community brings a wealth of cultural knowledge (including beliefs or practices), social norms, literacy:

a) *Sociability*. It affects satisfaction of user's needs of personal connectedness and relationships with other tourists and cultural tourism stakeholders;
b) *Trustworthiness* of information sources. It affects user's assessment of the reliability of the information content provided by the service.

Costs. They refer to consumer's physical and cognitive efforts of users while interacting with an app-based service. These efforts may be of two types:

- *Personal burden*. It refers to the amount of efforts a user has to put into interacting with a service to get information for personal use;
- *Collaborative burden*. It is the overload of efforts due to the participation to a collaborative process.

3 Research Methodology

Methodology used in this study consists of the following phases:

Phase 1: ***Identifying the domain.*** We selected IOS App Store and Google Play as mobile apps databases where to perform our search, since they are the two leading mobile app stores, in terms of numbers of apps and downloads (Chergui et al., 2016).

We initialized a list L of search keywords with English and Italian terms related to the cultural tourism domain. We performed a search on the above mentioned databases. The list L was possibly extended with new relevant keywords retrieved in the apps description. We carried out a systematic research in order to provide an exhaustive set *U* of mobile apps in the Cultural tourism domain. The process ended when no newer keywords or apps were found. The research was performed from 1 to 31 May 2020.

An app of this set is included in the analysis domain if:

the app description is written in English and/or in Italian;

the app preview (or associated website, if available) claims that the app provides tourism related information or service supporting the user in cultural tourism activities or learning process;

the app is not an old version or edition of another one in *U*

At the end of the process, the set U was constituted by 80 mobile apps.

Phase 2: ***Defining the analysis framework.*** Data were mainly sourced from the app description obtained from the store apps preview and associated web sites (if available). Moreover, in most cases, apps were downloaded and were analyzed in more detail to verify data extracted from the app description, or to generate data that were difficult or impossible to extract from the app description.

Subsequently, we analysed the selected mobile apps in order to identify which types of utility value are delivered to users. We assumed that utility components can be identified considering the motivations, expectations, needs and attitudes of consumers of cultural tourism services. The reason for this approach lies in the fact that the more the content of the service adapts to the specific motivations and expectations of the consumer, the higher the value of the service. The detection was carried out through empirical observation of the characteristics of the APP identified. In particular, for each app in the sample we gathered app data with respect to the Information Content, i.e. data on information categories used in the interaction between the tourist/user and the app-based service.

Information content were categorized in a set of utility component, basing on semantic similarity criteria.

Phase 3: App Analysis. Each author separately analyzed the mobile apps belonging to *U* by means of the framework defined as output of phase 2. At the end of that process, we verified that all the authors have classified the apps in the same way. We decided to consider a dichotomous scale to assess the presence (or not) of a utility dimension impacting on the consumer's perceived value.

4 Findings

The analysis of the apps led to the identification of the following utility components:

- ***Convenience***: Some apps aim to facilitate tourism experience providing services addressed to reduce efforts, time and cost in enjoying a cultural tourism experience. These apps facilitate the tourism experience by allowing tourist to find the lowest prices, take advantage of discounts and promotions, keep budget under control.

  The cultural tourist wants to save money, without having to give up quality. For this purpose, some apps (like Virail and Piratinviaggio) suggests offers for flights and accommodations. Other apps (e.g. Tiquets and Google Trips) allows tourists to compare offers of different websites, while Tripify helps the user to keep under control the expenses during the trip. Applications such as Tiqets and Virtlo allows the user to book tickets directly from the smartphone, skipping the queues and saving precious time.
- ***Risk reduction***: some features are addressed to reduce the likelihood and severity of an adverse event or to mitigate its impact. In this sense, mobile apps provide emergency contacts, indicate the least dangerous routes, real-time notifications during the experience, information on weather conditions, read reviews and advice from other users, guarantee quality and reliability of contents.

  Before booking a restaurant or hotel, visiting an attraction or simply before choosing the destination of the next trip, most tourists rely on the reviews and suggestions of those who before them have been in the place of interest. Several applications offer the possibility of inserting and reading reviews, reassuring the traveller about his future destination. Some apps offer reviews by locals or experts, as in the case of Spotted by locals or Mesmo. Other apps (e.g.EatnMeet or HostelWorld) offer travel insurances or free booking cancellation. Some apps guide tourists through less dangerous routes (e.g. women who travel alone and move at night) offering the opportunity to easily access to emergency contacts.
- ***Enhancing Experience***: some apps provide features aiming to improve and reinforce the quality of a cultural tourism experience. These features leverage on hedonic aspects of travellers, increasing their desire and pleasure to be involved

in a journey. For example, apps like Monugram and CicerosGet offer the opportunity to recognize monuments, piece of art and famous places from photos taken by the tourist, offering immediate information, according to a "Shazam-like" approach. Playtrip and Apptripper accompanies the cultural tourist to discover works of art, monuments, etc., making the trip even more interesting. To increase the fun, some apps offer quizzes about the places the tourist is visiting. Other apps leverage on augmented reality or "near to me" functions.

- ***Sociability***: apps for cultural tourism offer the opportunity to enjoy tourism attraction and to satisfy tourist's needs of personal connectedness and relationships with other tourists and cultural tourism stakeholders. Some apps allow the cultural tourist to share experiences with local people: apps like Withlocals-Tour & Viaggi, Cool cousin offer offering the opportunity to contact, chat, meet in person locals, as well to be guided on the journey by a local expert. Sharing is becoming an integral part of the experience, that's why applications like City Maps to go and Monugram allow integration with other platforms (e.g. social networks), while others like Modify and Geotourist create a network that connects users of the same application, allowing them to share with the community photos, travel notes, itineraries etc.
- ***Practicality:*** some apps offer the opportunity to better manage the tourism experience lifecycle. In this sense, features as customer profile management, search functions, instant multi-language translation, ticketing management, and all-in-one functions represent a valid opportunity to reduce user's effort while travelling. Other apps allow offline use and in advance content download. These features are useful in specific contexts where connection is not available or roaming charges are expensive.

The following table summarizes utility dimension and utility components arisen from app analysis.

Table 1. Utility dimensions and utility components of app-based services for cultural tourism

Utility dimension	**Description**	**Utility Component**	**Apps**
Convenience	Find the lowest prices, reduce booking times, take advantage of discounts and promotions, keep budget under control, manage more services in a single app.	Budget monitoring	Tripify (2017)
		Prices comparison	GoogleTrips (2019), Cultural Places (2017), TourScanner (2018)
		Time saving	Musement (2013), Tiqets (2014), Virtlo (2018) , Palmipedo (2017), SmartFy (2016), Tourist Office (2016), AnyTour (2018), GPSMyCity (2018), Piratinviaggio (2011), RoadTrippers (2011), Tripwolf (2008), Il mondo intorno a me (wam) (2013), GetYourGuide (2013), HostelWorld (2011), AllTrails (2010), Virtlo (2018), AroundMe (2017), Viator (2012)

		Economic convenience	Virail (2017), Piratinviaggio (2011), Couchsurfing Travel (2012), Mesmo (2019)
Risk reduction	provide emergency contacts, indicate the least dangerous routes, real-time notifications during the experience, information on weather conditions, read reviews and advice from other users, guarantee quality and reliability of contents	Security	W-her (2017), All Trails (2010)
		Reviews	Tripadvisor (2000), W-her (2017), WithLocals-Tour&Viaggi (2013), Pronatives (2016), Monugram (2018), AllTrails (2010), Viator (2012), GetYourGuide (2013), HostelWorld (2011), Eatnmeet (2019)
		Warranty	Touchnote (2010), EatnMeet (2019), Viator (2012), HostelWorld (2011), GetYourGuide (2013)
		Alert messages	Tripcase (2015), Monument tracker (2010), Ti porto io (2016)
		Certificate information sources	Foursquare (2009), Spotted by locals (2008), GoogleTrips (2019), Cultural Places (2017), Minube (2010), Anytour (2018), Jitt.travel
Enhancing Experience	Recognition of the place through an image, use of augmented reality, games to encourage learning processes, create your own personal gallery, keep the chronology of the places with annotations and photos, audio guides.	Recognize point of interest (shazam effect)	Google goggles (2010), Monugram (2018), GetCoo (2015), Tours&Travel (2018), Ciceros (2018),
		Near to me	Tripadvisor (2000), HostelWorld (2011), Klook (2015), GetCoo (2015), AroundMe (2017), Runnin' City- GPS&Audioguide (2016)
		Itinerary proposal	Yamgu (2014), Myeasyroute (2017), Klook (2015), Apptripper (2013)
		Storytelling	Playtrip (2017), Palmipedo (2017), Geotourist (2014), Smartify (2016), Izi travel (2012), Anytour (2018), Apptripper (2013)
		Augmented Reality	Playtrip (2017), Google Arts & Culture Open Heritage (2015), Virtlo (2018)
		Memories collection	Foursquare (2009), GetCoo (2015)
		Entertainment	My Wowo (2017), Esplorazioni (2016)
Sociability	Chat and / or receive suggestions from locals, meet locals, connect the profile to their social networks, enter the community, get awards, interact with community members, upload and share your experiences (videos or photos, travel notes, itineraries, etc.),	Interaction with locals Social Networking	Cool cousin (2015), Musement (2013), EatWith (2016), Izi Travel (2012), Tripify (2017), Civitatis (2017), Minube (2010), WithLocals-Tour&Viaggi (2013), EatnMeet (2019), CouchSurfing Travel (2012)
			City Maps to go (2014), Monugram (2018) Foursquare (2009), Ti porto io (2016), Touchnote (2010), Modify, Mapify (2018), Packpoint (2014), Geotourist (2014), Roadtrippers (2011), Polarsteps-Travel tracker (2015), GetCoo (2015), Mesmo (2019), ViaggiAmoItaly (2016), Voice Map Audio Tours (2015), Ciceros (2018), GetCoo (2015), AppTripper (2013), Couchsurfing Travel (2012), Tours&Travel (2018), Mapstr (2014)
Practicality	instant translations in multiple languages, content download for offline use, profile customization, integrate many services in a single	Multi-language interaction	Google goggles (2010), Google Arts & Culture Open Heritage (2015), ProNatives (2016), HostelWorld (2011)
		Offline use	Cool cousin (2015) , City Maps 2 go (2014), Sygic Travel (2008), Polarsteps-Travel Tracker (2015), Google Trips (2019), TripAdvisor (2000), Tripcase (2015), Yamgu (2014), Monument tracker

	app		(2010), Tiqets (2014), My Easy route (2017), Google arts&Culture Open Heritage (2015), GPS My City (2018), AllTrails (2010), Jitt.Travel (2015), Culturetrip (2011), Spotted by Locals (2008), Tripwolf (2008), Cultural Places (2017), Izy travel (2012), Zonzofox (2014), Tourist Office (2016), Packpoint (2014), Tripify (2017), Smartify (2016), My wowo audioguide (2017), Esplorazioni (2016), Virtlo, Apptripper (2013), Runnin' City-GPS&audioguide (2016), Ciceros (2018), HostelWorld (2011), GetYourGuide (2013), VoiceMap AudioTours (2015)
		User's profile customization	Monument tracker (2010), Foursquare (2009), Touchnote (2010), Google Trips (2019), Izi travel (2012), Tourist Office (2016), Tourscanner (2018), Packpoint (2014) , Zonzfox, GPSMycity (2018), WithLocals-Tour&Viaggi (2013), Pronatives (2016), Jitt.Travel (2015), Piratinviaggio (2011), OpenTable (2019), Sygic travel (2008), ViaggiAmo Italy (2016), Alltrails (2010)
		All in one	Tripcase (2015), Google Trips (2019), Artplace Museum (2016), Culture Trip (2011), Tripwolf (2008), Viaggiart (2014), Golsreal, Rome2Rio (2016), Il mondo intorno a me (wam) (2013), Tours&Travel (2018), Virtlo (2018), AroundMe (2017), Viator (2012),

The identification of relevant utility dimension for cultural tourists allowed us to characterize some aspects of the value proposition delivered by app-based services in that context. The value proposition of cultural tourism services refers to the ability to facilitate tourists to better satisfy their needs along the tourism experience lifecycle and it reflects service performances impacting on the consumer's judgement about the utility the tourist receives. According the following dimensions, namely *utility* and phases of the *tourism experience lifecycle*, we built a framework to characterize and map the value proposition of app-based cultural tourism services.

Table 2. Value propositions map of app-based services for cultural tourism

	Dreaming	***Planning***	***Experiencing***	***Recollecting***
Convenience	Find, select, filter places according some criteria	Find special offers; compare rates; save time in finding travel solutions; book tickets; tourist services reservation.	Keep your budget under control; fast-line / skip-the-queue services; real-time monitoring of overcrowding; real-time fares; last-second deals.	Costs and fares tracking
Risk reduction	Learn about threats, dangers,	Know the safest routes; read	Direct use of emergency	Users can provide suggestions and

	contraindications related to specific places	reviews; having the opportunity to cancel without repercussions; buy insurance	contact, real-time notification of adverse events, real-time meteo	advice about some security and safety related issues
Enhancing Experience	Virtual reality services, inspiring video, photo and storytelling campaigns.	Proposal of personalized itineraries and possibility to integrate activities with customized experiences	Receive context-based information. Take advantage of augmented reality, shazam-like and near-to-me services	Create a collection of memories with photos and personal notes
Sociability	Be inspired by the stories and images of those who have already lived the tourist experience or by those who live in that place	Receive suggestions and advice on which services to book; which suppliers to contact; which periods of the year, days, hours, are best for visiting the tourist attraction	Receive real-time support from other travelers who are on the spot at the time or meet locals willing to act as a tour guide	Share memories, experiences, emotions, opinions with other users.
Practicality	Save favorite places, favorite reviews, customize the weights of other users' review criteria	Save and manage quotations, reservations, calendars; plan itineraries.	Manage tickets and travel documents, receive information in real time	Manage and archive photo, video, souvenirs of their own holidays.

5 Conclusions

Cultural tourism represents a significant chance for many destinations, since it provides the opportunity to present a snapshot of the image and history of a region, symbolize the identity of a community and increase the liveliness of the local economy (Chen, Peng, & Hung, 2015; Hou, Lin and Morais, 2005; Wansborough & Mageean, 2000). Tourism destinations have the potential to become popular attractions, because travellers are increasingly interested in cultural tourism and related activities (Cuccia, Guccio and Rizzo, 2016; Gnoth & Zins, 2013).

The current market paradigm that shift towards a digital consumer society is leading new digital businesses to enter the market of tourism related services (Volpentesta et al., 2017). New technological advances on mobile-based technologies and IoT have made possible the development of new services providing value to cultural tourists along the tourism experience lifecycle. Although there are countless mobile apps aimed to assist tourists all along their experience, little research has been devoted to investigate the impact of these technologies on the management cultural tourism services.

This exploratory study attempted to provide a methodological approach and a multidimensional framework to position the offer of app based cultural tourism services.

We reviewed mobile apps that provide services for cultural tourists, by analyzing their functions and the information flow that occurs in the interaction between the user and the

service, in order to identify value dimensions of app-based cultural tourism services. Although several studies addressed the concept of information value, the available research lacks in defining an approach capable to analyze the relevance of information provided to targeted audiences by cultural tourism services. Our paper proposed a framework that, from a marketing related perspective, could represent a valuable tool for positioning cultural tourism information offer, with the twofold objective to analyze the value proposition of app-based services according to a consumer perspective and to understand gaps of current offering.

Moreover, the practical implications revolve around informed and effective action based on current knowledge and learning about the design of IoT based solutions. In fact, results could be used to suggest some direction to the design a new generation of services and to identify potential service delivery improvements within the IoT domain.

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The Relationship between Organizational Unlearning and Radical Innovation

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Abstract

In a context of continuous technological change and rapid market growth, companies must necessarily implement changes to remain competitive on the market, otherwise they risk to lag behind and not be able to survive (Wang et al.,2013). Many scholars consider innovation, especially radical innovation, as the solution companies must adopt to deal with such an unstable environment (Ettlie et al.,1984; Sood and Tellis, 2005). Radical innovation, in fact, is a product, service or process with both familiar and completely new features that significantly improves costs or performance and completely transforms the market or even creates a new one (Leifer, O'connor and Rice, 2001). Anyway, developing radical innovation within a firm is not so straightforward due to internal barriers like rigid organizational structures (Lyu et al., 2020). To overcome such organizational rigidity organizational unlearning is required (Leal-Rodríguez et al., 2015; Morais-Storz and Nguyen, 2017), as it is defined as "the process of discarding of old routines to make way for new ones, if any" (Tsang and Zahra, 2008, p.1437). Thus, the aim of our conceptual paper is to investigate the relationship between organizational unlearning and radical innovation through a critical analysis of contributions in the literature to date.

Keywords – Organizational unlearning, radical innovation, organizational change, entrepreneurial orientation

Paper type – Academic Research Paper

1 Introduction

In a context of continuous technological change and rapid market growth, companies must necessarily implement increasingly rapid changes to remain competitive on the market. The inertia of organizations with respect to substantial changes in the surrounding environment and their lack of adaptability can jeopardize their survival (Wang et al.,2013). Many scholars agree in considering innovation, especially radical innovation, essential for dealing with such an unstable environment (Ettlie et al.,1984; Sood and Tellis, 2005).

Radical product innovations can be defined as new products made from a new technology or a significantly innovative idea that will bring about revolutionary changes in existing markets (Chandy and Tellis, 2000; McDermott and O'Connor, 2002). A radical innovation allows the firm to gain a significant competitive advantage, in some cases creating a completely new market in which it is the leader (Lyu et al., 2020). In spite of the recognized importance of radical innovation, its development is not so straightforward due to firms' barriers like rigid organizational structures (Lyu et al., 2020). Researchers have noted that to overcome such rigidity organizational unlearning is necessary since it is considered an important condition to adapt to environmental changes (Leal-Rodríguez et al., 2015; Morais-Storz and Nguyen, 2017).

A firm that wants to acquire new knowledge, needed to implement a radical innovation, must unlearn obsolete and misleading knowledge and beliefs (Hedberg, 1981). Since a radical innovation involves moving away from the past routines and beliefs to facilitate the entry of new knowledge, carrying on an organizational unlearning is mandatory (Buchen, 1999). If a company remains anchored to the knowledge base it already has, without the intention of questioning it to develop new knowledge, then the possibility of implementing a radical innovation is drastically reduced.

Putting into practice, organizational unlearning promotes and supports the emergence of radical innovations. In order to implement such a practice, however, it is necessary that someone within the organization understands its urgency. Unlearning, in fact, provides for cognitive activities that lead the members of the organization to realize that some routines are obsolete (Starbuck and Hedberg, 2001). Although organizational unlearning has been shown to favour the process of adaptation to changes in the surrounding environment, allowing the company to change its internal dynamics, its relationship with the innovation process has not yet received much attention from scholars (De Holan and Phillips, 2004b). In particular, the relationship between organizational unlearning and radical innovation is under-investigated, although the concept of radical innovation has been extensively discussed in the literature. With this in mind, the purpose of this conceptual paper is to analyse the contributions in the literature dealing with the relationship between organizational unlearning and radical innovation in order to sustain this line of research and propose potential future developments.

2 Theoretical background

2.1 Organizational unlearning and forgetting

The concept of organizational unlearning gained considerable importance in the early 80s thanks to the study conducted by Hedberg (1981) "How organizations learn and unlearn". Although this concept has been widely debated in the years to come, scholars never agreed on a unique definition to describe the phenomenon. For this reason, Tsang and Zahra (2008) collected and analysed the main definitions proposed for organizational unlearning and assessed their common elements. What all definitions have in common is the emphasis on the process of getting rid of something within the organization. What is discarded are outdated beliefs, routines, norms and habits and in most cases the focus is on replacing them with new ones. It follows that the discarding and the replacement aspect are the two cornerstones of organizational unlearning. The discarding dimension implies that the company is clearly aware of which knowledge is no longer useful and must therefore be forgotten. Hence, the concept of organizational unlearning has been studied in parallel with the concept of organizational forgetting (De Holan, 2004).

In the management and organizational literature organizational unlearning has been studied considering two different meanings: voluntary, therefore intentional; and involuntary, therefore accidental. Accidental unlearning happens when a company loses part of its knowledge due to an unforeseen event, such as the involuntary deletion of data or loss of system memory, due to knowledge transfer both outside and inside the organization or to a change in the organizational life cycle (Wang et al., 2013). In this case the company loses valuable information and is impoverished (Cegarra-Navarro et al., 2016). This situation can cause the company to lose competitiveness in the market, so it must invest time and resources to recover forgotten knowledge (De Holan, 2004). Instead, we talk about intentional organizational learning when the process of discard obsolete knowledge is conscious and driven by a voluntary effort (Cegarra-Navarro et al., 2013). This process occurs when there is an awareness that current behaviours, actions, knowledge structures, assumptions and routines are obsolete and no longer appropriate and consequently there is a need to replace them with new ones (Lei, Slocum and Pitts, 1999).

At the hearth of voluntary organizational unlearning there is the intention to prepare the ground for acquiring new knowledge, therefore it is to be considered as the preparatory stage of the organizational learning process (Wang et al., 2013). Although learning is crucial to achieve a successful organizational performance, it is often hampered by barriers within the organization that appear in the form of rigid behaviours and obsolete knowledge (Starbuck and Milliken, 1988). Therefore, scholars agree that it is difficult for a firm to establish new routines because the previous ones and the already established cognitive structures hinder the absorption of new knowledge. It follows that organizational unlearning is required in order to change the status quo (Cegarra-Navarrol,

Cepeda-Carrion and Jimenez-Jimenez, 2011; Morais-Storz and Nguyen, 2017). In fact, Tsang and Zahra (2008) define organizational unlearning as a process in which obsolete knowledge, norms and routines are discarded in order to make room for new ones.

It is important to underline that organizational unlearning cannot be detached from the process of unlearning at the individual level. The organization, in fact, is made up of a group of individuals, so collective learning is derived from individual learning (Hislop et al., 2014). When the organization decides to discard previous routines it must necessarily involve the individuals in the organization, ensuring that they are all aligned with the decision and that they no longer apply such routines (De Holan and Phillips, 2004a; Wang et al., 2013). According to Tsang and Zahra (2008) it is more difficult to eliminate the practices which are socially rooted, such as those related to human resources management. Therefore, in order to facilitate the unlearning process, the organization needs to strive to create a stimulating environment and a context that allows individuals to get rid of what is no longer needed, encouraging openness to new knowledge and counteracting resistance to change.

Although the literature on organizational knowledge recognises the interconnection of the concepts of organizational unlearning and organizational forgetting, there is no clear distinction between them. If we adopt the definition of organizational unlearning from Tsang and Zahra (2008, p.1437), i.e. "the discarding of old routines to make way for new ones, if any", we note that many scholars attribute the same meaning to organizational forgetting (Huang et al. 2018; Klammer and Gueldenberg, (2019b). It follows that the meaning of the two concepts overlap and are considered as synonyms.

According to some scholars, however, what distinguishes organizational unlearning from organizational forgetting is the intentionality of the process of discarding obsolete knowledge (Klammer and Gueldenberg 2019). According to this approach, organizational forgetting refers to the involuntary loss of information (Wang et al., 2013). Organizational unlearning, on the other hand, intends that this loss occurs intentionally (Cegarra-Navarro et al., 2013; Hislop et al., 2014).

De Holan, Phillips and Lawrence (2004) extensively investigated the concept of organizational forgetting and proposed a framework from which it derives that unlearning is a mode of forgetting. Specifically, the framework is divided into two main dimensions: the mode of forgetting, whether intentional or accidental, and the type of knowledge, whether pre-existing or new. According to the authors, organizational unlearning is an intentional process that involves the dismantling of the extant body of knowledge, once it is understood that it has become ineffective in pursuing the business in a successful way.

2.2 Organizational unlearning and innovation process

The survival of companies is constantly threatened by an increasingly dynamic environment. This continuous change represents a major challenge for companies that need to address it by developing a strong innovation capability in order to remain

competitive in the market (Damanpour and Gopalakrishnan, 1998; Wang et al., 2013). A fundamental point to produce innovation, whether radical or incremental, is that the company must necessarily acquire new knowledge and get rid of obsolete one. As a result, if the company is persistent in relying on current beliefs, routines and procedures within the innovation process, it will not be able to respond positively to changes in the environment, so it will hardly be able to develop innovation. For this reason, organizational unearning is closely linked to the concept of innovation (Akgün et al., 2007; Wang et al., 2013). Many scholars have analysed the relationship between organizational unlearning or forgetting and innovation.

Assink (2006) asserts that inability to unlearn is one of the barriers preventing the company from developing innovation. According to the author, the inability to abandon outdated beliefs and start thinking in an unconventional way negatively affects the way information from the market is collected, interpreted and used, and thus disadvantages the production of innovation. Becker (2008) highlights the importance of questioning policies and procedures developed within the organization as soon as they are no longer able to contribute to the development of innovation by the company.

The development of innovation by companies is mainly due to their ability to adapt to a constantly changing environment and to exploit the opportunities that this change offers. In order to best embrace change, it is reasonable that the company should modify the current routines by implementing a process of unlearning or forgetting (Yang et al., 2014). The literature shows that many companies have not been able to abandon the old ways of working and thinking and consequently have not been able to recognise important changes in technology and the market, falling behind their competitors (Akgün et al., 2007). The willingness of companies to keep their cognitive structure and their institutional rules and practices unchanged limits their innovation behaviour and consequently reduces their innovative capacity (Huang et al. 2018). The core competencies possessed by companies in most cases are not sufficient to exploit and benefit from changes in the surrounding environment. Many companies, in fact, run into the so-called "competency traps" (Levitt and March, 1988), i.e. they mistakenly believe that if the practices adopted so far have always led to successful results then they should not be changed because they will guarantee the same positive results in the future (Srivastava and Gnyawali, 2011). Without being aware of this, companies develop internal obstacles that negatively affect their innovation performance.

2.3 Radical innovation

The concept of radical innovation is of great interest to both scholars and practitioners, as they recognize the fundamental role it can play for companies. Although there are multiple classifications of innovation, one of the most widely used counterposes radical innovations and incremental innovations (Dominguez Escrig et al., 2016; Gatignon et al., 2002), even if the distinction between these two concepts is not always clear (Assink,

2006). Incremental innovations arise from an already known knowledge base and consist of a series of small improvements to a company's products, services or processes. Even though these improvements involve a certain degree of novelty, they do not substantially change the existing product, service or process (Veryzer, 1998). On the contrary, the goal of radical innovations is to develop revolutionary technologies, products, processes or business models that completely disrupt the existing market (Thomond and Lettice, 2002; Verganti, 2008). Leifer, O'connor and Rice (2001) define radical innovation as a product, service or process with both familiar and completely new features that significantly improves costs or performance and completely transforms the market or even creates a new one. Radical innovation attacks existing businesses and offers great opportunities for growth and profit for the companies that introduce it (Assink, 2006). On the one hand, such innovations represent a great opportunity for organizations, which can gain a significant competitive advantage and become market leaders (Baker and Sinkula, 2007), but on the other hand they represent a threat if not promptly exploited. When an organization introduces a radical innovation, the products made by competitors become immediately obsolete and the market begins to be dominated by a new standard (Verganti, 2008). As a result, companies must adapt quickly to avoid the risk of lag behind and fail (Dominguez Escrig et al., 2016; Nijssen et al., 2005).

3 Organizational unlearning and radical innovation

Scholars recognised that the unlearning process can pave the way for innovation (Yang et al., 2014), but little has been studied about the relationship between organizational unlearning and radical innovation. This section will try to bring together what has been argued so far about the relationship between organizational unlearning and radical innovation in order to create a solid basis for further researches.

Yang et al. (2014) argue that it is worth exploring how the different dimensions of unlearning can have an impact on radical innovation. Specifically, the authors consider the two dimensions of unlearning: "changes of routines and beliefs" and "forgetting". This distinction is based on studies by Akgün et al. (2007) who argue that in order to produce substantial organizational change it is necessary to change the organization's routines and collective thinking, as well as to voluntarily lose or forget previous knowledge. According to Yang et al. (2014) it is appropriate to study these two dimensions of organizational unlearning separately. In fact, the former is internally oriented as it is mainly related to the employees of the organization who have to change the current procedures and modify the internal processes, while the latter is externally oriented, as organizations can eliminate the memories that have involved external stakeholders without them resisting it. The authors found that the change and forgetting dimensions have different impacts on the development of radical innovation.

Changing routines and beliefs, meant as expectations towards market, processes and technology (Akgün et al., 2007), allows the organization to increase the ability to produce radical innovations through the injection of new ideas, tools and procedures. This positive

relationship is further strengthened by the presence of slack resources, which is based on resource-based view (RBV) theory. According to RBV, the resources owned by a company influence the company's strategy and the results it can pursue (Barney, 1991). Slack resources are the resources that the company possesses in excess of those that are needed to conduct the business, consequently they allow the company to take more risks, investing in projects that do not represent a certainty and therefore feel freer to produce innovation. As argued by Yang et al. (2014), the presence of these resources favours the implementation of changes in routines and beliefs and, as a consequence, positively contributes to the emergence of radical innovation.

In parallel, the forgetting dimension is found to have a negative impact on the production of radical innovation. Yang et al. (2014) argue that companies need the support of a variety of external stakeholders, such as cooperative partners, customers or suppliers to successfully carry out an innovation process. It is unlikely that companies have sufficient internal resources and expertise to produce innovation in a completely autonomous way. Forgetting, either voluntarily or due to an unfortunate event such as the loss of memory of the systems, can cause a loss of interest by external stakeholders towards the company. The lack of their support may hinder the production of radical innovation.

Wang et al. (2013) contribute to the study of the relationship between organizational unlearning and radical innovation by recognizing the role of organizational flexibility as a mediator between the above-mentioned constructs. Organizational flexibility represents the ability of a company to deal with uncertainties arising from changes in the surrounding environment, responding promptly to them by allocating resources to different courses of actions.

A company characterized by rigidity and resistance to change will not be reactive to a changing external environment. Instead, through organizational unlearning, the company abandons procedures that it considers obsolete, adopts new practices and changes beliefs, enhancing the opportunity to acquire new knowledge and promoting organizational flexibility. The authors believe that organizational flexibility contributes to positively influence a company's ability to produce innovation, both incremental and radical.

According to Lyu et al. (2020), organizational unlearning moderates the relationship between environmental turbulence and radical innovation and between entrepreneurial orientation and radical innovation. In a constantly changing environment, companies are requested to change their beliefs structures, knowledge sets and procedures in order to keep up with external changes. In this scenario environmental turbulence refers to an external environment that changes quickly and in an unpredictable way. This leads companies to review their strategies, skills and knowledge as they may have become obsolete and ineffective. It follows that organizational unlearning is a powerful tool the firm can use to make the necessary adjustments to adapt to an ever-changing environment.

Lyu et al. (2020) stressed that being flexible is a fundamental characteristic that companies must have in order to survive and remain competitive. According to Wang et al. (2013), through organizational unlearning the firm abandons ineffective beliefs, procedures and routines, increasing its flexibility and being more reactive to change. Lyu et al. (2020) recognize entrepreneurial orientation positively associated with organizational unlearning. Entrepreneurial orientation concerns the strategic orientation of a company that includes methods and practices of decision making (Wiklund and Shepherd, 2005).

Entrepreneurial orientation is associated to the firms' tendency to change traditional routines, thus fostering the process of unlearning outdated knowledge, beliefs and procedures. It has been studied that companies with a high entrepreneurial orientation are more prone to change, as they question previous knowledge. As a consequence, they tend to be more innovative (Miller, 1983).

Based on contingency theory, Lyu et al. (2020) then explored how firm size moderates the relationships between the antecedents and organizational unlearning. According to contingency theory, the success of an organization derives from the combination of intrinsic characteristics of the organization and contingent variables. This theory is grounded on the idea that no unique and winning strategy for every company exists, but rather, the same strategy can be more or less effective if applied under different environmental conditions (Morton and Ho, 2008).

One of the variables widely investigated in contingency theory is the firm size. Lyu et al. (2020) assert that the larger the firm size the less positive impact environmental turbulence has on organizational unlearning. In fact, a small company can benefit from less bureaucratic inertia which makes it more adaptive to change. A turbulent environment requires a quick replacement of routines, beliefs and knowledge as they rapidly become obsolete. In a large, multi-layered company, the unlearning process is slowed down by stricter rules that govern its business operations, making it more difficult to replace values and habits that conflict with the ever-changing environment. On the contrary, the larger the size of a company, the greater the positive effect of entrepreneurial orientation on organizational unlearning. This happens because large companies have access to larger financial resources that they can use to implement entrepreneurial orientation activities.

4 Conclusions, limitations and future research direction

The aim of our conceptual paper is to investigate the relationship between organizational unlearning and radical innovation through a critical analysis of contributions in the literature to date. First of all, this study highlighted that although the single concepts of organizational unlearning and radical innovation are widely discussed in the literature, little is yet known about the relationship between them. Therefore, our conceptual paper aims to understand the underlying dynamics currently investigated and

to identify potential research gaps that future research could address to deepen the understanding of this relationship.

4.1 Contingency theory

Adapting to the constantly changing environment is a prerogative for companies that want to remain innovative and competitive in the market. Even more so, in order to introduce radical innovation, the company must adapt as quickly as possible to changes in the surrounding environment, so as to be the first to understand its potential, exploit it and achieve a significant competitive advantage. As the literature shows, organizational unlearning is a key factor in leading a company to introduce radical innovation (Lyu et al., 2020; Wang et al., 2013; Yang et al., 2014).

The literature so far demonstrates that contingency theory has only been used to better understand the company's ability to undertake an organizational unlearning process. In particular, Lyu et al. (2020) studied the variable of firm size to assess the impact of environmental turbulence and entrepreneurial orientation on organizational unlearning. Some of the most important contingency theories of organizational structures define three main contingent variables: environment, strategy and company size (Donaldson, 2001). As the impact of firm size on organizational unlearning has already been studied, it might be interesting to understand how other variables influence organizational unlearning and how they indirectly impact the production of radical innovation.

Contingency theory has been widely used in the literature to explain the dynamics of the organizational learning process (Cyert and March, 1963; Gnyawali and Stewart, 2003), as according to it organizations are depicted as open systems that continuously adapt to the environment (Romme and Dillen, 1997). Gnyawali and Stewart (2003) stated that organizations must adapt the learning process to the surrounding environment and in particular to the different environmental conditions they may face. Following the same logic, it would be appropriate to study how the nature of environmental changes affects the unlearning process and the consequent production of radical innovation.

4.2 Individual unlearning, organizational flexibility and radical innovation

The study of the literature revealed the fundamental role of organizational flexibility in triggering radical innovation within an organization. Wang et al. (2013) recognized the necessary mediating role of organizational flexibility between organizational unlearning and radical innovation. Sanchez (1995) decreed that the flexibility within an organization is to be understood in terms of resource flexibility and coordination flexibility. Both concepts of flexibility imply a direct involvement of the individual within the organization. In fact, in a turbulent environment individuals adapt by seeking new ways to manipulate the available resources (Wang, Qi and Zhao, 2019). Joint efforts by all the individuals in the organization to unlearn obsolete knowledge result in unlearning at the

level of the organization (De Holan and Phillips, 2004a; Hislop et al., 2014), which in turn discards the old routines replacing them with new ones and improving the overall flexibility of the organization. As the connection between individual unlearning, organizational flexibility and radical innovation is clear, the relationship between these constructs should be further investigated.

4.3 Limitations

Although this conceptual paper has contributed to prepare the ground for future researches concerning the relationship between organizational unlearning and radical innovation it has one main limitation. As this relationship is still poorly researched there are not yet many contributions in the literature, therefore our paper uses a rather limited number of papers to investigate and discuss such relationship.

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Managing Knowledge to Counter Climate Change

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Abstract

The purpose of this paper is to apply existing knowledge to counter climate change. The contribution to knowledge is to ground institutional analysis, individual behaviour, political science, economics, management and the management of global sustainability in the practices and science of governance found in nature. This is achieved by using bytes as the unit of analysis to explain how nature governs complexity on a more reliable and comprehensive basis than achieved by humans. Tax incentives could encourage organisations to adopt elements of ecological governance found in nature and in social organisations identified by Ostrom and the author. Ecological governance can provide benefits for all stakeholders as desired by CEO's of the US Business Round Table. Corporations then become a common good to allow them to promote global common goods like countering climate change, pollution and inequalities in power, wealth and income. Democracy is enriched bottom-up.

Keywords – Bytes, Climate change, Common good, Ecological governance, Tensegrity.

Paper type – Academic Research Paper

1 Introduction

The purpose of this paper is to present existing knowledge of how society might better counter climate change. The causes and solutions of climate change are widely understood and accepted. The difficulty is how to motivate nations of the world to take collective action. To understand how society might better counter climate change widespread knowledge is required on how to constructively manage wicked problems described as "the tragedy of the commons" (Hardin 1968).

These tragedies arise when different individuals or groups promote their self-interest by over exploiting life-sustaining resources to eliminate them for everyone. The extermination of humanity on Easter Island is an example. Climate change introduces the risk of exterminating humanity on the planet. For the first time the tragedy of the commons has become a global issue of human and institutional behaviour. Countless examples of such wicked problems and their solutions have arisen over millenniums in the context of excessive hunting, fishing, grazing and irrigation. But their solutions have yet to be taught in graduate schools.

Political scientists Elinor Ostrom and her husband Vincent spent their lives studying how since pre-modern societies knowledge exists on how individuals or groups could

avoid tragedies of the commons. In pre-modern hunter gathering societies the solution did not depend upon either markets or hierarchy but forming special types of network relationships that introduce checks and balances on power elites whose actions could destroy the common good for everyone.

The Ostrom's used the language of political scientists to describe the nature of these networks as "polycentric republics" (Ostrom 1987, 1990, 1993, 1998a 1998b, 2010. 2012, Ostrom & Allen, 2008, Ostrom, Walker & Gardner 1992). The communication and control architecture in such "polycentric republics" is also found in the communication and control networks existing in our brains (Kelso, Dumas, & Tognoli 2013). For this reason, this form of governance is described as "ecological" (Turnbull, 1991a, Marston 1992: 39). This makes the knowledge on how to counter climate change subjected to the natural science of governance (Turnbull 2000b, c, e, 2002b; 2005, 2008a; 2012b, 2013c, 2014b, 2015a, b, 2018a, Turnbull & Guthrie 2019a, b, Turnbull & Myers 2017).

The science of governance is grounded in natural laws identified by Neumann (1947), Shannon (1949) and Ashby (1957). These laws explain how to improve the reliability of data processing in respectively: decision-making, communications and control. Knowledge of the science of governance in turn explains why and how nature creates complexity and how best complexity can be managed (Kurzweil 1999, Pirson & Turnbull 2011a, b, 2012, 2015, 2016, Turnbull & Guthrie 2019a; Turnbull & Pirson 1919).

Governance science uses data as its unit of analysis. Data is now routinely metered in bytes. Bytes are eight units of data called "bits". Bits are represented by perturbations in matter and/or energy that make a difference. To minimise the materials and energy for living things to be created, developed, survive and reproduce in unknowable dynamic complex environments, evolution has developed processes for minimising the material and energy required.

Factbook (2019) reports: "The brain makes up 2% of a person's weight. Despite this, even at rest, the brain consumes 20% of the body's energy"! The human brain is thousands of times more efficient than the most advanced computer chips that cannot match its performance even ignoring their dependence on external power sources (*The Economist* 2020: 9).

Unlike the social science of economics that seeks to minimise the undefinable social construct of cost, the science of governance is based on minimising materials and/or energy. In this way Transaction Byte Analysis (TBA) subsumes and extends the Transaction Cost Economics (TCE) developed by Coase (1937) and Williamson (1975) for analysing only hierarchical organisations. TBA provides a method for analysing any type of organisation and so any type of collective activity by humans or any other specie. This is because no collective action can occur in society or nature without data processing within and between coordinating entities.

Managing wicked problems like climate change requires knowledge of how to manage complexity. This is common knowledge with natural scientists designing self-governing automobiles and space probes. An introduction to this knowledge for social scientists is

presented in the following sections. This knowledge provides a framework for understanding why current forms of markets and hierarchy are ineffectual to counter climate change. Section four suggests how tax incentives can introduce ways to introduced ecological forms of organisations and different types of markets to counter climate change.

2 Language, knowledge and the architecture of complexity

Words are the tools of thinking and special words are required to communicate special concepts to explain the complex communication and control architecture of ecological organisations. Mathews (1996) identifies a number of special words in a review of the literature. But Mathews omitted an overarching concept of complexity called "Tensegrity" that drives evolution. Evolution arises from the possibility of Tensegrity being challenged in way to allow novel improvements to arise to create a new entity that is better suited in a new context while also reproducing Tensegrity to maintain evolutionary processes. A process inhibited by hierarchies.

Buckminster Fuller (1961) coined the word "Tensegrity" by combing the words "tension" and "integrity". This concept has since been recognised by natural scientists but largely neglected by social scientists. One exception is Pound (1992, 1993: 11) who recognised its need but not its name in stating: "always have an opposition viewpoint" and at p.18 "There must always be an opposition party and the prospect of insurgency". Natural scientists like Harvard biologist Ingber (1996) described tensegrity as "The Architecture of life" and quantum physicist Bohm (1980) described the concept in different words as the architecture of the universe. Its relevance to social organisations was identified in the PhD dissertation of the author (Turnbull 2000f: 8, 69, 134).

The science of governance explains why the laws of nature found in the physical world apply to individuals, society and its institutions. This explains the similarities noted between biology and economics tabulated in Turnbull (2000f: 68). Ashby (1957: 1) explains why identical phenomena arise in both social and natural science by observing "*The truths of cybernetics are not conditional upon them being derived from another branch of science*. Cybernetics has its own foundations." The remit of cybernetics is "The science of communication and control in the animal and machine" (Wiener 1948). The science of governance has subsumed the science of cybernetics by being the science of communication and control in the animal, machine and social organisations.

Mathews (1996) identifies a key type of structure for creating or governing complexity that Koestler (1967) called a "Holon". However, Hock (1999) invented his own word "Chaord" from combining the words "Chaos" and "Order". In 1970, Hock became the founding CEO of the credit card company Visa International Inc. He created an organisation that meets the test of being composed of "polycentric republics". Visa was owned by its member banks with each bank having its own board of directors within a common legal entity. Each geographic board possessed the power to issue and manage its

own Visa cards to create hundreds of "polycentric republics". Each "Republic" cooperated ~ competed with each other in their mutually owned legal entity.

Koestler (1967) coined the word "Holon" to describe an entity that is both a "Whole" of sub-systems and component of a larger system made up of Holons that he called a Holarchy. The Greek word for "whole" is "Holo with the suffix "on" being a component, like protons and electrons being components of an atom. Holons were what Smuts (1925) and Simon (1962) were describing in a different language.

Holons possess quite different properties from hierarchies as revealed by Hock's (1999:30) description of a Chaord that he described in two different ways:

1. Any self-organizing, self-governing, adaptive, nonlinear, complex organism, organization, community or system, whether physical, biological, or social, the behavior of which harmoniously combines characteristics of both chaos and order.
2. An entity whose behavior exhibits observable patterns and probabilities not governed by the rules that govern or explain its constituent parts.

Hock (1999) described "chaordic" in three ways:

1. The behaviour of any self-governing organism, organization, or system, which harmoniously blends characteristics of order and chaos.
2. Patterned in a way dominated by neither chaos nor order.
3. Characteristic of the fundamental organizing principles of evolution and nature.

Beer (1959) pioneered the application of cybernetics analysis to management. He developed the Viable Systems Model (VSM) to describe any organizational structure that can produce itself and survive in a changing environment (Beer 1995). Because of their cybernetic heritage a number of VSM features are found in Holons, but the reverse does not apply.

Beer developed VSM before the concept of "corporate governance" became a discipline recognized by social scientists[1]. This made VSM subject to the discretion of management. It was not hard wired into organizational constitutions as found in organizations governed by polycentric subsystems in VISA, The John Lewis Partnership in the UK or the Mondragón Corporacion Cooperativa (MCC) in Spain.

Crucially VSM does not include the concept of tensegrity that is a defining feature of Holons. While Mathews (1996: 52-53) does not use the word tensegrity, he recognizes its existence and its special beneficial attributes by describing their contrary ~ complementary characteristics as a defining feature of a Holon. As examples, Mathews (1996: 41-44) refers to Holons as possessing: "Centralisation ~ de-centralisation", "Bottom-up ~ Top-down", "Autonomous ~ integrated", "Order ~ ambiguity",

[1] *Beer met the author in Toronto on August 3, 1996. After reading a version of Turnbull (1997) he advised that he had not extended his cybernetic insights to the governance of firms. Beer had been President of the World Organization of Systems and Cybernetic since 1987. He encouraged the author to publish in the Systems Science literature as undertaken in Turnbull (2005, 2007, 2012b, 2013c, 2014b, Turnbull & Guthrie 2019b).*

"Management ~ leader". This last feature does not communicate a contrarian relationship like the others. A better description would be to use the words: "Subordinate ~ leader" as arises for a Holon within a Holarchy.

Tensegrity naturally arises in mutual organizations from the conflicts arising within and between stakeholders. Tensions can arise between similar stakeholders, like the member banks of Visa, and/or between different stakeholders classes. Examples of the latter are: customers, distributers, suppliers, contractors, employees, executives, shareholders and host communities. Tensegrity is mostly extinguished in centralized command and control hierarchies. This could explain why management scholars and practitioners promote collegiate and cooperative relationships that obscure even further how tensegrity is hard wired into human behavior who represent an organizational Holon. Some scholars are aware of the benefits of contested relationships like Pound (1992, 1993), and Jensen (1993: 852) who reported on "The failure of internal control systems".

Different types of stakeholders may possess different interests in the firm that can create tensions, but the interests of such stakeholders are not typically formerly integrated into the governance architecture of firms. When they are, they like unlikely to possess meaningful power and/or influence to create serious tensions.

The MCC is an exception with multi-stakeholders interests participating in cooperative supervisory boards (Turnbull 1995b). How these potential tensions can be organized to create internal challenges for continuous improvements and adaptations to new risks and opportunities are raised in the next section. This begins by considering the systemic problems inherent in simply hierarchies involved in complex activities.

3 Why transform simple hierarchies to polycentric republics?

The imperative to transform existing dictatorial command and control business hierarchies into polycentric networks of stakeholder republics arises from simple hierarchies:

1. Possessing excessive exploitative powers that can corrupt their directors, managers, the business and society, (Jensen 1993: 852, Turnbull 2000f: 115; Monks & Sykes 2002: 9;) and,
2. Humans possessing limited physiological and neurological capacity to receive, process, store, process and communicates bytes, data, information, knowledge and wisdom to cope with complexity, (Williamson 1975: 21) and,
3. Cybernetic laws of requisite variety that state it is impossible to:
    a) Reliably communicate complexity up or down a hierarchy either simply or reliably without a requisite variety of independent cross checking channels, (Shannon 1949) and,
    b) Reliably directly amplify control of complex variables without supplementary co-regulators providing a requisite variety of regulation (Ashby 157: 265).

The above problems means that corporate governance codes supported by the World Bank, OECD, UK, US and around the world are promoting a system of exploitative governance, that is subject to failure because business and political leaders lack knowledge of the science of governance. The problems are not limited to publicly traded entities but also to private firms, government owned firms and even non-profit organizations.

How ecological governance can mitigate twenty systemic problems inherent in enterprises organized as simple command and control hierarchies are outlined in Table 1. "How mimicking nature can mitigate systemic problems in hierarchies". Details are provided in the authors PhD dissertation (Turnbull 2000f) and in Turnbull (1991a, 1997, 2000b, c, 2001, 2002b, 2005, 2007, 2008a, 2012b, 2013b, c, d, 2014a, b, 2015a, 2016a, 2018a, b, c, 2019a, d).

The practicality of firms transforming to polycentric republics is supported by their existence without any special laws in leading jurisdictions like the US, UK and Europe. A survey of the internal architecture of stakeholder-governed corporations around the world by Bernstein (1980) revealed that a common feature was a distribution of power to a number of boards and/or control centers. This suggests that the inherent conflicts of interest that can arise when workers can dismiss bosses and bosses can dismiss workers without a separation of powers do not allow such organizations to become sufficiently sustainable to be identified.

Table 1. How mimicking nature can mitigate systemic problems in hierarchies

	Toxic problems of hierarchies	Mitigation by mimicking nature
1	Society assumes top-down control is natural	Nature uses bottom/up control & top/down guiding
2	So no education about ecological governance with distributed control to simplify complexity	Complexity simplified with almost self-governing sub-systems dependent upon contrary guiding
3	Unitary boards obtain absolute power to identify and manage their own conflicts of interest to allow absolute corruption of directors, the business and society	Shareholders appoint one board to manage the business and a second to govern the corporation to establish tensegrity benefits for all stakeholders and society
4	Group think arises from directors captured by CEO to hide risks, misconduct & malfeasance	Governors/guardians of stakeholder voices obtain contested "requisite variety" of data for checks and balances
5	Corporations can lie and/or mislead themselves about director independence	Directors independence becomes irrelevant as Governors control minimized conflicts
6	Directors capture auditors who judge their accounts	Governors control auditors who judge directors accounts
7	Auditors lie that they are independent	Auditors kept independent by Governors
8	Accounting doctrines hide how investors get overpaid beyond their investment time horizons with surplus profits creating hidden sources of inequality and stakeholder exploitation	Ownership of surplus profits distributed by corporations issuing shares to citizen stakeholders that democratizes wealth and power. Reduces the need for corporate taxes and welfare programs
9	Directors control advisors to shareholders	Shareholder advisors controlled by Governors
10	Directors nominating themselves for election	Director nomination by shareholders & Governors
11	Directors control their own pay after setting and marking their own "exam papers" aka KPIs	Governors determine director pay from Stakeholder Key Performance Indicators (KPIs)
12	Directors control reports about corporate impact on the environment, stakeholders and community welfare and their own governance	Stakeholders provide guardians with reports for shareholders on Governors pay, corporate impacts on: stakeholders, the environment and society.

13	Directors control how they are held accountable to shareholders at AGMs and control the voting processes on own election and remuneration.	Stakeholder nominee controls conduct of AGMs. Governors determine AGM agenda, location, acceptance of proxy votes, vote counting, etc.
14	Directors ignorant of shareholder identities, etc.	All ultimate owners and/or controller made public
15	Share trading relationships and price manipulation hidden from directors and public	No shares traded without prior disclosure of any related derivatives and identity of counter parties
16	Shares traded covertly by third party exchanges and in "Dark pools"	Corporations directly execute all share transfers
17	Directors not held to account by various stakeholder groups who may have conflicting interest but on who directors rely upon to improve the quality, reliability, and efficacy of continuous operational improvements	Each common interest stakeholder group obtains rights to form their own non-profit associations to appoint advocates-supplementary regulators/ management mentors that avoid directors and shareholders being kept in a cocoon of ignorance
18	Directors of simple command and control hierarchies lack systemic process to cross check management actions and misreporting	Directors obtain stakeholder communication and control channels independent of mgers to cross check integrity of operations and outcome reports.
19	Impossibility of controlling complexity directly	Complexity controlled indirectly by stakeholders
20	Self-regulation/governance is impossible	Self-governance shrinks costs & size of government & compliance costs.

Such separations of powers need not necessarily produce polycentric republics as possessed by Visa Inc, The John Lewis Partnership or the MCC. These organizations, and especially the MCC and the Citizen Utility Boards (CUBs) established by Ralph Nader (Givens 1991) in the US provide working models for constructing Figure 1. Figure 1 does not represent any existing firm with polycentric republics. It is generic discussion model to illustrate some critical elements for introducing ecological governance.

A crucial essential feature is to introduce contestability and so tensegrity into the governance architecture of business by introducing a requisite variety of a separation of powers. This also eliminates a number of systemic toxic conflicts of interest while at the same time decomposing decision-making and communications overload of directors. Such outcomes are supported by the groundbreaking work of Persson, Roland, and Tabellini (1996). They showed how an appropriate separation of powers provides net advantages to all constituent stakeholders.

A complete separation of powers requires that no director who possesses the power to manage the enterprise is also involved in governing the corporate entity. The European two-tiered board would appear to achieve this objective but is compromised by supervisory boards also being accountable for management. Shareholders in Figure 1 are shown electing two boards and in different ways. The author has introduced this arrangement in two public companies he has founded (Turnbull 2000a, 2002c).

A separation of the power to manage from the power to govern is typically introduced by Venture Capitalists (VCs) as a condition for their investment. This arrangement is also introduced in Leveraged Buy-Outs (LBOs). Jensen (1993: 869) states that they are "proven models of governance structure" and "LBO associations and venture funds also solve many of the informational problems facing typical boards of directors." Legal scholar Dallas (1988, 1997) has presented arguments and proposals for a separation of corporate powers, as have Diermeier & Myerson (1999).

Senator Murray (1998) recommended to the Australian Parliament that all publicly traded companies should be required to separate the power to manage from the powers to govern by establishing the arrangements shown in Figure 1. Murray renamed the "Corporate Senate" described in Turnbull (2000a) that only had veto power over conflicts of directors interests to be come a "Corporate Governance Board" with executive powers over any conflicts of directors interests that included managing the AGM. Figure 1 suggests that the "Stakeholder Congress" appoints the chair of the AGM to avoid directors or governors being conflicted in their accountability to shareholders and other stakeholders.

This allows shareholders to exercise control over the appointment and remuneration of both directors and governors with information provided independently of them as indicated in Figure 1. Shareholders obtain access to alternative views on the ability of the enterprise to provide benefits for all stakeholders (BRT 2019). Such contestability introduces Tensegrity into the conduct of AGMs.

There is no ethical commercial reason for managers of an organization to become both over-worked and conflicted by also being involved in the political process of governing the organization. US company director consultant, Ralph Ward promoted his business by publishing Turnbull (2012a) that identifies how the arrangement described in Figure 1 can provide win-win outcomes for shareholders, directors, mangers, auditors, non-executive directors or governors and stakeholders.

Figure 1 describes, "A new way to govern: Organizations and society after Enron" (Turnbull 2002a) commissioned by the UK "Think and do tank" the New Economics Foundation as a public policy pocket book to identify an alternative to Thatcher privatization or State ownership. Columbia law professor Katharina Pistor (2015) prescribed the pocket book for a course module at the Swiss International Law School (Turnbull 2015a). The pocket book describes "A new model of corporate governance" (Fink 2018) sought by the largest asset manager in the world to allow companies to provide "benefits for all stakeholders" (Fink 2018). Fink is one of the 181 CEOs of the US Business Round Table (BRT 2019) that have made a similar commitment.

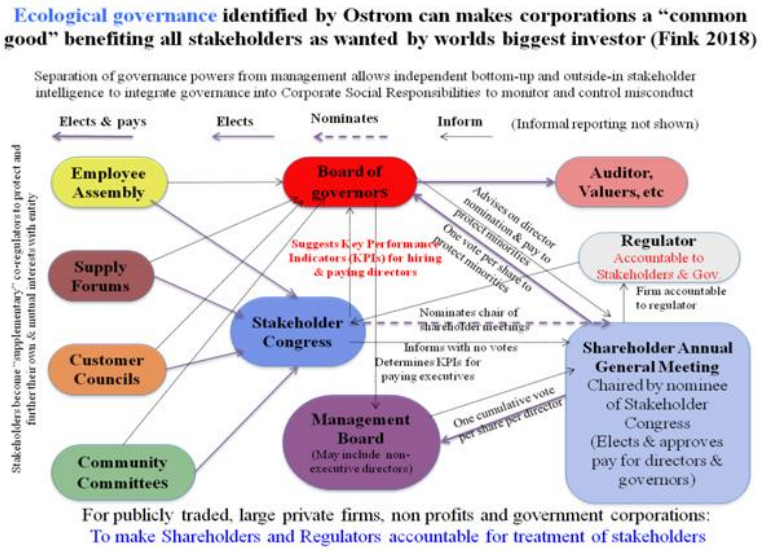

Figure 1

However, the BRT made no mention for the need to also introduce "A new model of corporate governance". CEO's accountable to all stakeholders can become accountable to no one. This led some commentators like Pistor (2019) to state that: "America's corporate leaders believe they can decide freely to whom they serve." A careful review of Figure 1 reveals that while stakeholder interests are represented in an influential manner, shareholder primacy is maintained to make shareholders accountable for protecting and furthering the interest of all other stakeholders. Achieving this objective would make corporations not only a common good but align their purpose in promoting the common good both locally and globally.

Figure 1 allows corporations to be become ethical as detailed in Turnbull (2019d). It creates the solutions identified in the right hand column of Table 1. In these ways ecological governance also directly increases the wellbeing of individuals by allowing them to constructively use their embedded instincts to introduce checks and balances for spreading organisational self-regulation and self-governance (Ostrom, Walker & Gardner 1992, Turnbull 2018b). How such transformation might be achieved is next considered.

4 How might corporations become a common good?

Elements of ecological governance could be introduced in various ways and stages to publicly traded corporations or other types of organizations in the private, public and/or non-profits sectors. These could arise from:

1. Governing bodies of organizations establishing a requisite variety of stakeholders advisory panels as shown in Figure 1 with any supporting geographical sub-units that besides increasing the depth and density of cross checking data from managers could also be used to promote Just In Time supplies, Total Quality Control for customers, Innovations by lead customers and/or users, employee voice (including anonymously to facilitate whistle blowers) and host community environmental and other feedback advice. Executives would be become accountable for making the entity a common good entity as proposed by the US BRT (2019).
2. Governing bodies establishing the above processes in formal regulations of the organization to facilitate the establishment of contestability, challenged, feedback and organizational tensegrity to promote continuous evolutionary improvements. Directors would become accountable for making the entity a common good entity.
3. Shareholders and/or members changing the constitution of their entity to introduce the arrangements outlined above to make shareholder and/or members accountable for transforming their entity to promote the common good with a "new model of corporate governance" such as proposed by Fink (2018).
4. Regulators mandating changes in corporate constitutions as above and/or
5. The government providing tax, and/or other incentives to implement the above processes with and/or without ecological ownership to create common good enterprises that also reduces inequality by democratizing the wealth and control of nations bottom-up.

Ecological governance enriches democracy by directly engaging with broad constituencies of voting stakeholders. This is why it is important that only voters are recognized as stakeholders, not corporate entities with who they may be associated as employees, contractors or agents. It creates a supplementary political process for individual voter to directly engage and participate in influencing institutions in the private, non-profit and government sectors. While Figure 1 maintains shareholders primacy, this can be extended to all *stakeholders* by introducing an ecological form of capitalism (Turnbull 2015b) that transfers ownership from shareholders to stakeholders after the time horizon of investors.

My first book, Turnbull (1975a) on *Democratising the wealth of nations*, was not about governance but ownership. It introduced the idea of Ownership Transfer Corporations (OTCs) as a way of creating an economic and political incentive for individual voters to become engaged in reforming capitalism. The book was published by the politically right Company Directors Association and launched and reviewed by a socialist Dr. Jim Cairns (1976) who had a PhD in economics and at the time was the Deputy Prime Minister of Australia. His favoraboe review was published in the Journal of Australian Stockbrokers providing evidence of the books bipartisan appeal. The publisher of the book had added

an alternative title for their members being “New money sources and profits motives”. Copies were sent to all members of parliament with a different covering letter that used the title most suited for the views of the recipient.

At the suggestion of the founder of the UK conservative Think Tank Respublica I changed the name OTC to the more politically nuanced language of “Endowment Corporation” in Turnbull (2014a). A short summary of the book was published by a politically left Australian Think Tank forty years after its publication (Turnbull 2015c). Academic presentations of the idea of replacing exclusive, static and perpetual property rights with inclusive, dynamic and time limited rights are presented in Turnbull (1973a. b, 1997, 1998) with the 1997 article republished in the Corporate Governance volume of *This History of Management Thought* (Turnbull, 2000d).

The Central Research Institute for National Economy in Prague translated articles for a visited they hosted me in 1991 and 1992 (Turnbull 1990, 1991b, d, f). In 1992 the State Commission for Reform of the Economic System hosted me in Beijing for lectures to their Cadres on using employee ownership as a technique for privation (Turnbull 1990). Some more notable practitioner and reform presentations are: Turnbull (1974, 1975b, 1980, 1983a, 1993a, b, 2002a, 2004, 2014a).

The majority of all business investments are time limited. Time limited property rights are not an alien, nor a provocative concept for venture capitalists and professional investors. A fact illustrated by the many Build Own, Operate and Transfer (BOOT) projects around the world. All intellectual property rights are time limited. A major intellectual problem is created by accountants assuming all business remain a “going a concern”. So unlike professional investors, accounting doctrines do not have time horizons. This means that investors can get overpaid receiving a cash return back after their time horizon. Any such return is by definition in excess of their incentive to invest to create a “surplus” profit. This is different and additional to any “super”, “excessive” or “monopoly” profit that may be received and reported before their time horizon. This makes them subject to measurement, reporting and taxation.

What is not reported is not managed, let alone taxed. As reported in my earlier writing surplus profits can be many times greater than the value of the original investment. However, economists assume that there is no limit to greed. This denies them possessing a concept or word to describe profits in excess of the incentive to invest.

Surplus profits have become an invisible and insidious systemic source of the inequality created by capitalism not considered by economists like Picketty (2014). As surplus profits cannot be measured, the best way of making the economy more efficient and fairer is to introduce dynamic property rights to democratize the wealth of towns, cities, regions and nations. Turnbull (1975a: 65-70) includes techniques for democratizing urban commons described in a subsequent literature archived by the New Garden Cities Alliance (NGCA 2020).

As corporations are typically taxed at a lower rate than many citizens and have ways to shift profits to tax havens, the transfer of corporate equity to individuals can generate

increased tax revenues and votes for political leaders. As shown in Turnbull (1975a, 2000d) tax incentive to provide investors with a bigger, quicker and less risky profits in return for gradually giving up ownership over the twenty year life a patent is relative small.

The endowment process can occur by shareholders agreeing to change their corporate constitutions to create a new class of Stakeholders shares. There is not limit to how many stakeholders shares can be issued but the percentage equity endowed each year can be constant. A process is established for any type of stakeholders shown in Figure 1 to become shareholders in a company that maintains shareholder primacy. My book suggests a proportion of stakeholders shares are reserved to fund a minimum universal wellbeing income described as a "Social Dividend".

Endowment corporations would payout all their profits each year like many cooperatives. Business growth, management and investor succession could be provided for through dividend re-investment in "offspring" enterprises. Giant corporations would become replaced with nested networks of locally owned and controlled enterprises of human scale as illustrated by the MCC. Investors "fading out with a profit" (Turnbull 1974, 1975b) would retain pre-emptive rights to continually be a shareholder in such networks of their choice.

Any incentive introduced to democratize the wealth of nations could also be used to democratize the control of corporate capitalism as indicated in Figure 1. This would enrich democracy on a bottom up basis with ecological governance. This would make self-governance practical to provide an additional way to reduce the size, cost and influence of governments (Ostrom, Walker & Gardner 1992).

Perhaps the most challenging problem in countering climate change is educating both democratically elected leaders and those leading other nations in self-perpetuating command and control hierarchies that neither markets nor hierarchies are sufficient, or even necessary. This problem requires a compelling proportion of the general population to demand changes as outlined above. The challenge for universities it to initiate educational courses at all levels of society to facilitate decision-making.

The economics Nobel Prize Committee have done their part in recognizing Elinor Ostrom in 2009 for sharing the knowledge of organizing collective action to avoid tragedies of the commons. It is ironic that she shared the award with Oliver Williamson who spent his life researching "Markets and Hierarchies" (Williamson 1975).

Markets are the cause of the problem as noted by a former Chief Economist of the World Bank. As Lord Stern he reported to the UK government that: "climate change is the result of the biggest market failure the world has ever seen" (Stern 2006). This is because markets did not price the pollution cost of burning carbon. Carbon taxing and trading provide a way to counter market failure but stop markets creating counter productive messages. To avoid markets creating messages to exacerbate climate change the definition of economic value needs to become by defined by the degree each bioregion of the world becomes sustainable for eternity. In other words the value of

money in each region needs to be tethered to a Sustainable Index for each region (Turnbull 1983b, 2011, 2016b, 2018b, 2019b, 2019c, 2020).

Hierarchies inhibit countering the problem of climate change as educational institutions and monotheistic religions unwitting reinforce the belief, that hierarchies are the natural of things. The opposite is the truth. As described by Hock (1995: 7):

> *Industrial Age, hierarchical command and control pyramids of power, whether political, social, educational or commercial, were aberrations of the Industrial Age, antithetical to the human spirit, destructive of the biosphere and structurally contrary to the whole history and methods of biological evolution. They were not only archaic and increasingly irrelevant; there were a public menace.*

Action research is required to test how best to introduce elements of ecological governance to institutions in the private, government and non-profit sectors. The immediate limitation is that no known graduate schools provide education in how to become a governance architect to lead implementation action. The biggest challenge is to disseminate this knowledge of how to sustain humanity on the planet.

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Strategic Design – A Study on the Value Added by Design in an Economic Context

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Abstract

The following paper aims to establish a strategic understanding of design by examining different approaches to quantify the value design can add in a business context. The approach of strategic design is based on the understanding of design as an integral part of the corporate strategy which can be derived from corporate culture as well as from a firms' mission. The paper intends to contribute to the subject of what economic value design creates for companies. Therefore, systematic approaches of how to quantify the value design may add in a business context have been juxtaposed with six structured in-depth expert interviews with firms from different sizes and branches in order to gather individual perceptions on the role of design in management. The study examines, how can a strategic understanding of design be established in a business context and to what extent does this lead to an added economic value.

Keywords – Strategic Design, Value Creation, Innovation, Understanding of Design, Design and Economics

Paper Type: Academic paper

1 Introduction

Design, it seems, is now everywhere. In fact, design is no longer only the professional scope of just product designers or interior architects. The use of design has already proven itself in a wide range of contexts and is becoming increasingly relevant, especially in innovation management (Micheli, 2014). Design is more and more integrated into business strategies and innovation processes of companies from various industries (Brown, 2009; Brunner, Emery & Hall, 2009; Martin, 2009). An increasing number of companies is seeking ways to turn design into a strategic resource for their organisation (Topaloglu & Er, 2017).

Design is undergoing a transition in the ways it is considered and used inside the companies. The traditional understanding of design inside business has been largely limited to the creation and development of products and services. More recently, the character of design has broadened towards a wider range of activities and responsibilities concerning the general business strategy and management. Designers and design-like methods, such as design thinking are increasingly considered to contribute in formulating new services and business models, restructuring a company's strategy, as well as in driving cultural change (Deserti & Rizzo, 2013; 2014; Lee & Evans, 2012; Lockwood, 2011; Buchanan, 2008; Junginger, 2008; Smith, 2008; Ravasi & Lojacono, 2005; Borja de Mozota, 2003; Turner, 2013). From a practical perspective, a growing number of design agencies (IDEO, Frog, NOSE) get involved in strategic services such as innovation strategy, technology strategy, business design.

However, the percentage of companies that have firmly integrated design into their business strategy is still relatively low (Wolf, 2009). Even if design is discussed a lot these days, it is still in need of a new image depart from pure shaping or implementing to enable a real strategic view. It is obvious that sending employees to design thinking workshops, hiring design graduates, and setting up interdisciplinary teams is not sufficient for an organisation to strategically benefit from design. To really make a difference, design needs to become an integral part of the organisation's strategy and management quite naturally. Knight, Daymond, and Paroutis (2019) call the strategic implementation of design, across marketing, sales, and operations a 'Design-led Strategy'.

Nevertheless, design investments and design activities have to prove and justify themselves (Rae, 2013). A prevalent problem can be seen in the inability to measure the economic value design creates for companies. The lack of a design measurement model leads to a requirement of representatives on top management level who are convinced that design can have much more impact to corporate performance if it is not only understood as a process of form-giving. Depending on the history of each individual company and the personal conviction of the management, the relevance of design is assessed differently.

Irrespective of the increasing number of articles highlighting the role of design in management and innovation, there are important gaps in the body of knowledge. Research is lacking on many important issues regarding the strategic value creation by design. There are still uncertainties regarding the term 'strategic design' and the general understanding of design as part of a firm's business strategy. Research is lacking on approaches how to integrate design in departmental structures, economic value chains, and the corresponding activities. Moreover, the predominant approaches to measure the value contribution of design in business contexts are still vague. Research is also lacking on the main challenges when design is anchored in a corporates' strategy.

This paper aims to provide qualitative empirical results in order to partly close these research gaps. Therefore, the research consists of two parts. Starting with a theoretical survey, based on the ability to classify the current state of design use within a company, several approaches to measure design value have been juxtaposed subsequently. The

scholarly part is followed by a qualitative research consisting of six in-depth expert interviews to examine the huge difference in the use of design in various companies to show overall aspects of design practice. Finally, the paper ends with the study's limitations and conclusions.

2 Theoretical review

The following sub-sections briefly present a synthesis of existing literature with regard to the general understanding of design, the integration of design in business value chains, the approaches to measure value contribution of design in business contexts, and main challenges of design management.

2.1 Understanding of design

A fundamental challenge in dealing with design is about the divergent understanding of design, which is both favoured and caused by low research activities making it difficult to clearly assign the areas of application, the way of organising design within a company as well as the stage at which design is included in the value chain (Viladàs, 2009). This lack of allocation leads to design being misunderstood and having to justify itself (Rae, 2013). As long as there is no common understanding of what design is, how it should be used and organized, it is hardly imaginable to establish a strategic understanding of design in an economic context. The almost 30 years old quote from Blaich & Blaich (1993) still holds its rationale: *„I have often wondered if any other discipline devotes as much time to define itself as design does."*

The necessary interlocking of the two disciplines management and design is well explained by Boland & Collopy (2004), where managers are told how to operate with a design attitude towards problem-solving oriented decisions. Besides that, also Nobel laureate Herbert Simon advocates new methods of management theory which should fundamentally internalize design (Simon, 1996).

Buchanan (1992; 2001) defines different levels of design usage in the 'f*our orders of design*' model. According to the author, design is about 'the human power of conceiving, planning, and making products that serve human beings in the accomplishment of their individual and collective purposes' (Buchanan, 2001). Based on that model, the first domain of *symbolic and visual communications* is the typical work of a graphical designer. It deals with the nature, shape, and meaning of *symbols* such as typography, illustration, photography, and print (Harland, 2011). The second order *material objects* includes the design of 3D-objects comparable to the work of an industrial or product designer, which is concerned with tangible, physical artefacts – with *things*. Since every product needs to be designed to be used, therefore there can be no 'non-designed' product. The third domain *activities and organized services* covers user experience and interaction as well as management tasks and strategic objectives for the first time. Here, the focus is on *action* and designing experiences rather than objects. In the fourth order of

complex systems or environments for living, working, playing and learning, Buchanan (2001) refers to the opportunity of design in integrating people into a broader ecological, social or cultural environment, which is to be adapted to human needs by designing environments. Design is understood as an 'idea or a *thought*' that organises the 'integration of information, physical artefacts, and interactions in environments of living, working, playing, and learning' (Buchanan 2001). This model helps to understand the wide range of design challenges ranging from symbols (graphic design), things and devices (industrial design), action and user experience (interaction design) and finally thoughts and strategies (environmental design).

Strategic design can be defined as the economic application of design to long-term strategic problem solving, which can only be defined individually on the basis of situational requirements by the problem solver and its context. Strategic design is therefore the basic orientation of all design aspects towards the same sense and purpose getting even more meaningful in a global and digital environment (Best, 2011; Zec, 2011). Strategic design helps companies to implement innovation strategies and becomes essential in increasing strategic challenges.

2.2 Organisational anchoring of design in a business context

How Design is situated in a business context, highly depends on its corporate understanding. The main difference in dealing with design is whether the business disposes of an own design department or working with an external design agency.

Operating with design is hardly successful when it's isolated from other disciplines, as it only works in conjunction with other departments (Best, 2011). Design does not create value as a stand-alone activity. It has to be able to work company-wide to overcome the silo organization and meet customer expectations (Rae, 2016). Every touchpoint of user and company has to meet the customer expectations. This requires a greater collaboration of departments (Micheli, 2014).

Using design as a way of product differentiation is also publicly known in economics, even if design was not included in internal economic dynamics for a long time. Design creates additional benefits for consumers that the product is given a value that is not defined by its price. Especially in times of technical convergent products, design is attributed an increasingly important role as a purchase argument (Zec & Jacob, 2010).

However, design needs an organisational anchoring. This can be seen as the activity of grounding and aligning design aims and goals in the organisation's structure, culture, needs, and aims. On one hand, the way of organising design within a company often defines how design can be used. On the other hand, how design is organised in a company is significantly influenced by the understanding of design. Very rarely design gets as much attention to be able to influence strategic decisions on management level. It requires certain organisational structures for design to operate as an element of corporate strategy.

2.3 Measuring the business value of design

There are several studies trying to examine the value added by design, showing that there is a positive correlation between the use of design and improved economic performance (Sheppard et al., 2018; Wescott et al., 2013). Research shows that managers feel a desire to quantify the value of design to prove the advantage of strategic design scientifically (Best, 2011). However, none of the existing approaches about the quantifiability of design contains a real key figure to show the value added (Rae, 2016).

The significance of these approaches trying to examine the value of design remains questionable as long as the criteria for determining an average to design-led company are not openly defined. In view of the inability to define design, how can it be measured and how can something be managed without it being measurable? For quantifying the value of design, it seems to be necessary to integrate design in a corporate understanding while convey design's success (Zec, 2011).

The use of design depends largely on the importance that is attached to design in the company. Therefore, different approaches as the Design Ladder (McNabola, 2013) have been analysed during the research to classify the maturity levels of design usage. The surveyed companies were asked to classify themselves into one of the four different steps of Non-Design, Design as Form-Giving, Design as Process and Design as Strategy (Danish Design Center, 2016). The Design Ladder is a useful tool to classify the current state of design in the company and is widely known in literature and practice (Wolf, 2009). The basic assumption is that a positive correlation between design and economic performance occurs (Danish Design Center, 2016). This relationship has been confirmed by Baars (2018), showing that some success criteria such as market position and return on invest increase with a higher position in the Design Ladder. However, a study by the British Design Council (2008) reveals that almost 70% of the companies surveyed do not measure a Return on Design Investment (RODI).

2.4 Challenges of strategic implementation of design

There was a movement to integrate design within the slogan „Design is a boss' job" into *top management and leadership positions* in the early 1990s (Topalian, 1990; Topaloglu & Er, 2017). The concept of Design Management has already attracted some attention in the 80's. If design is understood as a "bosse's job" it is directly connected to the beliefs and opinions of the management team and is therefore very dependent on just a few individuals in a firm. Designer as leaders need to be visionaries, as Otl Aicher or Steve Jobs once showed in an exemplary way. Designers need to be able to work interdepartmental speaking one language with other departments to advertise design internally (Micheli, 2014). A well realized design leadership improves the experience of each individual with the company (Dawton, 2011).

Another fundamental challenge in dealing with design is the *clash of two cultures* in form of economy and design (Best, 2011). While the university environment already

separates business economists and designers, it is extended to the working environment. The cultural peculiarities may cause the huge differences within firms in terms of views and perception of design as value creating. While some are degrading design as a simple form-giving process, others understand it as a differentiated way of organizing customer needs, as a process or even as a strategic tool (Best, 2011). The more design is integrated into corporate culture and the whole process of product development, the more effect it possible (Micheli, 2014). To use design as a resource, it needs to be omnipresent (Dawton, 2011).

Moreover, designers lack the ability to justify and communicate the added value of design, as there is no possibility of quantification and designers mostly lack the economic references. Unfortunately, the result is a devaluation of the design profession and a reduced appreciation of the design process.

Companies recognize that breaking down disciplinary barriers leads to innovation and to a higher customer orientation. In contrast to this, traditional corporate value chains and the strict division of labour in an organisation places the customer not in the heat but at the end of the chain (Baars, 2018). A diversified form of organization has to develop in such a way to enable an integration of the customer. In addition, the organisation of individual silos has to be abolished so that a project-specific cooperation of all departments is possible. Usually, internal design departments or external design agencies are entrusted with design-relevant tasks, regardless of the value-added process of the product (Baars, 2018). Thereby, design is often considered as a downstream activity. Design-led companies where design is well integrated into the process of product development are still the exception (Avore et al., 2018).

The supposedly new method of design thinking offers a solution approach to product development in which products and corporate structures are developed in a customer-centered manner, which can provide companies a decisive competitive advantage considering saturated markets. Design can only be used interdepartmental and interdisciplinary to gain customer centricity and a strategic design application.

Designing the social, economical and cultural environment towards human requirements using the approach of human centered design results in a long-term improved business performance. Through the changing economy where experiences are becoming a distinct economic value, user experience designers (UX) are transforming the human-machine-interaction to create new customer experiences which are more and more becoming the product itself (Gruber et al., 2015). In this context, design is the essential tool to build an overall and consistent customer experience by designing each touch point of customer, product and company. Companies such as Google, Amazon or Samsung are best practice examples in creating vast consumer experiences.

Research Questions

According to these given assumptions and challenges the main research questions of the present paper are:

- How can a strategic understanding of design be developed in business contexts?
- How can design be fully embedded in economic value chains and the corresponding primary and secondary activities?
- What are predominant approaches to measure the value of design in business contexts?

3 Methodology

3.1 Research Design

To get information on the research question a qualitative study is undertaken, including structured in-depth interviews with firms from different branches and sizes in order to gather individual perceptions on the role of design in management (Kuckartz, 2016). We chose this qualitative approach because of its strengths in analysing contemporary and unique phenomena with little theory (Yin, 2003).

3.2 Data Collection

Data were collected mainly through semi-structured interviews, and wherever possible internal documentation. We conducted 6 interviews between October and November 2019. In the study focused on how the interviewees perceived design and its strategic role within their company. The interview questions revolved around the core issues of this paper, the companies' understanding and definition of design, the anchoring of design in an organisation, the applying of design in the value chain, the ability to quantify the business value of design, and the main challenges related with strategic design.

Two interviews were conducted face-to-face, while the others were guided by phone. The interviews lasted between 42 and 78 minutes and were recorded and later transcribed. Multiple perspectives were gathered (Eisenhardt & Graebner, 2007) from interviewees from different functions such as design management, brand management, corporate communications, product design, and strategy. Table 1 summarizes the six companies and the interviews.

3.3 Data Analysis

The interview transcripts were subjected to a content analysis for systematical examination being structured and analysed in six main categories. The following table (table 1) gives an overview of the interviewees and their main understanding of design. Currently six interviews are completed, differing in their use and understanding of design.

Table 1: Overview of interviews and companies included in case study

No.	Size of company (No. of employees)	Year of foundation	Branch/ industry segment	Products/ services	Position of interviewee	Gender of interviewee	Duration of interview	Type of interview
1	14.000	1923	Engineering	Equipment for sheet metal processing	Head of Design Management	f	42 min.	phone
2	216.000	1995	Telecommunication	Software, hardware, services	Head of Design, Team Manager	m	78 min.	Face-to-face
3	16.000	1862	Security industry	Access -, door-, lock systems, room systems	Head of Strategic Product Design	m	45 min.	phone
4	1.049	1950	Sanitary industry	Flow regulators for showers and washbasins	Leading Expert Scouting and Foresights	m	57 min.	phone
5	90.000	1870	Financial industry	Range of financial services	Head of Brand Communications and Corporate Social Responsibility	m	43 min.	Face-to-face
6	360	1930	Office supplies	Writing implements	Head of Brand and Product Strategy	m	59 min.	phone

4 Results

4.1 Understanding of design

It has been discovered that the definition of the term design is highly dependent on personal adjustment of which nobody can be convinced externally. Design is able to generate additional benefits and to influence purchase decisions in an important manner. The results underline the assumption, that there is no ’non-designed’ product. Especially in technic centered companies design is understood as form-giving, mostly without any strategic use. The understanding of design must detach itself from the image of pure product design in order to be recognized as a strategy. The changed definition of design can be seen as a shift in meaning from product design to the design of a scenario, which explains the transformation to an experience economy (Gruber et al., 2015).

Table 2: Main assumptions regarding the role of design

No.	Branch/ industry segment	Main assumption
1	Engineering	Design is important, but not fundamental to an engineer-led business.
2	Telecommunication	Design is the most important instrument for customer centricity.
3	Security industry	Uniform product design is most essential.
4	Sanitary industry	The understanding of design must evolve with the spirit of the times.
5	Financial industry	Design can influence everything and is much more than just product design.
6	Office supplies	Every human decision is influenced by design. Design needs to be evaluated in its very own context.

4.2 Organisational anchoring of design in a business context

Most companies within the survey did not have an own design department but are working with external design teams, notwithstanding the fact that they are mostly design centered companies. The findings show that the organizational anchoring of design is not necessarily an indicator of a strategic design use. Furthermore, participants report that design is used in marketing and sales department, recognizing a strong connection between design and the technology development, in which above all methods of design thinking are used. Strategic design requires interdisciplinary cooperation and needs to be supported at management level to have strategic impact. The study approves the assumption that design needs to be established in the corporate strategy, but the greatest relevance is assumed in convincing employees – especially middle managers – of the added value of design and affect the corporate culture accordingly. In addition, a design manager could facilitate in guide design centricity.

The respondents argued, that design is mostly used as a factor to differentiate in Marketing and Sales, or to develop an own Corporate Identity. Apart from that, Design Thinking is widely known as a tool for product and technical innovation. The Human Resource Management uses design as a competitive advantage for Employer Branding within the War of Talents.

4.3 Measuring the business value of design

One of the main assumptions is, that the management level needs to be convinced of the value through design by (financial) metrics. However, design cannot be distinguished from other disciplines due to a lack of a uniform understanding of design and is therefore difficult to measure (Micheli, 2014). Participants see a positive correlation between design and business success, but none can quantify the share of design in the company's success, as there are many factors having an impact on business performance. The meaningfulness and thus the persuasive power of an indicator for the representation of added value through design remains still questionable. The results do not clearly answer the question if key performance indicators may or may not contribute to a changed perception in dealing with design. In fact, there is some evidence, that tangible examples

have a comparable effect to performance indicators if they are both meaningful and emotional. For example, when the company can record a substantial decrease of complaints or product returns simply by modifying the design of products and processes.

5 Limitations

The study followed a qualitative empirical approach including six in-depth interviews with long durations. One major limitation of our study is, that we were only able to picture a very limited excerpt of branches and company sizes. Therefore, the study is not representative, as we could have shown numerous of more examples of how design is used. Furthermore, the positions of the surveyed were limited for the same reason. Future research could try to counteract this limitation by a quantitative research. We rely on our participants telling the truth without being prejudiced by their companies view.

6 Conclusion

Strategic design not only contributes to product appreciation, it also enables companies to achieve a customer focus as well as a holistic customer experience that has to be the main aspect of every business. From a managerial perspective design is able to interlink different abstraction levels in a firm, when connecting the corporate vision and sensemaking with product development and customer service.

Designers are taught to understand the customer as the starting point of each problem-solving process. Therefore, the 'image problem' of design should be tackled. This can only be solved by establishing a new understanding of design and thus a new design culture. Managers should also strive to establish a common understanding of what design is, for example through an individual, company-wide definition. This may prevent that designers constantly have to defend themselves when collaborating with other departments.

With regard to the measurement of design value, the establishment of a strategic understanding of design in a business context depends on individual and personal attitudes and therefore can barely be justified by a simple number. Nevertheless, a figure representing the added value of design could contribute to the conviction of some people, managers in particular, but it can hardly provide the decisive argument. Managers should be aware, that design is and will remain an emotional subject, which importance could best be illustrated by success stories and not only by key performance indicators.

Saturated markets require a constant measure of innovation, which is fundamentally promoted by design. While management directs internal processes and strives for continuous optimization, strategic design enables the fundamental value creation of a company. The optimization of processes and the general management of the company is limited, so strategic design is needed to generate an added value (Baars, 2018). Only a collaborative approach of design and management leads to a perfectly balanced problem-solving process. Especially technology-driven companies may benefit from a more

strategic understanding of design, given the fact that holistic user experience and not high-level functionality only becomes distinctive in global competition.

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Specifying Knowledge Maps through Ontology Engineering[1]

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Abstract

Companies are burdened under information flow overload. The knowledge maps can support the knowledge workers and decision makers in this situation. Knowledge map as a term has been used with various meaning in several different scientific communities: not only in knowledge management, but also in education studies, in organization studies, in decision analysis, in artificial intelligence etc. To generalize the variety of the definitions (e.g. Eppler or Leibovitz) one can use the term of knowledge map as a description of the sources, flows, constraints and sinks of knowledge within the organisation. The current study considers knowledge maps from knowledge management perspective and is devoted to the generalising the numerous scattered knowledge mapping research and practices. It aims to identify and generalize the contents of knowledge maps - what are the main concepts, which are represented in knowledge maps, and relationships between them. The discussed research results in an ontology (or conceptual model, as it was defined by Gruber) for knowledge maps. Existing types of knowledge maps are associated with fragments of this ontology, so typical views and templates will are also highlighted. Such an ontology may help to select the necessary elements for knowledge mapping in specific company and situation. The research methodology is based on literature review, semantic analysis and ontological engineering.

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The paper helps to clarify the content of knowledge maps, its' meaning and possible components. It provides building blocks for creating company-specific knowledge mapping templates and practice.

Keywords – Knowledge maps, Templates, Ontology, Semantics, Knowledge management systems

Paper type – Academic Research Paper

1 Introduction

Companies are burdened under information flow overload. Knowledge Map can help as it describes what knowledge is used in the company, and how it flows around the business processes. It is the basis for determining knowledge commonality, or areas where similar knowledge is used across multiple process (IBM, 2004). The knowledge maps as a graphical "description of the sources, flows, constraints and sinks of knowledge within the organisation" (Leibowitz, 2005) can support the knowledge workers and decision makers. Knowledge map as a term has been used with various meaning in several different scientific communities: not only in knowledge management, but also in education studies, in organization studies, in decision analysis, in artificial intelligence etc. (Eppler, 2008).

The current study considers knowledge maps from knowledge management perspective and is devoted to the generalising the numerous scattered knowledge mapping research and practices. It aims to identify and generalize the contents of knowledge maps - what are the main concepts, which are represented in knowledge maps, and relationships between them. "Knowledge management perspective" means that we do not include into the term "knowledge map" different knowledge diagrams – like mind maps, concept maps, flowcharts, etc. that just depict the main relations between the pieces of knowledge body.

The discussed research results in an ontology (conceptual model) (Gruber, 1993) for knowledge maps. Questions are associated with fragments of this ontology, so typical viewpoints and templates are also highlighted. Such an ontology may help to select the necessary elements for knowledge mapping in specific company and situation.

Research in knowledge mapping is not so young and started in late 90-ies. There are some generalizing works in this area, for example, overview of the concept (Wexler, 2001), classification of knowledge maps using different criteria (by purpose, by format, by content) (Eppler, 2008), systemic survey of knowledge mapping research (Balaid et al, 2016). There are also some methodologies and frameworks with knowledge maps structure and templates (Harper, Trees, 2018; Hubert, Trees, 2018). But there is no surveys devoted to the content ("what") of knowledge maps, which analyse examples and templates of knowledge maps in order to identify possible components and building blocks of a knowledge maps. This research fills an aforementioned gap.

2 Research methodology

Our research methodology is based on literature review, semantic analysis and ontological engineering. Existing templates and examples of organizational knowledge maps from literature are analysed using semantic analysis – the main concepts, which are represented in knowledge maps, and relationships between them will be extracted. Methods of ontological engineering (Suárez-Figueroa et al, 2012) are used for establishing a unifying ontology (conceptual model) for knowledge maps. Such ontology development represents an example of design science research, which "extends the boundaries of human and organizational capabilities by creating new and innovative artifact" (Hevner et al, 2004).

The research process is represented at Fig. 1.

Research start from the analysis of existing types of knowledge maps and their classifications (section 3). This analysis helps to select knowledge map examples and templates for further specification. Literature review is the main method at this step.

Ontology development in section 4, on one hand, follows classical logic (requirements specification, knowledge reuse, conceptualization etc.), but, on the other hand, is mostly driven by the idea of pattern-based ontology design (Presutti et al, 2012). Specifications of content for the selected knowledge map examples and templates – information models or metamodels – can be considered as content ontology design patterns ("content patterns) for creating an ontology of knowledge maps.

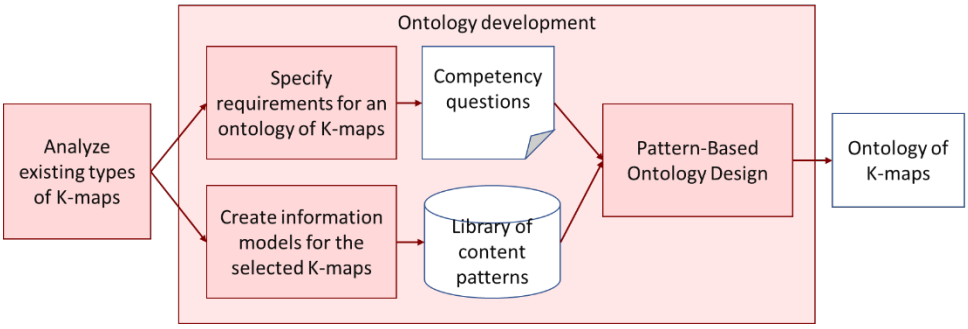


Fig. 1. Research process of the study

3 Analysis of existing knowledge map types

A number of different typologies of knowledge maps have arisen during the last two decades. The early developed ones have inconsistent classification parameters or describe only small part of the knowledge maps variety. Further we focus only on several mature classifications, namely (Eppler 2004), (Eppler 2008), (Hubert 2018).

The classic of visual approach to knowledge management Martin J. Eppler proposes several extensive classifications of knowledge maps. One of the most practical ones is (Eppler, 2004) which includes:

1. Knowledge source maps (where the knowledge is),
2. Knowledge asset maps (what kind of knowledge we have),
3. Knowledge structure maps (how the knowledge is interconnected),
4. Knowledge application maps (which knowledge is needed for the certain process),
5. Knowledge development maps (how certain competence is developed).

It can be noticed that only the set of the mentioned maps tells a convincing story about the organizational knowledge. Moreover, this set is not complete and priority of a certain map over the other may be defined only in the organizational context. In his later work Martin Eppler criticized this classification: "The main problem with this classification is that it is not comprehensive, versatile, or precise enough to be of general use in knowledge management" and suggested a new one (Eppler, 2008) – more precise, rigid and formal.

New Eppler's classification of knowledge maps is multi-faceted (Eppler, 2008) – it includes several simple classifications, which are created based on different classification principles or facets:

A. by intended purpose or KM process (''why?''), which includes knowledge identification maps, knowledge assessment or audit maps etc.
B. by content, which is represented in the map (''what?''): by *content format* (blogs, books, repositories, online courses, etc.) and *content type* (methods, experts, processes, departments, lessons learned, concepts, events, skills and competencies, patents, knowledge flows, and knowledge needs);
C. by graphic form for representing the map (''how?''): includes all spectrum of visuals from matrixes to metaphors
D. by their creation method (''how?'' and ''who?'') - from community generated maps that are constantly revised and refined by map users to automatically generated maps;
E. by the level, at what the map is applied (''who?'').

Facet A (by purpose) includes types, which intersects with the first Eppler's classification.

Facet E (by the level) is common for Eppler's and APQC's classifications what distinguish the organizational level at which the map is applied: personal, dyadic, team, departmental, community, organizational, inter-organizational levels in (Eppler 2008); enterprise, cross-functional, process- and role-based levels in APQC (Hubert 2018). At the enterprise level APQC recommends focusing on fit between strategic goals and organizational knowledge using Strategic Overview Map and on knowledge at risk in Expertise Overview Map.

At the next level, the maps help to identify knowledge (Expertise tacit map) and to understand potentials and gaps (Technical/Functional knowledge map). Lastly, at the process- and role-level APQC suggests identifying needs and sources of knowledge via Process-based map and Job/Role-based map. Another type of knowledge map at this level

is Competency/learning needs map. As the title implies, this map outlines learning needs for a certain task.

Another typology of knowledge maps is suggested by Novins (1997):

a) pointer models (points to the correct source, usually a person),
b) linkage models (adds some meta information on the sources),
c) solution models (relates knowledge areas to business problems).

Table 1. Some examples of knowledge map types and their content

Name of the map	Content	Source
Knowledge application map	knowledge, processes or steps	(Eppler 2006)
Knowledge source map	experts, competency areas, business areas, geographical location	(Eppler 2004)
Knowledge assets map	stock of knowledge; an individual, a team, a unit, or a whole organization	(Eppler 2004)
Knowledge assessment or audit map	knowledge asset, current ability, future importance	(Eppler 2006)
Knowledge identification map	experts, patents, practices and their location/coordinates	(Eppler 2006)
Knowledge assets map	location of important knowledge assets	(Gilbert et al. 2000)
Cross-functional knowledge map	functional or technical knowledge, expertise in tacit knowledge	(Vestal 2005)
Process-Based Knowledge Map	process, activity, knowledge needed, format of knowledge, knowledge gap	(Hubert 2018)
Job / role based map	Jobs, roles, specific knowledge	(Hubert 2018)
Expertise overview map	knowledge in various parts of business, knowledge at risk	(Hubert 2018)
Knowledge assets value creation map	knowledge asset, performance objective, general objective	(Carlucci 2007)

4 Ontology of knowledge maps development

4.1. Competency questions

The analysis of different types of knowledge maps helped to specify questions, which may be answered using knowledge map. These questions can be considered as competency questions, which define functional requirements for ontology engineering:

A. What kind of knowledge company have?

- What are the (main) knowledge assets?
- What are the (main) topics/areas of company's knowledge?

- What are the types of company's knowledge?

B. Where knowledge is used and what knowledge is needed?

- What knowledge is required for performing certain activities?
- What knowledge is required for producing certain products and services?

C. What are the sources of knowledge?

a. Which person or role owns knowledge?
b. In which organizational unit knowledge can be found?

D. How necessary and current knowledge can be assessed?

a. What is the level of importance of any specific knowledge?
b. What is the size of the gap in any specific knowledge?
c. What is the level of expertise in any specific knowledge?

E. How knowledge is exchanged?

a. What knowledge is exchanged between persons?
b. What knowledge is exchanged between organizational units?
c. What knowledge is exchanged between information systems?

F. How knowledge will be created/acquired/developed?

a. What are the stages of knowledge development?
b. What is the learning path or a roadmap?

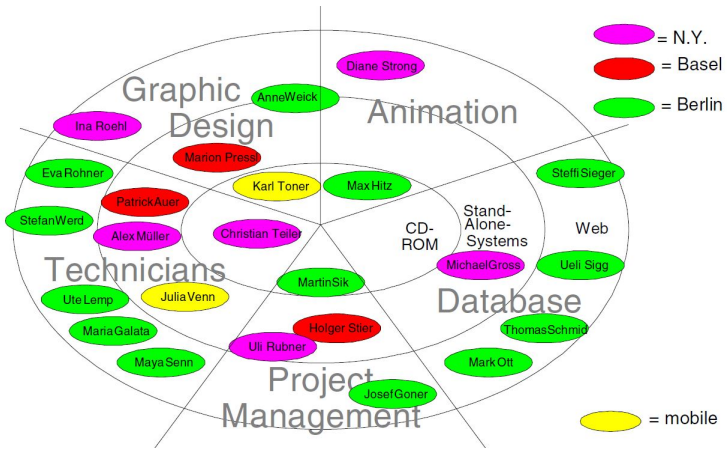
4.2. Specification of knowledge maps content

Specifications of content for the selected knowledge map examples and templates – information models or metamodels – can be considered as content ontology design patterns ("content patterns) for creating an ontology of knowledge maps.

Figure 2 demonstrates an example of information model, which specifies the contents of knowledge source map.

a) Example of knowledge source map

Source: (Eppler, 2004)



b) Information model (metamodel) for the knowledge source map

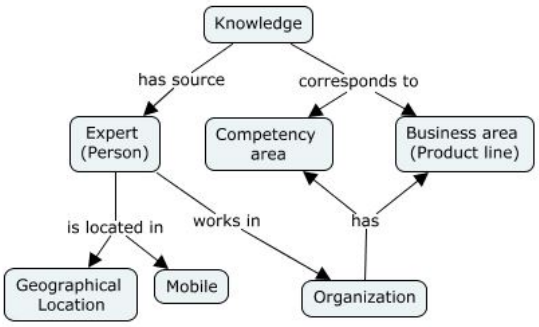


Figure 2. Example specification of knowledge maps content

4.3. Ontology of knowledge maps

According to (Presutti et al, 2012) the idea of pattern-based design implies that "the ontology project is divided into the problem and solution spaces. The problem space contains a set of requirements (see Competency questions), while the solution space contains a set of ontology-design patterns. The two spaces are compared in order to identify patterns matching the requirements." Then relevant patterns are selected and combined.

Fig. 3 shows the preliminary version of an ontology of knowledge maps. High level groups of concepts are aligned with competency questions.

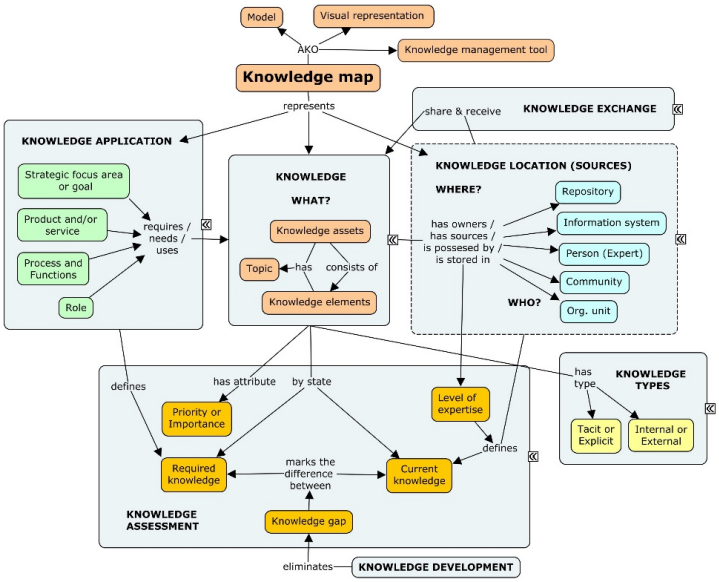


Figure 3. Ontology of knowledge map

Figure 3 generalizes the above described features and classifications of different knowledge maps into the skeleton of the ontology. This ontology gives the broader and deeper understanding of knowledge mapping techniques

5 Conclusion

For the last twenty years knowledge maps take into account the who, what and why of the knowledge mapping process. Best professional knowledge maps help identify intellectual capital, socialize new members, enhance organizational learning and help anticipate impending threats and opportunities (Wexler, 2001).

Knowledge mapping helps in the process of the continuously evolving organizational memory, capturing and integrating strategic explicit knowledge. This process takes place within a company or institution and between it and its external environment (Wexler, 2001). K-mapping may also support the learning within the company as it enhances and enriches the visibility of knowledge structure.

This paper and designed ontology helps to clarify the theory and practical content of knowledge maps, its' meaning and possible components. It provides building blocks for creating company-specific knowledge mapping templates and practice. In the context of digital era the created ontology may improve the design of information system for knowledge mapping and integration of this system into overall organizational IT architecture (Oberle, 2014).

In the context of digital era the created ontology may improve the design of information system for knowledge mapping and integration of this system into overall organizational IT architecture (Oberle, 2014). In addition, it ultimately enhances the cognitive comprehension and the deeper understanding.

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Value Chain Profiles and Business Performance in Microenterprises in Southern Ecuador

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Abstract

This research will show the value chain profiles of microenterprises in emerging countries in the dimensions of planning, installed capacity, maintenance, research and development, and procurement.
The sample used included 120 microenterprises from various productive sectors in the south of Ecuador. Data collection was carried out in 2019, by means of an online questionnaire, sent by e-mail through the Business Observatory of the UTPL to the managers and/or directors of the microenterprise. To identify possible groups of microenterprises, cluster analysis was used; a technique that allows identification of groups with similar characteristics, previously used to study configurations in microenterprises.
The present authors hope that the findings will contribute to the resource-based view (RBV), by characterizing the profiles of microenterprises according to value chains, in the particular context of an emerging economy such as Ecuador.
The determination of the number of profiles, characteristics, and needs of microenterprises will serve public managers for decision-making, helping to more efficiently target the resources and efforts needed to develop local microenterprises.

Keywords – value chains, business performance, cluster analysis, SMEs, Ecuador.

1 Introduction

Currently, Ecuadorian microenterprises compete at a disadvantage against global companies, with regard to innovation, human capital, knowledge, and technology development. Compared to other Latin American countries, Ecuador has an incipient degree of innovation, ranking 99th after Chile (51), Uruguay (62), Brazil (66), Colombia

(67), Peru (69), Argentina (73), and Paraguay (95); surpassing only Bolivia (Global Innovation Index 2019).

To reduce such competitive gaps, microenterprises need to take action to improve value chains and develop competitive capacities. The analysis of these chains enables identification of the main activities that develop value for customers and company, in order to contribute to the improvement of the activities in an efficient and effective way (Porter, 1985). Understanding the situation and the need of the customer together with the right supply enables improvement of the joint demand chain, leading to higher efficiency of the demand chain, and high customer satisfaction (Heikkilä, 2002).

Analyzing value chains, the present study recognizes that not all companies are equal. The existing differences in productive activities, marketing channels, and types of leadership require specific analysis and solutions; therefore, it is not possible to build a proposal and solution for all, with the priority being to characterize microenterprises.

Analysis of the value chain as a strategic planning tool aims to maximize value creation and minimize costs through the classification of the activities that generate value in an organization being the "primary activities", including inbound logistics, operations (production), outbound logistics, marketing and sales, and services (maintenance). The "support activities" include infrastructure, administration, human resources, research and development (R&D), and acquisitions.

Several studies have analyzed the components of the value chain and their impact on performance. For example, the empirical study conducted by Baihaqi & Sohal (2013) of 150 manufacturing industries in Australia analyzes the influence of supply chains on organizational performance through the following four variables: internal integration practices, information technology, information quality, and cost-benefit sharing. Additionally, by using the structural equation model, it demonstrates that technology and information quality positively influence the intensity of information exchange, while internal integration and costs are not related to business performance. On this theme, the study by Perona & Saccani (2004) analyzes how to manage the processes of the value chain in customer-supplier relations for the household appliances industry in Italy. This descriptive study, carried out with the application of questionnaires, in-depth interviews, and the use of integration techniques in three domains—operation management, technology management, and strategic planning—qualitatively verified the level of integration in customer-supplier relations for four household appliance industrial groups. Green management in the supply chain was analyzed by Holt & Ghobadian (2009) in their study applied to 60 companies in the UK manufacturing sector, where the authors identified three factors influencing the supply chain—legislative pressures, leadership committed to the environment, and the social factor.

The previously stated studies focused on a single segment of the value chains of companies: backward (suppliers), during the process, and forward (marketing); including, analyzing a single sector of productive activity, as observed in the research by Perona & Saccani (2004). Therefore, there is a great opportunity to work with all of the activities

for a country not yet properly explored. Additionally, in a preliminary search carried out in the preparation of the present study, no relevant work on the profiles of value chains in microenterprises in Latin America and Ecuador were found.

To close this gap, the present study seeks to answer the following questions: What are the profiles of microenterprises in southern Ecuador according to the behavior of value chains? What are the most frequent value dimensions in microenterprises based in Loja? And finally, what are the value chain configurations in competitive companies?

To answer the questions posed, the theory used will be the resource-based view (RBV) (Barney, 1991), suitable for this type of study and unit of analysis (microenterprise). This theory has been used in similar research, such as that developed by Rosca & Bendul (2019) and Parast (2019).

2 Conceptual background

2.1. Ecuadorian microenterprises' challenges for productivity

Productivity is the main creative force of prosperity. In a globalized world, competitive advantage prevails as a means for businesses to grow and position themselves in the markets. Productivity determines the degree of efficiency with which resources are used in organizations and countries *(Cooper, 2004)*.

An increase in productivity is largely explained by technical progress and knowledge development. Improving productivity in Ecuador is one of the main objectives of the productive sectors and is a major factor in determining the economic growth and development of countries.

In Ecuador, the degree of productivity and innovation of microenterprises is low compared to the rest of the world and Latin America, and there is currently high pressure to improve productivity levels due to competition and the internationalization of economies. Therefore, organizations plan and define both short and long-term strategies to be, and remain to be, competitive in domestic and international markets. *(*Global Innovation Index 2019*, s. f.)*

Ecuador, ranking among the last places (99) in the Global Competitiveness Index (*Global Innovation Index 2019*, s. f.) pursues a great challenge of reducing these gaps, which may in principle seem unattainable due to the unequal competition between small, medium, and large companies.

The Ecuadorian business network is predominantly made up of microenterprises (94%), and the cost of acquiring raw materials, production, and marketing is high compared to larger companies. It is therefore necessary to improve productivity, considering that not all companies need the same measures to grow and conquer local and regional markets because they are different.

Today, planning, technology, and innovation play an important role in global business management, becoming fundamental tools for companies to be effective, efficient, and

competitive. Ibujés Villacís & Benavides Pazmiño (2018) point out that the use of technology has increased the productivity of small and medium-sized enterprises (SMEs) in the textile industry in Ecuador, hitting quality standards and being more competitive in the global market.

2.2. The role of value chains in business competitiveness

In Ecuador, analysis of value chains has not been considered as a planning tool for microentrepreneurs to increase levels of competitiveness. Microenterprises cannot survive alone in a globalized world, and even more so, close relationships and coordination between the different activities of the value chain are required to be competitive (M. Lewis & Slack, 2003). To achieve greater growth, companies must coordinate effectively in the development of new products and strategic planning (Perona & Saccani, 2004).

Analysis of the value chain as a strategic planning tool aims to maximize value creation and minimize costs, through classification of the activities that generate value in an organization as "primary activities", which include inbound logistics, operations (production), outbound logistics, marketing and sales, and services (maintenance); and "support activities", which include infrastructure, administration, human resources, research and development (R&D), and acquisitions (Porter, 1998).

Reducing costs, increasing the quality of products, and being more competitive must be the result of making decisions based on the analysis and evaluation of all activities that involve the production process that generate value. Studies such as that carried out by Bayhaqi and Sohal (2013) of 150 Australian manufacturing firms show that considering only a part of the supply chain is not enough—the exchange of information is essential, but insufficient by itself to achieve significant improvements in the performance of the company. On this theme, the study by Perona & Saccani (2004) analyzes how to manage the processes of the value chain in customer-supplier relations for the household appliances industry in Italy.

However, most microentrepreneurs are not prepared to identify, plan, and manage the main activities that develop value for customers; they often start business activities ignoring many of the key dimensions of managing a business and must obtain the necessary skills to survive (Shepard et al., 2000). The importance of entrepreneurial skills, such as innovation and risk-taking, should not be overlooked as essential ingredients for the success of SMEs, according to Nieuwenhuizen and Kroon (2002) and cited by Urban & Naidoo (2012).

Ecuadorian microenterprises need to develop managerial skills that allow them to be more innovative and thus more competitive (Diaz-Villavicencio et al., 2016), but not in isolation. Collective learning and relationships of trust can also reinforce the growth and development of clusters, and businesses within them (Niu, 2010).

Hence the need to characterize microenterprises according to the criteria of planning, installed capacity, maintenance, research and development, and procurement. By grouping together, companies appear to be able to draw from a common and accessible set of resources, information, and demand for innovation in order to improve skills and create global competitive advantages (Niu, 2010).

3 Research methodology

3.1 Sample

The information was obtained in the city of Loja, capital of the province of the same name, located in southern Ecuador. The region has 442 microenterprises (Superintendency of Securities and Insurance Companies, 2017). The microenterprises considered were those that met the criteria of an annual sales volume less than US$100,001, while the number of persons employed being equal to or less than nine workers (regulation of the Trade and Investments Production Code, 2010).

Ecuador was chosen as it is an emerging market, highlighted by low individualism, high uncertainty, and high power of hierarchy expressed in the degree to which the less powerful states in a society accept and expect that power is distributed unevenly, whilst also accepting and respecting a hierarchical order in which everyone has a place (Hofstede, 2011).

For the identification of microenterprises, the present authors were supported by the Business Observatory of the Private Technical University of Loja (UTPL), who provided the database for this research.

Data collection was carried out during the months of September and November 2019, with an online questionnaire used as the data collection instrument, sent by e-mail through the Business Observatory of the UTPL to the managers and/or directors of the microenterprises. The link for the survey was accompanied by a message to encourage participation, with the present authors committing to publish the final results. Participation was encouraged through telephone calls and personal visits to microentrepreneurs. One hundred and twenty surveys were collected from 442 microenterprises in various sectors, representing a response rate of 27.15%. Then, 40 responses were excluded for presenting incomplete information, resulting in a total of 80 useful surveys for analysis.

The industries best represented were wholesale and retail (20%), information and communication (17%), administrative and support services (17%), manufacturing (8%), real estate (7%), teaching (7%), and others (24%), reflecting the significant productive sectors in the city of Loja.

3.2 Measures

To measure the value chain planning variable, five items were considered. Three of them related to production, materials, and demand forecasts, taken from Robinson & Pearce (1983) and Richbell et al., (2006). The fourth item related to demand flexibility by, Vickery et al., (1999) and the fifth to quality and competitive costs Bowersox D, Closs D, & Cooper B., (2002).

Installed capacity was measured with four items related to planning, maximum capacity, customers, and costs; the same items that were taken from Porter (1985).

The maintenance stage consists of four items related to preventive and corrective maintenance of microenterprises, according to Baihaqi & Sohal (2013). For the measurement of items, maintenance training, and an insurance system against fires or other incidents, the work of Ambulkar et al., (2015) was considered.

To measure technology in microenterprises, five items related to human talent, marketing, administration, finance, and service delivery were taken from Ernst, Hoyer, & Rübsaamen (*2010*), while for innovation; service, processes, marketing, and organization were taken from Dávila et al., (2019), Ibujés Villacís & Benavides Pazmiño, (2018) and Weerawardena & Julian (2006).

Finally, measurement of the four items of supply or raw materials and services supply chain was carried out considering the new trends that seek to reduce the costs of logistics and supply chain as described by Bowersox d, Closs D. & Cooper B., (2002).

All items used in the survey have a Likert scale of 5 points, with values of 1: totally disagree, 2: disagree, 3: neither agree nor disagree, 4: agree, and 5: totally agree.

3.3 Method of analysis

To identify possible groups of microenterprises, cluster analysis was used; a technique that allows identification of groups with similar characteristics which have previously been used to study configurations in microenterprises, (Weijland, 1999). The procedures and best practices described by Ketchen and Shook (1996) were followed. Calculations were supported with R studio software.

For the grouping, the variables of planning, capacity, maintenance, technology and innovation, and procurement were used, followed by the comparison of business performance.

First, hierarchical grouping was applied to determine the appropriate number of groupings. Then group centroids of the hierarchical procedure were used as initial grouping seeds to perform the k-means grouping procedure.

To explore the differences of the identified groups, the usual unidirectional ANOVA and a post hoc criterion (Tamhane T2, at $p<0.05$) were used, since the sizes of the groups were unequal (Moder, 2010).

4 Results

To identify microenterprise groups, the present study followed the two-step clustering procedure recommended by Ketchen & Shook, (1996) and Hair, Black, Babin & Anderson, (2010). First, hierarchical clustering was performed to determine the appropriate number of groups. In this study, Ward cluster and complete linkage solutions were applied, as suggested by Ketchen & Shook, (1996). Both methods suggested four cluster groups as being optimal.

Then, group centroids from the hierarchical procedure were used as initial grouping seeds to perform the k-means grouping procedure.

Table. Microenterprise groups according to analyzed variables

	Cluster averages			
	1	**2**	**3**	**4**
Cluster variables				
Planning	3.87	1.00	3.81	4.41
Installed capacity	2.74	1.00	3.27	4.11
Maintenance	3.34	1.00	3.92	4.41
Technology	4.27	1.00	2.75	4.53
Innovation	4.18	1.00	2.84	4.31
Dependent variable				
Business performance	3.56	1.80	3.39	3.99
Cluster size (N)	23	3	24	30

The solutions were consistent, which shows that the grouping was robust. The analysis of selected variables is presented below.

Significant differences between the four groups of microenterprises analyzed were found, as evidenced by the F test: F (3.76) = 38.43, p= 0.000 for planning; F (3.76) = 31.84, p= 0.000 for installed capacity; F (3.76) = 21.21 , P= 0.000 for maintenance; F (3.76) = 56.21, p= 0000 for technology; and F (3.76) = 42.14, P= 0000 for innovation.

4.1 Relationship between the analyzed clusters and organizational performance

After verifying that the microenterprise groups were statistically different, the study verified whether or not the performance of the clusters was statistically significant for the groups. The F test F (3.76) = 5.451, p= 0.0018 was employed for the performance level. Table 2 shows the results of the *post hoc* analysis which confirms that Group 2 was statistically smaller than Groups 1 (p=0.01), 3 (p=0.02), and 4 (p=0.01). Group 4 was greater than Group 3 (p = 0.02). There was no significant difference between Group 1, and Groups 3 (p=0.17) and 4 (p = 0.07).

Table 2. Comparison of performance averages of the analyzed clusters

Cluster (i)	Business performance (annual average)	Cluster differences (i-j) (p-values in parentheses) Cluster (j) 1	2	3	4
1	3.56	-			
2	1.8	1.76 (0.01)	-		
3	3.39	0.24 (0.17)	-1.58 (0.02)	-	
4	3.99	-0.42 (0.07)	-2.78 (0.01)	-0.58 (0.02)	-

4.2 Interpretation of identified clusters

Figure 1 shows the differences between the clusters. To facilitate the comparison and interpretation of the data in this study, the clusters were identified as Cluster 1 *"value chain medium*", Cluster 2 "*value chain deficient*", Cluster 3 "*value chain low", and* Cluster 4 *"value chain high*".

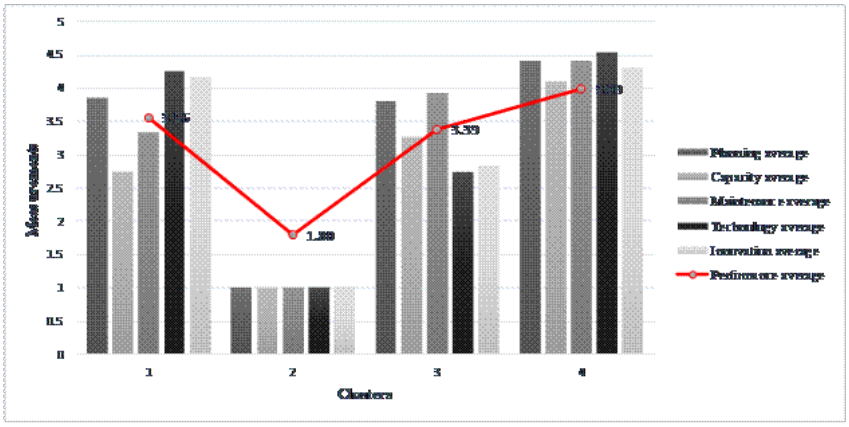

Figure 1. Cluster attributes

Cluster 1 ***"value chain medium"***—microenterprises in this group had the second highest scores in planning (3.86), technology (4.27), and innovation (4.18), after Cluster 4. Regarding the capacity (2.74) and maintenance (3.34) variables, Cluster 1 was in third place after Cluster 4 and Cluster 3. However, it was the group with the second best business performance (3.56). The productive activity of this cluster focuses on the following four sectors: wholesale and retail trade (26%), information and communication (22%), education (3%), and administrative services (3%).

Of the cluster, 22% is characterized by being made up of family-owned enterprises. In addition, the managers are partners or shareholders of microenterprises in 74%, and have a high level of higher education, also in 74%.

Cluster 2 **"*value chain deficient*"**—the microenterprises that made up this group had the lowest scores of the six variables analyzed with an average of (1). For performance, it scored (1.8). The productive sector is focused on professional, scientific, and technical activities; information and communication; and wholesale and retail trade.

Family businesses account for 33% of the group and the managers have a higher education level of 66%. Like Cluster 1, managers are partners or shareholders of microenterprises (67%).

Cluster 3 ***"value chain low"***—the 24 microenterprises of this group were positioned third when considering performance with 3.39, and were characterized by high planning (3.81), capacity (3.26), and maintenance (3.93) values. The cluster also ranks third for technology (2.75) and innovation (2.83). The productive sectors in this group were dispersed, highlighting administrative services, information and communication, health care, and manufacturing all with 17%, and wholesale and retail with a 13% share.

Family-owned enterprises accounted for 16%, managers were partners or shareholders of microenterprises in 83% and the level of higher education was (66%).

Cluster 4 ***"value chain high"*** consisting of 30 microenterprises was characterized by high levels of performance (3.99), derived from the correct use of administrative tools such as planning (4.41), capacity (4.11), maintenance (4.41), and use of high levels of technology (4.53) and innovation (4.31). Productive activity was divided into administrative services (27%), wholesale and retail trade with 20%, real estate (10%) and information and communication (10%).

Family businesses accounted for 6.67%, and 83.33% of managers are partners or shareholders of microenterprises, with 73% being trained at higher education level.

These results lead to the following two important findings:

The first is related to innovation which is not a competitive differential for the microenterprises analyzed, although it is necessary to explain aspects of competitiveness. Innovation is widely recognized as a key factor in the competitiveness of nations and enterprises (Galia & Legros, 2004). Madrid-Guijarro et al., 2009 note that small enterprises which do not adopt innovation in productive activities run the risk of becoming uncompetitive, because their processes and products could become obsolete. The authors state that innovation management could be affected by barriers associated with costs or resistance from the manager or employees.

Empirical evidence from Madrid-Guijarro et al., (2009) and Kotey & Sorensen, (s. f.) conducted in SMEs in Spain and Australia identifies the barriers that prevent companies from accessing innovation, limiting them from remaining competitive.

Madrid-Guijarro et al., (2009) studied the relationship between product, process, and innovation management, and the obstacles to innovation; the most significant barriers were associated with costs, while the least significant were associated with the resistance

to change of the manager or employees of companies. The results in their study show that the impact of costs is greater in small businesses than in large organizations. Kotey & Sorensen, (s. f.) identified poor infrastructure, poor staff skills, limited access to finance, and political uncertainties as barriers that prevent innovation in the companies analyzed.

Therefore, SMEs in southern Ecuador, having small structures, have not assertively promoted the management of innovation as a necessary factor to improve competitiveness. High production costs, poor infrastructure, limited support from governments, and being located away from the main development centers of Quito and Guayaquil remain as possible limitations for this differentiation between business clusters.

A second finding is the existence of different configurations in the value chain that can lead to the same performance, as is the case with Cluster 1 and Cluster 3. In Cluster 1, the strategies focused on innovation and technology. The microenterprises in this cluster focused their strategies on learning the market, thus generating innovative activities that create superior value for the customers served (Weerawardena et al., 2006) in addition to technological innovation in the microenterprise operating environment (Chege et al., 2020).

However, Cluster 3 had a value chain of flexible capacity with the market, and a certain degree of resilience in maintenance to supply chain change as its strategies, allowing it to achieve similar performance to Cluster 1. These results are similar to those from studies by Vickery, S. N., Calantone, R., & Dröge, C. (1999) on the flexibility of production chains; they are also similar with a study by Ambulkar et al., (2015) on the degree of resilience to supply chain change. However, the two clusters have a good level of value chain planning in common, this being an essential link in the performance of the two clusters. Perona & Saccani (2004) showed in their study in Italy that adequate coordination in the development of new products with strategic planning enables companies to achieve greater growth and thus better performance.

Finally, education and previous experience are elements to be highlighted in the four business clusters of southern Ecuador for good business performance. Richbell et al., (2006) point out that there is a significant association between education and previous experience of small business owner-managers who explain the presence or absence of a business plan within the small business.

6 Conclusions

This research enabled the identification of microenterprises according to the value chains of emerging countries according to planning, installed capacity, maintenance, research and development, and procurement, contributing to the RBV theory.

In light of this analysis, in Loja, four profiles of microenterprises from southern Ecuador were identified according to the behavior of value chains, whose results show that innovation is not a differentiating factor in business performance, although it is a necessary requirement to explain aspects of competitiveness. There are also different

strategies available to achieve similar performance. Therefore, once the profiles of microenterprises were identified, knowledge and good performance could be enhanced with the help of universities and observatories.

The present research identified some limitations such as the distrust of microentrepreneurs to provide information, which decreased the number of observations and limited territorial reach to the city of Loja. It is therefore recommended to extend this research nationally and to other emerging economies, and to conduct research on the value chain and its impact on competitiveness.

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Knowledge Management System Requirements and Supporting IT-Based Solutions in Engineering-To-Order Manufacturing SMEs

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Abstract

The objective of this paper is to explore the characteristics of a knowledge management system supporting an Engineer-To-Order manufacturing strategy in the context of small and medium-sized enterprises. For this reason, after the identification of a preliminary set of requirements, three in-depth case studies of Italian SMEs are discussed. The paper introduces an IT-based tool to support the knowledge management to enhance the performance of Engineer-To-Order manufacturing. The results of the paper could provide valuable guidelines for managers adopting a knowledge management system to foster knowledge management practices in the Engineer-To-Order business.

Keywords – Knowledge management, ETO, Information Technology, SMEs, case study.

Paper type – Academic Research Paper

1 Introduction

Engineer-To-Order (ETO) is a manufacturing mode for highly customised products which need to be designed and engineered in detail according to customer's specifications (Pandit and Zhu, 2007). Some of the common problems associated with the ETO processes resulting from high customisation are difficulties in estimating costs, lead-times and delivery dates, expensive rework due to late realisation of errors, material wastage, conflicts between project and manufacture schedules (Pandit and Zhu, 2007).

Most of the abovementioned problems have inefficient or ineffective information management and the difficulty of synergising the various parties involved in the process as the predominant causes (Pandit and Zhu, 2007). Therefore, there is the need to support better the generation, analysis, sharing and reuse of specialised and domain-oriented knowledge required by ETO information-intensive business processes (Pandit and Zhu, 2007). For this reason, Knowledge Management Systems (KMSs) can be adopted as a managerial platform to deal with the challenges involved by ETO. Indeed, due to the peculiarities of the ETO manufacturing strategy, the methods and supporting tools to handle the information flows from order receipt to product delivery and commissioning need to be carefully tailored (Adrodegari et al., 2015; Rahim and Baksh, 2003).

The necessity of knowledge-based solutions that can be translated into bespoke knowledge management tools is even more relevant when focusing on small and medium-sized enterprises (SMEs) adopting an ETO strategy. Research by Jami Pour and Asarian (2019) suggest that to enhance business performance, SME managers must define policy and practices to manage organisational knowledge. However, while there are many studies that analyse the processes of dissemination of knowledge and highlight the adoption of KM in large companies, as regards SMEs the framework of knowledge is still fragmented (Cerchione et al., 2016). In addition, the body of literature as well as the availability of commercial KM tools focusing on SME are relatively sparse and do not draw a picture of maturity and completeness (Kramer et al., 2017).

In order to overcome these gaps in the literature, this paper aims to explore the characteristics that a KMS should present to address the needs of an ETO manufacturing strategy in the context of SMEs.

2 Engineer-to-order and knowledge management

There is no general consensus in the literature on the definition of ETO. According to the definition by Willner et al. (2016), for the scope of this paper we will consider as part of the ETO category all those products ranging from the traditional "low volume, highly-customised" product to the product that requires limited order-specific engineering.

The ability to reduce lead times and costs, while providing high levels of customisation and flexibility are key components to ETO firms' competitiveness (Gosling et al., 2015; Birkie and Trucco, 2016; Cannas et al., 2018). ETO companies reply to invitations to

tender from potential customers. The tender includes information on product performance, price, delivery lead-time and commercial terms. Typically, 85-90% of cost is committed at the tendering stage (Hicks et al., 1999). The tendering success rate is often less than 30% (Konijnendijk, 1994; Hicks et al., 1999). The tendering process consumes engineering resources since it requires the preliminary development of the conceptual design and the definition of major components and systems (Hicks and McGovern, 2009). After the contract has been awarded, a detailed project planning would be required in order to ensure that jobs are completed in a timely manner. However, several authors highlight that among the main challenges ETO projects have to face there are the lack of planning and monitoring of design and engineering activities, while production is typically planned in detail, and the lack of an integrated approach to the management of all processes (Adrodegari et al., 2015). One critical issue is to accurately determine the engineering due date, and thus the order delivery date (Grabenstetter and Usher, 2014). Setting these dates represents a challenge also at this stage, since it would assume full knowledge of the product and the associated design, which is not available because the design for the ETO product has not yet been completed (Grabenstetter and Usher, 2014; Zennaro et al. 2019).

In ETO firms, the engineering process is the largest controllable consumer of lead time, using one-half of the total (Grabenstetter and Usher, 2014). The engineering process is a bottleneck core process (Amrani et al., 2010). Errors, ambiguities or misunderstandings in requirements definition at the design stage can commit substantial costs, which are realised during manufacturing and later stages of the product life cycle (Hicks and McGovern, 2009).

ETO manufacturing environments are very complex (Barbosa and Azevedo, 2019). Digital technologies are emerging as promising means for managing complexity. However, there is a lack of approaches focusing and addressing the needs of ETO environment (Adrodegari et al., 2015; Barbosa and Azevedo, 2019), and this is true also for the knowledge management domain. In particular, Adrodegari et al. (2015) identified a lack of IT support in particular for the two fundamental tasks of project management and planning.

Some authors have proposed IT tools for automated knowledge management. Among these, Kłos (2016) developed a KMS for ETO manufacturing companies based on ERP systems. Elgh (2011, 2014) developed a conceptual framework for modelling and management of product knowledge of systems supporting the design and manufacture of highly customised product variants. According to Elgh (2014) a KM tool for ETO should satisfy the following requirements: facilitate capturing, support structuring, enable storage, facilitate retrieval, support visualisation of text, figures and tables, include querying functionality, enable versioning control, include authorisation control, support relations to supporting documents, preferably reside upon an existing available tool. Mourtzis et al. (2014) developed a methodology for fast and accurate knowledge-based estimation of maintenance time for complex engineered-to-order products, based on Key

Performance Indicators (KPI) monitoring. Li et al. (2011) provided a review of knowledge-based systems that could support product knowledge identification, capture, representation and reuse during the processes of One-of-a-Kind product development. Among the most popular knowledge-based systems the authors identified Web-based, ontology-based, STEP-based, and case-based approaches.

3 Methodology

The methodology adopted in this research consists in a literature review followed by multiple in-depth case studies. The literature review presented in the previous section enabled the identification of a preliminary set of characteristics and needs of ETO companies. The following case studies empirical research had the objective to confirm, refine, and integrate literature findings. Therefore, we combined deductive reasoning with inductive theory building (Eisenhardt, 1989; Yin, 1994; Sousa and Voss, 2001). Three ETO manufacturers from different industry sectors participated in the study. Data collection was primarily based on a series of in-depth semi-structured interviews supported by observations, archival sources related to project documentation, and facilitated workshops over a period of approximately two years. Facilitated workshops had the objective to present the knowledge management needs and consequent IT tool requirements identified during interviews, and to collect feedback on possible refinements. The evidence emerging from interviews and meeting was contrasted with the existing body of knowledge from the literature, and integrated by discussions between the research team, and with practitioners. Based on the identified requirements, an IT tool to support KM in ETO organisations was developed and then implemented in the three case study companies. Training session were organised both to train the companies' personnel on how to use the tool and to sensitise them on the importance of the knowledge management process supported by the IT tool. A final workshop was organised to collect feedback on the benefits or limits of the tool experienced during the first months of use.

4 Case studies

In this section the three case studies are presented. Since this paper focuses on the non-physical information flow in ETO firms, the tendering, planning, and engineering design processes of each company will be analysed.

4.1 Case A

Case A is a company designing and producing machines and modules for the automation of assembling processes. Each machine is composed by several assembling stations in a line and usually includes feeding groups, handling tools, mechanical processing, and controls. Each machine is designed based on the specifics of the item to be assembled. On average, 60% of the modules of each machine are standard modules,

while the remaining 40% are fully customised. The ETO process starts with one or more meetings between a sale officer and the potential customer. The customer provides a sample of the item that the machine should assemble, and technical documents summarising the specifics of the product and assembly process. The following stage is the development of the offer. The tendering stage is highly critical. The offer is developed directly by the sale officer, but support from the technical office is often required to understand how the non-standard modules would impact lead time and costs. Tendering is a costly activity and all the effort is lost if the order is not eventually won. For this reason, the company would like to introduce a sales configurator tool to automate the elaboration of tenders. The configurator should enable the selection of standard modules and already developed variants from a database containing descriptions, and cost and time estimates updated based on the lesson learned by past projects. It should also facilitate the tendering of new modules. Also in the case the order is not confirmed, all the documentation produced for the offer is stored in the knowledge repository for future reuse. If the order is confirmed, it is necessary to plan in detail all the activities, from design, to production, assembly, testing, and commissioning. All the plans (activities, deadlines, responsibilities) are summarised in a textual document called "minutes". The documents is updated all throughout the development of the project and is shared with the customer. Case A laments the difficulties in monitoring the progress of the project using such a document, that could contain hundreds of pages, and the lack of a proper project management tool to plan the activities and have an overview of all ongoing projects.

4.2 Case B

Case B designs and realises single piece electrical systems and control panels for specific applications. Each system is composed by sub-systems that could be completely configured and personalised according to the specifics of the machine to cable. The first stage is the meeting with the customer and the collection of the electrical system requirements by a sale officer. The customer provides the officer with technical data sheets and drawings of the machine to equip. All these documents are analysed by the technical office that selects and dimensions the components to integrate. The operational research office estimates the number of person-hours required, while controlling and business administration offices define the price. Therefore, the tendering stage involves several offices and represents a highly time-consuming activity. Finally, a design review is organised with the customer to identify further needs for corrections and improvements; this is the last step before the order confirmation by the customer. Actual engineering of all the components of the electrical system could finally start. The design activity requires constant exchange of documents between the electrical designers and the mechanical designers of the machine at the customer's site. Many design changes are required not only during the design stage, but often also during the manufacturing stage.

Case A laments a lack of communication and collaboration with customer's designers. Therefore, electrical designers often lack the information needed to find the most suitable design choice, and adopt temporary measures, thus postponing the identification and solution of problems. Currently, the sharing of documents between the company and the customers is managed in an informal way, mainly through file sharing platforms like Dropbox and Google Drive, that require long times both for upload and download, and expose to the risk of loss of information. Furthermore, due to the lack of a shared project plan the customer often does not provide the required documentation on time, thus leading to delays and longer lead times. All the documentation of past projects is currently paper-based. Therefore, the retrieving of past knowledge takes long times and it is mainly based on the memory of single designers. This hinders the ability to reuse past solutions in different contexts and take advantage of the modularity of the systems.

4.3 Case C

Case C designs and manufactures special tools and profiles for machining chip removal of single-spindle lathes, multi-spindle, transfer and work centres. Each special tool or profile is designed based on the specifics of the piece and the material to work.

The first contact with the customer is by a sale representative. The representative collects information regarding the needs of the customer, and usually the order of tools is confirmed directly during the first meeting. Differently from big size high value ETO products, in the case of small size low value ETO products the tendering stage is less critical, and often completely neglected, as in the case of Company C. The customer will know the price only after the product will be manufactured. Therefore, the relationship with the customer needs to be built on trust and loyalty. One of the main difficulties at the order confirmation stage is the definition of a delivery date, due to the lack of a planning tool. Before starting the design activity, the designer always searches the knowledge repository of the company for any information available related to that family of tools or the specific customer. The repository is based on Microsoft SharePoint Designer and looks like a web site with a tree view menu. One of the main criticalities pointed out by Case C, is the fact that searching functionalities are not available, and in order to retrieve information the user has to navigate the menu guided by his intuition. Only one person in the company is in charge of adding new information to the repository and deleting obsolete one, but a clear procedure for the approval of the content is not defined. On one side, this causes delays in making useful information available to the personnel, on the other side it exposes to the risk of sharing outdated information. In addition, there is the risk of inconsistency between multiple instances of the same piece of information, since none automatic control is operated during the input phase and a tracking of previous versions of the same data is not available. Moreover, currently differentiated access profiles are not defined and it not possible to make only a certain type of information available according to the roles in the company.

5 The developed IT tool

Based on the knowledge management needs collected from the literature and from the analysed ETO cases, an IT tool have been developed and tested in the three case study companies. The tool consists of a web-based platform integrating three different modules: Sales configurator, Project management tool, Knowledge repository. The Sales configurator enables the semi-automatic preparation of an offer based on the information collected from past projects. All the standard modules of a product are catalogued together with the possible variants. To each standard module a set of parameter related to costs and lead time is associated. The update of these parameters is automatically required by the tool whenever a project including such module ends based on the final balance of the project. For all non-standard modules, a blank form to complete is available. Each new module after completion is included in the catalogue of standard modules of the configurator. The tender documents is easily composed by the tool based on the modules selected. The tool provides also the total cost and time required for the development of the project, thus facilitating the definition of the price and the delivery due date. If the order is confirmed, all the data from the tender are automatically imported by the project management module, and a draft Gantt chart is developed. The draft can be modified as needed. The module includes a timeline of the project, with alerts for intermediate deadlines and milestones. This module provides also a document sharing space with versioning to facilitate file sharing among designers and to gather all project documentation, and a discussion space in the form of a forum to improve communication and collaboration among project partners, avoiding the use of e-mails. Finally, the knowledge repository module collects all projects documents and data, along with other information relevant for the company, and makes them easily accessible thanks to advanced tag-based search functionalities enhanced by Natural Language Processing machine learning algorithms. The repository offers differentiated access profiles and manages a workflow for information input and deletion approval.

The developed IT tool has been implemented in the three case study companies. Training sessions have been organised in each firm to explain the use of the tool. In addition, a general hands-on workshops was held to raise awareness on the importance of knowledge as a key asset for ETO companies. Six months after implementation a feedback was collected from each company. Case A reported several benefits connected to the use of the IT tool. One advantage of the sales configurator is the possibility for the sales representative to provide the customer with an estimate of price and delivery time already during the first meeting. This is a key competence for competitiveness since it reduces the time needed to win a new order. Furthermore, on one side, less time is necessary to elaborate the final offer document, thus increasing the tendering capacity of the company, on the other side, the majority of activities needed to prepare an offer do not require highly skilled human resources that could be devoted to more value-adding activities. The project management modules has replaced the old “minutes” and

automated the workflows, thus improving the planning and monitoring of all project activities.

Also Case B reported a positive feedback, especially with reference to the design phase. The forum and the document sharing functionalities have improved the collaboration with customer's designers, and reduced both the time spent for re-design and the total time required to complete the design of the electric system. The compression of time is a consequence also of the possibility of retrieve knowledge and solutions developed in past projects through a quick search of the knowledge repository.

Case C reported that the main benefits came from the new knowledge repository module that provides advanced searching functionalities with respect to the one previously available. That reduces the time needed for information retrieval. In addition, the presence of a formal procedure for approving the update of recorded data, guarantees consistency and validity of the information retrieved. It also enables every user to propose the insertion of new knowledge, thus minimising the loss of knowledge while ensuring its trustworthiness. Complete past project documentation, that previously was stored in a separate database, now is available among the information searchable in the repository, and this facilitates knowledge reuse since information is less fragmented.

6 Final remarks

Although each company has to develop its own approach to KM and one-fits-all solutions do not exist, based on the results of this research, it is possible to outline some common traits related to KM specific for the ETO context. These traits could also be easily translated into requirements that an IT-based tool should satisfy in order to support KM in ETO organisations.

The knowledge domains which appear to have the greatest value to ETO, and to which the knowledge management system should be applied, are those related to tendering, project planning and engineering design processes. According to ISO 30401, in order to effectively manage knowledge through its stage of development, the KM system should cover the following activities: acquiring new knowledge, applying current knowledge, retaining current knowledge, handling outdated or invalid knowledge. Due to length constraints an extensive discussion of all the requirements related to each activity with a detail for each ETO process is not possible in this paper. Therefore, a summary is provided in Table 1.

Table 1. Summary of ETO KMS requirements

Process / **KM Activity**	**Tendering**	**Project planning**	**Engineering design**
Acquiring new knowledge	- Facilitate collection of customer requirements and their timely storage in the knowledge repository to	- Foster lesson learning and post-project assessments - Facilitate communication with the customer	- Facilitate communication and collaboration among designers to foster innovation

	make them immediately available		
Applying current knowledge	- Use standard cost and time parameters based on past experience for modular products to facilitate the creation of a tender	- Use standard cost and time parameters for modular products to facilitate the planning of the project - Facilitate project monitoring to enable improved actions and decision making	- Facilitate searching of past design solutions to foster knowledge reuse (e.g. through tagging) - Facilitate documents sharing among engineering teams
Retaining current knowledge	- Keep records of all tenders, also unsuccessful ones. - Document new product modules and include them among standard modules for reuse in future tenders	- Enable the storage of all project documents in a single repository. - Enable documentation and communication of all project activities, deadlines, responsibilities and milestones	- Enable classification and storage of all design solutions - Keep records of the motivations of design choices
Handling outdated or invalid knowledge	- Foster the regular update of standard modules documentation at the end of each project.	- Foster standard cost and time parameters update at the end of each project	- Implement a formal approval process for information input and deletion in the knowledge repository

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How does Emotional Intelligence (EQ) and Neuro-Linguistic Programming (NLP) influence Transformational Leadership (TFL) ability?

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Abstract

The emotional intelligence of leaders is a critical component of being able to lead self and others effectively. The qualities of emotionally intelligent leaders have been linked with transformational leadership abilities. Though current research in leadership shows correlations between Emotional Intelligence (EI) (Goleman, 2015, Mayer & Salovey, 1997), Transformational Leadership (TFL) (Bass, 1985, 2000), and Self-Actualisation (SA) (Maslow, 1961, 1963, 1971, Hall, 2008, 2009), there are no existing studies showing how, or if, Neuro-Linguistic Programming (NLP) can influence transformational leadership ability and correlating self-actualising behaviours.

A qualitative thematic analysis approach, including four (4) in-depth case studies, interviews, and participant observations will be undertaken to provide insight into the factors influencing transformational leadership ability through an EI and correlating NLP lens. Case studies specifically will be used as a methodological approach to explore and advance theoretical foundations and highlight new knowledge and themes emanating from the research (Corley & Gioia, 2011; Eisenhardt, 1989; Gehman et al., 2017; Gioia, Corley, & Hamilton, 2013; Whetten, 1989; Yin, 2003).

This study will explore how EI and NLP influences TFL ability. Current studies in EI and TFL show correlations between both in terms of inherent behavioural dimensions. This research will uniquely contribute to the existing body of knowledge by using an NLP lens to demonstrate correlating self-actualisation behaviours and investigate the impacts of transformational leadership ability on self-actualising leaders.

Purposive sampling will be used to select four (4) highly emotionally intelligent participants, who are recognised as Leaders in their fields and in respective organisations in Australia. Case studies will be developed with an in-depth focus on the background, context, and career development path of the four leaders, the aim being to provide insight into factors influencing transformational leadership ability through EI and the NLP model.

Keywords – Emotional Intelligence, Neuro-Linguistic Programming, Transformational Leadership

Paper type – Academic Research Paper

1 Introduction

1.1 Approach

There are a vast number of leadership and leadership development theories, practices, models and styles, such that attempting to provide a single definition of leadership is problematic. Despite the lack of a common definition, the understanding and practice of leadership and leadership development are experiencing fundamental changes (Avolio, 2007; Bennis, 2007; Day and Antonakis, 2012). These changes require the traditional types of leadership, or what Bennis (2007) calls "tripod" leadership forms, and even the more recent theories including; transformational, charismatic, and authentic leadership practices, need to advocate for a fuller, and more integrative focus on a multi-level, multi-component and inter-disciplinary approach to leadership. Leadership is a function of the leader, the led, and the complexity of the emotion context (Avolio, 2007).

Studies in EI treat emotions as a unitary and predictable stable construct, and as such does not address the granular aspects of emotion leadership (Kaplan, Cortina, Ruark, LaPort & Nicolaides, 2014), such as what is happening *within* a leader moment-to-moment (Jordan & Lindabaum, 2015) in the workplace.

As emotions are fleeting and ephemeral in nature (Weiss and Cropanzano, 1996) such that Jordan & Lindabaum (2015) refers to them as "the curse of the emotions". An overview of emotion management will be briefly discussed to provide grounding for the research. Management of one's emotions is a key part of the process of self-actualisation (Maslow, 1971; Hall, 2009), a process this research suggests can be promoted using NLP.

1.2 Research Gap

Though current research shows correlations between EI, transformational leadership and self-actualisation, there are no studies that examine the long-term impacts of transformational leadership on leaders. This research will contribute to understanding the long-term effects of transformational leadership style on leaders by employing EI and an NLP lens as a mediating technique to measure correlating self-actualising principles and behaviours.

There is currently no research linking NLP to EI. It will therefore explore the following sub-research questions during the thematic case study analysis approach; (i) how EI mediates the relationship between transformational leadership and self-actualisation (ii) how NLP influences transformational leadership ability, and (iii) how NLP promotes self-actualising leaders. By so doing, the correlation between NLP and EI will become prevalent, and be significant for this research.

Further, present multi-level leadership studies in EI and transformational leadership typically focus on the *individual-to-group/follower-leader* affect-effect impact of transformational leadership (To, Tse, Ashkanasy, 2015; Hur, Van de Berg, Wilderom,

2011; Cote, Lopes, Salovey, Miners, 2010; Griffith, Connelly, Theil, Johnson, 2015). There is limited research exploring the self as part of a within-person dynamic in a multi-level leadership study (Jordan & Lindabaum, 2015). This research will explore the *self* from a self-actualisation impact perspective (Maslow, 1961; 1962; 1971; Hall, 2008). It will add to the within-in leadership variance using the NLP model to explain self-regulation and emotion management behavioural practices (Jordan & Lindabaum, 2015) aligned to self-actualising leaders.

Finally, there is a dearth of research literature into NLP despite its application and use across countries for 30 years (Kong, 2010). This research will contribute to bringing the impact of NLP in leadership into the academic mainstream, and contribute to providing an explanation, and model of leadership practice that can be used to develop self-actualising, peak performing leaders that have the capability to lead themselves and others, and to transform and transcend predetermined environments and accepted social constructs that limit human potential.

1.3 Limitations

There is limited academic literature on NLP, meaning the findings of this study cannot be generalised.

This study will involve a select small sample of 4 case studies including interviews as part of a qualitative approach. It lays the foundation for a further longitudinal study.

2 Literature Review

2.1 Theoretical considerations

This literature review is based on the following theoretical frameworks:

- Emotional Intelligence (EI) (Goleman, 1998, 2008, 2015; Mayer, Salovey, Caruso, (2004) Freedman (1998, 2019) – EI is a theory about the ability to actively understand, process, and influence one's own emotions and those of others to guide behaviours.
- Transformation Leadership (TFL) (Bass, 1985, 2000) – TFL is a theory about a leadership style that transforms followers' attitudes, values and behaviours and inspires them to pursue higher-order and organisationally relevant goals.
- Neurolinguistic Programming (NLP) (Perls,1954, Satir, 1988, 1991, Erickson, 1982, 1983, 1985, 1986, Bandler & Grinder, 1975, 1976, 1979, Hall, 1997, 2003) – NLP is a model of communication, a coaching technique, and an attitude, that focuses on individual internal learning to improve self-awareness, develop greater skills in self-management, communication, and interpersonal awareness.

2.2 Emotion and the workplace

Work is an emotional experience. For followers, it can be a source of anger, distress, frustration, and embarrassment, but also a spring of pride, belonginess, fulfilment and excitement (Ashforth & Humphrey,1995; Boudens, 2005). Leadership is primarily a relational process, an interaction between the leader where leader behaviour affects the performance, well-being, and creativity levels of their followers (Jordan, Lindebaum, 2015). For this reason, managing one's own emotions, and those of followers is a critical managerial function akin to managing markets or finances (Leavitt & Bahrami, 1988).

Like Leavitt and Bahrami, Rafaeli and Worline (2001) argue that the job of management has become the management of emotion. This thinking is re-affirmed by Goleman (2015), who from an emotional intelligence and Leadership perspective, posits that it is the primal task of a Leader to manage their own emotions first, prior to others.

The role of emotion and leadership in the workplace remains a subject of scholarly interest; ranging from early leadership studies that sought to articulate the effects of charismatic leaders on followers' hearts and minds (Weber,1947), to understanding how transformational leadership ability inspires and instils hope and optimism in followers (Bass,1985).

Similarly, there is growth in the area of leader emotion management (LEM) with the aim of furthering understanding into leader impact on the work-related emotions and feelings of followers (Ashkanasy & Tse, 2000; Humphrey, 2008' Humphrey, Pollack & Hawver, 2008; Pescosolido, 2002). For example, Koning & Van Kleef, 2006, explored the effects of leader anger displays on organisational citizenship behaviours (OCBs), with a focus on demonstrating the adverse effects.

Though literature in this area is scant, it raises opportunities for further research into the type of emotion displays linked to transformational leadership ability.

2.3 Emotion management

Emotions can be defined as acute, intense, fleeting, ephemeral reactions to an event (Weiss and Cropanzano, 1996). Often used interchangeably with moods, whilst they are both affective (or feeling) states, moods are more diffused and longer lasting. People generally feel their emotions whilst the mood runs in the background without triggering conscious awareness of it (Watson, 2000).

Emotion and moods tend to be intertwined temporarily as moods such as "feeling let down", can develop into full blown emotional experiences, such as "feeling depressed". That being said, Ekman and Davidson (1994) argue that the distinction between emotions and moods are not entirely clear both from an experiential perspective and in terms of functions. On the contrary however, Bandler & Grinder (1975); Bandler, (2008), Grinder, (2013) argue that emotions are a great resource for choosing resourceful states and breaking chronic mood patterns that can spiral out of control.

Jordan and Lindebaum (2015) separate the display of emotion into 2 parts; emotion experience (or felt emotions) and emotion expression (or displayed emotions). Suggestibly, Watson's (2000) "full blown emotional experience" sits in the latter category. Lawrence et al (2011) argue that transformational leaders characteristically use strategies to manage their emotional experiences (or feelings) in response to specific situations in the workplace, including interpersonal interactions. Correspondingly, Jordan and Lindebaum suggest that a transformational leader is one who uses emotion management practices to decide how they experience their emotion (Jordan and Lindebaum, 2015). The experience of emotion for the transformational leader does not need to equate to the chosen strategy for display. The chosen strategy is chosen because of a deep understanding of 'self', and how emotions operate and pertain to self, termed as self-management, which is a dimension of EI (Goleman, 2015).

Whilst there is research connecting EI, which includes self-management, to Transformational Leadership, (Ashkanasy & Tse, 2000), it is not clear if both Jordan and Lindabaum (2015) and Lawrence et al (2011) are suggesting that only transformational leaders are best able to manage their experience emotions.

Hall (2008), thinks differently. Arguing, from a human development perspective, self-management of mind, body and emotions is an activity for people striving to achieve excellence, in any field. The striving, or what he terms as "self-actualising" (2008), is a term borrowed from Maslow's self-actualisation psychology (1961, 1963, 1971) and includes managing emotional experiences.

This is a unique approach to current models of self-management given its focus and intrinsic connection to the self-actualisation psychology of Maslow, and its re-interpretation of the term leadership as concerning not just organisational, but personal outcomes.

Self-regulation and within-person leadership

Self-regulation is a leader's ability to manage emotions within their person (Jordan & Lindabaum, 2015). The within-person model enables leaders to display and use a range of emotions consistently across several situations in the workplace (Ashkanasy and Jordan (2008). The adjudication of the choice of emotion displayed by the leader is, however, dependent on how the emotion is perceived as situationally appropriate by followers (Jordan & Lindabaum, 2015).

In terms of how the within-person leadership variation occurs, Gioia & Poole (1984), key proponents of the within-person model suggest that the leader experiences situational cues which trigger responses by way of 'discrete emotions' in the leader. The leader is confronted by a series of strategies from which they can select. The selection warrants a decision on a 'script', or schematic knowledge structure held in memory that specifies a behaviour that is appropriate for specific situations. The leaders memory bank includes case based knowledge (Schmidt & Rikers, 2007), heuristics, (Abe & Izard, 2009), knowledge about the group and the personal norms of an organisation (Hertel & Kerr,

2001) and followers' expectation of the situation to select the appropriate script through which the emotion will be displayed.

Whilst the emotion chosen in the within-person leadership variance is driven by memory scripts based on multiple experiences, the veracity of action taken by a leader is questionable, given the adjudication of leader action and choice of script, is determined by the response of followers. Arguably, what is a within-leadership centred approach is equally externally driven and determined. This presents some challenges signalling opportunities for further development and expansion of the theory.

2.4 Emotional Intelligence

There is a growing body of research that suggests that a leaders' ability to understand and manage their own feelings, moods and emotions, as well as those of their followers, contributes to effective leadership performance across a variety of organisations (Gardner & Stough, 2002, George, 2000, Kerr, Garvin, Heaton & Boyle, 2006). In the workplace particularly, managing one's own emotions, and those of employees, is as much a critical managerial function as managing markets or finance (Leavitt & Bharami,1988). It is arguable to suggest therefore that the emotional intelligence of leaders is a critical component in being able to lead effectively (Jordan & Lawrence (2009). Importantly, there is research linking the qualities of emotionally intelligent leaders to transformational leadership abilities (Bass, 1985; Barling, 2000)

As a subset of social intelligence, emotional intelligence (EI) includes the ability to monitor self and other's feelings and emotions, to discriminate between them, and to use the information to guide one's thinking and actions (Mayer & Salovey,1997). Further, it involves the capacity to reason about emotions, to use emotions to enhance thinking, to accurately perceive emotion, to access and generate emotion to assist thinking (Bandler and Grinder, 1975, 1976, 1979), to understand emotion and emotional knowledge, and to reflectively regulate emotion to promote emotional and intellectual growth (Mayer & Salovey, 2004). Salovey's definition of EI, including the Salovey-Mayer EI model (2000), and key mainstream EI models, including Baron (1997) Cooper and Sawaf (1998), Goleman (2008), and Six Seconds (1997), are similar in approach with a common focus on self and other.

Whilst agreeing with two-fold approach of EI, Hall (2002) argues from a neuro-semantic perspective that the ability to guide the emotions of self and others includes understanding the meta-correlations between thinking, feeling, speaking (or languaging) and behaving, as part of the interplay of the movie-mind. As a mind-body-emotion system (Hall, Bodenhamer, 2009), the way we think determines how we feel, which informs what we speak (or language), and how we then behave (act). Thinking directly determines behaviour (Hall, Bodenhamer, 2009).

The meta-correlations between thinking, feeling, and behaving, is a key experiential addition of NLP to the theoretical EI approaches of Mayer & Salovey (1997, 2004); Bar-

On (1997), Goleman, 1998), with the exception of Freedman, whose Six Second model (1998) moves EI into the sphere of experiential practice.

In exploring the meta-correlations, NLP borrows from, and employs the principles of hypnotherapy (Perls,1954, Satir, 1988, 1991, Erickson, 1982, 1983, 1985, 1986) as a means of working with the unconscious mind, part of the mind-body-emotion system, to facilitate individuals' (including leaders) capacity to connect with their own abstract mental reality or intra-personal awareness. The ability to guide the emotions of self and others requires engaging with the vast reservoir of learning that is the unconscious mind (Erickson, 1982). 'Patterns' (Bandler and Grinder, 1975, 1976, 1980; Dilts, 1999, Hall, 2008, 2009, 2010) for working with the unconscious mind, as part of NLP's mind-body-emotion system, is a critical part of self-management and self-regulation, and a self-actualising behavioural prerequisite. This is a current gap in traditional EI models, discourse, and leader emotion management (LEM) approaches.

2.5 Management of emotions

Management of emotions involves the management of one's own personality. From the context of the individual leader, this includes their leadership perspective, goals, self-knowledge, and social awareness (Averill & Nunley, 1992; Gross,1998; Parrott, 2002). For example, small children are often taught to count to 10 before getting mad, or to smile at grandpa. As they grow older their means of emotional self-management increases and become stronger. There is now the ability to avoid feelings, or to intentionally re-frame situations to reassure themselves to achieve calmness and self-composure (Erber,1996; Larsen, 2000, Tice & Bratslavsky, 2000; Wenzlaff, Rude & West, 2002).

Similar to using emotions, management of emotions uses emotions toward greater self-improvement. The skill for both areas of EI improve as one develops psycho-socially and physically.

In EI literature, research suggests that there are five mainstream emotional intelligent models, each with a varying slant or focus (Kewalramani, Agrawal, Rastogi, 2015).

Fig 1 below shows correlations between the five models (Kewalramani, Agrawal, Rastogi, 2015) classified under four headings: (i) understanding self, (ii) understanding others, (iii) managing self, (iv) managing others. The analysis is an attempt to demonstrate the intrapersonal and interpersonal nature of EI, which given the theoretical underpinning of some models, arguably requires further study.

EI Model Type	Understanding Self	Understanding Others	Managing Self	Managing Others
Salovey-Mayer-Caruso (2000)	Perceive emotions (Branch 1) Understanding emotions (Branch III)	Understanding emotions (Branch III)	Facilitating Thought (Branch II)	Managing emotions (Branch IV)
Bar-On (1997)	Intrapersonal General Mood	Interpersonal	Adaptability Stress Management	Social skills

Cooper and Sawaf (1998)	Emotional literacy (Sense)	Emotional fitness and Emotional Depth (Understand)	Emotion Alchemy (Apply)	Emotional Alchemy (Apply)
Goleman (1998)	Self-Awareness	Empathy	Motivation Self-Regulation	Social skills
Joshua Freedman (1998)	Know Yourself	Choose Yourself	Choose Yourself	Give Yourself

Fig 1: Indian Journal of Positive Psychology, 2015

2.6 Transformational Leadership

Current research in Transformational leadership (TFL) suggests consistency in definitions of TFL. TFL is a process in which leaders use emotions to communicate a vision, elicit responses from followers, and ensure they are emotionally motivated to perform beyond their expectations (Humphrey, 2002, Brown & Moshavi, 2005). This is consistent with Bass (1985), a founding scholar of TFL. Bass defines TFL as a form of leadership that through transformation of followers' attitudes, beliefs, values, and behaviours, intends to inspire followers to pursue higher-order and organisationally relevant goals.

Traditionally, TFL constitutes 4 dimensions:

1. Raising others to a higher level of achievement or idealised influence,
2. Motivating followers to transcend their personal interests for collective welfare, or inspirational motivation,
3. Developing followers' abilities to facilitate their own personal growth (individualised consideration), and
4. Developing followers' intellectual capability to approach problems in new ways, or intellectual stimulation (Bass, 1998, Avolio, 1999).

Taking the 4 dimensions together, Wang and Howell (2010) and Wu et al (2010) argue they should be collapsed into two categories:

1. Idealised influence and inspirational motivation - This is where a transformational leader displays similar behaviours toward the group. For example, communicating a compelling vision to the whole group; and
2. Individualised consideration and intellectual stimulation – This is where the same leader display different behaviours in addressing the individual uniqueness of each person in the group. For example, the provision of personalised coaching for each member of the group.

Both TFL dimensions are consistent with the 'self' and 'other' focus of traditional EI models (Salovey-Mayer, 2000) and self-actualisation principles and practices (Maslow, 1961, 1963, 1971; Hall, 2008).

2.7 Emotional Intelligence and Transformational Leadership

A growing body of research has shown that emotional intelligence is inherently associated with TFL (Barling, Slater & Kelloway, 2000; Leban & Zulauf, 2004). Similarly, EI and TFL scholars (Gardner and Stough, 2002; Barbuto and Burbach, 2006) suggest that the ability to monitor and manage the emotions in self and others correlates with the inspirational, motivational and individualised considerations of TFL(Hur, Van den Berg, Wilderom, 2011). Of interest to this study, are the influences self-actualising behaviours have on transformational leaders' ability viewed through an NLP lens.

TFL theory highlights the importance of leaders' impact on the emotional state of others, and several studies have provided emotion-type insight into the transformational leader-follower link with emotional intelligence (Ashkanasy & Tse, 2000). The qualities of empathy, motivation, self-awareness, trust and emotional stability, are qualities of a transformational leader that are directly associated with emotional intelligence (Goleman, 1998, Bar-On, 1997, Mayer & Salovey, 1997), and self-actualising behaviours (Maslow, 1971).

2.8 Emotional intelligence and self-actualisation

Similarly, emotional intelligence has been linked with the theory of self-actualisation (Maslow, 1961, 1963, 1971; Hall, 2008; Gilligan, 1997, Gilligan and Dilts, 2011), through its association with the positive psychologies of Maslow and Jahoda (Bar-on 2010).

Similar to the within-person leadership model, where a leader is self-challenged to choose a mental script that is contextual to managing an emotion in the workplace (Jordan & Lindabaum, 2015), so too is the ongoing process of self-actualising about becoming more fully aware of ones' emotions, choosing which emotions to listen to and which ones to nurture (Hall, 2007).

However, there is a further aspect to EI, one that concerns the depth of intelligence within emotion, involving an intentional and experiential move to find out who we really are deep down below as a member of the human species, and as an individual (Maslow, 1962) leader. This aspect of EI is not often referred to in traditional EI theory and practice. Arguably therefore, the connection between EI and self-actualisation is in the actual process of becoming aware (Hall, 2007), and using emotion to facilitate thought (Schwartz, 1990) particularly in terms of the meanings we give experience, and how we understand the difference between "the map and the territory"(Korzybski's,1933).

Interestingly, using emotion to facilitate thought is an EI dimension that Mayer et al, (2004) argued should be removed from EI theory. On the contrary, this study embraces it as a key component of the unfolding process (Francis, 1992), a process that is characteristic of self-actualising transformational leaders.

2.9 Neuro-Linguistic Programming (NLP)

NLP is a model of communication a coaching technique, and an attitude (Hall, 2008), that focuses on individual internal learning to improve self-awareness, develop greater skills in self-management, communication, and interpersonal awareness (Bandler & Grinder,1975, 1976, 1979). The principles of NLP appear consistent with the emotional intelligence theoretical framework.

A recent longitudinal study (Tosey, Mathison & Michelli, 2005) demonstrated that NLP is a structured and systematic means of mapping subjective experience and constructed reality of people experiencing transformative development (Linder-Pelz & Hall, 2007). This study will leverage this characteristic NLP tool to explore and provide insight into transformative behaviours of a small sample size of emotionally intelligent and self-actualising leaders in Australia.

Kohn (2010) posits that within the NLP model, subjective experience is broken into three main representational systems (Bandler & Grinder,1975, 1976, 1979):

1. **The Visual representation system:**

Includes external images, and remembered or constructed internal mental images

2. **The Auditory representation system:**

Includes external images and remembered or constructed internal sounds and internal dialogue, such as a person talking to themselves on the inside. This is also referred to as 'Auditory Digital' (Bandler and Grinder, 1979)

3. **The Kinaesthetic representation system:**

Includes tactile sensations caused by external forces acting on the body and emotional responses.

Some NLP practitioners suggest that individuals prefer one representational system over others in each context. Whilst there is truth in this, the founders of NLP are very clear in saying that people tend to employ all representational systems all the time, whilst having, at least, a subconscious awareness for one system over another at differing contexts (Bandler and Grinder, 1979).

The sub-modality dimensions of NLP provide a visual, auditory and kinaesthetic framework for leaders to become more self-aware of the distinctions of their representations systems, and those of others, including their followers (Tosey and Mathison, 2010) How people use their senses internally, and the kinds of representations utilised is distinctive with each person, hence a key focus for NLP is making sense of how people interact with experience, with self, and with others (Pollitt, 2010).

2.9.1 NLP – how it works

Neuro-Linguistic Programming holds certain presuppositions that underpin it as a model of communication, a mind-body-emotion system of how we map and model information, run our own brain, and structure excellence that enables the replication of genius (Bandler & Grinder,1975, 1976, 1979).

The human experience of reality commences with an event or some action, speech, behaviour occurring in the world 'out there'. As we see, hear, feel, smell, or taste the experience, we represent it, (literally re-present) it on the screen of our minds as pictures, sounds, sensations, smells, etc (Bandler and Grinder, 1979). We take a snapshot of it in our minds, such that it becomes a movie that we play.

In this way, we develop an internal representation of it. It becomes our frame of reference through which we make sense of things. The is the filter through which we see and judge the world. As we continue to use the same frame, and similar frames repeatedly, it habituates, and becomes our frame of mind, or the way we see things (reality). It becomes our perspective and perceptual filter. Eventually, with further habituation and repetition, it becomes the framework that governs how we think, feel, and understand, use, and express our emotions. The framework of our personality (Hall, 2006).

In effect, this research suggests that thinking directly impacts behaviour (Gooty, 2010), and that the emotional 'state' of mind of leaders, determines follower behaviour – toward (Hatfield, Cacioppo & Rapson, 1994), or away from (Bower, 1981; Clark & Taraban, 1991; Fredrickson, 2001; Parath & Erez, 2007), becoming self-actualising human beings capable of leading sustained personal and organisational change (Hall, 2008). An NLP lens will provide crucial insight into the subjective mapping process of selected leaders to explore how they structure their experience, with the view to understanding how EI and NLP influence transformational leadership ability, which this research understands as a by-product of self-actualising individuals.

Research on aspects of NLP, particularly the representational systems theoretical framework, has raised some questions. Fromme and Daniell (1984) suggest caution in the therapeutic use of NLP, however, agree that people that are skilful with imagery may find NLP techniques useful particularly in exploring its role in communication. Similarly, Bradley and Biedermann (1985) argue that the theoretical, and linguistic analysis of clients' messages and interactions requires further empirical testing, however, suggest that NLP remains a viable model and guide for understanding language and related linguistic distortions.

The concerns expressed by Fromme and Daniell (1984) whilst anachronistic, signposts a number of historical criticisms levelled against NLP (Dowd & Pety, 1982, Ellickson, 1983, Gumm et al, 1982, Owen, 1977; and Shaw, 1977), and one that this study will contribute to by way of a systematic response to the research question. By so doing, an aim of this study is to contribute to providing academic input into scant NLP literature.

2.9.2 NLP and self-actualisation

The term self-actualisation (SA), or self-actualisation psychology (Hall, 2008), is not a grand abstraction or a defined, static, mystical state attained by a select few of a particular age. It is rather, a fluid, non-static, episode or spurt in which the powers of a person come

together in a particularly efficient and intensely enjoyable way, and in which the person is more expressive and spontaneous and fully functioning (Maslow, 1961, 1962, 1971)

In these episodes, the person is more truly themselves, perfectly actualising their potentials to the core of their Being. For this reason, it is argued that each person must do that for which he or she is fitted – because "what a person can be, they must be" (Maslow, 1961). The process of doing that for which one is fitted includes what are called "peak experiences" (Maslow, 1962).

Unlike the theoretical approaches of traditional EI and models (Goleman, 1998, Bar-On, 1997, Mayer & Salovey, 1997), these peak experiences are available to us now, on a moment-to-moment basis of experiencing fully, vividly, and selflessly with full concentration and absorption. This type of momentary experiencing without the self-consciousness of the adolescent, is experiencing when the person is wholly and fully human. This is a self-actualising moment, or a moment when the self is actualising itself (Maslow, 1971).

Interestingly, whereas leader emotion management (LEM) practices require the repeated selection of a mental script adjudicated as ethically justified by followers, the self-actualising experience is driven by a cause outside the self-actualisers own skin, something outside themselves. Further, unlike the mental scripts that are judged as appropriate by followers, self-actualiser actions are not judged as such, they are simply experienced beyond the traditional adjudication labels of 'good' or 'bad'. In addition, whereas all people experience self-actualising moments at different degrees of intensity, in self-actualising people particularly, these moments occur with more frequency, intensely and perfectively than the average person (Maslow, 1962).. This makes it amenable to further research.

Research is required, for example, to explore the 8 SA behaviours (Maslow, 1971) and their suggested correlations with the 4 TFL behavioural dimensions (Judge and Piccolo, 2004; Liao Chuang, 2007; Courtright & Colbert, 2011; Bass, Avolio, Jung & Berson, 2003; Schaubroeck, Lam & Cha, 2007), so as to contribute to the Maslowian thinking that SA is not merely about performing well but striving to be the best human being moment-to-moment as a continuous learning process (Bracket & Bar-on, 2010).

2.9.3 NLP and the self – a within-person variance leadership approach

NLP is a method designed and used to uncover the structures inherent in human behaviour (Bandler and Grinder, 1975). Aligned to the philosophical tenets of phenomenology, Bandler and Grinder, like Husserl (1907) before them, developed a systematic and experiential discourse focussed on distinguishing the "real world" from the "perceived" world, suggesting that our perception is limited and influenced by our neurology and our social and individual histories.

Similarly, in turning inward to examine the self, Husserl argued that the same social and individual constraints affect NLP's "surface" structure (Bandler and Grinder, 1975, 1976). Beyond this "I" lies a deeper hidden "I myself", similar to NLP's "deep" structure

(Bandler and Grinder, 1975, 1976). Borrowing from the phenomenology of Husserl, Hall, similar to Bandler and Grinder, argue that human beings can undergo a state of detachment, of standing back from the realm of reality, in order to experience it fully. This self-reflexive ability (Hall, 2002), or what is aptly called the ability "to shut out the noise of the world" (Maslow, 1971), constitutes the crux of knowing self, through standing outside of the self, to see self.

Like the within-in person leadership model, self-reflexivity, in part, is a strategy for managing the experience of emotions – and is a distinct constituent of the process of self-regulation (Lawrence et al, 2011). Arguably, self-reflexivity is a constituent part of the self-actualisation pyramid enabling people to move beyond lower needs to their higher ones (Hall, 2008) via an act of pre-potency or becoming that which we already are (Maslow, 1961). The self is one of the most challenging concepts to comprehend. It is not a thing or entity. It is a process of ever-becoming more than we are. As a narrative construction, it is always open to change and flux (Hall, 2002).

Arguably, the within-person model, which is a structure for the management of emotions (Jordan & Lindabaum, 2015) and the self-regulatory practice of emotional intelligence (Goleman, 2015) aligns with the mind-body-emotion system of the NLP model (Bandler & Grinder, 1975, 1976, 1979) and is therefore able to contribute to providing insight on the influences of TFL.

3 Research Design and Methodology:

The following approaches will be used to explore the research question:

- A qualitative thematic patterning approach will be used to execute the research, and enable the emergence of themes (Boyatzis, 1998, Roulston, 2001)
- Utilisation of multiple data sources, (including interviews, case studies and participant observations) to facilitate triangulation
- The research will be explored through the subjective experience of participants
- Interview questions based on the NLP model and designed on Visual, Auditory and Kinaesthetic (VAK) sub-modalities (Bandler and Grinder, 1975, 1976) for tracing the thread of participant conversation and to explore the structure of internal and subjective experiences.
- *A bracketing* approach will be used to facilitate suspension of judgement during data analysis (Moustakas, 1994)
- The themes and data sources from this research cannot be generalized given the small sample size

3.1 Data collation and analysis

- Leximancer (2018), a content analysis tool will be utilised to reduce potential for bias and human subjectivity whilst manually coding textual data (Baldauf & Kaplan, 2011).
- Four single-embedded case studies with 4 high performing EI leaders to describe context and processes, (Braun & Clarke, 2006) and literal and theoretical replication (Scholz & Tietje, 2002, Yin, 2003)
- 60-90 minute 1:1 semi-structured interviews with leaders using a recording devise (Manen, 1990). Data analysed on how leaders construct their realities through language (Drew, 2005).
- Participant observations of verbal and non-verbal behaviours during interview and case study to be analysed into themes and reviewed in terms of SA behaviours (Maslow, 1943, 1962, 1971; Hall, 2011).
- Personal feedback and observation sheet to capture researcher thoughts and feelings, and to provide context to enable interpretation and theming.

3.2 Sampling

Purposive sampling will be used to select 4 high performing emotionally intelligent Leaders (participants) from the researcher's network according to the below framework for selection:

- Participants must have a minimum of 10 years' professional experience working in the Corporate sector in Australia.
- They will be between the ages of 30 – 70.
- They will come from a range of professional disciplines including HR, Management, Business, Coaching & Personal Development, and Learning & Organisational Development.
- They will have an interest in EI, NLP and TFL practice.
- They will be open to NLP as a coaching method.
- Participants will be a mix of male and female

4 Conclusion

Potential implications of the research for leaders of organisations

From a theoretical perspective the research approach will:

- Explore the link between EI, NLP, and TFL abilities in terms of SA behaviors
- Signal the requirement for a further longitudinal research to enable greater generalisability
- Leverage current EI theoretical models with a corresponding practical approach

- Use NLP as an explorative framework and thereby bring it into academic literature

From a practical perspective it will:

- Provide a blue print for modelling excellent leadership practices so as to teach them to aspiring leaders
- Start discussions for a new type of emotion leadership based on self-improvement practices that actualise potential

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The Role of Emotional Intelligence in Academic Leadership

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Abstract

Studies on emotional competence have traditionally focused on the emotional competence of students and business leaders. There has been little analysis on how emotional competence influences university academics in teaching and career growth. Generally, academia appears to be driven by intelligence, scientific theories, policy, and related measures of success. Positions in the academic workforce are commonly awarded to those who have demonstrated high levels of scholarly attainment, relying on strong cognitive abilities combined with dedication and hard work within a field of knowledge. The influence of emotional competence in academia has remained unclear. The two primary aims of this theoretical paper are: 1. To examine how emotions contribute to academic performance. 2. To ascertain what kind of coping strategies academics use to manage emotions including their impact on complex outcomes in professional academic settings. Limitations and implications of the proposed research are included in the paper.

Keywords – Emotional competence; emotional management; cognitive skills; academic performance;

Paper type – Academic Research Paper / Practical Paper

1 Introduction

Generally, organizations downgrade the role of emotions in academic and business success (Mayer, Roberts, & Barsade, 2008). This aim of this research is to understand the role of emotional competence in academic success. Academia appears driven by scientific theories, academic credentials, intelligence, policy, and related measures of success (Mihaela, 2015). Positions in the academic workforce are commonly awarded to those who have demonstrated high levels of scholarly attainment, relying on strong cognitive abilities combined with dedication and hard work within a field of knowledge (Jaremka, et,. 2020). In the process, the emotional health of both academics and the students they serve is often neglected. Evidence suggests that emotion management skills are important as cognitive skills to career success (Mayer et al., 2008). Yet when it comes to performance evaluation and career advancement, the academic setting gives importance to things like research output, student teaching evaluations, and service to the

university. These measures, particularly the latter two, rely strongly on emotional intelligence rather than cognitive skills. Although emotional intelligence is required in order to build trust and rapport with students and colleagues, there is no systematic approach to or understanding of emotional competence within the academic workforce.

Furthermore, students benefit more from emotionally competent teachers. Mayer and Salovey (1990) defined emotional competence as "the ability to monitor one's own and others' feelings and emotions, to discriminate among them and to use this information to guide one's thinking and actions" (p.198). However, emotional management, as used by the authors is more in line with Mayer and Salovey's (1997) revised definition which states that "the ability to perceive accurately, appraise and express emotion; the ability to access and / or generate feelings when they facilitate thought; the ability to understand emotion and emotional knowledge; and the ability to regulate emotions to promote emotional and intellectual growth" (p.10). Petrides and Furnham (2000) discuss the idea that "EI research draws heavily on personality variables such as empathy, optimism and impulsivity, but often influences other, somewhat vaguer, constructs that seem to be potential correlates (e.g. motivation, self-awareness, happiness) rather than essential elements of EI. By contrast, the information-processing approach is much more focused and explicit as to the constituent parts of EI and its relationship to traditional intelligence" (p.314). Emotional management not only influences the academic arena but business organizations as well (McGough, 2004). Achievement in all domains, including facilitating learning experience for students is pivotal in order to justify an academic role (Preckel et al., 2020).

In this paper, we attempt to show that emotions contribute to academic performance. The specific objective of the paper is to present a theoretical explanation of how emotions contribute to academic performance. Moreover, we ascertain the kinds of coping strategies individuals use to manage emotions including their impact on complex outcomes in professional academic settings. Overall, the proposed paper will advance our understanding of the role of emotions in professional academic settings.

According to Mayer and Salovey's (1990) framework, emotional competence (intelligence) includes the following abilities; 1) Knowing/recognizing one's emotions; (2) managing emotions; (3) motivating oneself; (4) recognizing emotions of others; (5) handling relationships. In 1997, Mayer and Salovey further refined emotional intelligence into four mental abilities: perceiving/identifying emotions, integrating emotions into thought process, understanding emotions and managing emotions (Mayer & Salovey, 1997).

Petrides and Furnham (2000) discuss the idea that "EI research draws heavily on personality variables such as empathy, optimism and impulsivity, but often influences other, somewhat vaguer, constructs that seem to be potential correlates (e.g. motivation, self-awareness, happiness) rather than essential elements of EI. By contrast, the information-processing approach is much more focused and explicit as to the constituent parts of EI and its relationship to traditional intelligence" (p.314).

Research points out that there is a biological base to emotional competence, as Damasio (1994) defined emotion as a "combination of a mental evaluative process, simple or complex with dispositional responses to that process, mostly toward the body proper, resulting in an emotional body state, but also toward the brain itself (neurotransmitter nuclei in brain stem), resulting in additional mental changes" (p.139). Damasio's (1994) work provided further credibility to emotional competence.

Literature also establishes a strong association between Big Five personality traits and emotional competence (Athota & O'Connor, 2014; McCrae, 2000; Matthews et al,. 2006). Personality trait 'extraversion' has been found to have significant association with emotional competence (Matthews et al., 2006). The authors use emotional competence only due to the conceptual nature of the paper do not get it.

The framework of emotional intelligence has been positively associated with social network size (Austin et al., 2005), life satisfaction (Palmer, Donaldson & Stough, 2002), cognitive competencies such as verbal, spatial, and numerical aptitude factors (Bass, 2002), the prediction of job advancement criterion (Zeidner, Matthews & Roberts, 2004), better social and personal relationships; also, higher levels of life satisfaction and lower levels of depression (Austin, Soklofske & Egan 2005). Emotional intelligence has been found to have a positive correlation in dealing with moods and behaviors (Forgas, 2001), managing stress (Jain & Sinha, 2005) and even sports performance (Perlini & Halverson, 2006). Furthermore, low emotional intelligence in males has been positively associated with illegal drug and alcohol use, deviant behaviour and poor relations with friends (Brackett, Mayer & Warner, 2003). On the whole, the concept of emotional intelligence has shed new light on the importance of a healthy emotional life.

Overall, emotional competence has found to play a significant role in building personal and professional life. Much research has focused on how emotional competence is utilized among student and business communities. But to the authors' knowledge there is limited research on how emotional competence influences academic teaching and career advancement. We suggest that logically, good teaching requires emotional intelligence.

2 Good teaching

Emotional Intelligence is an essential attribute for educators in the university environment. The literature on best pedagogical practice emphasises the role of the educator in fostering a learning environment that inspires and engages students towards self-directed learning. This approach is illustrated by the Socratic phrase "kindling of a flame, not the filling of a vessel" (Robinson, 2011, p. 251). A student focus that influences conceptual change and that motivates and inspires students to become life-long learners (Biggs & Tang, 2007) are key themes in the literature. Student focussed teaching which conversation, debate and time for questions promotes self-directed learning (Trigwell, 2006). Therefore, emotional intelligence can play a key role in student focused teaching.

Passion and commitment in teaching the subject plays a pivotal role in positively influencing students' learning experience. According to Ramsay (2001), "the example of a teacher who is enthusiastic about his subject and passionate and truthful in his arguments is the most precious discovery a student can make. Being passionate oneself about independent thinking is the best way to develop independence in others" (p. 139). Therefore, the emotional component of teaching is significantly important in addition to the cognitive ability of an employee. Cognitive and emotional connectivity facilitates a pivotal learning experience in the classroom. Mezirow (1997) stresses that "educators must assume responsibility for setting objectives that explicitly include autonomous thinking and recognise that this requires experiences designed to foster critical reflectivity and experience in discourse". Such education, he says, is learner-centred, commonly involving "group deliberation and group problem solving".

Empathy is an integral part of emotional competency. Belanger and Longden (2009) found that students value teachers who display not only "enthusiasm for ideas and subject matter" but also "empathy towards them as persons". The literature emphasises mindfulness of the needs of students with diverse learning styles and levels of self-motivation (Ednilson & Hanna, 2009) coping with the pressures of today's university environment (Toohey, 2010) and the benefits of student-centred blended learning activities (Caulfield, 2011). These themes reveal a clear link to emotional intelligence as a preeminent trait of a good teacher in the academic environment. University teaching is about inspiring a large and diverse cohort of students, some of whom bring a high level of motivation, and others who turn up begrudgingly (Biggs and Tang, 2007). Emotional intelligence is essential in order to provide both empathy and inspiration in the classroom.

Based on the existing research we found two important research gaps in the literature.

2.1 Research Gap #1

The first research gap in this paper seeks to highlight is around the crossover between emotional intelligence research and the pedagogical literature. Research on emotional intelligence is primarily located within the fields of Management and HR, appealing to managers in private industry but rarely focusing directly on the academic workforce. Meanwhile, the research on good teaching practice implicitly highlights the need for emotional intelligence but does not provide enough research support that it in the language of emotional intelligence. The considerable overlap between the two fields seems accidental. Further research is required to explicitly draw these two fields together.

2.2 Lack of E.I. Training and Recognition

Research by Schimanski and Alperin (2018) found that university procedures for review, promotion and tenure focused excessively on "research at the expense of teaching and service" (p10). Research output is commonly judged according to oversimplified

rules-of-thumb like journal impact scores, leading to "barriers to career advancement" (p10) for educators taking non-traditional approaches (e.g. social media engagement) regardless of whether these novel approaches connect with students and the wider public. This leads to an institutional understanding of *impact,* and therefore career advancement, which is aloof; devoid of any need for emotional competence. Furthermore, the work of Brennan and Magness (2019) highlights the grave consequences of incentive structures built around the preservation of insider power and status, rather than the best service of the ostensible mission of the organization. Therefore, priority should be given in promoting emotional competence.

An extensive empirical study by Osinski and Hernandez (2013) found that *closeness to the student* was the preeminent trait of good teachers as reported by students themselves, once the restraints of the typical teacher evaluation survey were removed and a more open survey was used. The authors found a disconnect between the kinds of questions asked in formal surveys – and therefore judged as important by university administrators – and what students themselves deemed as the most important characteristics.

2.3 Research Gap #2

The second research gap this paper seeks to highlight is around the crossover between Emotional intelligence research and university procedures for review, promotion and tenure. Emotional Intelligence is the defining factor which distinguishes good teaching, yet it is absent or seriously lacking in university review and promotion metrics. Further research is required into how senior leaders of universities could use emotional intelligence for the purpose of identifying, recognising and promoting academic talent. Academia needs higher education practitioners with emotional intelligence and intrinsic motivation to promote learning mindset among students (Naude, Nel, van der Watt and Tadi, 2016). Generally, criteria for promotion revolves around, Research and Scholarship, Teaching and Curriculum Development, Academic Leadership and Service to the University. Academics need to demonstrate some level of performance in these areas in order to be considered for promotion. Yet the emotional component is significantly required for effective teaching, academic leadership, and service to university criteria. In this study we attempt to show that the role of emotional competence is central to good teaching and that academics may be rewarded for exercising emotional competence in teaching rather than just cognitive abilities.

Even though this paper focused on emotional competence of academics in teaching, it is vital to develop emotional competence beginning in the early years. Early social experiences play significant role in overall development of cognitive and emotional abilities, including the reduction in antisocial behaviour (Palmer, 2005). Therefore, developing emotional competence ought to be promoted for teachers in order to positive learning experience. Overall, the aim of this paper was to explore a research gap, therefore, empirical evidence is lacking in this conceptual paper. Robust qualitative and

quantitative studies are required to further establish the research proposal. A cross-cultural and longitudinal study can further strengthen the proposed research.

3 Conclusions

Overall, the paper explores the importance of emotional competence in promoting student learning opportunities. High cognitive ability and the publication of scientific papers are seen as important in promoting student learning, yet this paper has raised important questions about the role of emotional competence in teaching and promoting student learning opportunities. This paper has identified two gaps in current research: 1) That there is a lack of emotional competence training and research in academia and 2) Emotional competence has not be identified in higher education policy. The principle theoretical implication of this paper is clear: emotional intelligence in academic teaching practice requires further empirical research. Moreover, emotional competence should be given additional importance in promotions in the academic setting due to its influence on student learning.

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Service Provider Incentives in Value Co-Creation Networks – a Systematic Mapping Study

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Abstract

The main objective of this study is to create a systematic map of the existing state-of-the-art research on service provider incentive models and incentive functions in digital business ecosystems that promote collaborative value co-creation. The chosen research method is the systematic mapping study. The classification of publications revealed eight main categories of interest: 1) Incentives for collaboration 2) Incentives for cooperation 3) Design of incentive models 4) Trust management 5) Potential challenges with incentives 6) Incentives in non-cooperative networks 7) Incentives in value creation networks and 8) Blockchain or token-based incentives. The resulting systematic map was visualized using a sunburst chart combined with the research gap analysis. The identified gaps in the incentive related research were related to the lack of studies from the ecosystem point of view, lack of studies related to automating incentives processing and addressing the incentive related KPIs in ecosystems. To further strengthen the collaborative working and innovation between service providers, the following areas are suggested for further study: ecosystem level approach to incentives, service providers' preferences on desired incentive models and digital assistants for automating incentive functions for service providers.

Keywords – Incentives, Digitalization, Ecosystems, Value co-creation, Mapping study

Paper type – Academic Research Paper

1 Introduction

Business ecosystems compete with their diversity and scale. A business ecosystem is a diverse network of different types of organizations which together are able to produce

more value than any organization alone (Moore, 2006). High diversity means capabilities to evolve, adapt and innovate faster than the competition. High scale means capabilities to develop and expand the ecosystem further.

Business ecosystems are especially characterized by value co-creation activities actualized as collaboration between the ecosystem actors (Ranjan and Read, 2016). Previous research has shown that customers and other stakeholders' involvement in the value-creating process within the ecosystems has a positive effect on the final perceived value (Vuori et al., 2018, Prahalad and Ramaswamy, 2004). However, the perceptions between the different ecosystem actors may vary a lot due to their different viewpoints and variations in modus operandi, leading to a need to understand better the different incentives of the actors in business ecosystems.

Incentives are a mechanism to amplify desired outcomes in business ecosystems. Collaboration, sharing of information and co-creation of new solutions can be boosted by appropriately incentivizing these actions. Especially from the knowledge management point of view, incentives can support collaborative knowledge creation and more efficient knowledge transfer between different organisations (for example, Berger and Lettl, 2013).

The focus of this mapping study is to explore and recognise the different opportunities related to incentive models from the perspective of a service provider as an actor in a business ecosystem. More precisely, this study aims to identify the current state-of-the-art research on ecosystems related incentives published during the past 10 years. The study will consider both the technical and business-oriented research on incentive models.

In this paper, we use the Finnish national Aurora Artificial Intelligence programme (Kopponen et al., 2019) as a motivational example of a need to better understand ecosystem-level incentives.

The rest of the article is structured as follows: Chapter 2 presents a brief overview on the theory of incentives and contracts. Chapter 3 introduces the AuroraAI programme and defines a list of areas of interest for the study. Chapter 4 presents the research questions and the process of conducting the mapping study. In Chapter 5 the results of the mapping study are presented and visualized. The major findings are then discussed in Chapter 6 followed by the conclusions in Chapter 7.

2 Theoretical background

This section introduces the theoretical background of incentives. First, the contract theory is explored as basis for incentives. Then, theories of motivation are explored to better understand the needs linked with incentives. The chapter is concluded by an overview of the game theories and use of dynamic incentives.

2.1 Contract theory

The contract theory (Hart 1983, Holmström, 1994) and, in particular, the principal-agent theory forms the basis for the incentive theory (Laffont and Martimont, 2002). The principal and agents can agree on using incentives as a component of the contract to optimize the overall business value for both.

The incentive theory acknowledges the agents always pursue at least partly their own private interests. These private interests could be due conflicting objectives between the principal and agents, or due private information known only by the agents. The incentive theory calls these two issues as (1) moral hazard and (2) adverse selection.

For the context of this paper, the facilitating operator of the ecosystem can be considered as the principal and service providers as the agents. However, the principal-agent theory becomes challenged when extended to ecosystems because of its limited scope of addressing the complexity of ecosystem inherent relationships and collaboration.

2.2 Motivation theory

The different theories of motivation investigate and explain the behaviour of why people and organisations get motivated and what is the incentive they desire most.

The need-based motivation theories approach motivation through satisfying a person's or organisation's needs. A few examples of need based motivation theories are: (1) Maslow's hierarchy where the needs are related to physiological, safety, social, esteem and self-actualization (Maslow, 1943), (2) ERG theory where the needs are regrouped as existence (E), relatedness (R) and growth (G) (Alderfer, 1969), and (3) 2-factor theory where the needs are divided into hygiene factors and true motivators (Herzberg, 1968).

In the process-based motivation theories the approach is more focused on actions. A few examples of process-based motivation theories are: (1) Equity theory, which measures the ratio between a person's inputs (contributions) and outcomes compared to a referent. If the comparative ratios look equal the equity is perceived as fair. If not, then the situation is perceived as unfair and de-motivating (Adams, 1963), (2) Expectancy theory, where the level of motivation is determined by assessing how likely it is the effort leads to high performance in the reference group (expectancy), is the performance going to be rewarded (instrumentality) and how desired are the potential rewards (valence) (Victor Vroom in 1964, discussed in Lawler, et al., 1973), and (3) Reinforcement theory (Skinner, 1938) where interventions either aim to increase the desired behaviour (reinforcement) or to decrease the unwanted behaviour (punishment and extinction).

2.3 Game theory

From the ecosystem point of view, defining the incentive model becomes an optimization problem which can be modelled with game theories.

In non-cooperative games the Nash equilibrium refers to a state where each party is assumed to know the strategies of other players and still players cannot gain anything by changing only their own strategy (Kuhn et al., 1996).

The cooperative game theory (Harsanyi, 1963) allows players to form alliances and it focuses on the collective actions and collective payoffs. The latter theory is likely to be more usable in networks which promote collaboration and co-creation.

2.4 Need for dynamic incentives

The dynamic nature of collaborative networks produces small, fast, diverse and distributed contributions, which ideally should be captured by the incentive mechanism.

Distributed Ledger Technologies (DLT) based on blockchain are one potential solution for introducing mechanisms that can cope with the required dynamics (Wood, 2014). The natural characteristics of DLT systems seem to be well aligned with the needs of incentives:

- The incentive logic can be encoded directly into the blockchain (automation).
- The distribution of incentives is almost immediate (real-time payoffs).
- The unit of incentives can be very granular (small contributions).
- All incentive related transactions can be verified by anyone (high transparency).

3 Example: AuroraAI

The Finnish national Aurora Artificial Intelligence programme for 2020-2022 aims to develop a new distributed digital service operations model to support people's life events through a network of smart services and applications (Kopponen, et al., 2019).

In this smart network, a number of service providers are brought together to co-create seamless and versatile service offerings for different life events. Incentives are a potential mechanism to ensure the business case for each service provider will be healthy and with a sufficient scale.

For the purpose of this mapping study, the incentive related requirements were extracted and summarized in four themes as depicted in Figure 1. These high-level themes will be used as a guide later in the mapping process to assess the relevance of the identified articles.

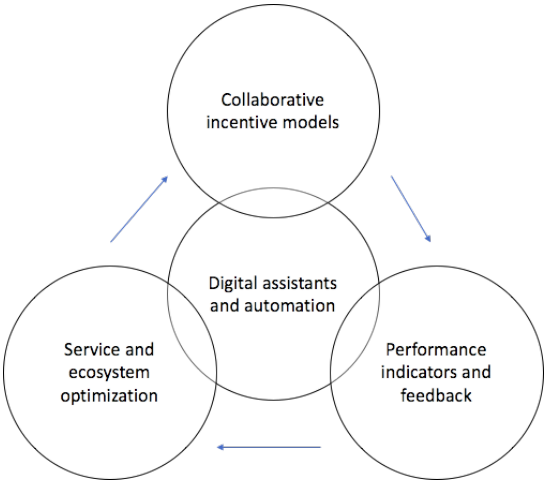

Figure 1. The incentive related topic areas based on AuroraAI ecosystem.

4 Research method

The chosen research method is the systematic mapping study according to (Petersen, 2015). The steps of the process are presented in Figure 2.

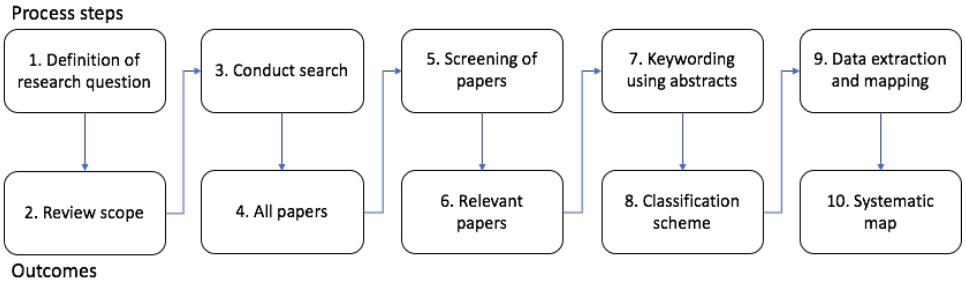

Figure 2. The overview of the systematic mapping process.

The goal of this mapping study is to identify the current state-of-the-art research on the service provider incentive models. Thus, the research questions are the following:

RQ1 *= What topics have been addressed in the current research on service provider incentive models?*

RQ2 *= Where and when were the studies published?*

RQ3 *= What are the current research gaps?*

First, a set of pilot searches were conducted using a modified PICO model (Santos, 2007) and selected topical anchor words to estimate the number of expected results. Based on the pilot searches, the final search string was decided as presented in Figure 3.

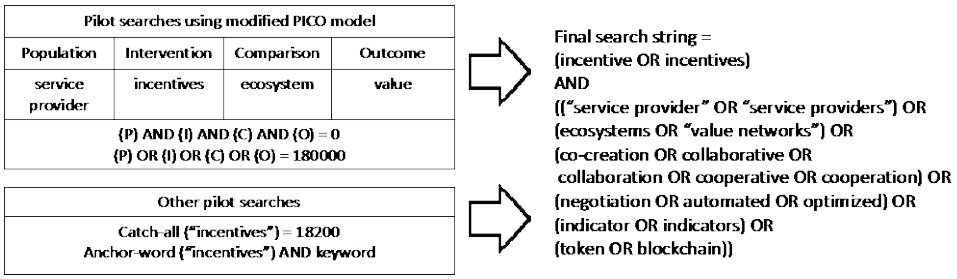

Figure 3. Formulation of the search string

The search, which was limited to titles, was conducted in multiple article databases: Google Scholar (890 articles), Elsevier ScienceDirect (78 articles) and IEEE Xplore (146 articles). The inclusion and exclusion criteria as presented in Table 1 was used in the screening phase with two reviewers for 932 articles combined. After screening, 61 remaining articles were dynamically classified into eight main categories.

Table 1. Inclusion and exclusion criteria.

Inclusion criteria	Exclusion criteria
- Topic is about service provider incentives or supporting functions - Topic is relevant in a value network or ecosystem - Topic is relevant for collaboration or cooperation	- Any other topics - Study has been published earlier than 2010 - Study is in other language than English

5 Results of the mapping

As outcome of the mapping process, 61 articles were included into the final map.

5.1 Topics of publications

The classification of articles revealed eight main categories which are described next with the references to the original publications.

Incentives for collaboration

Collaboration means working together for a common goal through shared objectives and vision, shared resources and shared responsibility (Jardine, 2010). The nature of collaboration is dynamic and roles of stakeholders may change during collaboration. Another concept which can be understood quite similarly is "co-creation".

The studies identified under the category of "incentives for collaboration" discuss how to define incentives for collaborative innovation when also small contributions are rewarded (Boss, et al., 2017), punishments in collaboration (Meng, Jang, 2010), definition of collaboration (Jardine, 2010), rewards sharing based on contributions (Bachrach, et al., 2012), risk-sharing in collaboration (Song, et al., 2017), incentives in knowledge sharing (Perkmann, et al., 2013) and aggregated performance (Zehir, et al., 2017).

Incentives for cooperation

Cooperation differs from collaboration in the sense it is more focused on reaching individual objectives with the help of other stakeholders. Cooperation typically means sharing resources or information based on agreed individual responsibilities.

The category of "incentives for cooperation" is the largest category and contains the highest number of sub-categories. The topics covered range from motives and trust to social preferences (Boone, et al., 2010 and Moisan, et al., 2017), choice of partners (Archetti, 2011), optimal distribution of incentives (Chen, Perc, 2014), cost and risk (Boukendour, Hughes, 2014) and resource-sharing (Vega, et al., 2013). Several papers utilize game theories.

Design of incentive models

The category "design of incentive models" discusses the different types of incentives (Hawa, 2010, Pajarito, et al., 2018, Manzato, 2010 and Mantilla, 2014). One common topic that is repeated in this category is the concept of dynamic incentives that change based on the state of collaboration (Vespa, 2015, Chen, et al., 2015, and Zhang, et al., 2015).

Trust management

A profound topic related to incentives is trust management. The level of trust between stakeholders affects the form of incentives which can be agreed for collaboration or cooperation. The identified studies in category "trust management" discuss defining a trust degree for selfish users (Wang, et al., 2016), addressing cold-start problem when trust is not yet there (Lafuente, Seigneur, 2015) and encouraging trust with incentives (Pippin, Christensen, 2012).

Potential challenges with incentives

In addition to potential trust management issues already mentioned, the category "potential challenges with incentives" extends to further challenges like the issue of community instability where participants join and leave (Song, et al., 2015) and incentives in uncertain collaborative environments (Bachrach, et al., 2013).

Incentives in non-cooperative networks

Incentives are naturally used also in competitive environments. As an example, knowledge sharing with non-cooperative incentives is discussed in (Kwiatkowski, 2010).

Incentives in value creation networks

The category "incentives in value creation networks" was one of the major interests in this mapping study. Two prime articles were identified in this category. The first discusses the potential challenges and research topics related to incentives in value creation networks (Hulkko-Nyman, et al., 2013). The second article presents an overview into a system concept of Service Value Networks (SVN) with highly specialized service providers contributing to an overall value proposition (Blau, et al., 2010).

Blockchain or token-based incentives

This category contains several examples of practical implementations or implementation proposals using bitcoin or token-based incentives. The articles in this category cover token design (Laskowski, et al., 2019), token use cases in vehicular networks (Bae, Cho, 2019, Wang, et al., 2019, and Park, et al. 2017) and peer-to-peer communication networks (ImaniMehr, et al., 2019, and Aslani, et al., 2018).

5.2 Frequency of publications

The publication years of the selected publications are distributed quite evenly over the time period under study (2010-2019) as in Figure 4. This further suggests the topic under study is scattered and covers aspects from multiple research domains. The average number of publications per year is 6,1 for the defined search and inclusion criteria.

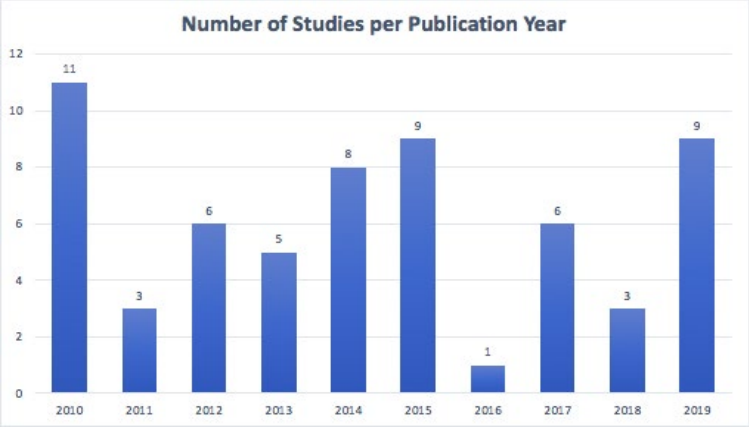

Figure 4. The number of studies per publication year.

5.3 Venues of publications

Most of the articles have been published in Journals (38%) and Conferences (33%). Still there are also single articles (16%) and a few thesis (7%) which are relevant for the topic. A few articles were published in a book or technical report (6%).

6 Discussion

The findings from the classification phase are evaluated next in comparison to the research questions set for this mapping study. The identified articles will be placed in a visual map together with the identified gaps. The research gaps are identified based on the theory part in Chapter 2 and the identified themes in Chapter 3.

6.1 What topics have been addressed in the current research on service provider incentive models (RQ1)?

Based on the results, the current research on incentive models is scattered into multiple research domains and there are few systematic approaches which combine the individual topics to an ecosystem level approach. The Figure 5 presents a summary of the currently addressed research topics and the identified gaps combined into one visualization.

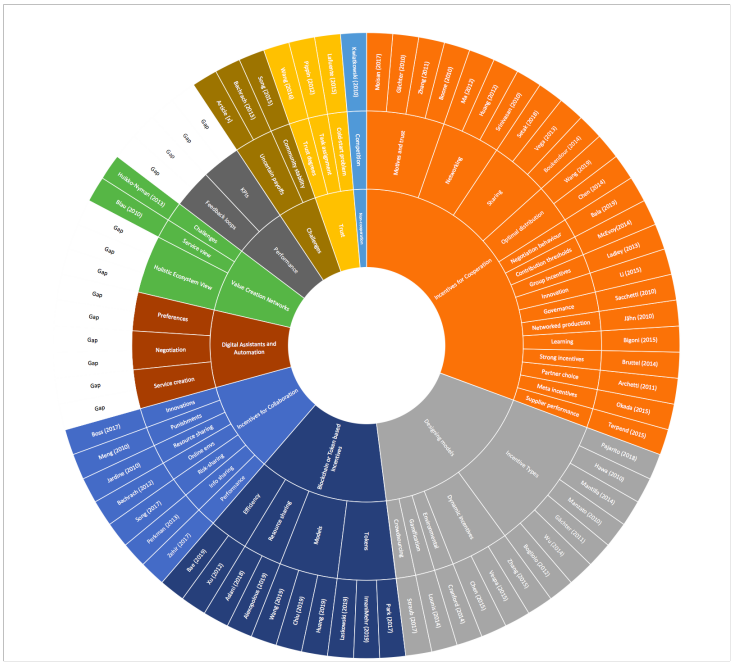

Figure 5. Illustration of the addressed topics and identified gaps.

6.2 Where and when were the studies published (RQ2)?

The identified existing research has been published quite evenly distributed over the time period under study (2010-2019) as described in Chapter 5.1. There is also a highly diverse number of publication channels. Clearly, there is no single channel with a sole focus on addressing the incentive functions in digital ecosystems.

6.3 What are the current research gaps based on the identified research activity (RQ3)?

The lack of systematic studies from ecosystem perspective is a research gap. Further, when comparing the findings with the topics of interest in Chapter 3, the lack of studies related to automating incentive processing, performance KPIs and feedback functions are also research gaps.

7 Conclusions

This mapping study has looked at the incentives-related research from multiple angles: From contracts theory to behaviour theory and from individual's view to ecosystem's view. Throughout the investigation, the need for a more systematic approach to describe the different aspects of incentives related functions has become clear.

On the other hand, there is a need to keep the incentive models understandable regardless of the complexities of ecosystem collaboration. This suggests a higher level of automation and simple tools are needed in incentive processing for service providers. To conclude this study, the following topics are suggested as focus areas for further research:

Ecosystem level approach to incentives. This research topic should study especially the trust management aspects of collaboration at the ecosystem level. Trust management is linked with the characteristics of the sharing economy: willingness to share risk, share information and share rewards among the actors of the ecosystem. Thus, it creates the base for defining the actual incentive models.

Further study on service providers' preferences. Incentive model is only one component of the business model canvas for the service provider. Further study is suggested on investigating what are the desired incentive models and functions from service provider's view. This research could be done as structured interviews with a number of digital service providers.

Further study on digital assistants and automating incentive functions for service providers. Based on the results of this mapping study, there is not much existing research on automating the incentive functions for the service provider. Further study is suggested on clarifying the need and requirements for digital assistants to help service providers understand the incentive models, measure the results and maximize their own business case.

Collecting feedback from pilot projects like AuroraAI helps to further align the research activities with the highest practical value. It is suggested to gather systematically the feedback from AuroraAI and other pilot programs.

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Digitalization and Business Model Change in Manufacturing SMEs: an Explorative Investigation

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Abstract

The Fourth Industrial Revolution (I4.0) is dramatically affecting firms' strategies, transforming their business models. In particular, a bunch of technologies like IoT (Internet of Things), cloud platforms, big data, and data analysis are offering firms the possibility to manage products functions, remotely and globally, kickstarting the design of innovative business models. The aim of this article is to investigate how incumbent manufacturing SMEs can manage the evolution of a new business model enabled by IoT in parallel with its extant business model, with particular attention to the main resources and capabilities required, as well as the main difficulties encountered.

Keywords – IoT, Business Model Innovation, Digitalization, SMEs.

Paper type – Academic Research Paper / Practical Paper

1 Introduction

The Fourth Industrial Revolution (Industry 4.0, I4.0) is dramatically affecting firms' behaviors and strategies, transforming products design, manufacture, operations and services (Rüßmann et al., 2015). This disruption is linked, in particular, to a series of technologies within the I4.0 framework that will dramatically change the way firms operate in their markets (O'Connell et al., 2015). Among I4.0 technologies, a set of outward-oriented, front-end set of technological streams – IoT (Internet of Things), cloud platforms, big data, and data analytics – are transforming business markets landscapes, offering firms the possibility to monitor, optimize and automatize product functions, remotely and globally (Porter and Heppelmann, 2014). These technologies are at the core of a radical transformation of manufacturing leading to a change of firms' business models (BMs) with the expansion of service innovation opportunities (Lusch and Nambisan, 2015).

The emergence of these disruptive technologies pushes incumbent firms to change and adapt their BM to stay competitive (Rachinger et al., 2019), thus transforming markets landscapes (Porter and Heppelmann, 2014) and posing big challenges to entire industries (Stock and Seliger, 2016). Indeed, "not all incumbents perform better after adding new business models to their existing one" (Kim and Min, 2015, p. 34). This suggests that despite some years have passed from the explicit call for research on how firms can organize these experimentations with BMs effectively (Andries et al, 2013), the lack of a better understanding of how this process unfolds overtime continues to be mentioned as a gap in the literature (e.g. Laudien and Daxböck, 2016; Müller et al., 2018; Parida et al., 2019).

Against this background, the purpose of this article is to investigate BM innovation (BMI) from the point of view of B2B manufacturing firms, whose traditional strategies are being disrupted by the ongoing I4.0 revolution (Laudien and Daxböck, 2016; Müller et al., 2018), especially as regards SMEs, for which these issues are even less investigated (e.g. Paiola and Gebauer, 2020). Therefore, more particularly, we aim to answer the following research questions: how can incumbent manufacturing SMEs manage the evolution of a new business model enabled by IoT in parallel with its extant business model? What are the main resources and capabilities required and what the main difficulties encountered?

The reminder of the article is structured as follows: in the next section, we set the theoretical bases for our study, then we illustrate the methodology we followed and the present the results of our analysis, before discussing them in light of existing studies and highlighting implications for theory and practice.

2 Theoretical background

IoT was firstly used to indicate the interconnection of physical objects through adding sensors for various purposes, including identification, sensing, communication and data collection (Ashton, 2009)." These features of IoT have affected manufacturing paradigms and the way of doing business, among which the possibility to offer these additional innovative services or features to the existing products is likely to influence value creation processes, which attracted researchers' attention on how firms can redesign their business models accordingly (e.g. Suppatvech et al., 2019; Paiola and Gebauer, 2020).

In this regards, authors have put forward different archetypes of IoT-based business models based on the role and importance of digital processes enabled by the IoT-related technology. Among the others (e.g. Laudien and Daxböck, 2016), for example Suppatvech et al. (2019), with a focus on the provision of servitized offerings through the use of IoT, propose four archetypes of IoT-enabled servitized business models based on their main value propositions: (i) add-on business model that uses IoT in enabling additional functions or adding personalised services to the existing physical products or service; (ii) sharing business model, where the customers pay for using or accessing a product for a limited amount of time; (iii) usage-based business model that uses IoT to measure the amount of product usage and allow customers to pay for or subscribe to the plan, based on their actual usage and needs (pay-per-use or subscription); and (iv) solution-oriented business model that utilises IoT in enabling the provision of integrated solutions to customers' needs, which in B2B practice relate to supporting customers' core operations and increases in efficiency, and expanding business capabilities.

It is clear how the opportunities offered by the IoT have made this stream of research merge with the BMI one that has increasingly focused on different strategies of BMI. More particularly, many (e.g. Khanagha et al., 2014; Savič et al., 2016; von Delft et al., 2019) distinguished between making incremental changes to individual components of the BM and disrupting the BM acting on multiple components. Others have distinguished among developing, transforming, enhancing, extending or redefining the BM (Laudien and Daxböck, 2016; Paiola and Gebauer, 2020), which recalls another relevant dispute, i.e. complementarity versus substitutability (Casadesus-Masanell and Tarzijan, 2012). Markides and Charitou (2004), introducing the concept of dual business, paved the way through research on how to manage multiple BMs.

Taking the dimension of time into consideration, come authors have taken a learning process perspective to study BMI, embracing the evolutionary view that sees BM development as an initial experiment followed by constant fine-tuning and learning (Savič et al., 2016). In this domain, despite the literature encourages firms to experiment with BMs stating that BMI cannot be completely anticipated and firms cycle through an iterative learning process by conducting experiments that allow them to test individual elements of a new BM (von Delft et al., 2019), it is still unclear how they can organize these experimentations effectively (Andries et al, 2013). After some years, the lack of a better understanding of how this process unfolds overtime (e.g. key phases, activities and

roles, customer involvement) continues to be mentioned as a gap in the literature (e.g. Laudien and Daxböck, 2016; Müller et al., 2018), even within the specific literature on digital servitization (Parida et al., 2019). Considered that the research in this domain has only marginally focused on SMEs in favour of large companies (Müller et al., 2018; Cosenz and Bivona, 2020), this study aims to investigate how incumbent manufacturing SMEs can manage the evolution of a new business model enabled by IoT in parallel with its extant business model, with particular attention to the main resources and capabilities required, as well as the main difficulties encountered.

3 Methodology

3.1 Research design and case selection

We designed an inductive research method founded on a qualitative exploratory and longitudinal research design based on a multiple case study (Bryman & Bell, 2011), which is recommended in exploratory research, as it provides detailed data and allow for the investigation of current managerial challenges (Yin, 2009). A purpose-oriented case selection was adopted (Eisenhardt, 1989): medium firms exploring the possible uses of IoT-based technologies to expand their service-oriented offerings and innovate their BM that could provide congruous access to information and knowledgeable informants were our target. Among many cases examined, we selected two exemplary cases located in two of the most industrialized areas having an acknowledged tradition and an excellent standing in the North of Italy, namely Lombardy and Emilia Romagna, and belonging to the same industry, i.e. packaging.

3.2 Data collection

We carried out multiple interviews, which were recorded and transcribed, with multiple respondents between 2016 and 2020, thus obtaining real time primary data, which was complemented by site observations, meetings and secondary data to enhance validity and reliability. We also gathered data from the preceding years to cover any relevant information and reconstruct the evolution of BMI since the beginning. In-depth longitudinal access is a desirable requisite of strong qualitative case study theorizing especially by means of the comparative case study method (Pettigrew, 1990).

3.3 Data analysis

We employed multiple tools and tactics for data analysis. Firstly, we performed the within-case analysis starting from the interview transcriptions and from other meetings and interactions minutes. More particularly, we prepared a comprehensive overview of each case's relevant features, using acknowledged techniques of data reduction and

display for structuring and thereby simplifying information (e.g. Miles and Huberman, 1984). This allowed identifying the relevant aspects pertaining to the changes of business model elements. Secondly, by analysing and ordering the significant events along the considered period, we outlined the phases of the new business model, building a stylized process. Thirdly, we proceeded with the cross-case analysis to identify similarities and differences across the two cases, always by means of tables.

4 Case analysis

4.1 Within-case analysis: Case Alpha

Company Alfa is located in Lombardy, it is a leader manufacturer of complete packaging systems for dried food. It is a medium-sized enterprise that employs 110 people with a total turnover of 30MEur, with a strong and long-standing reputation in quality, innovation and customer service.

Alfa recently signed an innovative performance-based contract with one large customer, leveraging a customized IOT-based remote condition monitoring solution. This product-service system allows Alfa to monitor customer's operations performance remotely and control machine settings and functioning to fulfil agreed-upon productivity and Overall Equipment Effectiveness (OEE), to which monthly fees are parameterized. The analysis and visualization of customer's processes data are fundamental to guarantee the agreed-upon Service Level Agreements, whose failure to achieve is at the supplier's responsibility and impact on actual revenues following bonus-malus mechanisms.

First attempts at the new solution date back to 2013-2014, but different improvements have been made over time. The next section describes this evolution.

4.1.1 Different phases in Alpha's BMI

At the end of 2013 a large player in the food industry is in need of replacing complete lines of packaging machines of one of its production plants in Italy. An invitation to tender for the supply of several production lines is transmitted to different suppliers both in Italy and internationally. The supply encompasses different connectable machines some of which coming from different suppliers (for asking the supplier to act as integrator). Moreover, the bid specifically calls for the provision of the machines within an overall contract in which the supplier would have committed to guarantee an agreed-upon level of performances (an OEE of 85%) along the machines' lifetime.

Alfa's CEO and R&D Manager meet the challenge and leverage all the internal competences they possess to satisfy the customer's needs. They commit for weeks in crafting an appealing and sustainable tender and in the end, as for January 2014, the bid is closed with their being selected as suppliers. Then the design and production of the production lines begin, and that requests several months to be accomplished, involving Alfa's BUs without any relevant organizational changes to the business-as-usual. In July

2014 the first production line is tested and begins production, which makes a new phase begin.

Most part of the innovative job requested to Alfa by the new service offering starts in 2014, when machines begin to be installed and tested. All the operational activities are hosted in the same product BU, no organizational modification is made. The team dedicated to the innovation development is however extended: alongside the CEO and the R&D manager, the first ramp-up period goes in parallel with the construction and assembling of the lines, that is managed by the technical division, and the production division as in business as usual. The team's work is aimed at the actual design of the solution (the service component of the product-service system) and is founded on the work of three internal people (taken from the technical office) and a newly hired computer engineer, dedicated to the design of software.

Although the team is quite small, it continues to have frequent and dense interactions with other internal organizational divisions and is regularly connected to a crew that is in charge of making the complex system work at the customers' premises. As new machines and lines are installed and added in the customer's factory, new members are gradually added to the on-site crew, totalizing 10 components (shifting accordingly to the customer's workhours) at the end of period 2. All these people belong to the same organizational BU inside Alfa.

A great deal of interaction characterizes the relation with the customer: both TMTs participate in main technical meetings, and the customer's contribution in the specification and refining of the design of the service is significant. "*There was a very good feeling among us, helped also by the very high professional level of the new managers in the client's organization*" says Alfa's CEO.

The first outcome of this phase is a functioning prototype of IoT-based solution capable of sustaining the contractual agreements: Alfa has to constantly monitor and be able to study process-related data in order to eliminate any operational dysfunction that may impede to reach the desired outcomes. This first version, called prototype 1.0, is a customized solution that leverages IoT technologies, and transmits data to a special control room in-house in order to be capable to monitor 24/7 every relevant efficiency-related input. This period sees also some relevant contributions from external actors and players, especially as regards the technologies that are more distant from Alfa's core knowledge, like for example data analysis and software design. A relevant role, especially in the first steps (but also in intermediate searches for solutions and benchmarks) is played by the CEO's epistemological network: he is in fact involved in cross-industry I4.0-related professional communities, in which precious experiences and prospective solutions circulate among participants.

Against this background, when in 2019 the same key customer asks to apply the solution to another of its production plants, Alfa approaches this subsequent request having accumulated almost 6 years of direct experience, and therefore possessing a much higher awareness of the project's challenges and their best solutions: it acknowledges the

possibility to leverage this unique experience in order to design services and solutions also for different customers and industries. In line with this, Alfa recognizes that architectural choices made years before are not appropriate for a replication of the solution neither for the same customer nor for other customers. Alfa chooses to develop the new solution using a cloud-based architecture and selects a world class cloud platform services provider. Version 1.0 is indeed adapted and finally migrates to the cloud, envisioning prototype 2.0. The internal team (with the help of few external contributions) works intensively for upgrading the graphic user interface (GUI) and the user experience (UX), and makes machines' data visual reporting more effective and usable, thus greatly improving the versatility of the solution, that now the customer can access from desktop controls and distributed personal devices via a dedicated app. Here the role of the cloud-related tools is fundamental in leveraging the full potential of IoT technologies for the innovation of the business model.

In the beginning of 2020, Alfa enters the current period of development with a significant experience and a bunch of customers that already have entered the first level of its 2.0 offer. Overall, 13 customers have installed the level 1 (for a total of 40 machines) and are paying fees or using for free within the warranty period (all the users of prototype 1.0 are invited to migrate to 2.0). Figure 1 highlights Alfa's BMI phases key points.

				Period 3: Replicate and commercialize	
		Period 2: building and refining the prototype			
	Period 1: inception				
Temporal horizon and main events	end 2013: Alfa wins the tender with a key customer	july 2014: the first line of 7 is activated, Alfa begins to learn	mid 2016: version 1.0 is stable (prototype 1)	mid 2019: version 2.0 (prototype 2) and 4layer value-proposition	New machines are upgraded, old applications (1.0) migrate to prototype 2

Figure 1 – The BMI process in Alfa

4.2 Within-case analysis: Case Beta

Beta is a medium-sized company that produces machines and solutions for the packaging of tissue products, with strong capabilities related to innovation and service development. It employs 120 people, has a turnover of 50MEur and is located in the industrial cluster named "Packaging Valley" in Emilia Romagna. Beta has developed a platform-based solution leveraging IoT and cloud solutions, and a complete connectivity outfit developed for the new machines (also available in retrofitting kits for some previous generations). The system is capable to report with an easy-to-use visualization interface the most relevant performance indicators related to the installed machines, available 24/7 in desktop, laptop and smartphone GUIs (increasing attention has been dedicated to UX). The system has a back-end engine able to automatically support users

to have ML-based hints and suggestions to correct any emerging efficiency problems and to introduce procedural changes able to improve efficiency and efficacy. The system is distributed for a free trial period during the warranty period (also helping to avoid free-riding behaviours during the warranty period): incremental revenues are based on the ability to convert free users into fee payers at the end of the warranty period (or earlier), basing on sales force activity.

4.2.1 Different phases in Beta's BMI

It is January 2016 when a Digital Transformation Manager (DTM) - formerly a Beta's sales manager - is appointed to explore the possibilities offered by the I4.0 scenario and in particular by the family of IOT-related technologies (IOT, Cloud, BD, data analysis), actively investing for the design of a possible new service solution, capable of sustaining machines' efficiency and able to differentiate Beta's offer in an increasingly overwhelmed competitive arena. The idea is to leverage technologies to design advanced services linked to the installed base lifecycle, thus generating incremental revenues through recurrent and stable fees within the same market.

The initiative is fully endorsed by the company's CEO, that gives the DTM a "blank proxy" on the strategic exploration activities related to the new technological applications, regarding which she reports directly to him. An intense 6-month period of exploration begins: the DTM exploits all the available external network contacts to explore the possibilities I4.0 could offer to her firm, participating in seminars and work groups, interacting with actual and potential customers, consultancy firms, research centres and universities.

At the end of this period, the DTM has clearer ideas and a better comprehension of the possible uses of the technology. However, the DTM acts alone and has the permission to demand resources to other internal offices (as the technical office, and the IT dept.), i.e. the specific budget is quite limited. The CEO helps for positive internal negotiation for resources and protects the projects from attacks and boycotting from other departments that may feel endangered by the possible future growth of the new business. Against this background, the DTM starts to pretotype the solution with the help of an external consultant, previously working in the industry and with a deep operational knowledge. "*We literally confined ourselves in a room for weeks… he made the customers' voice, and we developed the architecture of the new service functionalities*" says the DTM.

Therefore, the second period of Beta's innovation process begins with a clear intention to invest in the development of a prototype, but with a very gradual approach. For the second half of 2016, the DTM uses external partners and an internal employee co-opted within the technical office (with the CEO endorsement). This little group gives shape to the prototype 1.0, that is developed and distributed until end 2019, when the development of a second prototype begins. Approximately from 2017, the DTM starts scouting its account portfolio in search of a suitable customer to test the system and "go live". As Beta's DTM says: "*We are trying to invent new services that affect directly the customer's*

business; in a sense we are creating our future customers". Finally, a first pilot testing using a real use case is started, with the installation of the solution in two machines of one customer.

As long as the solution takes shape, additional resources are added to the project team through successive hiring. Notwithstanding, it remains a rather lean structure: with a first addition in fall 2017, then another after summer 2018 the team totalizes 4 people (plus one part-time internal and the DTM), mainly specific technical competences in the field of PLC programming and digital competences related to modern software languages and electronics. This progressive enlargement of the project team is fundamental to stabilise the functionalities of prototype 1.0 and manage the installations to gather feedbacks and analyse data useful for the service development.

With gradual increase of commitment and investments, this setting works smoothly for about two years. In that period, the number of installations rises, and - in the second half of 2019 - 45 machines of existing customers have installed prototype 1.0, of which approximately the 60% pays a fee (mainly those who expired the warranty period). The need to internalize that activity is at this point very clear: the DTM is conscious of its importance for the subsequent development of the solution. Therefore, she chooses to abandon the 1.0 software architecture to build on a more replicable and scalable one based on cloud technological modules. The team reproduces prototype 1.0 within the new cloud architecture and some precious features are added, especially in UX and visual reporting (both strategic aspects).

Between the end of 2019 and the beginning of 2020, prototype 2.0 is bundled with new released machines and offered in free subscription for the warranty period. In addition, a general campaign of migration is started to convert all 1.0 applications to 2.0. Currently, prototype 2.0 has 8 machines and 5 clients, and demonstrates to be reliable.

Prototype 2.0 marks the beginning of a new period of Beta's innovation process, which is fundamental for the replication and further commercialization. Following the request of one of the pilot customers, Beta recognized that the solution could be easily adapted also to other producers' complementary machines. This suggests also a possible application to different industries' operations, enlarging the scope of replication of the solution. A further person is hired in this period in order to streamline the technical back-end software-related activities of the solution. As far as challenges are concerned, the DTM acknowledges that keeping the new service team integrated with the original BU has been advantageous for the smooth development of the innovation, but also recognizes that for its further diffusion a specific investment in a dedicated sales force has to be made. Figure 2 highlights Beta's BMI phases key points.

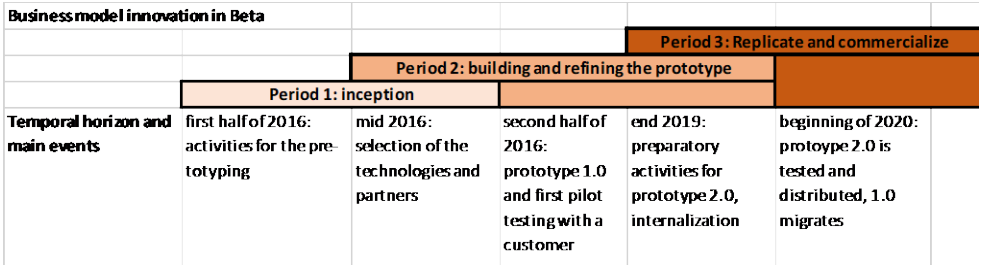

Figure 2 – The BMI process in Beta

4.3 Cross-case analysis

The two cases enable us to describe how exploration of IoT technologies can be approached by medium-sized manufacturing firms, going from envisioning the innovation to its broader commercialization. They also allow us to identify major common points and common challenges the two cases share (see table 2).

As far as organizational aspects are concerned, both cases embed and integrate the experimentation in the extant organization, and in particular in the product-related service side of the business unit. This choice is related to the connection between the activities to be implemented and the service-oriented activities already existent within the firm. In both cases the TMT is in favour or directly involved in the project, and this circumstance endures for all the investigated period.

Resources and competences dedicated to the new project grow during the period, following its capability to demonstrate its validity. The extent of financial resources allocated to the project comply to the conservative approach usually adopted by SMEs, due to limited resource slack. Both cases decide to internalize critical resources in order to hold the control of the development of the solution (this is critical for its replication and diffusion).

A similar approach is present also in the management of the value proposition, where the firms find it convenient to leverage technology in order to create a multi-layer offer of services with different degrees of completeness and different data intensity. Performance-based value propositions are particularly interesting and result to be directly comprehensible to sophisticated customers, that in both cases are international corporations with leadership positions in global markets (key customers).

As long as the revenue model is concerned, both cases adopt the subscription model with monthly fees (instead of the up-front one, traditional in manufacturing), and support the first commercialization phases through a free trial period (during the warranty), as an effective strategy to reduce market's uncertainty and lower cognitive mis-perceptions about the services' usefulness. This strategy is also important to convince the customer to grant data access to the supplier, being connected to warranty extensions. In both cases, data-related services affect supplier-customer relationships, since the ongoing information exchange influences the depth of knowledge exchange and mutual faith.

From a strategic point of view, it is also to be underlined that at the moment the new services are perfectly complementary to old businesses, generating additional streams of revenues (even if they ask for additional risk mitigation activities). This situation may change as the innovative business model catches on. Anyway, both firms recognize the hindering role of not having a sales force dedicated to the new advanced services.

A last comment regards a feature that distinguishes the cases and regards the inception: while in case Alfa the BMI starts as a consequence of a key customer specific request, Beta's management committed itself in the proactive search of viable uses of IoT technologies.

Table 2 – Business model innovation in the selected cases

Case	Origin	Organizational setting	Value proposition	Value creation	Value distribution	Value capture
Alfa	Reactive	No separated units are created, and the BMI is fully integrated in the product-related BU Alfa's CEO is fully involved in the BMI	Value-based service associated to the product, where subscription fees are weighted on performances	New-hired resources: 3 in house (10 on site coming from the extant filed service organization) External sources mainly for technology-related specific needs	Customer relationship is deepened; horizontalization and diversification of the offer	The revenue model is based on (additional) monthly fees
Beta	Proactive	No separated units are created, and the BMI is fully integrated in the product-related BU The CEO protects the newborn project from attacks and criticism	Improved availability control over machines via IoT, in subscription mode	New hired resources: 5 (software and digital) External networks (universities, technology suppliers, KIBS and consultants) help to explore and to build the prototype	Customer relationship is deepened; horizontalization and diversification of the offer	The revenue model is based on (additional) monthly fees

5 Discussion and conclusions

The purpose of this article was to investigate how incumbent manufacturing SMEs can manage the evolution of a new BM enabled by IoT in parallel with its extant business model, with particular attention to the main resources and capabilities required, as well as the main difficulties encountered.

Overall, based on a qualitative in-depth analysis of two cases, we show that SMEs analysed seem to experiment with BMI in parallel to the extant business model while still relying on its revenue streams (Laudien and Daxböck, 2016), which is consistent with the resource constraints of SMEs. Along the same line, the evolution of the new BM follows

some steps that recall the initial ones presented in the framework by Khanagha et al. (2014). His analysing a very large firm, compared to our SME context, could be the rationale behind the lack of the creation of an independent organization immediately after the piloting in our cases. Indeed, in SMEs, transition processes are slower and need careful action for the reasons explained above, which also includes the contextual ambidexterity in experimenting with the new BM while maintaining the extant business (Markides, 2013). This is reflected also in the fact that the experimentation is incremental in terms of resources dedicated to the new business, despite the change can lead to radical BMI. Actually, recalling the archetypes presented by Suppatvech et al. (2019), firms arrive to the most sophisticated one, i.e. solution-oriented business model. This seems to be the result of a learning process that makes the strategic intent and objectives increasingly clearer and the involvement of the management increasingly active.

Another interesting evidence emerged from cases is the relevance of customers in the experimentation phase, supporting, on the one hand, the fundamental role played by customers in the digitalization path (Rachinger, 2019) and, on the other hand, the relevance of an open approach to pursue BMI (Liao et al., 2019). Experimenting with the customer is beneficial for the firm since it allows piloting and fine-tuning the new solution, however it can create some difficulties for the replication and standardization of the service for different firms, because the solution is somehow crafted around the pilot customer. This point of the BMI evolution –i.e. between piloting and replication– seems to be particularly critical due not only to, among other issues, the effort required to abstract a general model from the implemented pilot one, but also to the need to internalize some competences that, with the new BM, become core for the firm.

This study has both academic and managerial implications. From an academic standpoint, our results provide support to the opportunities offered by IoT to innovate a firm BM and at the same time extend the contribution to the specificities of SMEs with respect to large firms in experimenting a new BM. This suggests the relevance of the dimension of firm size to shed more light on different BMI strategies and associated organisational solutions. Furthermore, we prove that open innovation with customers can allow the firm to be flexible in experimenting a new BM, which further supports the need to merge the open innovation and dynamic capability perspectives of BMI that have progressed independently (Liao et al., 2019).

From a practical viewpoint, managers can appreciate that also SMEs may take advantage of IoT to innovate their BM to offer new products and services more aligned with customers' needs and get some indication of possible paths. Moreover, managers can get some interesting advices regarding the challenges they are likely to encounter along the BMI experimentation, as well as the key resources and capabilities BMI may require.

We recognise this study has some limitations, mainly related to the fact that we analyse two cases and, thus, we do not claim to be exhaustive in presenting possible paths of BMI based on IoT solutions and associated requirements and challenges. Future studies could

enrich our understanding by analysing other cases to confirm or find out new paths for BMI experimentation.

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A Bibliometric Analysis Deconstructing Extant Research on Sharing Economy Business Models

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Abstract

Digitalization has become known as one of the biggest drivers of developments in society and has put pressure on companies to innovate their business models with emphasis on the opportunities provided by application of new digital technologies. Accordingly, there has been a major growth in business models focusing on resource exchange, referred to as sharing economy. Currently, there is also a growing interest among researcher into the phenomenon of sharing economy with an exponential growth in published research. However, to date the literature addressing the sharing economy appears complex and unstructured. The purpose of this study is to take stock of extant literature with a particular focus on distinguishing between constituent elements of sharing economy business models across peer-to-peer (P2P), business-to-consumer (B2C) and business-to-business (B2B). This study was conducted using a bibliometric method to map prior research in the field of sharing economy. Utilizing a broad structured search in the Web of Science database we identify the most relevant articles and synthesis its insight to suggest a framework distinguishing between core properties of P2P, B2C and B2B sharing economy business models. In addition to provide a better overview of existing literature, the framework provides a foundation upon which further research can be built. The framework can also serve practitioners with a better understanding of the phenomenon of sharing economy and thereby a better basis for making strategic decisions in relation to their business model innovations.

Keywords – Bibliometric analysis, Business model innovation, Business-to-Business, Business-to-consumer, Sharing economy

Paper type – Academic Research Paper

1 Introduction

Digital transformation requires businesses to rethink and innovate their business models. Li, Brass, Hitt, Wang and Li (2018) claims that Internet and Big Data are currently making an impact in all industries, and therefore businesses need to reconsider their business models adapting to the environment. As new forms of businesses evolve, there is an emerging growth of practices of a sharing economy. A recent search on google scholar indicate an astonishing amount of published research articles for search phrases, such as: "digital business models"- 3 080, "digitalization" - 61 800, and "sharing economy"- 28 000 - only since 2016! Another illustration of the increasing interest in the sharing economy is the recent number of special issues addressing the phenomenon (Maurer, Mair & Oberg, 2020). In practice, within Europe's five most prominent sharing economy sectors, total value of transactions is expected to reach €335bn within 2025, from €28bn in 2015 (PwC UK, 2016, p. 3-4). This indicates increased attention to the phenomenon of a sharing economy, for research and practice alike.

Despite an overwhelmingly growing interest in the emerging phenomenon of sharing economy, it is referred to as an umbrella concept that is conceptualized with an inherent variety and unclear dynamics (e.g. Trenz, Frey & Veit, 2018; Wilhelms, Merfeld & Henkel, 2017). To date, there exists no unified definition (Schor, 2014) and the phenomenon remains debated (Martin, 2016). However, the idea of sharing instead of owning is not new (Belk, 2010; Botsman & Rogers, 2010; Schor, 2014). Extant research refers to the same phenomenon with terms ranging from; access economy, circular economy, collaborative consumption, collaborative economy, gig economy, to peer economy (Bellotti et al., 2015; Strømmen-Bakhtiar and Vinogradov, 2020). Despite the vast number of interchangeable terms, extant research seems to agree on some core properties of the phenomenon; relating to (1) peer platforms that coordinate (2) peer providers and (3) peer consumers. (e.g. Botsman & Rogers, 2010; Hamari, Sjöklint & Ukkonen, 2015; OECD, 2016; Schor, 2014). Schlagwein, Schoder and Spindeldreher (2019) suggest, after an analysis of 125 definitions, that commonly addressed core properties of 'sharing economy' relates to peer activities of coordinating sharing of goods or services through a digital technology platform without transfer of ownership. Consequently, existing research within the sharing economy is primary focusing on issues related to peer-to-peer (P2P) activities of obtaining, giving, or sharing access to goods and services, coordinated through community-based online services (Maurer et al., 2020), and have recently also attended to the P2P business models underpinning the sharing economy phenomenon (e.g. Apte & Davis, 2019; Assadi, 2020; Mosmann & Klutt, 2020).

However, established business model research (e.g. Baden-Fuller & Haefliger, 2013; Osterwalder & Pigneur, 2010; Teece, 2010; Zott, Amit & Massa, 2011) emphasize the distinction between business-to-consumer (B2C) and business-to-business (B2B) business models, but it remains uncharted to assess how these established business model distinctions relates to the P2P patterns described in the sharing economy literature. A business model "defines how the enterprise creates and delivers value to customers, and then converts payments received to profits" (Teece, 2010, p. 173). Mosmann and Klutt (2020) argue that the sharing can be of a commercial or non-commercial nature, and

therefore that the understanding of the phenomenon of sharing economy could be extended beyond P2P, B2C and B2B business models in particular. Therefore, the aim of this study is to assess extant research addressing sharing economy business models to synthesize a foundation upon which subsequent empirical research can be built. There is especially called for more research to unresolved issues in the case of B2B relations (Grondys, 2019), emphasis on the commercial aspects (OECD, 2016), and Agarwal and Steinmetz (2019) calls for further research on B2B and their engagement in sharing economy (Kathan, Matzler & Veider, 2016). Moreover, the lack of theorization of the business model variations underpinning the sharing economy in general, and in relation to distinctions between P2P, B2C and B2B in particular, warrant taking stock of extant research to establish a unified foundation for subsequent research (Maurer et al., 2020). The ambition of this study is therefore to address the following research question: *How can sharing economy business model variations and similarities be conceptualized beyond P2P and thus encompass traditional business model perspective of B2C and B2B?*

In order to address this research ambition, we started out examining extant published academic research by conducting a structured literature search, resulting in an initial sample of 1266 documents for the timeframe 1997-2020. By excluding irrelevant categories we had a final of 184 articles for our bibliometric analysis. To conduct the bibliometric analysis, we applied VOSviewer and identified 19 highly relevant interrelated sharing economy articles upon which we conducted a content analysis. This study identifies core articles addressing the constituent elements of sharing economy business model and illuminate variations and similarities across P2P, B2C and B2B business models as these are reported in extant research. Discussing these findings against the underlying theory, we suggest a framework distinguishing between P2P, B2C and B2B sharing economy business models. The proposed framework can serve as an important contributor and basis for discussion related to strategic decisions as it provides useful information for various structures and thereby value creation and value capturing activities, as well as guide future research.

2 Theory

The purpose of this chapter is to explain the concept of business models and how it relates to the sharing economy and thereby illustrate the gap in current theorization. Extant theory on business models will be presented before introducing current theory on the transition of sharing economy as well as business models variations.

2.1 Digital business models

Recently, “digitalization has been identified as one of the major trends changing society and business in general” (Parviainen, Tihinen, Kääriäinen & Teppola, 2017, p. 63; Veit et al., 2014). Since digitalization has influenced various business activities including companies’ business models, “digitalization has put pressure on companies to reflect on their current strategy and explore new business opportunities, by transforming their existing business models” (Rachinger, Rauter, Müller, Vorraber & Schirgi, 2019, p.

1143). This digital transformation is causing change in companies' business model, that be changes related to their products or services, the organizational structure, or automation of processes (Hess, Matt, Benlian & Wiesböck, 2016). Further, fundamental changes in the way businesses operate and generates value is referred to as a shift towards digital business models and the missing link between business strategy, processes, and information technology (Veit et al., 2014). Technology facilitates easy access to information and customer solutions at a lower cost, hence it is argued that businesses needs to be more customer-centric (Teece, 2010, p. 172). In terms of digital transformation, businesses need to re-evaluate their value propositions in terms of understanding business model design options as well as customer needs and technological trajectories (Teece, 2010, p. 173).

2.2 Sharing economy

The financial collapse in 2008 necessitated that people and firms found new and creative ways to create value and reduce costs (Habibi, Davidson & Laroche, 2017). Re-creating value by using existing resources, either for monetary or non-monetary benefits, contributed to more efficient use of resources (Botsman & Rogers, 2010). As a result, the term "sharing economy" were introduced and opened new ways to deal with capitalism and consumerism (Agarwal & Steinmetz, 2019). The increased attention regarding sharing economy is causing disruption in well-established and mature industries when consumers are provided with convenient and cost-efficient access to resources without the responsibility of ownership (Eckhardt & Bardhi, 2015; Schor, 2014, p. 4; Trabucchi, Muzellec & Ronteau, 2019).

Defining the sharing economy in a way that reflects common usage has proven to be difficult due to the wide range of perspectives (Schor, 2014, p. 3). One recent attempt on providing a unified definition by Plewnia and Guenther (2018, p. 576) define sharing economy as "activities or platforms which facilitate the sharing of material, products, product services, space, money, workforce, knowledge, or information based on for-profit or non-profit transactions in a variety of different market structures". However, Mosmann and Klutt (2020, p. 40) find that sharing economy are identified across P2P, B2C and B2B relational patterns. Hence, the literature indicates a shift towards a new set of business models that are emphasizing resource exchange rather than offering new ones (Laamanen, Pfeffer, Rong & Van de Ven, 2018, p. 213).

Access to new technology and its potential benefits has been an interesting topic within sharing economy as it allows for interaction between individuals, who not necessarily know each other, to get in touch for resource exchange (Schor, 2014, p. 12). Both products and services are described in the digital business strategy literature as they both can take advantage of the possibilities within digital resources (Bharadwaj, El Sawy, Pavlou & Venkatraman, 2013, p. 474). More user-friendly solutions as a result of digital improvements is facilitating more comfortable users, which in turn can open new business opportunities as a result of increased quality and quantity of generated data (Bharadwaj et al., 2013, p. 474; Laamanen et al., 2018, p. 213; Schor, 2014). Digital infrastructure that is

well embedded in the business strategy is seen as a strategic dynamic capability as it enables the company to scale up or down their infrastructure in line with the market (Bharadwaj et al., 2013, p. 475).

Sharing platforms, consisting of all involved parts, is referred to as communities where control and coordination is of high importance for being able to attract and retain participants (Mosmann & Klutt, 2020, p. 40-41). Their decisions regarding market orientation and market structure is fundamental when shaping the platforms' business model. In terms of market orientation, sharing economy platforms are either for-profit, striving to optimize generated revenue and asset maximization, or non-profit platform where the primary goal is to serve needs at a community rather than seeking growth or revenue maximization (Schor, 2014, p. 4-5). Companies' market structure reflects their market orientation, and the sharing economy literature distinguishes between P2P and B2C. Within P2P platforms, value capturing is generated through commissions where revenue-growth rise with the number of transactions, whereas for B2C platforms, value capturing occurs through maximizing revenue per transactions (Schor, 2014, p. 5). Sharing economy in terms of P2P has received a lot of attention. P2P is referred to as multisided platforms, consisting of intermediaries who brings together distinct groups of users where network effects is said to be a key differentiator when it comes to value creation (Bharadwaj et al., 2013, p. 475; Jabłoński, 2018). Communities as the source of value creation indicates a shift in value creation drivers (Stabell & Fjeldstad, 1998). Analysis conducted by Lang, Shang and Vragov (2015, p. 787) reveals that the co-creation mechanism within these communities can minimize the risk of revenue loss and will benefit the consumers as well as the producers.

Based on the underlying theory related to digital business models and sharing economy, we recognize a need for a better overview in the field of sharing economy. We note that much of the literature is based on the sharing economy as a whole, and does not differentiate between P2P, B2C and B2B. Agarwal and Steinmetz (2019, p. 12) suggests that P2P and B2C business models within the sharing economy can be variations of each other, but that B2B is rather excluded in existing literature. This missing link is also recognized by Grondys (2019) and Kathan et al. (2016) as they argue that existing literature to a large extent is focusing on private sharing and less focus on issues in B2B relations.

3 Methodology

In order to enlighten the understanding of the ambiguous umbrella-term 'sharing economy' and identify P2P, B2C and B2B business model variations we conducted a broad and structured search in prior published research. We subsequently conducted a bibliometric analysis on the database of retrieved articles in order to distil our search further. There is a significant increase in quantification of science, especially within use of bibliographic analysis used for evaluation and monitoring of scientific outputs has become widespread (Verbeek, Debackere, Luwel & Zimmermann, 2002). Fahimnia, Sarkis and Davarzani (2015) promotes some of the strengths associated with bibliometrics:

> *Network analysis through bibliometric tools can prove powerful for identifying established and emerging topical areas. It can also help identify the clusters of research and researchers showing how the various areas of thought may have emerged based on author and institutional characteristics. Identifying the more influential researchers within the clusters sets the stage for determining additional emergent study fields through capturing of more recent topics covered by these researchers. (p. 102)*

The aim of this study is to establish an understanding of business model variations as described in extant research on sharing economy, and thereby provide a foundation for future research and practice. Levy and Ellis (2006, p. 172-173) supports our choice of a literature review to (1) understand the existing body of knowledge, (2) provide us with a solid theoretical foundation, (3) substantiating the presence of the research problem, (4) justifying the proposed study as one that contributes something new, and (5) framing the valid research methodologies, approach, goals, and research question for the proposed study.

3.1 Search procedure and sample

The structured search, and subsequent refinement into a database of relevant research articles, progressed in several stages. Initially we experimented with several different search phrase combinations. By using following search string *Topic=((Business-model) AND Topic=(Digit* OR Sharing-econom*))*, without any limitations, we identified 1266 documents in an exhaustive search for the period 1997-2020, enabling us to understand the development of research focusing on the sharing economy. Then, we limited our search to only include English documents from articles, proceedings papers, reviews, editorial material, book chapters and book reviews. Excluding irrelevant categories and keep those with 50 or more contributions, we had reduced our database to 809 articles.

In the next stage, we selected all articles with ten or more citations within the timeframe 1997-2017, a total of 170 articles where we read all the abstracts. For all 397 articles within the timeframe 2018-2020 we did not emphasize the amount of citations as the articles might not have reached a certain amount of citations yet.

With the new sample of 567 articles published between 1997 and 2020, we now conducted a first order categorization of these articles by colour coding, based on the relevance for our research question, reducing the sample to 190 relevant articles. We subsequently omitted from our database the most recent articles of 2020 as this year had just started, and bibliometric analyses of that year would be skewed by the lack of a full year's publication. The 2020 articles were read and utilized in the positioning of our research question. Considering the final limitations and exclusions our final literature search sample was 184 articles which we downloaded from the WoS database.

3.2 Three phased analysis

The analysis of the 184 research articles included in our final search database also progressed in three distinct phases. First, we conducted a descriptive analysis of the

overall characteristics of the sample. Subsequently, conducted a bibliometric analysis, and finally we utilized the bibliometric analysis to further distil our sample and identify 19 core research articles included in a content analysis.

3.2.1 Descriptive analysis

Downloading our final search from the WoS database to Excel we had the basis for the descriptive analysis. We cleaned up all data in Excel so that the analytical tool Microsoft Power BI could read the data and create visualizations. Afterwards, all articles were represented with their title, author(s), journal, discipline category(s), and publication year. The descriptive analysis revealed the development within the field of sharing economy, journals that have emphasized the topic and discipline categories. The purpose of the timeframe is to map out the development of published articles within the last 22 years whereas the categorization overview has the purpose of identifying which categories the articles are allocated. We also constructed an overview of the top ten journals in terms of published articles.

3.2.2 Bibliometric analysis

We applied the software VOSviewer on the database of 184 articles downloaded from WoS enabling us to conduct bibliometric analysis. To answer our research question we conducted co-occurrence, co-citation, and bibliographic coupling analysis in VOSviewer to get a visual overview in terms of keyword relevance and citations (Van Eck & Waltman, 2009). This analysis is some of the most commonly studied types of relations (Ding, Rousseau & Wolfram, 2016, p. 285). By applying VOSviewer we were able to make an overall visualization of the articles as they were categorized into four different clusters narrowing our dataset down to a core of highly relevant interrelated sharing economy articles. By calculating network centrality for individual articles related to each of these clusters we were able to identify central articles for each cluster. When conducting the co-occurrence analysis we saw that both terms “business model” and “business models” was represented. In order to obtain a more trustworthy analysis we created a VOSviewer thesaurus file in addition to the file including all 184 articles to combine those two terms represented as “business model”. However, we did not combine terms like “digitization” and “digitalization” as these terms cover different aspects of the digital concept.

3.2.3 Content analysis

Finally, we utilized the findings from our bibliometric analysis to identify the most influential articles as we did a content analysis of the most relevant articles related to our research to spot conformity and differences within sharing economy business models. The categorization of the 567 articles and the exclusion of year 2020 resulted in a final of 184 articles representing the years 1997-2019. To get down to a core of highly relevant articles we did a two-fold process based on the 184 articles. This time we dug more into each article to ensure high thematic relevance. After skim reading all articles with high focus on results, implications for practice, and conclusion, we were able to discard

articles that did not contain information regarding business models or business model elements within the field of sharing economy. This process done we had identified 19 articles supported by the bibliographic coupling and the analysis of cluster belongingness, total link strength, and citations.

4 Findings

There has been a significant increase in the number of published articles in recent years, with the majority dealing within business and management, published in journals related to sustainability and technology.

4.1 Descriptive and bibliometric analysis

The exponential increase results in 75 percent of the articles included in our database were published between 2017 and 2019. That the 25 percent of articles included in the database published prior to 2017 are distributed evenly over a fairly flat and stable period between the years 1997 and 2011 followed by a gentle increase in 2012 before the development really gained momentum in 2017 (Figure 1).

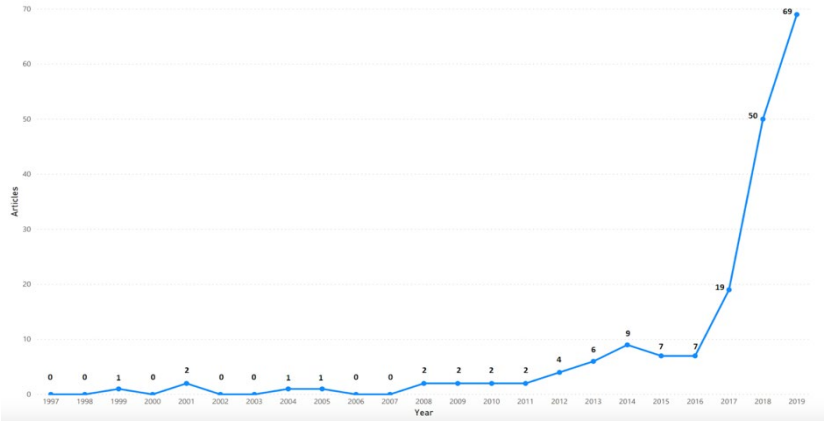

Figure 1: Development of publications per year for the period 1997-2019 (N=184)

The co-occurrence analysis (Figure 2) is generated in VOSviewer where several analyses were conducted to ensure high thematic relevance of keywords. Cluster two (red) has "sharing economy" as the most influential keyword but other close related terms that were identified in the theory chapter like "collaborate consumption", "access-based consumption", and "collaborate economy" is represented as well. The keyword "peer-to-peer" indicates a large amount of sharing economy articles related to P2P, whereas keywords for B2C and B2B is not present. Cluster one (green) contains keywords related to business models and strategy whereas cluster three (blue) consists of keywords related to digi* concepts like "digital transformation" and "industry 4.0". Cluster four (yellow)

contains three keywords representing the business model elements “value creation”, “value capture”, and “value proposition”.

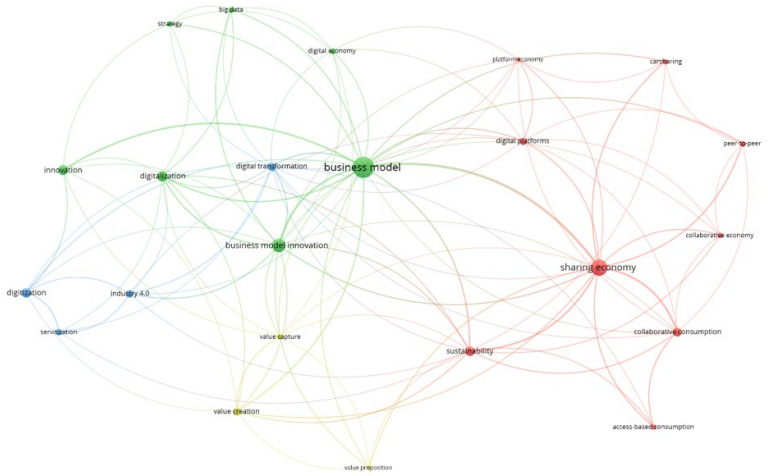

Figure 2: VOSviewer map with co-occurrence analysis

From the co-citation analysis (Figure 3), only Cohen and Kietzmann (2014) is included in our core articles as the other authors do not contribute to our research question. An explanation that we have only managed to identify one of our core articles in this analysis may be due to the fact that business models have been studied for a long time, but that sharing economy is relatively new, hence fewer citations. Another explanation related to the green cluster may be that much has been done in the field of sharing economy but limited when it comes to business models.

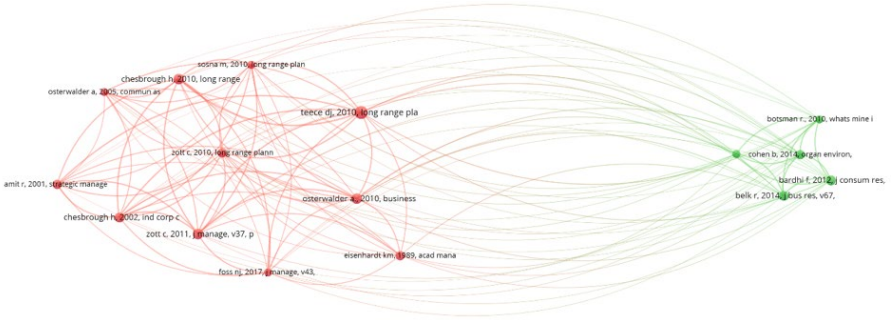

Figure 3: VOSviewer map with co-citation analysis

4.2 Content analysis

Within the sharing economy, P2P business models consists of a triadic structure where value creation takes place through decentralized transactions and co-creation where review systems are applied. Value capturing occurs through commissions, and where emphasis is placed on flexibility and safety for the consumer. B2C business models consists of a dyadic structure where value creation takes place in a centralized resource pool. Value capturing occurs through commissions, membership fees and public

subsidies, and where emphasis is placed on flexibility and safety for the consumer. B2B business models consists of a polyadic structure where co-creation is the basis for value creation. Value capturing occurs through membership fees and commissions, and where emphasis is placed on flexibility through coopetition.

5 Discussion

Based on analyses of findings and the ensuing discussion, there are some clear patterns. For the purpose of a better overview we have separated P2P, B2C and B2B, respectively, and each of the business model elements. There are several obvious similarities between these, but there are also some distinguishing characteristics that make them different in several ways. We have compiled these findings into a framework presented in table 1.

Table 1: Compilation of findings according to business model dimensions of P2P, B2C and B2B

	P2P	B2C	B2B
Value creation	• Triadic structure *(Ritter & Schanz, 2019)* • Decentralized transactions *(Acquier et al., 2019)* • Co-creation *(Apte & Davis, 2019)* • Review-system *(Täuscher & Laudien, 2018)*	• Dyadic structure *(Ritter & Schanz, 2019)* • Centralized resource pool *(Ritter & Schanz, 2019; Acquier et al., 2019; Vaskelainen & Münzel, 2018)*	• Co-creation (Laczko et al., 2019; Grondys, 2019)
Value capture	• Commissions (Acquier et al., 2019; Täuscher & Laudien, 2018; Guyader & Piscicelli, 2019)	• Commissions, membership fees, and public subsidies (Acquier et al., 2019; Täuscher & Laudien, 2018; Guyader & Piscicelli; Vaskelainen & Münzel, 2018)	• Membership fees, Commissions (Täuscher & Laudien, 2018)
Value propositions	• Flexibility (Apte & Davis, 2019), Safety	• Flexibility (Vaskelainen & Münzel, 2018), Safety	• Flexibility, "Coopetition" (Grondys, 2019)

Examples	*Airbnb, Uber*	*Zipcar, Wikipedia*	*WeWork, HeadBox*
Distinguishing characteristics	Consists of a triadic structure where value creation takes place through decentralized transactions and co-creation where review systems are applied. Value capturing occurs through commissions, and where emphasis is placed on flexibility and safety for the consumer.	Consists of a dyadic structure where value creation takes place in a centralized resource pool. Value capturing occurs through commissions, membership fees and public subsidies, and where emphasis is placed on flexibility and safety for the consumer.	Consists of a polyadic structure where co-creation is the basis for value creation. Value capturing occurs through membership fees and commissions, and where emphasis is placed on flexibility through coopetition.

Within the **value creation** dimension, two distinct structures have been identified for P2P and B2C, respectively. Triadic structure where interaction between two (or more) distinct type of users is facilitated by intermediaries is strongly associated with P2P platforms, while dyadic structure where interaction between owner and user occurs without the use of intermediaries is associated with B2C platforms. Within triadic structures, value creation takes place at a decentralized level, while within dyadic structures it occurs through a centralized resource pool. Ownership of resources is a part of the basis to separate the approaches; in P2P platforms, companies typically does not own any resources, while in B2C platforms, companies them self owns these resources. The literature does not relate B2B platforms to any specific type of structure, but as we argue that B2B platforms can take the form of triadic and dyadic structures, depending on the platform's purpose and thus ownership of the resources, we characterized this as a polyadic approach in this ecosystem. However, value co-creation within P2P and B2B platforms has been put forward as crucial activities and take the form of review systems in P2P.

There are several similarities within the **value capture** mechanism. Commissions is put forward as a source of value capture within both P2P, B2C and B2B. Within P2P platforms commissions is the only mentioned source for value capturing and is the primary revenue stream within B2C platforms. However, it is also recognized that membership fees and public subsidies are other sources for value capturing within B2C. In terms of B2B platforms, membership fees are the most preferred revenue stream but commissions are also frequently used.

In terms of **value propositions**, flexibility in relation to their consumers is put forward within P2P and B2C which can be achieved through operating different business models that leads to cost savings and efficiency. Within B2B platforms flexibility for both consumers and the company itself is achieved through the network of suppliers, referred to as the coopetition-model. Technological developments that facilitate better coordination and safety in terms of fraud and theft will in turn make more comfortable users and hence serve as an important value extender.

6 Conclusion

This study addressed sharing economy business model variations based on an exhaustive structured literature search and subsequent bibliometric analysis to identify 19 core articles to synthesize the current state in the sharing economy related to P2P, B2C and B2B business models. To answer the research question of this study we mapped similarities and differences in P2P, B2C and B2B sharing economy business models within the established business model dimensions; "value creation", "value capture" and "value propositions". The study contributes by distinguishing important characteristics between P2P, B2C and B2B at each of the business model dimensions. Our study reveal that business model structures provide variations when it comes to value capturing and that technological developments and value networks are at the bases of value propositions. Moreover, the study confirms that most studies relates to P2P sharing economy business models. Consequently, further research is called for to better inform sharing economy business model variation, in particular for B2B. In addition, there is a lack of empirical studies, especially addressing B2B sharing economy business models and contingencies of these experienced within different industries and business sectors.

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Knowledge Management and the Role of Collective Intelligence & Organizational Design in Enhancing Productivity and Innovation among Employees

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Abstract

Knowledge management can be defined as the process which is based on managing, utilizing, sharing and developing information and knowledge to enhance the functions of an organization. It assists organizations in enhancing their flexibility, profitability, and productivity leading to more innovative organizations (Hussinki et al., 2017). This paper will look at the role that knowledge management play to foster collective intelligence and under different organization designs to improve the productivity of human resource. Thus, the paper will present different theories, models as well as novel approaches related to the effective implementation of knowledge management in managing employees and helping them to achieve the organization's goals. Organizations and employees who collaborate to share knowledge usually tend to be more creative, innovative, and productive. In the present time, innovation is also becoming significantly important for organizations to counter the problems associated with economic meltdown which have been experienced by almost every company. It is pertinent to note that the right organizational design can determine the success or failure. By blending the concept of Knowledge Management with Organizational structure, Organizations can produce a workforce that is not only engaged but that is also innovative

The methodology of research of the paper is pre-dominantly theoretical and by studying and analyzing existing literature on the subject of Knowledge Management, Collective Intelligence and Organizational Structure. In the last decades, the basic functions and nature of organizational design have experienced dramatic changes. The nature of traditional organizational designs are more closely related to the mechanistic model and ideal bureaucracy which were proposed by Burns and Stalker, and Weber, respectively (Ahmad et al., 2017). The paper highlights the viability of the process of knowledge management among employees in the most common forms of organization designs.

From the analysis of this paper, it may concluded that the efficiency or performance of the human resource that is utilized by the organizations to accomplish their goals can only be enhanced if they create sufficient opportunities to promote and amalgamate collective intelligence and knowledge management, which in turn could help them to come up with innovative processes. The paper also suggests the organization design that better facilitate employees in sharing knowledge and experiences effectively.

Keywords - Knowledge Management, Collective Intelligence, Organizational Design, Organizational Structure

1 Introduction

Knowledge management can be defined as the process which is based on managing, utilizing, sharing and developing information and knowledge to enhance the functions of

an organization. It can also be described as a multidisciplinary approach that is used to accomplish the organization's goal by utilizing the available sources of knowledge in the best possible manner (Inkinen, 2016). The concept of knowledge management was developed as a response to deal with the increasing significance of knowledge for the companies. In any business, determination of success or failure largely depends on knowledge and for these reasons, it is also considered as an important source of wealth. It assists organizations in enhancing their flexibility, profitability, and productivity leading to more innovative organizations (Hussinki et al., 2017).

Moreover, it also represents an important competitive advantage for the business as well. This paper will look at the role that knowledge management play to foster collective intelligence and under different organization designs to improve the productivity of human resource. Thus, the paper will present different theories, models as well as novel approaches related to the effective implementation of knowledge management in managing employees and helping them to achieve the organization's goals.

2 Knowledge Management and Collective Intelligence

2.1 Overview

Collective intelligence can be described as a tool that helps to connect computers and people to develop intelligent systems to provide an added value to the core functions of the business (such as human resource management). Numerous studies have highlighted that there are various projects which have been conducted based on the cooperation of the employees who were connected to and performing their work on modern systems of IT. Even though individual applications commonly differ according to their functions or purposes, there are several common elements between them, such as the gene group (Woolley, Aggarwal, & Malone, 2015). An example of such a system can be taken from SaaS.

Within human resource management, SaaS (i.e., software as a service) can be defined as the delivery or provision of human resource software under the environment of cloud computing. For human resources, the delivery model of SaaS is usually included under the domain of those applications which can be classified as SaaS ERP (i.e., enterprise resource planning), since the functionality of human resource is generally considered as an important component of ERP software (Seethamraju, 2015).

SaaS is significantly helping the organizations and employees to better comprehend the needs of the customers, as well as the market that they need to target to attain financial success. Organizations that typically utilize SaaS are primarily interested to use it so that they can decrease their infrastructure costs (Yusuf, Silas, & Haruna, 2018). It also assists organizations to make user-friendly changes and easy upgrades within their processes or knowledge management systems. By using this tool, employees are better able to upload their ideas for enhancing the products and processes of the business and they often utilize the system to come up with the most effective solutions for the problems that they face in their day-to-day work (Wang et al., 2016).

In the article of Valmohammadi and Ahmadi (2015), it has been stated that fostering innovation among employees can provide significant opportunities to create collective intelligence and knowledge management within the environment of organizations. If collective intelligence and knowledge management are utilized by organizations as support to promote innovation among employees, the goals of the organizations would be met more efficiently and in less time.

2.2 Implications to foster Innovation

In recent years, it has been observed that innovative thinking among managers and entrepreneurs is becoming a major trend. To sustain profitability and ensure the survival of the business under a highly competitive environment of today, various non-technical and technical innovations are becoming increasingly important to revive the business model (Liebowitz, 2019). In the present time, innovation is also becoming significantly important for organizations to counter the problems associated with economic meltdown which have been experienced by almost every company. This, as a result, is stressing the importance to find better ways in enabling efficient management of innovation under the organizations. However, despite these issues, organizations can effectively accomplish their goals by utilizing the known methods associated with knowledge management, collective intelligence and most importantly the internal training and development of employees (North & Kumta, 2018).

Organizations and employees who collaborate to share knowledge usually tend to be more creative, innovative, and productive. They are also fast learners, which further assist them to enhance their collective intelligence and capabilities. This, as a result, enables them to share ideas and solve complex problems by giving novel or creative solutions. It is highly significant for organizations to generate social capital, transfer knowledge and innovate through inter-organization collaborations. The aim of those communities which are developed by collaborative learning networks is usually based on interacting and learning new knowledge from other users (Giampaoli, Ciambotti, & Bontis, 2017).

This newly learned knowledge is further shared under the network to other users. In several instances, users (or employees) might not have the same level of knowledge or expertise as their peers, but they are often interested to attain similar experiences of knowledge and practices. Platforms of the internet can be taken as a good example since it allows employees to comprehend new knowledge through promoting discussion in their teamwork, share ideas, lectures and provides them the opportunity to mentor each other. Thus, it can be stated that knowledge management, as well as collective intelligence input usually comes from the discussions, as well as conversations of employees/users. By using technologies related to WEB 2.0 or social media, this input can help to provide a type of intelligence that may represent new knowledge creation, presentations, and recommendations (Peters & Heraud, 2015). The below-provided figure summarizes the existing roles of collective intelligence and knowledge management in fostering innovation among the human resource of an organization to achieve high profitability and growth

2.3 Explicit and Tacit Knowledge

There are several forms and types of knowledge (i.e., procedural knowledge, specific skills, know-how, facts, etc.) that are often used by the organizations to assess the effectiveness of their employees (Bratianu & Bolisani, 2015). A general representation is that the hierarchy of knowledge often goes from data (i.e., figures and facts) to information (i.e., contextual data) to knowledge (i.e., meaningful information) and then finally to intelligence or wisdom (i.e., insightful knowledge). Under the realms of knowledge management, the knowledge that is possessed by the employees is often categorized into tacit and explicit knowledge. Explicit knowledge can be defined as numbers or words which can be shared and communicated easily in the form of codified processes, scientific formulae, hard data or universal principles. On the other hand, tacit knowledge is usually considered significantly difficult to formalize and is usually highly personal. Hunches, intuitions or subjective insights are usually included under this category of knowledge (Addis, 2016).

Thus, in most organizations, explicit knowledge is commonly found within the databases or documents. In contrast, tacit knowledge is usually present within the heads of employees. Many programs associated with knowledge management that have been provided to the employees have exaggerated the approaches of transforming tacit knowledge into explicit knowledge. However, such approaches were observed to be futile as no database can be created to imitate the vast experience of a knowledgeable employee and to comprehend (by using judgment) which information or data can be implemented under a certain/given situation (Nonaka & Toyama, 2015).

In most cases, the best approach is usually based on making some tacit knowledge into explicit knowledge by offering pointers to those experts who are responsible to implement such knowledge into a given context and assist those who might want to implement it. Therefore, under the management of knowledge, the challenge that human resource managers can face could be related to managing explicit knowledge by utilizing those techniques or methods which might be used under the information resource management discipline. These challenges can also be based on developing an environment for employees that helps them to share knowledge and come up with novel ideas (Park, Vertinsky, & Becerra, 2015). This approach is often regarded as similar to those approaches that are observed under the communities of practice.

3 Organizational Design and Knowledge Management

3.1 Organizational Design

Organizational design or structure can be described as an interrelationship and arrangement of positions and parts of an organization. It can also be defined as those established patterns associated under the relationships that exist between the important parts of any firm that outlines control, communication, as well as the patterns of authority. The structure of any organization differentiates its important parts and assist in

delineating the relationships that exist between them. Therefore, strong emphasis is usually put on control and communication (Albers, Wohlgezogen & Zajac, 2016).

In the last decades, the basic functions and nature of organizational design have experienced dramatic changes. The nature of traditional organizational designs are more closely related to the mechanistic model and ideal bureaucracy which were proposed by Burns and Stalker, and Weber, respectively (Ahmad et al., 2017). The characteristics associated with traditional structures usually include a high level of formalization, standardized activities, formal influence, centralized authority, vertical communication, a significant number of organizational levels, and rigid or strict tasks' definition. Various findings have provided a substantial amount of evidence that this model can be useful in stable or simple situations (Zheng, Yang, & McLean, 2010).

In contrast, organic models are usually considered as the logical opposite structures of traditional models. The characteristics of such models include less formality under rules, heterarchy, flat structure, low standardization, and flexible tasks' division. Several experts have suggested that organic models of organizational structure/design are usually created for knowledge-based companies who conduct their operations under dynamic milieu. Within the organic structure, knowledge and information flow among (or between) employees is more prompt, which further offers support within the exchange of experience and helps to promote unlimited creativity within employees. The below-provided sections highlight the merits and demerits associated with the process of knowledge management among employees in the most common forms of organization designs (Clement & Puranam, 2017).

3.2 Knowledge Management and Functional Structure

Within the organizational designs, functional structure is considered as the most basic design. This structure was created on the idea of grouping employees who perform the same activities or tasks under a single department of the firm. It tends to centralize decision making and coordinating procedures at the top level of the organization. Upon analyzing the processes associated with knowledge management under the functional structure, a good flow of information and knowledge would be discovered within the departments due to the similarity of activities and tasks (Jones, 2013).

As specialists under this organizational design (having the same discipline) are grouped and required to work in a single department, this also sometimes results in the promotion of knowledge creation. The same background, education and common interest field of employees also assist in organizing the training programs/courses more appropriately under the department (Foss, Lyngsie, & Zahra, 2013). The conditions under such a structure are considered positive for organizing the important databases of departments. For instance, the gathered data/information can be stored in a single centralized library, which can be administered by specialized employees and cataloged in a logical manner (Clement & Puranam, 2017).

However, the disadvantage of this structure is that the knowledge and information flow between the departments is usually poor. Employees are often observed

to be hostile towards each other and feel isolated due to the stringent functional divisions. There is also a significant lack of coordination between important functions of the business that, in turn, decreases the opportunities to come up with innovative ideas related to the creation of novel products or processes (Mills & Smith, 2011).

3.3 Knowledge Management and Divisional Structure

Divisional organizational structures are often observed under those firms who want to diversify their products, customers, and markets or who are endeavoring to achieve organizational growth. Under this design, every activity that is required to create a product or service is integrated (or grouped) to form an autonomous unit. Moreover, this structure usually decentralizes the decision-making processes by pushing responsibilities and authorities down to the lowest levels of the company. Knowledge management also differs significantly under this structure in comparison to the functional one. This is because typically the experience and flow of knowledge are observed to be efficient under the divisions that are set apart (Maier & Hadrich, 2011).

Nevertheless, the flows that are observed between specific strategic business units or divisions are found to be poor or limited. Processes associated with specializing and learning are not facilitated under this structure due to limited functional specialization. Handling of every activity under the business units is the responsibility of employees who are hired to work within them. These activities can range from finance, marketing, sales to production, logistics and supply chain management (Dalkir, 2013).

Hence, it can be stated that employees are usually provided with optimal conditions for developing and creating more general knowledge (rather than specialized knowledge). Within divisional structures, horizontal flows of knowledge and information are not typically found. Their practicality under this structure can be questioned. When divisions conduct their operations in differing fields (for example, entirely different markets or products) a single holistic process associated with the knowledge management under the systems of organizations is often not required (Becker, Kugeler, & Rosemann, 2013). In addition to this, several issues/problems related to the database's location (or knowledge base) can occur due to the large size of the firms and their diversified activities. Due to this demerit, managers can face significant variability in the problems associated with handling the knowledge management process under divisional structure depending on the size of their organization (Maier & Hadrich, 2011).

3.4 Knowledge Management and Matrix Structure

Matrix structure was created in response to the increased changeability and complexity under the environments of the organizations. It is described as the permanent and stable form of the organization which incorporates both vertical and horizontal relationships (i.e., both divisional and functional structures that are focused on vertical ones). Moreover, this structure also combines the important operational functions with markets, projects or products to highlight the simultaneous reporting relationships with two

different directors. The knowledge and flow of information under this structure is usually multidirectional (Hislop, Bosua, & Helms, 2018).

Furthermore, several experts have suggested that effective information sharing is one of the key strengths of the matrix structure. The creation of knowledge can also be more efficient in this structure if different specialists cooperate and support each other appropriately and engage in solving problems. This can also assist in updating processes and further promoting the creation of knowledge. Thus, it can be inferred that despite having some drawbacks that are exemplified in practice under this structure, overall, matrix design can be considered as a good structure to facilitate knowledge management (Becker et al., 2013).

3.5 Knowledge Management and Project Structure

Task forces and project structures that are considered as organic forms of organizational structure that are usually based on the work performed by temporary teams, commonly regarded as the most suitable and flexible designs for the processes associated with knowledge management (Fang, Lee, & Schilling, 2010). Experts or specialist employees who engage in projects by forming particular teams primarily emphasize on budgets, dates, and goals rather than sharing experiences or creating knowledge under project structure. Employees usually form groups to solve problems or complete a particular task and after adequately completing their objectives, the groups are disbanded with employees taking their experiences and knowledge with them (Mueller, 2012). (See figure below)

Employees, under traditional organizations, who have the same work background or discipline are often found to attend the same courses, meet with each other, report to the same leader/supervisor, share rooms, and work on different projects without disbanding or separating from their teams/work units. However, under pure project structure, employees are not given sufficient opportunities to share their experiences or develop novel organizational knowledge, which is also regarded as an important disadvantage of this organic design (Fang et al., 2010).

3.6 Hypertext Organizations

Hypertext organization utilizes the strengths of standardization and bureaucratic efficiency, as well as task force dynamism and flexibility. Such organizations combine the ‘project team layer’, ‘business system layer’ with a ‘knowledge-based layer’. This is considered as a value-added element of hypertext organizations. Daily operations or working activities are usually carried out under the business system layer. Moreover, the operations under this layer are commonly conducted along the lines of those models that can be considered as bureaucratic. In other words, this layer comprises all the activities associated with the delivery of products and services and it is also considered as the area where the majority of the tacit knowledge can be found in the company (Petersen & Wiil, 2011).

The organization's part which represents the business system layer directly deals with the market environment and customers of the business. Whereas, knowledge-creating activities that are performed by different project teams (such as the development of new products or strategies) are often found in the project team layer. The operations of this layer are conducted along the lines which are based on the model of a task force where employees are drawn from their normal work activities/responsibilities to participate under the work of project team where they are required to accomplish specific goals in a given time frame (Jo & Joo, 2011).

This layer can be considered as a place where conversion of knowledge takes place, pulling employees' tacit knowledge from the business system layer to engage it towards the development of new products, ideas, and concepts. After the completion of the project, employees return to their respective functional departments under the business system layer. Knowledgebase layer can be defined as a place where the generation of knowledge under the above two layers is stored and codified so that it can be made accessible for all the employees in the organization (Petersen & Wiil, 2011). The most efficient structure of the organization's knowledge base is usually created by considering its intent (i.e., the performance expectations, long-term goals, and vision). The important point to consider under the hypertext model is that it is mandatory for employees to possess sufficient capability associated with shifting themselves between these three different layers with relative ease, and the must have the ability to separate their business practice and mindset (Nwafor, Okezie, & Azubogu, 2018).

4 Conclusion

From the above analysis, it can be concluded that the efficiency or performance of the human resource that is utilized by the organizations to accomplish their goals can only be enhanced if they create sufficient opportunities to promote and amalgamate collective intelligence and knowledge management, which in turn could help them to come up with innovative products and processes. This also includes adapting to those organization's structures (i.e., matrix structure or hypertext organization) that better facilitates employees in sharing knowledge and experiences effectively.

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The Role of Entrepreneurial Universities in Regional Knowledge Spillover and Social Innovation

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Abstract

The aim of this paper is to investigate the role of entrepreneurial universities (EU) emerging perspectives that enrich regional knowledge spillover and enhance social innovation system. The existing knowledge spillover within the regions has influenced the creation of new knowledge and cross-disciplinary areas of research that empowers regional small firms and higher education institutes (HEIs) to face the economic, social, and industrial turbulence. This paper explores the impact of entrepreneurial universities effects on regional knowledge development, knowledge spillovers and social innovation based on understanding entrepreneurial universities strategic activities. Additionally, research on entrepreneurial universities emerging perspectives has received considerable attention due to its key enabling inspirations that enable higher education institutes (HEIs) and small firms (SMEs) to meet the development of business networks with ensuring the regional as well as social benefits. Where, it facilitates the regional innovation system and as a result, entrepreneurial university premeditated initiative that promotes regions tacit knowledge utilization, knowledge retention in small and medium-sized enterprises (SMEs), and knowledge dynamics. Finally, it is significant to highlight that while addressing the tension between

globalization and localization the idea of entrepreneurial universities initiatives and importance of social and regional innovation system has been viewed -with the perception of growing regional knowledge development process; and or taxonomy of knowledge economy for regional economic development.

Keywords - Entrepreneurial universities, Innovation ecosystems, Knowledge spillover, Social innovation, Regional growth.

JEL Classification: I23, R58, 038, 052.

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1 Introduction

Nowadays the world is facing numerous multifaceted challenges exclusively in the areas of health, energy, environment, sustenance and social justice. The corona pandemics of our time is offering the most recent examples of how a global market and knowledge society are gaining experience in handling global crises. Therefore, in this turmoil condition, the significance of higher education institutions (HEIs) such as entrepreneurial universities emergences gradually recognizing that they can perform an important role by engaging themselves with the broader stakeholder community in order to overcome the outstanding challenges of the modern era. Thus, several researches' have identified that 'Entrepreneurial Universities (EU) 'plays a great role in promoting innovation driven regional growth that developed within the universities and government research and development institution. In addition, it has been observed that entrepreneurial universities act as a significant facilitator for regional economic and socioeconomic development, due to the spin-off of new, innovative initiatives that add value through knowledge creation and entrepreneurial discovery process (EDP) (Daniel et al., 2020; Saha et al.,2020a; Saha et al., 2020b).

In Contemporary, it is also necessary to mention that currently the changing perception for HEIs has put more emphasis on "entrepreneurial university" as well as "third mission" conception that fascinate one of the key activities of the HEIs, i.e. knowledge exchange with business, public organisations and society as a whole (OECD, 2019; OECD, 2017a; www.heinnovate.eu). The current discussion on knowledge spillover and regional innovation strategy represents one of the most common policies and practices to address the stresses between globalization and internationalization, i.e. (the processes by which HEIs as well as small firms can able to carries its activities worldwide and facilitate its internal operations to the international markets). However, many scholars (Budyldina, 2018; Pugh et al., 2018; Thomas, Pugh, 2020) highlight that the entrepreneurial university is first and foremost a regional actor. Accordingly, Sánchez-Barrioluengo & Benneworth's (2019), opinion it is increasingly common to claim that driving regional development represents a new 'third' mission for universities alongside the first (teaching) and second (research) mission.

Additionally, research on entrepreneurial universities emerging perspectives has received considerable attention due to its key enabling inspirations. Meanwhile,

entrepreneurial universities empowering the higher education institutes (HEIs) and small firms (SMEs) to meet the challenges of business networks with a positive impact of achievement of regional as well as social benefits. Where, it facilitates the regional innovation system and as a result entrepreneurial universities premeditated initiatives promote regions tacit knowledge utilization, knowledge retention in small and medium-sized enterprises (SMEs), and knowledge dynamics (Fuster et al., 2019; Baporikar.,2019). Consequently, the example of "World Class Universities for Societal Impact" conference shows the socioeconomic benefits, i.e. (the initiative as a novel means for broadening the societal impact by building a global brand, strategic collaboration and employment). Wherever, HEIs positive impact on societal development and technological disruption has a great influence in achieving an effective social innovation and sustainable development (Chan, 2018).

Regarding this vibrant topic several researchers have various thoughts. Though, there is a lack of definition or consensus about what an entrepreneurial university is (Pugh et al., 2018). According to Kirby et al. (2011) state that entrepreneurial university is a natural incubator that, by adopting a coordinated strategy across critical activities (e.g., teaching, research and entrepreneurship), tries to provide an adequate atmosphere in which the university community (e.g., academics, students and staff) can explore, evaluate and exploit ideas that could be transformed into social and economic entrepreneurial initiatives. Therefore, this paper from a conceptual perspective point of view, considers that regional innovation strategies and entrepreneurial universities key enabling features can enable regions to reinforce their regional knowledge spillover and raise social innovation–driven regional growth.

2 Theoretical background of entrepreneurial universities role on regional knowledge spill over and social innovation

The relevance of discussing entrepreneurial universities role on regional knowledge development process that accelerating the social innovation process, it is necessary to mention about the emerging perception of entrepreneurial universities strategic initiatives, which are nowadays have become a crucial issue. Since, it provides *an enthusiastic provision for academics, researchers, students and policy-makers in order to address and facilitate the development effect of an entrepreneurial universities strategic perspectives; entrepreneurial learning strategies, and collaboration with the multi-stakeholders' (practitioners' policymakers and research community) quadruple helix network* (Carayannis & Campbell, 2009); (Lindberg, et al., 2014).. Henceforth, directed research emphasizes the importance of entrepreneurial universities positive effects that consequently boost and enrich social as well as regional innovative skills, and creativity, diversity and inclusiveness at the university level (Caseiro & Santos, 2019); (Santos & Caserio, 2015).

On the other hand, from the policymakers' perspective point of view, all over the world entrepreneurial universities are considered as the central actors in regional innovation and development, as they can play direct and indirect roles in regional development. According to Pugh et al., (2018) entrepreneurial universities can play a direct role in

developing a regional strategy and working directly with government and policymakers. They are resolving regional social and economic problems, promoting innovations through projects, research or work as a knowledge spillover channel through dissemination of new knowledge and information. Consequently, Olo et al., (2020) also noted that their active role in regional development can be in commercialising their knowledge through spin offs, patents and licensing. In this way regions gain profit through job creation, spin offs, knowledge spillovers, attraction of new talents, and research that may be translated into products and services. Thus, HEIs can impact economic well being and foster innovations in the region.

Considering entrepreneurial universities significant role on regional knowledge spill over and social innovation, Audretsch et al. (2012) stress that the role of universities should be more than generating technology transfer (patents, spin-offs and start-ups), and rather, contribute and provide leadership for creating entrepreneurial thinking, actions, institutions and entrepreneurial capital. Simultaneously, concerning entrepreneurial universities initiatives for social innovation and social entrepreneurship development. Thomas, Pugh (2020) emphasized that the entrepreneurial university concept should go beyond its purely economic roles as a key deliverer of supports and services to local populations. Entrepreneurial university concept should incorporate socially-oriented ideas as social innovation and social entrepreneurship thinking. Furthermore, universities needs to develop and or create an environment of a positive force for social good in their regions“ According to his opinion, university‘s role in social problem solving are as follows: such as care for the elderly, digital inclusion, and education for art. Where, all these activities should be taken into consideration in the conceptualization of the entrepreneurial university’s impact on the regional community, too.

Similarly, considering the role of social entrepreneurs in the process of social innovation, it is necessary to mention that ‘social innovation’ actually deals with the contemporary social practices of social entrepreneurship (i.e. the development process, ability and opening the innovation process to the society). Wherever, multidisciplinary contributors like business people, accounting persons, economists and sociologists jointly put their effort with an aim to meet the social needs in a better way (such as by *providing better working conditions, better education facility, community development or healthcare services)* than the existing solutions, as well as to extend and strengthen the civil society (Biggeri et al., 2018). Similarly, Abbott et al. (2015), also highlighted that entrepreneurial universities contributes to social innovation processes by *providing knowledge which helps progression between the stages in helping move the process forward, either as piece of existing knowledge or something co-created with the affected community*; *making its resources available, whether providing direct financial support or providing access to university infrastructure and assets in the innovation process*; *supporting the social innovation process, either through advising social innovators how to access external knowledge resources, or persuading others to support participation in a social innovation.* Regarding this matter, Kim and Fuessel (2020) point out that HEIs needs not just only to support the progress of social innovation, but also to embed change making into their culture, operations, and educational offerings.Where, entrepreneurial

universities initiatives on social and regional innovation system have been viewed that focused on the taxonomy of knowledge economy.

2.1 Entrepreneurial universities in the context of European strategy for Smart, Sustainable and Inclusive Growth

In the "European strategy for Smart, Sustainable and Inclusive Growth" (COM (2010) 2020, 2010), for supporting the transformation of Europe into a "smart, sustainable and inclusive economy" providing enhanced productivity, high employment levels, and better social cohesion, the emphasis was placed on the following priorities:

- "Smart growth" (connected with creating an economy that is based on knowledge and innovation);
- "Sustainable growth" (linked to encouraging a greener and more competitive economy that supports sustainable development without degrading the environment);
- "Inclusive growth" (aimed at promoting an economy that supports both "territorial and social cohesion" creating more employment opportunity).

Significant changes in the economic and social context are associated with the phenomenon, which Thurik et al. (2013) call the shift from the "managed" economy in the direction of an "entrepreneurial" economy. The entrepreneurial economy is closely linked with innovation (Audretsch & Thurik, 2001; 2004; 2011), the central element of innovation being knowledge (Kruja, 2013). Today, innovation is not considered as being solely focused on technological innovations; it is increasingly focused on social innovation and the enhancement of knowledge on social innovation via research, use of various platforms, networks and tools that are supported in different policy areas including education as well (European Commission, 2014); (European Commission, Directorate-General for Research and Innovation, 2015). So, in the process of generating (disseminating) new knowledge and innovation, various business and non-profit organizations are involved, also higher education institutions being no exception (Kruja, 2013). Consequently, it is to be noted that modern universities play a key role in Regional Innovation Ecosystems and nowadays are becoming constructive places for innovation and "natural incubators", as they provide appropriate support structures for students and staff to initiate innovative projects, including intellectual, commercial and conjoint (Fernández-Nogueira et al., 2018 (Reichert, 2019).

According to OECD (2012), "A Guiding Framework for Entrepreneurial Universities" identifies seven specific areas of actions and initiatives, such as: leadership and governance, organizational capacity, people and incentives; entrepreneurship development in teaching and learning; pathways for entrepreneurs as well as university-business/external relationships for knowledge exchange in order to measure and transform institutions entrepreneurial role through multi-dimensional digital self-assessment and management tool (www.heinnovate.eu/en)

2.3 Entrepreneurial Universities in the context of Regional innovation systems and entrepreneurial Ecosystems

In order to determine entrepreneurial universities significant role in the context of regional innovation systems and entrepreneurial ecosystems, many researchers (Cooke, 2016; Brown, 2016; Reichert, 2019) commented on the way entrepreneurial universities improves the ability of enterprises, regions and countries to adjust to the new circumstances and enhance their capacity for knowledge-intensive production and innovation and stimulate local economies growth. Relating to this issue, Reichert (2019), indicated that the central contribution of a modern university is supporting regional innovation systems and entrepreneurial ecosystems (i.e. sustainable regional development), that accomplishing these following goals (Reichert, 2019). Such as:

- *Implementing interdisciplinary approach to promote digital and entrepreneurial skills and facilitate integrating technological development and human action;*
- *Incorporating project-based group learning system in order to establish a "university-business co-creation platform";*
- *Preparing students to address "disruptive" economic, social and technological challenges through entrepreneurial ecosystems at the regional and national levels;*
- Increasing digital skills of students as a response to face the challenges of digital transformation of the society in the regional development perspective;

Therefore, it is assumed that entrepreneurial universities play a significant role in promoting self-organised student activities such as innovation events for start-ups and investors, running a venture capital fund, etc.; this way students involve relevant stakeholders and get public support adopting the role of social innovators.

3 Research Methods

3.1 ***Definition of Entrepreneurial Universities used in this research***

This study mainly took the combination of both empirical evidence and inductive reasoning. Empirical argument depicts the methods of gathering information and data (knowledge). *Whereas, inductive reasoning depicts* some level of sustenance in the form of probabilistic reasoning and the groundwork of most scientific theories. *Definition of Entrepreneurial Universities used in this research to consider the responsiveness of regional knowledge development process that acts as some effective ways to foster the social innovation process which influence on regional entrepreneurship and provincial economic value. Where, the creative regions development process has a global charisma but in the context of Regional Innovation Strategy (RIS) its application has to be regional.* So, there is a vibrant role of entrepreneurial universities that enhance regional knowledge on regional organizations (ROs) for sustainable economic development program.

Therefore, to understand the study within the limited time frame, this paper considers *to carry out a systematic study about the entrepreneurial universities strategies that*

mainly focus on Higher Education Institutions (HEIs) policies and approaches. It measured in identifying the right path for entrepreneurial universities collaboration with knowledge-driven growth and societal engagement for promoting Social Entrepreneurship (SE) and Social Innovation (SI); determining entrepreneurial universities premeditated role and regional innovation strategies combined effort has a synergistic effect on regional economic development, is considered as one of the major policy and process of building regions, organizations and institutions more innovative and competitive. Thus, it is assumed that the added value of this knowledge development process will lead the regions to achieve their collective knowledge, and vice versa, through entrepreneurial universities strategic activities. Accordingly, focused research put emphasis the activities of entrepreneurial universities that linking different firms, people, and knowledge at a regional level. Where, education of HR and cooperation with HEIs appears as critical factors for the successful regional social innovation ecosystems, i.e. regional economic development.

4 Innovation-led Regional Knowledge Spill over Enhance Social Innovation system and Entrepreneurial setup

In the era of modernization, innovation-led regional knowledge spill over and entrepreneurial setup has been observed as the corner-stone of creating distinctive entrepreneurship and the knowledge-driven innovation center in the region associated with the regional innovation capacity development and social innovation system. Connecting to this issue, it is necessary to see whether entrepreneurial universities distinctive features and regional innovation strategies significant mechanisms along with the social innovation transformation development integrate together to accelerate and foster regional knowledge spill over and social innovation and social entrepreneurial network or not.

Concerning social innovation, several researchers have numerous opinions. Such as Szewczuk-Stępień, Jurczyk-Bunkowska, (2020), designated that social innovation is about cooperation with national and international public and private organizations to create changes in the surroundings. On the other hand, social entrepreneurship, commonly defined as an entrepreneurial activity with a social purpose, has been presented as an important economic phenomenon that has been observed on a global scale (D'Amario, Comini, 2020). According to Research shows that social entrepreneurship and social innovation are tools that meet social challenges and contribute to sustainable development (Pozzebon & Fontenelle, 2018).

Consequently, the synergetic encouraging influence of entrepreneurial universities and regional innovation strategies vibrant capabilities (know-how) put the emphasis on knowledge and innovation – driven regional growth, i.e. (sustainable value creation process within the region). In order to rationalize, Fig.1 illustrate whether the manifestation of entrepreneurial universities smart, inclusive and sustainable development goals, i.e. HEIs and small firms' performance can really effect the strategic positioning in a network that mediated through its enhanced innovativeness, i.e. (stimulus regional knowledge growth) or not; whether entrepreneurial universities regional and social

ecosystems initiatives (key drivers of regional innovation development & social economic development strategy) can really empower to influence the regional economic development through knowledge production, knowledge development, i.e. (innovation-driven knowledge spillovers) or not to cope up with the *societal challenges, social needs and systematic social change* that empower sustainable growth, social innovation and skills development. Whether, entrepreneurial universities support and focus the development of regional as well as social innovation strategies or not; whether the *entrepreneurial universities positive effect influence regional knowledge development process, knowledge spill overs and social innovation process* that are mainly based on the understanding of entrepreneurial universities strategic activities.

It can really incorporate its main novelties for enhancing regional economic development, i.e. (technological innovation and entrepreneurship) or not.

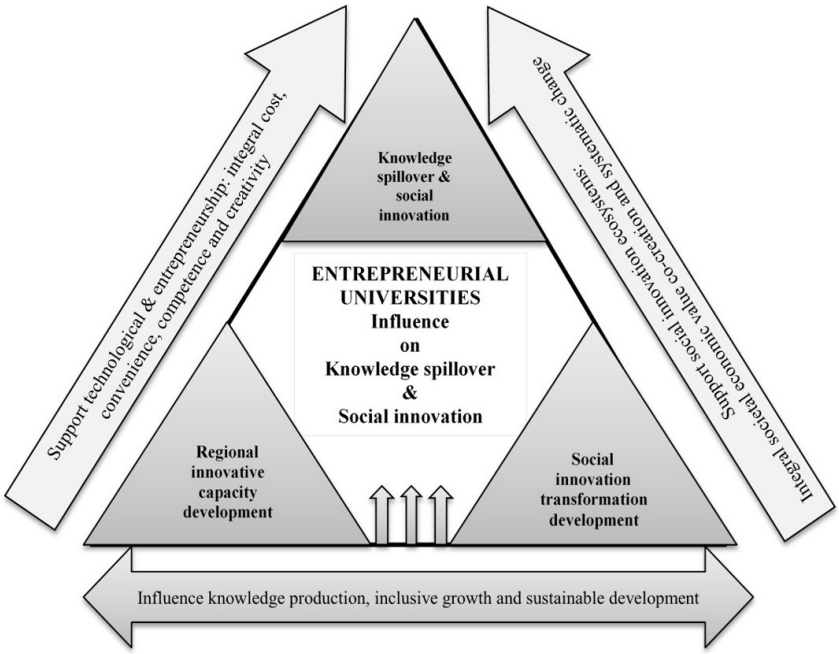

Figure 1: Thematic model of entrepreneurial universities role on influencing innovation-driven regional knowledge spillover and social innovation. (own interpretation).

In order to justify, the above mentioned Fig.1 and its illustration, the European Commission' Entrepreneurship 2020 Action Plan also states that "The role of higher education in entrepreneurship goes far beyond the delivery of knowledge to participate in ecosystems, partnerships and industry alliances. With high-tech and high-growth enterprises increasingly becoming a focus of entrepreneurship-related public policies, higher education institutions are an active component of the innovation policies of Member States and EU". Universities are viewed as proactive contributes to innovation, technological development and economic growth in a knowledge driven society (D'Amario, Comini, 2020) Similarly, Guerrero & Urbano (2010), stated that to address

entrepreneurial universities regional knowledge spillover and social innovation, it is necessary to mention that entrepreneurial society actually refers to places where knowledge-based entrepreneurship has emerged as a driving force for economic growth, employment creation and competitiveness.

Relating to the question of how regional knowledge spillover can accelerate their innovative capabilities through the distinctive features of entrepreneurial universities strategic approach and how entrepreneurial universities can foster inclusive growth as well as regional innovation systems and entrepreneurial ecosystems? This study leads to recognize the following three important research propositions or RPs that enable us to comprehend the rationalization of this research intents such as:

- RP1: Which states that entrepreneurial universities key enabling strategies and regional innovation ecosystems are the main driving forces, priorities and stimulation of a region to accelerate the regional knowledge production system and its implementation, i.e. (to enrich regional knowledge spillover);
- RP2: Which indicate that entrepreneurial universities intention is to provide a huge possible opportunity for implementing regional development strategies distinctive features in order to mobilise the existing resources, i.e. (human capital) through their knowledge, networks and dynamism that are available at local level, to create more value, i.e. (to enhance key enabling technologies for achieving competitive advantage);
- RP3: Which expresses that the added value of this regional knowledge development process (knowledge spillover) will lead the regional as well as social innovation transformation to achieve social entrepreneurship through the transfer of explicit distinct knowledge of the community awareness, and vice versa.

In short, it can be said that this study suggested that – the role of entrepreneurial universities on regional knowledge spillover could be very stimulating and sophisticated approach for the new EU member states territories their research institutions, universities, small and medium enterprises in order to create new business opportunity with worldwide competency. On the other hand, regional innovation ecosystems could be supportive for the universities and business to provide assistance in prospectuses to ensure that graduates have the right skills and transversal competences. Furthermore, it can be specified that the emerging conception of the entrepreneurial universities dynamic and inclusive approach is the process of entrepreneurial mindset development and social innovation process development. Where, entrepreneurial education means the activation of innovative processes and approaches that not only allow individuals to learn about entrepreneurship, but also to develop a social perception along with the entrepreneurial mindset for promoting inclusive and sustainable development.

5 Conclusions

To understand the practical, social and academic perspective of entrepreneurial universities role on regional knowledge spillover and social innovation, this paper discourse the significance of entrepreneurial universities key enabling activities that

connecting regional, inter-regional, national and global interactions at a regional level and contributing to knowledge based economy with the emergence social innovative process that foster social entrepreneurship. From the academic point of view, it may attract the young generation to go for higher studies on entrepreneurial and social innovation ecosystems and develop an entrepreneurial mind setup for social change. Whereas, from socioeconomic development point of view, it could enable universities to make an essential contribution to meet the societal challenges of promoting knowledge based economic development through universities' multidisciplinary teaching & research activities. Accordingly, the consequence of this study shows entrepreneurial universities inventiveness is influential instruments to foster and develop knowledge-development societies competitiveness, regional innovation and provincial growth due to their intrinsic competence.

Henceforth, it can be said that the entrepreneurial universities concept has been realized as the leading concept for formulating regions strategic goals and measures that are related to regional knowledge spillover through entrepreneurial universities formal factors, i.e. capitalization of knowledge, interdependence with the industry and government, independence with another institutional spheres, hybrid organizational forms and renovation. This thematic paper has focused on how entrepreneurial universities can generate the necessary conditions (social, cultural, institutional and territorial economic growth) in order to achieve the highest competitiveness and regional innovation levels possible. Though there are certain loopholes in entrepreneurial ecosystems to be protected, especially when referring to the strategic role of entrepreneurial universities. Finally, in view of the above discussion, it has been understood that an entrepreneurial university faces many challenges in the contemporary uncertain environment; they are very concerned about finding the ways to integrate traditional educational and research activities in the comprehensive institutional strategy, which has to be elaborated in the entrepreneurial agenda.

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Dimensions of Social Innovation in Universities and their New Roles during the Pandemic

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Abstract

Social innovation has been receiving growing attention from policy makers, international institutions, non-governmental organizations, researchers and the business sector around the world. Despite a growing belief that social innovation represents one of the key solutions to solving current societal problems, the field of social entrepreneurship research in higher education institutions provides disparate discussions of this phenomenon and there are only a few systematic reviews conducted, which severely impedes the advancement of social entrepreneurship practice and research in education context. Current literature describes the field of study regarding social innovation and entrepreneurship in higher education institutions (HEIs) as being not well-developed nor agreed upon. A macro-lens regarding the awareness of relevant actors about multiple dimensions of social innovation in universities, and connectivity with the reality of today, is needed. By building on existing frameworks on (social) innovation in higher education, created to increase competitiveness of universities worldwide, the present paper aims to discuss the dimensions in which higher education institutions can innovate and become social entrepreneurial. It seeks to present the perspectives against which relevant actor personnel should identify and analyse social innovation in HEIs. Also, this paper is an attempt to show that now more than ever there is a critical need to examine the societal impact of COVID-19 on higher level institutions actors. Further research should identify how higher education innovation assists societal challenges and investigate the most expected outcomes of social entrepreneurship in higher education. Also, it should explore the common ground where more actors can sustain the innovation.

Keywords – Social innovation, social entrepreneurial university, dimensions of social innovation, higher education institution, COVID-19.

Paper type – Academic Research Paper

1 Introduction

The higher education institutions are constantly changing and evolving to adapt to the needs of the current society (Clauss, Moussa and Kesting, 2018; Janiunaite and Gudaityte, 2007; Larran Jorge and Andrades Pena, 2017). The discussion about the social role of higher education institutions and the role they play in social entrepreneurship is highly relevant in the current social, economic and political context. In the past decades, the universities around the world have been required to become more involved in addressing the societal needs, and thus become more relevant for the communities which they serve. Universities have fought to maintain a balance between their traditional missions of education and research and their newer mission of direct contributors to economic and social development. Nowadays, the higher education institutions are seen more as drivers of social innovation and change as their main role is to help overcome social inertia and to advocate for a move away from the status quo and their inherent social problems (Janiunaite and Gudaityte, 2007). Thus, it is pertinent to ask the question as to how can higher education institutions become innovators and agents for social change? Also, what drives the model of social entrepreneurial university?

Although higher education presents the characteristics of a true potential social innovator through the skills and competencies developed for its graduates and the impact of its research, the scientific literature has failed to provide a detailed account of the dimensions of social entrepreneurship in higher education and the means through which these could be enriched. Thus, the paper aims to discuss the dimensions in which higher education institutions can innovate and become social entrepreneurial. Also, it seeks to understand the synergies and interconnections between these drivers of innovation in higher education context.

2 Characteristics of a social entrepreneurial university

Social entrepreneurship is becoming an extensively used term in various domains of activity, from health sector, to food industry and environment management (Weerawardena and Mort, 2012). It has so many ramifications that every analysis made in this field has an important role in clarifying social entrepreneurship's dimensions and the means through which these can be enriched. Social entrepreneurship nowadays seems to wear many forms, from corporate volunteering (Haski-Leventhal, Kach and Pournader, 2019), to social philanthropy (Leborgne-Bonassie, Coletti and Sansone, 2019), and social finance (Langley, 2020). In the current paper, we decided to approach the higher education area by directing our research towards the shape that social entrepreneurship takes in the higher education institutions (HEIs). This may lend itself in helping to alleviate the challenges that has evolved recently in society.

The context of higher education has changed dramatically due to the internationalization, the increasing competition between universities and through the development and growth of private universities. A university that is not entrepreneurial is more likely not to be competitive in the new market of higher education and won't

survive in the newly created environment based on extreme competition. Păunescu and Cantaragiu (2013) argue that higher education institutions are more likely to succeed on this market characterized by increasing competition if they build socially responsible practices and create an identity of a society-oriented university. To develop, universities should also have the ability to translate knowledge, creativity, and innovation into action and measurable outcomes as this is the essence of organizational intelligence (Riviezzo, Liñán and Napolitano, 2017). Also, they should care about all stakeholders' needs and they should be driven by a sense of moral commitment to serve their communities (Nejati et al., 2011).

With regards to the development of entrepreneurship in the HEIs, scholars ardently debate on whether universities should be construed as businesses with business-like purposes, mentalities and models, or as non-profit organizations with a tradition in serving the community in which they are present and the overall society (Schulze-Cleven and Olson, 2017). In the paper, we argue that it is fruitful to view universities (i.e., public universities in particular) as more similar to entrepreneurial non-profit organizations involved in commercialization activities and aiming to drive social change.

One of the models of entrepreneurial university, more frequently used in previous researches in diagnosing the entrepreneurial orientation of universities of various sizes and profiles from around the world, is Clark's (1998) model. The model refers to five principal pillars of an entrepreneurial university, which can be easily translated for the case of a university that intends to perform entrepreneurship with a social orientation. Thus, Drăgan (2018) discusses about five characteristics of the social entrepreneurial university, which build upon Burton Clark's (1998) model for the entrepreneurial university: (a) a strengthened social core and mission; (b) an expanded socially oriented periphery; (c) a socially stimulated academic heartland; (d) diversified funding for social initiatives; and (e) an integrated social entrepreneurial culture.

For the social entrepreneurial university, the signs of a *strengthened social core and mission* were taken to be the creation and implementation of university social responsibility plans (or the equivalent inclusion of a strong social responsibility dimension in the university's strategic plan) and sustainability plans. The socially *stimulated academic heartland* is considered to be the results of activities implemented with regards to the teaching and research of social entrepreneurship and closely related subjects such as social innovation, corporate social responsibility, social impact and community engagement. With reference to the *expanded socially oriented periphery*, for a socially oriented HEI it is crucial to extend relations with external stakeholders, to engage in volunteer actions and to encourage members of the universities to get involved in public engagement. The HEIs will need *funding for social initiatives*. Enterprising universities are competing for grants and contracts in order to expand their income sources (local governments, philanthropic foundations, royalty income from intellectual property, earned income from student fees and alumni fundraising) to go towards social initiatives. Furthermore, enterprising universities should develop a work culture that can easily adopt change. An integrated *social entrepreneurial culture* is considered to be the results of a social mission and a social vision, precisely statements which expressly

include the responsibility and desire of the university to serve its local community and society as a whole, to contribute to the economic and social wellbeing of those it serves and to mobilize its resources in order to identify means to solve the social and environmental concerns of its times.

3 Methodology

The paper aims to define and analyse the dimensions of social innovation in higher education, as well as their specific variables, which create the framework for a social entrepreneurial university. To explore the potential for social innovation in higher education institutions, the research relies on the HEInnovate framework (2018), a self-assessment tool created by the European Commission in partnership with OECD, which can be used by universities in order to initiate institutional development to increase the competitiveness of European universities and their relevance for economic and social development. The HEInnovate framework contains seven areas of focus: leadership and governance; organizational capacity: funding, people and incentives; entrepreneurial teaching and learning; preparing and supporting entrepreneurs; knowledge exchange and collaboration; the internationalized institution; and measuring impact.

Moreover, to further explore the dimensions of social innovation in higher education institutions, a multitude of criteria came out from studying the formal reports drafted by European University Association (EUA) – Institutional Evaluation Programme (IEP) of the universities from different countries, as well as from relevant international rankings of the universities worldwide. As such, the current research builds also upon the following dimensions of the EUA-IEP framework: norms and values, mission and goal, governance and activities, teaching and learning, service to society and research, internationalization, and quality culture. Furthermore, the analysis integrates the criteria used by QS Stars University Ratings to assess the social role of universities: community investment and development, charity work and disaster relief, regional human capital development, and environmental impact (Păunescu, 2017).

Building upon these frameworks, the paper discusses the dimensions against which relevant actors should identify and analyse social innovation in HEIs. It seeks to understand what the dimensions of a social entrepreneurial university are, and what are the synergies and interconnections between these drivers of innovation in higher education context. As Loogma et al. (2013) argue, any change in the educational system can be analysed using the theoretical lens of social innovation, especially if we are concerned with the depth of the changes.

4 Dimensions of social innovation in higher education institutions

Higher education has a tripartite mission: to provide education, ensure research and the third mission of the universities has been linked to their involvement in society and contribution to socio-economic development (Păunescu and Cantaragiu, 2013). Some researchers regard the third mission of the university as its ability to align its activity to

economic development of the community in which it is present (Etzkowitz, 2013), or having its faculty engaged in academic entrepreneurship (D'Este and Perkmann, 2011).

There are many social problems that the traditional public sector, or even private companies, cannot solve or fall beyond its scope. For this reason, universities can play a very important role in addressing these problems through entrepreneurial actions that could assist all possible actors who can lead the way to new horizons and new developments (Găucă, 2019).

There is an abundance of research into innovation in higher education, whether in curricular programmes (McClure, 2015), delivery mechanisms (Davis and Jacobsen, 2014), pedagogical approaches, support service mechanisms (Sultan and Wong, 2013) or effective management (Amaral, Fulton, and Larsen, 2003). The majority of these studies, however, tend to overlook the role of individual actors, nor the individual motivations of undertaking entrepreneurial actions or the dimensions of innovation that generate social changes (Hasanefendic et al., 2017). This relative disregard for individuals as innovators in higher education contexts and dimensions of social innovation might derive from the constraints posed by institutional factors (i.e. power structures, values, norms, taken-for-granted attitudes, behaviours and routines), which can delimit the level of success for innovation in higher education institutions (Campbell and O'Meara, 2014).

Innovation in higher education institutions takes part in all core and organizational processes and involves several groups of actors who are expected to take responsibility for initiating entrepreneurial actions. As the field of study regarding social entrepreneurship in HEIs is not well-developed nor agreed upon, a macro-lens regarding the awareness about multiple dimensions of social innovation in universities, and connectivity with the reality of today, is needed (Găucă, 2019). The present paper describes further the perspectives against which relevant actors should identify and analyse social innovation in HEIs.

Leadership and governance. Universities nowadays face high pressure from all stakeholders, being required to provide consistent socio-economic returns to justify the fund absorption rate by delivering highly skilled and entrepreneurial graduates. Nelles and Vorley (2011, p. 347) state that "university, administrators, board members, department heads, and the directors and staff within structures that support the third stream are important sources of initiative, all of which contribute to developing knowledge exchange strategies, processes, systems and a supportive … organizational culture." The higher education institutions are required to be innovative in structures (i.e., numbers of layers within organization, number of decision makers and support staff), systems (i.e., centralized or decentralized decision making process, digitalized education, technology-assisted learning and labs), leadership (i.e., KPIs defined, existence of an external advisory board, recurrency of the meetings with external advisory board, number of projects worked on together and number of decisions taken together, rankings pursued), strategies (i.e., flexibility of the strategy and its alignment with the current reality), and culture (i.e., appreciation for the cultural differences).

Teaching and learning. Higher education institutions contribute indirectly to the development of social innovations through teaching, as the process of learning enables

individuals to widen their skills and knowledge and become more prescient of the social problems encountered in today's societies and better equipped to act themselves as agents of change (Janiunaite and Gudaityte, 2007). The higher education institutions are expected to demonstrate innovation in their approach to teaching and learning by implementing a student-centred learning and by using multiple and alternatives learning methods, tools and materials, such as: case studies, business plan writing, problem-based learning, competitions, technology-assisted learning, etc. HEIs are also expected to support their faculty and staff members, by offering them opportunities for free or paid training and education, international exchange programs, participation at conferences. Similar opportunities should be also extended to students: opportunities for employment and career choices and development during and after the study, experiential learning, reflection and deep learning, part-time and life-long learning, interdisciplinary learning, emotional learning and curriculum.

Research. Through research, higher education institutions can develop innovative and sustainable solutions to social and environmental issues and thus contribute to increasing the responsiveness and impact of public policies, fostering social inclusiveness and allowing organizations to make better use of their resources in providing effective products and services. From the perspective of the research field, social innovation in higher education institutions should take into consideration challenges with local, national or global impact, that create economic well-being and competitiveness, research with societal relevance (i.e., addressing poverty, health issues etc.), and the quadruple helix (government, academia, industry, civil society).

Knowledge exchange. Social innovation in higher education institutions relies on trans-discipline and the ability to work across the boundaries that separate academic disciplines and ensure the transfer and exchange of knowledge. Taking into account the perspective of the knowledge exchange, social innovation in higher education institutions should lead to hubs for local development, from knowledge transfer to knowledge exchange, cooperation with private companies, cooperation with local groups with specific societal relevance (blind people, rroma society, persons with disabilities, poor groups, abandoned children etc.). Thus, the higher education institutions are required to have strong links with the socio-economic environment through incubators (i.e., partnership with business incubators, products developed in partnership, leased workforce for business incubators), technological parks, business portals and other external initiatives, and continuously create opportunities for innovation, which drive social change.

Partnerships and networking. The role of higher education institutions in creating social change is not only indirect, as these organizations can also play a more active part in the development of social innovations through research, triple helix partnerships, community engagement and many other forms of collaboration and partnerships (Krampetz and Smith, 2011; Brennan et al., 2014). HEIs are expected to actively encourage individuals to be innovative, by joining professional networks, alumni networks, business portals, etc. The quadruple helix, in which higher education institutions are placed within webs of interactions, supports the networking and

collaboration with all the other social agents such as governments, civil society, industry players and various communities (Park, 2014).

Funding. From the perspective of funding, social innovation in higher education institutions should facilitate access to private financing for their potential innovators to create innovative products and facilities and should ensure that there is a range of sustainable sources of funding. Also, this means that there are funds for entrepreneurial agenda of faculty, staff and students and there are scholarships funded by government, public sector, university or private companies.

Impact. Cabrera et al. (2018), after an analysis of the demands of the various stakeholders of the higher education system in regards to university social responsibility, concluded that the business sector is interested in receiving support for innovation, the public sector is interested in transforming universities in engines of economic and social development and that students are interested in receiving training imbued with social values and the opportunity to become involved in philanthropic activities. Taking into account the public policy perspective, social innovation in higher education institutions should lead to descentralization actions, leading roles of universities in the community agenda, systematic and structural changes, engines for higher education mobility and growth. Taking into account the business environment perspective, social innovation in higher education institutions should lead to knowledge providers, innovation partners, absorptive capacity of workforce, businesses that engage in education, talent providers. Taking into account the competition perspective, innovation in public higher education should lead to international rankings, highly regarded awards, globalization.

5 What roles can higher education play during and after the pandemic?

At the start of this journey very few people had heard about COVID-19 and least of all no one expected the tsunami of a pandemic that has occurred throughout the whole world. A research study from the European Union (Eurostat, 2020) has shown that the impact of the pandemic on jobs in some countries has been far greater than others. Ireland is one of those countries where the impact has been great. At present, there is over one million Irish workers depending on state funding for their livelihood. In Greece and Spain, according to the European Union report (Eurostat, 2020), the impact is at more than 13%. The exact data for Ireland it is at 12.7%. This is rated as the fifth highest in Europe. For other states such as Romania, Poland, Germany and Belgium, for example, the impact appears to be at 8%. There is a difference. According to some data it is the lower paid workers who are the most affected. So now more than ever they will need to be given the opportunities that third level can deliver. They need to be offered the opportunity to upskills and afforded the opportunity of social mobility that a higher education level can provide. From a gender perspective, it appears to be women who are more affected by this lockdown that has occurred in an effort to spread the virus. The EU report (Eurostat, 2020) has estimated of 45 million jobs in the EU alone affected by COVID-19 and another 22% of those employed are left bare to the risk.

Uncertainty abounds in Europe and the world in the wake of Covid-19. So, what will now happen to those who have to change their career perhaps or seek employment in

another area? The higher education sector has a definite role to play. Those most impacted are seriously disadvantaged. Remote learning is an opportunity now more than ever. However, this also depends on certain infrastructures been in place, such as access to the internet. That aside funding has to be made available to people who have been affected by COVID-19 to purchase the appropriate technology. It is also important that they are taught how to use this technology also. The economic impact on third level institutions due to COVID-19 will also be great. There will be no international students in some places that could cushion the bill. Nevertheless, those less fortunate have to be given the opportunity to upskill. Robots are in use to do the jobs of lowly paid workers in certain areas. They are the future. So, it is imperative from a moral and ethical point of view that higher education institutions reach out to those people and ensure that they are given an opportunity to work. As Rockfeller said the "Country does not owe you a living, but you owe the country to make a living in it" (cited in Martin, 1999). The economic impact of COVID-19 is going to last for some time. What is key to getting an economy moving is jobs. Jobs that will require a skilled workforce. This is where the higher education institutions come in to assist and prepare a workforce that is fit for purpose. Re-training programmes and education is key to getting economies moving following COVID-19.

Capacity will have to be built within HEIs to take on board the mature students that will need re-training. Governments will have to put funding into these organisations to ensure that educational programmes are provided to upskill people. Frameworks that will ensure participants have opportunities to build on credits will now be more important than ever. Technology expertise will have to be taught and a good infrastructure put in place. This will be costly but as Mandello (2003) says "Education is the most powerful weapon which you can use to change the world." The merits gained by investments in our HEIs will assist enormously in providing an ultimately a more sustainable society. The actions of higher education institutions in the aftermath of COVID-19 will set the course for economic sustainability for the future, if they provide the educational and training pathways for those most vulnerable in our society.

In this spirit, the International Association of Universities is reflecting on the impacts of COVID-19 on higher education around the world. A Global Survey on the impact of COVID-19 on HE has been conducted. It is planned with this report that solutions will be sought that can be replicated around the world. It has recognized the importance of having institutional portals and social networks to disseminate information regarding research, and to make available open access courses for those working in healthcare and other sectors.

6 Conclusions

The paper introduces a framework which explains the dimensions of social innovation in higher education institutions and describes the perspectives against which relevant actors should identify and analyse social innovation in HEIs. The key elements included in the framework are as follows: leadership and governance, teaching and learning, research, knowledge exchange, partnerships and networking, funding, and impact.

Also, taking into consideration these perspectives of social innovation in higher education, the paper discusses the roles that the higher education institutions can play now with the pandemic that has occurred throughout the whole world. The use of technology in supporting teaching and learning in higher education institutes has never been more important. The uptake of remote teaching and learning that has occurred due to COVID-19 has really highlighted how inequalities exist for some due to poor access to internet facilities and in some homes no access to a computer. This paper is an attempt to show that now more than ever there is a critical need to examine the societal impact of COVID-19 on students attending higher level institutions. Concerns defiantly have arisen at institutional level regarding students learning experiences during this pandemic. Knowledge construction and engagement of students is pivotal to their learning. COVID-19 has challenged everyone that is involved in higher level education to ensure that students are not short changed.

Future research should investigate, based on secondary data available at country level, how the synergies and interconnections between these drivers of innovation in higher education context address societal problems and impact the society. This could be achieved by conducting a systematic analysis and highlight how higher education assists social mobility and enhances the quality of life for people.

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Guidelines to Ensure a Cultural Festival Sustainability in an Emerging Country: Case Study Loja, Ecuador

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Abstract

The document explores the factors that influence the visit to The International Living Arts Festival (FIAVL, by its Spanish acronyms), through the study of sociodemographic variables of the visitors, the media through which they found out about the festival and the variables of recommendation and evaluation of the mentioned event.
In order to carry out this analysis, we use quantitative methods. Our sample includes 314 data, corresponding to people who attended open events (OFF), which are free events that took place as part of FIAVL 2018, using cluster analysis to segment them.
Our research contributes to the Theory of Planned Behavior (TPB) on the influence of factors in the choice of attendance at cultural events. Considering the analysis of the aforementioned variables, it is shown that there are internal and external factors that affect both the recommendation and the evaluation; these are mainly influenced by the means of communication by which the attendees found out about the event.
By identifying the sociodemographic profile of the attendees and the media with the greatest influence, the main contribution of this work is to provide clear evidence of the need to propose guidelines focused on specific groups of attendees; that guarantee the sustainability of cultural festivals in emerging countries, such as Ecuador.

Keywords – The International Living Arts Festival of Loja, sociodemographic profile, media, social networks.

Paper Type.- Academic Research Paper.

1 Introduction

One of the facts that gave rise to the FIAVL, dates back to the construction of the Benjamín Carrión National Theater in 2013, which led to the first perspective of performing arts in Loja province. By 2014, the first meeting of performing arts organizers and producers is held, in addition to the development of several workshops. Finally, in the "citizens outreach" tv and radio program number 388 hosted by the Ecuadorian government, dated August 30, 2014, it was declared that the International Living Arts Festival (FIAVL, by its Spanish acronyms) will be held in the city of Loja, taking as a model the Avignon festival, which has been developed for dozens of years in France (Ministry of Culture and Heritage, 2018). In emerging countries, these types of festivals are of utmost importance, since they vitalize the economy of the cities in which they take place (Pulido-Fernández, Cárdenas-García, & Carrillo-Hidalgo, 2016). In the case study of Loja, Ecuador, an increase in visitors of 52% is calculated during the development of the FIAVL in 2017 compared to visits in 2016 (UTPL, 2017). It is for this reason that this research has relevance in scientific development, especially because it is a subject that has not been adequately addressed from the different sectors involved. The results are expected to contribute to the government, business, academia and local society in general. The destination also receives the contribution, as a new opportunity for tourism development. Burneo (2016), mentions that the creation of a cultural product which transcends in the festival execution and contributes to the city that hosts the event, is pertinent because it creates new opportunities for local development.

Therefore, it is important to analyze the factors that come together in the tourists' visit to this type of festivals. The literature states that this can be done through the variables study related to the sociodemographic profile of the visitor, ways of traveling and social networks used to find out about the event (Collins & Potoglou, 2019).

An aspect that influences attendance to the festivals is the ways of traveling, since this variable allows the theories of travel behavior to be identified, as well as the internal and external variables that influence this factor; thereby determining the guidelines to guarantee the sustainability of the event (Collins & Potoglou, 2019).

Through the analysis of social networks, a different way of reaching the consumer of this type of event has been identified, taking into account the interaction that exists between the consumer and the festival brands which exist in the market. According to Hudson, Roth, Madden and Hudson (2015), in their work on the brand interaction of a festival through social networks; in which they identify that this interaction is related to the visitor's emotional attachment to the festival and, in turn, this attachment has a direct effect on the so-called "word-of-mouth marketing" which influences the loyalty building and the impact on the visit (Hudson, et al., 2015).

Although there are studies in emerging destinations on the variables that determine the attendance to cultural events or the consumers' preference, most have been approached

from the perspective of tourism expenditure (Pulido-Fernández, Cárdenas-García & Carrillo-Hidalgo, 2016). Other studies address the economic impact and the image of the destination; perceived not from the attendees direct point of view, but from the perspective of potential markets. However, the factors inherent to the recommendation, return visit and cultural event evaluation, have not been clarified yet in the existing literature (Arnegger & Herz, 2016). Even Maeng, Jang and Li (2016), state that it is necessary to further investigate the motivations for attending Festivals, since only the motivations for tourism have been analyzed so far.

The contribution of this work aims to fill the gap on cultural events research in emerging countries, where the profiles of consumers attending this type of event have not been adequately characterized, in order to identify the expectations of every group and seek to meet their requirements.

In light of the preceding considerations, this work aims to answer the following research question: What are the guidelines for the FIAVL sustainability, according to the sociodemographic variables of the attendees and the use of social networks?

To answer the question stated, the aim is to work in a conceptual framework based on the Theory of Planned Behavior (TPB) (Schifter & Ajzen, 1985). This theory has been used in research carried out by Collins and Potoglou (2019), on the influence of internal and external factors that lead travelers to choose to visit cultural festivals; similarly Han, Meng and Kim (2017), address the same theory in research on emerging bicycle tourism and behavioral theory; also Kim and Han (2010), about the paying intention of travelers in conventional hotels and the modification of the Theory of Planned Behavior.

2 Conceptual background

2.1 Sociodemographic determinants for a cultural event sustainability.

The organization and planning of the visitors' travel is essential to guarantee the success and sustainability of the festivals (Collins & Potoglou (2019). It is stated that there are several factors by which visitors decide to attend an event and / or festival. According to research by Collins and Potoglou (2019), the results are focused on several internal and external factors. Internal factors include the use of a car, trips with young children, the possibility of making independent trips on different routes and times, travel costs and physical health and mobility problems. Regarding external factors, they indicate the location of the city, type of overnight accommodations, the location of the event and the quality of public transport services. These are factors that the Theory of Planned Behavior (TPB) identifies, over which the decision maker would have limited control. By identifying them, it is possible to anticipate how attendees perceived or foresaw the effects on their trip and festival experience. It also highlights how these factors are interconnected in terms of influencing the visitors' final choice.

Visitors who attend cultural events correspond to different profiles; for example, at events related to film festivals, the spectators are quite young with a high level of education and an average age of 26.3 years old (Báez & Devesa 2014). Similarly,

Robbins et al. (2007) determine that age is a main factor that influences the intention of visiting a cultural event or festival. On the other hand, Nicolau (2008) associates the possibility of visiting an event with the level of income. For Collins and Potoglou (2019), socioeconomic characteristics such as age, income, family life cycle and the presence of children influence the intention to travel to an event.

Through the sociodemographic profile results, it is possible to identify the visitors' characteristics who arrive at a certain tourist destination and of those who attend a cultural festival. These data shall make it possible to establish segments of the groups, in order to focus and promote cultural events in different media based on specific groups.

2.2 Media that influence visits to cultural events.

In large social contexts such as schools, universities, workplaces, neighborhoods and online digital communities; people join smaller groups in which they experience a higher level of communication, security, belonging, interdependence, social norms and psychological well-being in comparison to the rest of the social context (Stadtfeld, Takács & Vörös, 2020).

Therefore, the media are important tools to transmit information to the general public. Currently, there are traditional means of communication such as: press, television and radio, which are used by a certain segment of users to find out about products or services that exist in the market or to learn about news or events that occur worldwide.

During the last few years, the emergence of information and communication technology has caused a fundamental change in the world tourism system; for example, the way to look for travel-related information, to receive travel advice and to communicate mobility guidelines, which has deeply changed the practice of the tourist activity (Gössling, 2017).

These technological innovations have brought a new form of communication, generating a greater use of media such as social networks; they have become an important recognized channel for tourist information (Han, McCabe, Wang & Chong, 2018).

Currently, social networks are an element of personal, professional and business interaction to share content and increase visibility to other users.

Researchers are interested in these tools because of the scope that this emerging phenomenon has generated, due to the valuable information that can be produced, through the interrelationship of cultures; this means the exchange of experiences and shared interests. For this reason, experts have considered social networks as a means by which users' practices, relationships and culture can be understood (Boyd & Ellison, 2007).

Social networks in cultural festivals also play an emerging and important role, since they must generate recommendation systems, in which the offer and marketing strategies are personalized according to the preferences of the identified users in order to achieve the best results in terms of the number of the applications users and, consequently, the results of promoting events through social networks (Milovanović, Bogdanović, Labus, Barać, & Despotović-Zrakić, 2019).

Considering the importance of digital tools, it is possible to investigate the analysis of the media that influence visits to cultural events, with variables related to the sociodemographic profile of visitors and their direct relationship.

3 Research Methodology

3.1 Sample

In order to answer the question posed in this research, the sample of people attending the OFF events of the International Living Arts Festival in 2018, was determined. It is a probability sampling design; therefore, it consists of simple random sampling. As a result, the formula for sampling infinite populations was used to determine the exact number of people to be surveyed, since there is no exact data on the number of attendees. For this work, 386 surveys were applied between November 16 and 26, 2018. Nevertheless, at the time of analyzing the data, 72 surveys were excluded because the data were not consistent for the analysis and the application of the model, leaving a total of 314 valid responses for the analysis.

The surveys were applied during eleven days in which this event took place in the city of Loja. According to Burneo (2016), this city is traditionally known as the epicenter of some artistic and identity manifestations in Ecuador. These characteristics have served as motivation for the city to host the festival that has been held since 2016.

The survey instrument was applied on-site by the Tourism Career students from Universidad Técnica Particular de Loja (UTPL), to people who were attending open events, called in official programming as "OFF events" because they are free for the attendees. These events took place at different schedules. The survey was prepared by the teachers' team from the Departmental Section of the Hotel and Tourism Faculty of the UTPL; the development of this instrument arise from previous research on the profile of the tourist and is adapted to this type of event under technical validation of the Ministry of Tourism of Ecuador (MINTUR, by its Spanish acronyms) and the contribution of the organizers in every edition of the festival. The set objectives to apply the survey were: to evaluate the OFF events, to determine the sociodemographic profile and to know through which media the attendee found out about the event.

3.2 Measures

The instrument was made up of some sections, in which 47 questions were grouped. The sections that correspond to this study were:

- Section A: FIAVL data
- Section D: Evaluation of Loja as a tourist destination

Section A includes the variable that corresponds to the means of communication through which the attendee learned about the festival. This variable was made up of six indicators: social networks (1), television (2), radio (3), written press (4), digital press (5) and others (6); in the last indicator, some responses were given such as: friends, festival

webpage and municipality. In line with similar works in emerging contexts (Dávila, Andreeva & Varvakis, 2019), we chose the Likert scale of 1-5 as evaluation options for the questions implemented in our questionnaire. Other variables considered in this section are: the evaluation of the events, in which the attendee has participated, is built with a Likert scale from 1 to 5, where 1 represents "not at all satisfied" and 5 "very satisfied". The recommendation of the FIAVL to other people is also measured, it is done on the same scale as the previous variable. As well as, the variable of whether the attendee would participate in other editions of the FIAVL, which is also evaluated on the same Likert scale from 1 to 5, where 1 represents “I would not participate again" and 5 “I would definitely participate again". Section D considers the remaining variables which determine the sociodemographic profile of the respondents; as gender which includes two elements: masculine (1) and feminine (2); age is an open-ended question that is determined by the respondent; in the same way, the level of Education includes some options: none (0), primary (1), secondary (2), tertiary (3) and postgraduate (4). Finally, the income level of the respondents was also considered, placing ranges of 500 dollars, drawing from the premise of the unified basic monthly salary in Ecuador for the year 2018 ($ 386.00), the indicators were: less than $ 500 (1), from $ 501 to $ 1000 (2), from $ 1001 to $ 1500 (3), from $ 1501 to $ 2000 (4), from $ 2001 to $ 2500 (5), from $ 2501 to $ 3000 (6) and from $ 3001 onwards (7).

From the analysis of these data, three dependent variables (core) were determined, which allow evaluating the development of the festival in general way, in this sense we have: evaluation of the events which were attended, whether the attendees would recommend the FIAVL to other people and whether they would participate in future editions. While the control variables are associated with: age, gender, educational level, income level and the media.

3.3 Method of analysis

There are two main approaches to segmenting a market, that is, a priori and a posteriori. Segmentation "a priori" or "common sense" involves grouping people according to profile (Mazanec, 2000). For example, the country of origin is often used to segment visitors of a tourist destination, as it offers advantages to destination management organizations to develop personalized marketing strategies (Dolnicar, 2008; Zeugner-Roth & Zabkar, 2015). Segmentation "a posteriori" or "data-based" consists of statistical techniques that include analysis of clusters, correspondence analysis and analysis to identify and outline customer segments (Dolnicar, 2004).

Cluster analysis was used to identify possible groups of those attending the FIAVL OFF events, this is a procedure used to determine the best group segmentation according to motivations and behavioral characteristics (Kim, Duncan, & Jain, 2016). According to Formica and Muzaffer (1998), this technique has been used in previous investigations by exploring existing markets to events that combine cultural exhibitions, a process that has been developed through cluster analysis to identify groups of respondents based on motivational behaviors.

First, we applied Hierarchical clustering to determine the appropriate number of groupings. Next, we used Centroid clustering of the Hierarchical procedure as initial grouping seeds to perform the k-means procedure. In order to explore the differences between the identified groups, we used the usual one-way ANOVA and a post-hoc criterion (Tamhane's T2, at $p < 0.05$), since the sizes of our groups were unequal (Moder, 2010).

For the grouping, the following variables were used: gender, educational level, income, age, social networks, TV, radio, written press, digital press, others (friends, festival webpage, Municipality), and then we compared the evaluation behavior, recommendation and assistance to future editions of the festival in each group.

4 Results

To identify the groups of participants in the FIAVL 2018 event, the two-step cluster analysis was applied, which is recommended in the work of Ketchen and Shook (1996), as well as in the work of Hait et al. (2006). In a first phase, Hierarchical cluster analysis is applied and in this way it is possible to identify the most appropriate number of groups. In this phase, the Ward and complete linkage cluster solutions were applied and compared, as suggested in the work by Ketchen and Shook (1996). For the present case study, the grouping into 4 clusters was taken into account, since it is the most appropriate procedure for the presentation and analysis of the results. Then the Centroid clustering of the Hierarchical procedure, which was above explained, was used as initial grouping seeds and thus, to develop the grouping procedure known as k-means.

Table 1: Groupings of FIAVL-OFF attendees, according to the analyzed variables.

Variables del cluster	**Average of clusters**			
	1	2	3	4
Gender Average	1.42	1.54	1.52	1.48
Education Level Average	3.08	3.08	2.87	2.91
Income Average	2.33	3.23	1.92	2.67
Age Average	3.88	4.54	3.04	3.96
Social Networks Average	0.33	0.23	0.90	0.02
TV Average	0.08	0.23	0.00	0.20
Radio Average	0.17	1.00	0.00	0.00
Written Press Average	0.17	0.23	0.01	0.14
Digital Press Average	1.00	0.00	0.00	0.00
Other (friends) Average	0.00	0.00	0.00	0.20
Festival webpage Average	0.00	0.00	0.00	0.03
Municipality Average	0.00	0.00	0.00	0.01

Dependent variable				
Event evaluation Average	4.42	4.38	4.60	4.33
Recommendation Average	4.58	4.92	4.85	4.73
Cluster size (N)	12	13	193	96

The clusters were consistent using the two techniques, mentioned in the methodology; this indicates a robust solution. A statistical analysis based on the grouping variables is presented below. Table 1 presents the grouping of attendees at FIAVL 2019, based on the variables that have been selected for this research.

Relationship between the analyzed clusters and the satisfaction of FIAVL - OFF attendees.

Once it is verified that the groups of attendees are statistically different, this study will verify whether the satisfaction in the mentioned clusters is statistically different. When analyzing the evaluation that the participants made to the event within each cluster, the Test F (3,310) = 3.47, p = 0.01 shows that the groups are not statistically similar. Table 2 shows the results of the post-hoc analysis where can be confirmed that cluster 3 presents the highest event evaluation average for the 2018 FIAVL edition, which is statistically and significantly higher than cluster 4 (p = 0.00) and almost significantly higher than cluster 2 (p = 0.08), finally it is evident that there is no significance with cluster 1 (p = 0.18).

Table 2: Comparison of satisfaction averages among the analyzed clusters.

		Differences between clusters (i-j) (p values in parentheses) Cluster (j)		
Cluster (i)	Average	1	2	3
1	4.41	-		
2	4.38	0.032 (0.447)	-	
3	4.6	-0.184 (0.185)	-0.216 (0.081)	-
4	4.33	0.083 (0.348)	0.051 (0.377)	0.267 (0.002)

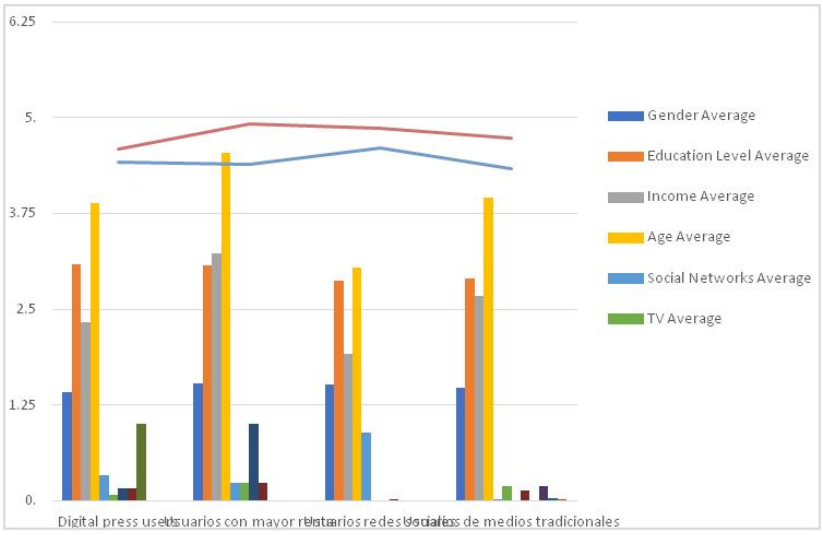
When analyzing whether the participants in each cluster would recommend the FIAVL to other people, the Test F (3,310) = 1.40, p = 0.24, also indicates that the groups are not statistically similar. Table 3 presents the results of the post-hoc analysis where it is possible to state that cluster 2 has the highest evaluation average and is statistically and significantly higher than cluster 4 (p = 0.03), and it is also almost significantly higher than cluster 3 (p = 0.07), to conclude it is observed that there is no significance with cluster 1 (p = 0.13).

Table 3: Comparison of recommendation averages among the analyzed clusters.

		Differences between clusters (i-j) (p values in parentheses) Cluster (j)		
Cluster (i)	Average	1	2	3
1	4.58	-		
2	4.92	-0.339 (0.091)	-	
3	4.85	-0.271 (0.133)	0.068 (0.226)	-
4	4.72	-0.145 (0.277)	0.193 (0.038)	0.125 (0.075)

Interpretation of the identified clusters.

Figure 1 allows observing the differences between the clusters, in such a way that the discussion of the results obtained in the present study is facilitated. In order to achieve this objective, a label is given to each identified group according to the most outstanding results.



Graph 1: Attributes of the clusters.

Group 1. This group includes 12 people, being the smallest group in relation to the rest of the analyzed groups. Regarding gender, there is equality in the analyzed data, obtaining an average of 1.42. In the case of educational level, it has an average similar to cluster 2 (3.08). The income level variable has an average of 2.33, the highest income is $ 1,500.

According to age, this cluster shows that the average is 39 years old, similar to the average age of cluster 4, so that the total average is 3.88. The most used means of communication in this group belongs to the digital press with an average of 1.00, considered the most outstanding of this group in relation to other groups analyzed. For this reason, this group has been called “digital press users”, it should be considered that this is the group with the lowest number of data, which is reflected in the results for the festival's recommendation. An additional factor is associated with the expectation generated by the digital press, which is not related to the lived experience; for this reason, this is one of the groups that would least recommend the festival.

Group 2. This group has 13 people, it is made up of 7 men and 6 women, with an average of 1.54, similar to group 3 that we will analyze later. The income level differs between the two genders, the male gender has the highest level of income up to $ 3,000, obtaining this indicator the highest average of all the groups analyzed (3.23), for this reason they have been called "higher income users”. The average of the educational level variable is similar to cluster 1 (3.08). The age variable has an average of 4.54, which implies that the average age is approximately 45 years. The means of communication most used by this group to find out about the FIAVL was radio (1.00), presenting an equal average, although with less significance in the media such as: social networks, television and the written press (0.23). Muñiz, Rodríguez and Suárez (2017), mention that the factors of the sociodemographic profile, such as the education level and those related to income, are determining variables; both in the probability of participation and in the frequency of participation in this type of event. Likewise Georgiev, Noulas and Macolo (2014), present some hypotheses about the factors that motivate participation in this type of event and conclude that social aspects play an important role when determining the probability of a user participating or not in an event.

Group 3. This group is made up of 193 people, it is the largest among all analyzed groups. The data shows a greater representativeness, but not outstanding, of the female gender with 101 people and a total average of 1.52. In relation to clusters 1 and 2, this group shows a lower educational level, the secondary level being the predominant one, obtaining a total average of 2.87. The income level variable indicates that this group has the lowest income level (less than $ 500) of all the analyzed clusters, with an average of 2.87. The age variable reflects that this is the youngest group with an average of 3.04, which corresponds to 30 years old. The use of social networks predominates in this group with an average of 0.90, due to this result, this group has been called "social network users”. This group along with cluster 2 are the ones that would recommend the visit to the festival, which means that for both groups the lived experience does meet the expectations.

Group 4. This group is made up of 96 people. As in the previous groups, there is no significant difference between male (50) and female (46), obtaining an average of 1.48. The educational level variable shows similarity to the average of cluster 3 obtaining a result of 2.91. The income level corresponds to the second position of all the groups, being surpassed only by cluster 2 with an average of 2.67. The age of this group has an average of 3.96, which indicates that the average age among the members is 40 years old.

The group is called “traditional media users”, due to the use of means of communication such as: television, written press and friends, which are more frequent for this cluster. This is the second most robust group which does not recommend the festival, the existence of possible external factors could condition the visit to the event.

6 Conclusion

The purpose of this research work was to identify the guidelines that lead to achieve the sustainability of the FIAVL, through the recognition of the attendees' sociodemographic profile and the most used means of communication to find out about the event.

The results obtained in this investigation corresponding to the satisfaction variable, showed that the identified groups are not statistically similar; in this case, cluster 3 presented the highest average with respect to the event evaluation, which shows to be significantly higher than cluster 4. For the remaining clusters 1 and 2, the results show that there is no significant difference because the rates are similar between these groups.

For the second outcome variable analyzed, which corresponds to the propensity to recommend the FIAVL to other people, we find that cluster 2 has the highest and most significant evaluation average in relation to cluster 4, the others do not have a significant difference because the average is similar.

Regarding the analysis of the sociodemographic profile, it is stated that gender does not seem to be a determinant factor of the visitor's profile, since its configuration is comparable in all the analyzed clusters and hence, the number of men and women is similar in the results. In cluster 3, age is lower than what is shown in the other analyzed clusters, the same result was obtained in relation to income level and educational level.

This research is relevant because it allowed us to characterize the sociodemographic profile of the visitors who attend cultural events in emerging countries, such as Ecuador; through the analysis of the FIAVL 2018. Likewise, it allowed identifying the use of the media with greater frequency, through which the attendees found out about this event, highlighting the main results based on the groups analyzed; thus we have that in Cluster 3 users prefer the use of social networks, Cluster 4 maintains the use of traditional media, Cluster 1 prefers the use of digital press and Cluster 2 uses radio as their preferred means of communication. The results of this research have practical relevance, since the findings allow establishing guidelines for the sustainability of a cultural event in Latin America. The identification of the profiles of those attending the FIAVL event, the need to improve the offer to attendees and the proposal of guidelines, constitute a significant contribution to the public management of the sector and to the organizers of the event.

As any type of research, this study has some limitations; caution is needed in generalizing the results, since this study involves the analysis of a single edition of the event, in a single event area (OFF events) and in a single city. Consequently, it is recommended to extend this type of research to other festivals that take place in Latin America, in all areas of programming, considering several editions and the analysis of the quality-price ratio.

This work contributes with the Theory of Planned Behavior (TPB), which allows analyzing, in this case, the relationship of the media in the influence of visiting the FIAVL. Through this analysis, it is possible to propose the appropriate guidelines for the sustainability of this type of event.

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Do the Consumers´ Behaviour Matters? An Application of the Theory of Reasoned Action for Assessing Non-Banks Correspondents in Ecuador

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Abstract

The purpose of this paper is to identify the key factors that influence the intention of use of non-banking correspondents (NBC) in Ecuador.
The present study used a sample of 4961 people economically active in Loja province. The data was collected using scales previously validated in international context. The hypotheses were tested using structural equation modelling (SEM).
By improving our knowledge about the intention of using new technologies in the financial sector, and by exploring the aspects that affect the intention and attitude towards the use of NBC in emerging economies, this research contributes to the Theory of Reasoned Action and Theory of Planned Behavior.
By identifying the most important determinants for NBC adoption in emerging economies, this study brought valuable information to managers of banks for the efficient allocation of resources for the deployment of new NBCs.

Keywords: Technology acceptance model; Customer Knowledge; Ecuador;

1 Introduction

The use of new technologies in the financial system, in addition to increasing levels of financial deepening, makes it possible to reduce the costs of financial institutions. But as mentioned by Zhang, Weng, & Zhu, (2018) and Shih & Fang, (2004), even though operating financial costs are reduced, it must be analyzed how the insertion of new forms of banking.

These new forms of banking offer customers greater comfort and a higher level of access, which is easier and quicker. Despite these benefits, the levels of use remain low, motivated by cultural factors as mentioned by Zhang et al., (2018); Warkentin, Charles-Pauvers and Chau, (2015); Yuen, Yeow and Lim, (2015) and Zhao, Shen and Collier, (2014). In the same line, Riyadh et al., (2020) point out that clients in the financial system are used to the conventional banking system and they use to demand traditional transactions.

Because the use of NBC depends on the consumer's acceptance, this research is based on the Theory of Reasoned Action, proposed by Fishbein and Ajzen (1975). The theory proposes that behavioural intentions are set as the pre-behaviour factor, i.e. they are about the likelihood of performing a behaviour. In this theory are inserted beliefs generated by the behavioural aspect, as well as by the normative. Normative beliefs have an impact on people behaviour, so the information or belief affects behaviour intentions (Fishbein & Ajzen, 1975).

This theory has easily developed in some researches that include endogenous and exogenous variables which affect behaviour. Several studies around the world have focused on analysing the intention and the subsequent behaviour of individuals concerning their income and their use of financial products and services (Yen Nguyen & Cassidy 2018, Ali, Raza, & Puah 2016, Farhat, Wajeeha, Mohd, & Mokhtar 2019; Oladapo, Omar, Muda, & Abdurraheem 2019).

This research is the first empirical attempt to test the customers´ behavioural intentions to use NBC in an emerging economy, such as Ecuador. By doing so, we contribute to a better understanding of the intention of the use of NBC in emerging countries. This study introduces a new construct to measure the effectiveness of the perceiving quality in the intention of use of them. In line with recent studies (Zhang & Mao, 2020; Oladapo et al., 2019; Charag et al., 2019), we applied the Theory of Reasoned Action.

When conducting a study on the perception of non-bank correspondents, the literature provides two approaches, firstly, in expanding the use of the TAM methodology and, secondly, in providing the perception of location factors, comfort, adequacy of the places where the non-bank correspondents are located. Previous studies have analyzed different technologies such as ATMs Shih & Fang, (2004) electronic banking Pham & Phi Anh, (2018), but a search of literature performed by the present authors shows that there is a lack of studies that analyse how customers perceive NBC in emerging countries. It is important to fill this gap because NBC allows people to carry out traditional transactions, but unlike the current system, they are located close to the clients' place of residence and with greater ease of accessing these services.

2 Conceptual background

2.1 Financial innovation and consumers´ behaviour.

Information and communication technologies (ICT) are heavily related to innovation. The banking industry is one of the most dynamic sectors in the economy, and it is considered an intensive activity based on ICT (Keramati, Azadeh, Mehran-Gohar, & Afshari-Mofrad, 2012). Understanding the main determinants of technological banking adoption is crucial for banks to improve the way of doing business. Internet banking has emerged as one of the most profitable e-commerce applications (Lee, 2009), and banks take this as an opportunity to get more clients and promote their financial products.

There are three widely-known theoretical models used to explain the relationship between users beliefs attitudes and intentions; Theory of Reasoned Action (Fishbein & Ajzen, 1975), Theory of Planned Behaviour (Ajzen, 1991) and Technology Acceptance Model –TAM (Davis, 1989). These theories have been used by recent studies: (Martins, Oliveira, & Popovic, 2013); (Nasri & Charfeddine, 2012); (Giovanis, Spyridon, & Polychronopoulos, 2012); (Al-Ajam & Nor, 2015); (Kaakeh, Hassan, & Van Hemmen Almazor, 2019); (Seenat Maryam, Saqib Mehmood, & Abdul Khaliq, 2019).

Sakala and Phiri (2019) used the TAM to identify the factors that affect the adoption and use of mobile banking services in Zambia, resulting in a significant positive relationship between perceived ease of use, perceived utility, user, external variables, user intention with the use of mobile banking services. In the other hand, the study also found that the variables related to user attitude and user intention have no significant relationship. In their study, Jamshidi & Hussin (2018) found that adoption of Islamic Credit Card would be more likely to occur among banks consumers when it is compatible with their value system and norms. As a result, they also found that there is a positive and significant relationship between the relative advantage and attitude toward the use of Islamic Credit Card by banks customers. In the same line, Siray (2014) revealed that the variables like attitude, subjective norm, perceived behavioural control, perceived risk was significant in affecting users´ behavioural intention to use e-banking.

By focusing on determinants related to NBC adoption, the results of the present study are going to complement the insights provided by the aforementioned literature.

2.2 Financial inclusion in Ecuador

In Ecuador, insufficient access to products and services provided by the national private banking system is tied to the lack of attention to those most vulnerable groups, generally located in the most remote or marginal areas. According to Central Bank of Ecuador, in December of 2019, 61 of each 100 Ecuadorian had access to financial products and services. It means about 6.8 million adults who are included in the financial system. About 3,7 million of them are men and 3,1 million are women. Between 2017 and 2018, the number of current and saving accounts decreased by -2.56% and 16.10% respectively (Central Bank of Ecuador, 2020).

To improve customer' access to their financial products and services is a challenge that the banking industry must face off. The connectivity is another problem that affects financial inclusion. According to the National Institute of Statistics and Censuses, about 37.2% of the Ecuadorian population had internet access, but there is a gap between rural and urban population, so, in the rural areas the average of internet access was about 16.1% in contrast with urban areas with 46.6% (National Institute of Statistics and Censuses, 2020).

The national financial system has primary and complementary services for the financial sector. NBC stands out. In Ecuador, the banking industry has evolved over the years to get more clients and improve banking deepening. One of the most recent access channels is NBC, which are private firms located in commercial places where people can use them to make some banking transactions without having to go to the bank. Thus, NBC is recognized as channels that promote financial inclusion. In Ecuador, NBC is the banking channel that ranks second growth, after ATMs. According to the Superintendent of Banking (2020), in April 2015 Ecuador has 23,858 NBC and in April 2020 the amount was 28,321, with an increase of 18.7% in this period. There are five private institutions which offer this service along with the 24 Provinces. The Province of Loja has 3% of the total of NBC in April 2020, an important fact is that Loja has NBC in all its 16 towns. The Loja city concentrated about 65% of the total. Although, the NBC grow on average less than ATMs. In April 2020, there were 4554 ATMs versus 28,321 NBC. To deploy an NBC is cheaper than to deploy an ATM. Operating an NBC cost about 3,000 dollars instead of an ATMs which cost runs from 20,000 dollars to 30,000 dollars depending on if it is a simple ATMs or a multiple services ATM (Superintendency, 2020).

Considering the use of NBC depends on the consumer's acceptance, this research is based on the Theory of Reasoned Action, proposed by Fishbein and Ajzen (1975). The theory proposes that behavioural intentions are set as the pre-behaviour factor, i.e. they are about the likelihood of performing a behaviour. In this theory are inserted beliefs generated by the behavioural aspect, as well as by the normative. Normative beliefs have an impact on people´s behaviour, so the information or belief affects behaviour intentions (Fishbein & Ajzen, 1975).

3 Research Methodology

3.1 Sample

Data collection was carried out in Ecuador in the Province of Loja, in which according to data issued by INEC 2014 is the Espindola town, considered one of the poorest cantons in Ecuador determined by unsatisfied basic needs, was 4961 surveys were conducted for the economically active population, the criterion of using a non-bank correspondent was a non-mandatory option.

The sample is made up of 52% of men and 48% of women, it is more representative in people in ages ranging from 18 to 48 years, while people over 49 years represent

approximately 24%. The secondary education level is the one with the highest percentage with more than 44%.

In the sample, 86% is a client of a financial institution, of which banks have the highest percentage with around 58%, unlike the cooperative sector which is 27%. Additionally, it is important to mention that 72% have used an NBC, while 28% have not used it.

Table 1. Sample description.

Question	Category	Percent
Gender	Male	52,37%
	Female	47,63%
Age	18 - 28 years	26,31%
	29 - 38 years	25,14%
	39 - 48 years	22,60%
	49 - 58 years	15,88%
	59 - 60 years	6,39%
	68 years or more	3,61%
Level of instruction	Primary	18,81%
	Secondary	44,00%
	Technological	10,70%
	Undergraduate	22,92%
	Graduate	2,74%
	None	0,73%
Are you a client of a financial institution?	Yes	85,79%
	No	14,21%
What kind of financial intermediary customer are you?	Bank	57,59%
	Cooperative	26,93%
	Savings bank	0,85%
Have you used the attention channel known as NBC?	Yes	71,90%
	No	28,10%

A survey was established by the University Technical Particular of Loja, which contained two sections, in the first section are general data related to age, gender, education and questions related to the use of the financial system were established and especially of non-bank correspondents.

In the second section are the questions that make up each of the constructs such as attitude toward using the NBC, intention to use NBC, perceived usefulness of mobile payment services, perceived ease of use of NBC, perceived security of NBC, perceived compatibility of NBC, subjective norms, perceived quality of NBC. Except for the perceived of NBC construct, the instruments are based on studies such as Jamshidi & Kazemi, (2019); Breward, Hassanein, & Head, (2017); Gardner & Amoroso, (2004) and Shih & Fang, (2004).

The instrument to measure Perceived of NBC was created by the authors and validated by academic specialists before its application, each of the items that make up the survey

was measured using a 5-point Likert scale, which varies between (1) totally disagree, (2) disagree, (3) neither agree nor disagree, (4) agree and (5) strongly agree.

Method

The structural equation model (SEM) is used to check the hypotheses, as mentioned by Ringle, Wende and Will, (2005) allows describing models that evaluate the validity of the theories applying empirical data. SEM helps to assess relationships between multiple independent and dependent variables. According to Henseler, Ringle and Sinkovics, (2009), SEM allows the evaluation of complex models with several variables, being adequate to determine an optimal estimate. The present study uses software ADANCO for supporting our SEM analysis.

In order, to obtain results, the reliability and validity of the model were analyzed, and then an evaluation of the structural model was carried out to test the hypotheses, as suggested by Anderson and Gerbing (1988).

Measurement model

The measurement model evaluated the reliability of the construct, indicator, convergence validity and discriminant validity, considering the results obtained in the AVE, reliability, Cronbach's alpha, loadings and t-values. Table 2 shows good reliability as all the variables have values above 0.7 for Cronbach´s alpha, Rho (pc) and the Rho A tests. Following suggestions of Churchill (1979), the loadings above 0.6 allow us to confirm that the indicators are reliable. AVE values greater than 0.5 for all variables show adequate convergent validity, following the criteria of Fornell and Larcker (1981). Furthermore, the discriminant validity was confirmed by checking that the square root of the AVE of each variable is greater than the correlation between this variable and the other ones.

With this analysis, we can indicate that the model presents reliability in the indicators and constructs, in addition to presenting adequate values to check the convergent and discriminant validity, that is, that the constructs are statistically different and the structural model can be applied.

Table 2 Measurement results of indicators that make up the constructs

Construct	Indicator		Loadings	Media	Alfa Cronbach's	Composite reliability	Rho A	AVE
Attitude toward using the NBC								
	AU01	Using NBC is a good idea	0.922	4.34	0.9423	0.9585	0.9424	0.8525
	AU02	Using NBC is wise	0.915	4.11				
	AU03	Using NBC is beneficial	0.936	4.30				
	AU04	Using NBCis interesting	0.921	4.22				
Intention to use NBC								
	IU01	I plan to use NBC in the future	0.867	4.26	0.9025	0.9320	0.9054	0.7742
	IU02	If I had the opportunity, I used NBC in the future	0.894	4.29				
	IU03	I intend to use NBC	0.913	4.12				
	IU04	I use NBC as much as possible	0.844	3.95				
Perceived usefulness of mobile payment services								

	PU01	NBC is a useful form to realize financial transactions.	0.868	4.34	0.8708	0.9126	0.8789	0.7244
	PU02	NBC is a fast and agile service channel	0.897	4.32				
	PU03	NBC is a channel useful of attention.	0.895	4.31				
	PU04	Using NBC has improved my approach with the banking system	0.734	3.98				
Perceived ease of use of NBC								
	PF01	It is easy to become skillful at using NBC	0.942	4.20	0.9468	0.9619	0.9501	0.8634
	PF02	The interaction with NBC is clear and understandable	0.958	4.20				
	PF03	It is easy to use NBC	0.946	4.22				
	PF04	My experience using NBC is positive	0.868	4.08				
Perceived security of NBC								
	PS01	The risk of fraud for using an NBC is high	0.746	3.59	0.6522	0.7803	0.7558	0.5467
	PS02	I consider using NBC as a safe way to realize financial transactions	0.848	3.88				
	PS03	The risk of falling victim to theft when using NBC is high.	0.604	3.49				
Perceived compatibility of NBC								
	PC01	Using NBC fits well with my lifestyle	0.926	4.01	0.8576	0.9139	0.8806	0.7807
	PC02	Using NBC fits well with the way I like to purchase products and services	0.933	3.99				
	PC03	I would appreciate using NBC instead of alternative modes of other traditional service channels of the banking system.	0.784	3.68				
Subjective norms								
	SN01	People who are important to me would recommend using NBC	0.949	4.04	0.9307	0.9558	0.9345	0.8781
	SN02	People who are important to me would find using NBC beneficial	0.933	4.01				

	SN03	People who are important to me would find using NBC a good idea.	0.930	4.12				
Perceived quality of NBC								
	CNB01	The location of the NBC is a key factor for I am choosing it.	0.684	4.19	0.8202	0.8674	0.8313	0.5228
	CNB02	I prefer to use NBC located in well-knows shopping centers or retails.	0.719	4.35				
	CNB03	I prefer to use NBC of well-known financial institutions.	0.676	4.33				
	CNB04	My empathy and confidence with the owner of NBC are very important.	0.668	4.21				
	CNB05	Cleanliness and order are decisive for I am choosing the NBC I will use.	0.786	4.51				
	CNB06	I will use NBC that have rapid attention and where there are not much people waiting.	0.794	4.64				

Table 3 Correlations between constructs

Construct	AU	IU	PU	PF	PS	PC	SN	NBC
AU	**0.8525**							
IU	0.4998	**0.7742**						
PU	0.4726	0.4234	**0.7244**					
PF	0.4836	0.3892	0.5648	**0.8634**				
PS	0.1286	0.0723	0.1211	0.1365	**0.5467**			
PC	0.3965	0.3583	0.3935	0.4866	0.1265	**0.7807**		
SN	0.2863	0.2320	0.3279	0.2948	0.1050	0.3361	**0.8781**	
NBC	0.2909	0.2606	0.3535	0.3047	0.1043	0.3104	0.4256	**0.5228**

Squared correlations; AVE in the diagonal

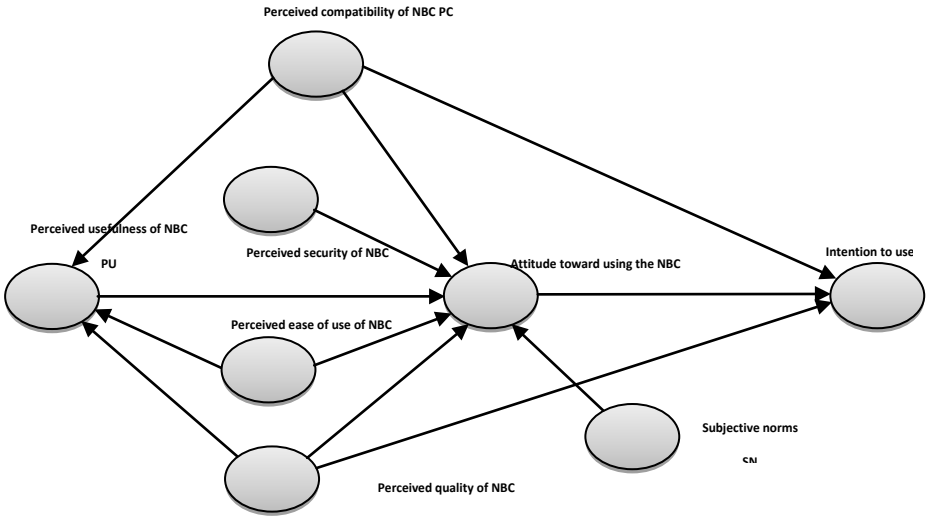

Figure 1 Structural model

Structural model

The structural model presented in figure 1, was assessed after running the bootstrapping procedure. The SRMR value below 0.08 (see table 4), indicate an adequate fit of the model, in line with the criteria proposed by Henseler et al. (2016). R^2 values in table 5 show that the model explains 54% of the variance of Intention to use NBC, 58% of Attitude towards use NBC and 61% of Perceived usefulness of mobile payment services.

Table 4. R^2 and SRMR

Construct	(R^2)	Adjusted R^2
AU	0,5802	0,5794
IU	0,5474	0,5470
PU	0,6186	0,6182
SRMR	0,0779	

As shown in table 5, are hypotheses were accepted. Fist, hypotheses 7.1, 7.2 and 7.3 shows that the perceived quality of NBC is an antecedent of the perceived usefulness of NBC (0.000, p <0:05), the Attitude Towards using the NBC (0.0016, p <0:05) and the Intention to use NBC (0.000, p <0:05).

Beyond the perceived quality of NBC, the intention to use NBC is predicted by Attitude towards using the NBC (H1) and the perceived compatibility of NBC (H5.2). The attitude of using the NBC is predicted by Perceived usefulness of NBC (H2), the perceived ease to use of NBC (H3.1), the perceived compatibility of NBC (H5.1), the subjective norms (H6) and the perceived quality of NBC (H7.1). Third, the Perceived usefulness of NBC is predicted by the perceived ease to use of NBC (H3.2), the perceived compatibility of NBC (H5.3) and the perceived quality of NBC (H7.3). Our results are in line with Schierz, Schilke, & Wirtz, (2010), who have found a positive relationship between the perceived usefulness of NBC, the attitude towards using the NBC and the Intention to use NBC.

Table 5. Test of Hypotheses

Hypothesis	Beta	Standard error	t-value	p-value	Cohen's f^2
H1: AU -> IU	0,5103	0,0209	24,4192	0,0000	0,3176
H2: PU -> AU	0,2769	0,0250	11,0621	0,0000	0,0682
H3.1: PF -> AU	0,2766	0,0243	11,3787	0,0000	0,0629
H3.2: PF -> PU	0,5391	0,0189	28,5162	0,0000	0,3616
H4: PS -> AU	0,0574	0,0137	4,2008	0,0000	0,0065
H5.1: PC -> AU	0,1661	0,0218	7,6092	0,0000	0,0288
H5.2: PC -> IU	0,2119	0,0203	10,4214	0,0000	0,0533
H5.3: PC -> PU	0,1245	0,0187	6,6554	0,0000	0,0191
H6: SN -> AU	0,0681	0,0185	3,6739	0,0002	0,0054
H7.1: CNB -> AU	0,0665	0,0211	3,1537	0,0016	0,0051
H7.2: CNB -> IU	0,1173	0,0172	6,8133	0,0000	0,0192
H7.3: CNB -> PU	0,2276	0,0183	12,4128	0,0000	0,0866

The importance of the perceived ease of use of NBC for leveraging the perceived usefulness of NBC and the attitude toward using the NBC is in line with the study of

Riyadh et al., (2020). The study of Shih & Fang, (2004) showed that there is a positive relationship between the perceived security and the attitude towards the intention to use NBCs, as shown in our hypothesis H4.

6 Conclusions

The present study aimed to analyze the determinants of the use of NBC in an emerging country like Ecuador. First, our results showed that the perceived usefulness of NBC influences positively the attitude towards using NBC, and this variable influences the intention to use NBC. Second, we identified the antecedents of the aforementioned variables, and within these antecedents, the results helped to discover the role of the perceived quality of NBC as a key determinant for leveraging the intention to use NBC.

Our results complement previous studies (Zhang & Mao, 2020; Baptista & Oliveira, 2016; Schierz, Schilke, & Wirtz, 2010) that aim to explain to intention to use ATMs in developed countries. By exploring a new variable such as the perceived quality of NBC, and by improving our understanding of the determinants of the intention to use NBC, a new banking channel, in an emerging economy, this study contributes to the Theory of Reasoned Action as well as the Theory of planned behaviour. In this sense, this is the first study that applies these theories to determine the intention of use in NBC in the Latin American context.

There is a high potential for the use of NBC in emerging economies, and the present study provides insightful evidence for supporting decisions of managers and policymakers, oriented to the development of NBC in those contexts.

Like all studies, this research has some limitations, so it is not possible to generalize the results obtained. We recommend that future studies include data from other Ecuadorian provinces or other emerging economies.

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Immigrant Entrepreneurship and Social Inclusion: Do Integration Factors Really Work? Perspectives from Italy

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Abstract

This study seeks to explore the phenomenon of immigrant entrepreneurship in Italy, with the main objective to explain the factors that influence the decision of immigrants to become entrepreneurs in the host country, especially during the pandemic situation. A Structure Literature Review (SLR) in the Italian context is presented followed by a quantitative empirical research, aimed to deepen the understanding of both, the factors and the process. A system of integration indicators was constructed, analyzed and compared to immigrant entrepreneurship phenomenon through a multivariate logarithmic regression model (log-log) estimated by the Ordinary Least Squares (OLS) technique, referred to the secondary data collected on ISTAT official website and Italian Chambers of Commerce. Findings pointed out a weak relationship between the set of immigrant enterprises and institutions, due to the limited resources devoted to integration and social inclusion of immigrants. Therefore, we argue that a well-structured, clear and specific regulatory framework on the integration of immigrants and, in particular, on immigrant entrepreneurship, can positively contributes to create a solid socio-economic environment, both for immigrants and for native-run businesses. Drawing from the state of the art of the immigrant entrepreneurship phenomenon, was pointed out the limited contribution of management and accounting studies in deepening this topic. Considering the development of this phenomenon in the new era of globalization and the growing of recent flows of immigration in all continents, particularly in Europe, we claim for the need to fulfil this gap through further studies. In this regard, this empirical research provide useful insights in pointing out some research path to cultivate in the future.

Keywords – Immigrant Entrepreneurship, Social Exclusion/Inclusion, Structured Literature review (SLR), Italy, Quantitative approach

Paper type – Accademic research paper

1 Introduction

The participation of immigrants in local labour market is one of the most discussed issues in literature, paying particular attention to immigrant workers as job seekers, and only in the last decades focusing on immigrant entrepreneurship as a particular phenomenon. The events occurred during the recent weeks, related to a progressive social tension due to the global pandemia and the increase in the gap between rich and poor people, have elicited some reflections related to both social inclusion and entrepreneurship, presented in the following section (section 2), while section 3 describes the methodology used, the definition of the research questions, and the application of the Structured Literature Review (SLR). Section 4 describes the empirical research methodology and performance. A system of integration indicators was constructed, analyzed and compared to immigrant entrepreneurship phenomenon through a multivariate logarithmic regression model (log-log) estimated by the Ordinary Least Squares (OLS) technique. It referred to the secondary data collected at ISTAT official website and Italian Chambers of Commerce. The National Council of Economics and Work (CNEL) list of indicators was used to construct indices on immigrant integration. Section 5 discuss the findings of the research and policy opportunities of immigrant entrepreneurship in the Italian context, presents several limits and unanswered problems as well as opportunities for future research direction.

2 Some drivers to reach a new paradigm of integral and inclusive entrepreneurship

The logic under which this problem is analysed concerns the accounting perspective and some drivers emerge from what we are experiencing, namely: the ways adopted to manage the companies and involve people and the environment and the new research perspectives that are necessary to help companies do their best. About the way to manage companies the first concerns a more in-depth concept of ethics within the company, the second is about the need for a globalization of solidarity. The explosion of episodes of racism, the loss of jobs and therefore the presence of progressive tensions claim for a challenge for the entrepreneur who, in addition to managing the business in the best way, must also react to face and manage emergency situations.

But this ... why? We are imbued with an economic theory that aims at profit as an end in itself and this has been demonstrated by the need of the Coronavirus to close all production activities to safeguard health (!) and consequently the social and environmental aspects have potentially gained benefits .

Regarding to the first driver, ethics discourse in the company arises in a domineering way. According to Rusconi (2019), the company is a system of stakeholders, who often are in conflict with each other. In the absence of an ethical basis, there is a risk of being exploited for the company and/or for personal interests, especially in the context of a large company. The ethical basis is fundamental for the relational mediation necessary to make the right decision considering the specific circumstances (Rusconi, 2018, Baldarelli, 2005).

Another important author moves in search of variables that can guide the entrepreneur. In fact, some "drifts" stand out which we had perhaps not noticed before the Pandemia. These include the pervading of "work" as the "whole" of our existence that leaves no room for other circuits such as: family, friendships and hobbies (Bruni 2018: 13).

The entrepreneur often underestimates that the current state of the art market is mainly based on a new and destructive destruction, that is to make "spoils" of the "lives" of workers as a "sacrifice" devoted to the idol of money and capitalism. Over time we have lost authenticity with the (wrong) belief that everything can be "bought" (Bruni, 2018: 25). It is dangerous to move from a logic of work for everything, to that of consumption for all (Bruni, 2018: 29) endorsed perhaps by a minimum income. To avoid this path, some guidelines are outlined. According to Bruni (2018), it is necessary to re-discover the work, also by those who have the responsibility to govern the companies that leave their "aseptic" rooms and mix with the workers and employees in the various departments to appreciate the work done by the employees and collaborator at all levels. Managers should approach workers by understanding their needs and recognizing them as people who work all the year to contribute to the company and therefore should be treated as such.

The second variable is that in this context, examples of companies that try to reason differently (Baldarelli, 2011) seem to emerge as it is needed to activate “the globalisation of solidarity” (Cillerai, 2002: 370). But what is the meaning of this? The meaning is that since in the countries where immigrant entrepreneurship are present, they need to develop a model of growth and relations and to adapts themselves to the circumstances and the competitive as well as environmental situations of the specific area where they operate. In this way coming up with a model, differing for certain aspects from country to country and capable of adapting itself to the local specific context. Indeed, every company has the intention of adapting itself well into the place where it is sited, but the rooting with respect to environment typologies: competitive, social, cultural, political, seems more complete to us and especially seems truly in favour of sustainable development of the place where they are means that the development of “ethical” potential in these companies, opens itself up to acquiring a whole series of “bearings” that respect their place of origin. Moreover, these “bearings”, from their place of origin without badly upsetting the base that already exists, get a stimulus, from time to time, different to taring the vector of objectives and ways for governing the economic factors and the environmental and social sustainability, in order to become real engines for economic development in that area where they operate as well as in the surrounding ones (Baldarelli, 2011).

About the new perspectives of research that are required to help companies do the best there is the rise of protests by some intellectuals, such as Cooper (2005) in which potential and persistent inequalities should be noted. "I think that it is important for academics to break down the myths of our contemporary age, promote a recognition of and find potential solutions to gross inequalities, and ensure that our students leave university with the ability to be sceptical and to give a voice to the disadvantaged” (Cooper, 2005: 597) as some immigration situations could also be. So even the

entrepreneur will have to deal with the search for a new relationship, not only based on power and interest, but on friendship and mutual trust.

After this analysis in the next paragraph we will consider methodology of research.

3 Methodology

The study starts with a SLR pursuing Massaro et.al. (2016) guideline, and is followed by a quantitative empirical research focused to the Italian context.

The early step of the SLR, was to identify that to date there has been not other SLR on Immigrant and/or Ethnic Entrepreneurship, specifically for the Italian context, published in academic journals indexed in Scopus. Then the research was expanded on other SLR with a specific focus on Immigrant and/or Ethnic Entrepreneurship in the international arena. From this second research three significant papers were individuated (Dheer, 2018; Yalaz, and Zappata-Barrero, 2018; Aliaga-Isla, and Rialp, 2013), pointing out the necessity of more studies on immigrant entrepreneurship, especially in Italy. We adopted the Scopus database. Three keywords - immigrant entrepreneurship, ethnic entrepreneurship and immigrant entrepreneurs – were used. The selected articles were analysed according to a Literature Review Protocol, based on objectives, theoretical frameworks and methodologies. There were analyzed with the help of the computer-assisted qualitative data analysis software NVIVO 12.

The second research step was based on the empirical quantitative analysis. A system of integration indicators was constructed, analyzed and compared to immigrant entrepreneurship phenomenon through a multivariate logarithmic regression model (log-log) estimated by the Ordinary Least Squares (OLS) technique. Secondary data (Vartanian, 2010) were taken from ISTAT official website and Italian Chambers of Commerce. Three main dimensions are taken in consideration in order to measure the immigrant integration in the Italian context: territorial attractiveness, social dimension and economic dimension (Golini, et.al., 2001; Cellini, and Fideli, 2002; CNEL, 2013). The outcome of interest was the measure of the relationship of the host country integration factors and their influence in the entrepreneurial activity of Extra EU immigrants in Italy. For homogeneity reasons, data refer to the year 2017. They are elaborated with STATA software.

3.1 Research questions

As mentioned above, this study seeks to explore the immigrant entrepreneurship phenomenon in the Italian context and identify the reasons that push immigrants to become entrepreneurs in the host country. In order to reach the objective, the following research problems and questions arise:

- RQ1: Depict a state of the art of immigrant entrepreneurship in Italy.
- RQ2: Are immigrants decisions to become entrepreneurs related to the degree of social and economic integration in the host country?

By answering these questions, we aim to contribute in finding gaps for future lines of research and creating critical conscious of how this field of knowledge has evolved.

3.2 Selecting relevant publications

In order to explore the development of the immigrant entrepreneurship in the Italian contexts, to highlight gaps and address future research, a SRL was conducted. For this research step we selected the Scopus data base due to its emphasis on providing relevant multidisciplinary research connected through linked content citation metrics from multiple sources. There were three key-words, and the research arena was limited to Italy:

- Ethnic Entrepreneurship Italy - 12 results
- Immigrant entrepreneurship Italy - 30 results
- Immigrant Entrepreneurs Italy - 48 results

Despite the attention is on immigrant entrepreneurship, the term ethnic was taken in consideration too, as previous literature in the field has done. However, when used in this context, it is purely considered as the operational definitions used by the author and the particular study being discussed at that time.

For the selection of articles, paper titles, key words and abstracts have been reviewed to ensure that they discuss one or more of the three key arguments of the research topics. Editorials, commentaries, interviews, conference proceedings, book reviews and very short articles (4 pages or fewer) were excluded (Lockett, 2006), as well as articles not available in the electronic form (Jones, Coviello, and Tang, 2011). We decided to maintain books and books chapters founded in the electronic form, as they make a notable contribution in constructing the literature of immigrant entrepreneurship in Italy. There was no exclusion of articles based on language only articles in English language are found. After the first research with the above mentioned parameters, 90 potential articles for the review were identified. Duplicates, resulting from the crossed research within the keywords (25 articles) and 1 article with no author were discarded. Specifically, we tried to be consistent with academic trends; this does not mean, in any case, that other publications do not contribute or are less relevant for academic arenas. 64 abstracts were reviewed, 13 were discarded because treats argument not closely related to the topic, or which not concern the Italian context. For 50 articles or book chapters we tried to download the pdf file, through the proxy of the University of Urbino library. 18 full text articles were not available in free download, therefore only abstracts were reviewed and included in the final analyse. In sum, 32 articles downloaded in full text and eighteen abstracts were included in the final analyse.

This search had no time-constrain. However, it is only in the last fifteen years that we have a growing interest from researchers, policy makers and professionals on immigrant entrepreneurship studies in the Italian context. The retrieved articles cover a period of time from 1998 to 2019, peaking in 2014 (7 publications) and 2018 (8 publications) (Figure 1), in line with the growing interest on this field in the global arena, especially in Europe.

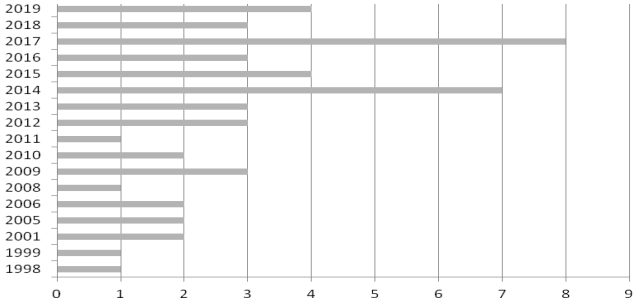

Fig. 1. Trends of publication through years (focused country – Italy)

3.3 Defining the Literature review Protocol

In order to read, classify and analyse the content of the selected publications, a literature review protocol was developed. Table 1 schematically represents the final version, or a coding frame, of the formal reading protocol. Based on this protocol, a coding list is created and used for coding articles with NVivo 12 software.

Table 1. Literature Review Protocol

Article Impact	**Belonging scientific discipline**	**Article Content**	**Future research**
Author(s); Title; Journal; Year/Nr/Impact Data – base found Citations	Macro domain (e.g. SSD); Discipline	Research objective; Theoretical framework; Research results; Audience	Identify Gaps; Develop future paths and address questions

3.3.1 Article Impact

Articles have been selected drawing from internationally recognised academic journals cited in Scopus, covering different disciplines, considering valid for the study only scientific journal articles and a limited number of book chapters. In order to measure the article impact, the number of citations was considered. Table 4 at the end of this section, shows the list of authors, article title, year of publication, journals and number of citations. However, the latter is not exhaustive for the fact that, as Dumay et.al (2014) outline:

> *"one problem with determining the impact from citations alone is that older articles can accumulate more citations than others" (Dumay, et., al., 2014: 270).*

As we can notice, this is not always true, because articles published in the early years (1998; 1999; 2000), have less citations than some others. Three articles have the major number of citations, namely: Baycan-Levent, and Nijkamp, 2009 (60 citations); Mingione, 2009 (28 citations); Dei Ottati, 2014 (36 citations); Brzozowski et.al, 2014 (31 citations). On the other side, books and book chapters have the lowest citation number or no citation at all, independently from the year of publication. The language of

downloaded articles or abstracts is English, so it cannot be said that there is a linguistic problem for citations.

3.3.2 Thematic grouping by scientific domain (ERC)

Articles were divided into core categories by their scientific domain. The scientific domain was defined by article research focus, journal research domain and author research field (Table 2).

After analyzing all articles by the above mentioned criteria, two main scientific domains were defined as follows:

- SSD – Social Sciences & Demography (31 articles)
- EMA – Economics, Econometrics, Management and Accounting (16 articles)
- Multidisciplinary – both SSD and EMA (3 articles)

Classification of the selected publications according to their scientific domain is fundamental for one of the objectives of the present research, which aims to identify the state of art of the immigrant entrepreneurship research in Italy, and the role that the management field, and in particular, the accounting field, have on the topic. The research confirmed what previous studies pointed out (Dheer, 2018; Yalaz, and Zap-pata-Barrero, 2018; Aliaga-Isla and Rialp, 2013). The immigrant entrepreneurship topic mainly concerns the social sciences and in particular the field of sociology, and it is only in the last 8 years that the management field is dealing with the subject. In particular, Aliaga-Isla, and Rialp, (2013), among others, pointed out that:

> *"The review also revealed a heavy reliance on sociological theories which, on one hand, have enriched the understanding of the topic but, on the other, in a certain way is troubling, considering the multidisciplinary character of immigrant entrepreneurship. As we suggested before in the objectives, the incorporation of theories and perspectives from management field would be interesting to study the performance of immigrant businesses" (Aliaga-Isla, and Rialp, 2013:837).*

Table 2. List of articles object of the review

Authors	Title	Year of pubblication	Source	citation	Article Scientific domain
Knights, M., King, R.	The geography of Bangladeshi migration to Rome	1998	International Journal of Population Geography	12	SSD
di Friedberg, O.S.	Immigrant and entrepreneur: An inevitable choice? Moroccans in Milan [Immigre et entrepreneur: Un choix inevitable? Les Marocains a Milan]	1999	Studi Emigrazione	0	SSD
Schmoll, C.	Immigration and new productive margins in Naples metropolitan area [Immigration et nouvelles marges productives dans l'aire métropolitaine de Naples]	2001	Bulletin d'Association de Geographes Francais	3	SSD
Filippi, V.	Immigrants turning entrepreneurial: their presence and role in Veneto and Treviso	2001	Studi Emigrazione	0	SSD

	[Quando gli immigrati diventano imprenditori: La realtà dell'artigianato in Veneto e a Treviso]				
Cologna, D.	Chinese immigrant entrepreneurs in Italy: Strengths and weaknesses of an ethnic enclave economy	2005	Asian Migrants and European Labour Markets: Patterns and Processes of Immigrant Labour Market Insertion in Europe	6	SSD
Ricci, A.	Italian emigrants in Romania. Document and testimony of a communicator [Emigranti italiani in Romania. Documenti e testimonianze di una comunità dimenticata]	2005	Studi Emigrazione	1	SSD
Loda, M.	Retail business in the historical centre of florence. Mass tourism and new immigrant enterpreneurs [Der einzelhandel im stadtzentrum florenz zwischen touristischem druck und ausländischer unternehmerschaft]	2006	BELGEO	1	SSD
Ambrosini, M., Boccagni, P.	Self-employment work and small enterprises as channels of integration for immigrants: The case of the Province of Trent [Lavoro autonomo e piccole imprese come canali di integrazione dal basso degli immigrati: Il caso della Provincia di Trento]	2006	Studi Emigrazione	0	SSD
Rovinello, M.	French businessmen in the nineteenth-century Mezzogiorno: Technical innovation, sociability, networks and negotiation of identities	2008	Journal of Modern Italian Studies	2	SSD
Baycan-Levent, T., Nijkamp, P.	Characteristics of migrant entrepreneurship in Europe	2009	Entrepreneurship and Regional Development	60	EMA
Mingione, E.	Family, welfare and districts: The local impact of new migrants in Italy	2009	European Urban and Regional Studies	28	SSD
Lapolla, G.M., Belluscio, S.J.	The grand Gennaro	2009	The Grand Gennaro (book)	1	SSD
Allasino, E., Ricucci, R.	Between knowing and doing: Eastern European killed immigrants in Torino [Tra il sapere e il fare: Immigrati qualificati dell'Europa dell'Est a Torino]	2010	Studi Emigrazione	1	SSD
Carbone, S.	Chinese entrepreneurial activity in Messina [L'imprenditoria Cinese a Messina]	2010	Studi Emigrazione	0	SSD
Santini, C., Rabino, S., Zanni, L.	Chinese immigrants socio-economic enclave in an Italian industrial district: The case of Prato	2011	World Review of Entrepreneurship, Management and Sustainable Development	13	EMA
Schmoll, C.	The making of a transnational marketplace. Naples and the impact of Mediterranean cross-	2012	Cambridge Journal of Regions, Economy and	9	EMA

	border trade on regional economies		Society		
Pechlaner, H., Bò, G.D., Volgger, M.	What makes tourism an attractive industry for new minority entrepreneurs: results from an exploratory qualitative study	2012	Tourism Review	8	SSD
Ribeiro, A., Rezaei, S., Dana, L.-P.	Gender and family in transnational entrepreneurship	2012	International Journal of Business and Globalisation	11	EMA
Dei Ottati, G.	Ethnic firms and industrial districts: An interpretation of the development of Chinese enterprises in Prato [Imprese di immigrati e distretto industriale: Un'interpretazione dello sviluppo delle imprese cinesi a Prato]	2013	Stato e Mercato	6	SSD
Donatiello, D.	The integration of immigrants into the middle class. Strategies and trajectories of Romanian workers in Turin [L'integrazione degli immigrati nel ceto medio. Traiettorie di lavoratori romeni a Torino]	2013	Stato e Mercato	0	SSD
Foreman-Peck, J., Zhou, P.	The strength and persistence of entrepreneurial cultures	2013	Journal of Evolutionary Economics	17	EMA
Dei Ottati, G.	A transnational fast fashion industrial district: An analysis of the Chinese businesses in Prato	2014	Cambridge Journal of Economics	36	EMA
Brzozowski, J., Cucculelli, M., Surdej, A.	Transnational ties and performance of immigrant entrepreneurs: the role of home-country conditions	2014	Entrepreneurship and Regional Development	31	EMA
Arrighetti, A., Bolzani, D., Lasagni, A.	Beyond the enclave? Break-outs into mainstream markets and multicultural hybridism in ethnic firms	2014	Entrepreneurship and Regional Development	17	EMA
Smans, M., Freeman, S., Thomas, J.	Immigrant entrepreneurs: The identification of foreign market opportunities	2014	International Migration	12	SSD
Lan, T., Zhu, S.	Chinese apparel value chains in Europe: Low-end fast fashion, regionalization, and transnational entrepreneurship in Prato, Italy	2014	Eurasian Geography and Economics	11	SSD/EMA
Wu, B., Liu, H.	Bringing class back in: Class consciousness and solidarity among Chinese migrant workers in Italy and the UK	2014	Ethnic and Racial Studies	9	SSD
Matricano, D., Sorrentino, M.	Ukrainian entrepreneurship in Italy: factors influencing the creation of ethnic ventures	2014	Journal of Innovation and Entrepreneurship	0	EMA
Ceccagno, A.	The Mobile Emplacement: Chinese Migrants in Italian Industrial Districts	2015	Journal of Ethnic and Migration Studies	13	SSD
Riva, E., Lucchini, M.	The Effect of the Country of Birth of the Owner on Business Survival. Evidence from Milan Metropolitan Area, Italy	2015	Journal of Ethnic and Migration Studies	8	SSD
Chen, C.	Made in Italy (by the Chinese): Migration and the rebirth of textiles and apparel	2015	Journal of Modern Italian Studies	3	SSD
Nanni, M.P.	Immigrant entrepreneurship in Italy during the economic crisis	2015	The Other Side of Italy: Immigration in a Changing Country	0	SSD

			(book)		
Solano, G.	Multifocal entrepreneurial practices: The case of Moroccan import/export businesses in Milan	2016	International Journal of Entrepreneurship and Small Business	14	EMA
Pedrini, M., Bramanti, V., Cannatelli, B.	The impact of national culture and social capital on corporate social responsibility attitude among immigrants entrepreneurs	2016	Journal of Management and Governance	3	EMA
Szarucki, M., Brzozowski, J., Stankevičienė, J.	Determinants of self-employment among Polish and Romanian immigrants in Germany	2016	Journal of Business Economics and Management	7	EMA
Brzozowski, J., Cucculelli, M., Surdej, A.	The determinants of transnational entrepreneurship and transnational ties' dynamics among immigrant entrepreneurs in ICT sector in Italy	2017	International Migration	12	SSD
Ong, X., Freeman, S.	Understanding chinese immigrants in prato's industrial district: Benefits to local entrepreneurs (book chapter)	2017	Native and Immigrant Entrepreneurship: Lessons for Local Liabilities in Globalization from the Prato Case Study	1	SSD
Zhang, Y., Zhang, M.	The mechanism of sustained immigrant entrepreneurship: Wenzhounese immigrants in Italy (book chapter)	2017	Native and Immigrant Entrepreneurship: Lessons for Local Liabilities in Globalization from the Prato Case Study	1	SSD
Guercini, S., Ottati, G.D., Baldassar, L., Johanson, G.	Introduction (book chapter)	2017	Native and Immigrant Entrepreneurship: Lessons for Local Liabilities in Globalization from the Prato Case Study	0	
Becucci, S.	Ethnography of the fast fashion community: Chinese entrepreneurs in prato (book chapter)	2017	Native and Immigrant Entrepreneurship: Lessons for Local Liabilities in Globalization from the Prato Case Study	0	
Ceccagno, A.	City making and global labor regimes: Chinese immigrants and italy's fast fashion industry	2017	City Making and Global Labor Regimes: Chinese Immigrants and Italy's Fast Fashion Industry (book)	13	SSD/EMA
Guercini, S., Milanesi, M., Ottati, G.D.	Paths of evolution for the Chinese migrant entrepreneurship: a multiple case analysis in Italy	2017	Journal of International Entrepreneurship	4	EMA
Barberis, E., Violante, A.	Chinese immigration to italy and economic relations with the homeland: A multiscalar perspective (book chapter)	2017	Native and Immigrant Entrepreneurship: Lessons for Local Liabilities in Globalization from the Prato Case Study pp. 31-52	0	SSD
Bolzani, D.,	Evaluations of export feasibility by	2018	Journal of	3	EMA

Boari, C.	immigrant and non-immigrant entrepreneurs in new technology-based firms		International Entrepreneurship		
Fauri, F., Tedeschi, P.	Labour migration in Europe volume I: Integration and entrepreneurship among migrant workers – A long-term view	2018	Labour Migration in Europe Volume I: Integration and Entrepreneurship among Migrant Workers - A Long-Term View (book)	0	SSD
Brzozowski, J., Cucculelli, M., Surdej, A.	Exploring transnational entrepreneurship. Immigrant entrepreneurs and foreign-born returnees in the Italian ICT sector	2019	Journal of Small Business and Entrepreneurship	1	EMA
Bolzani, D.	Internationalization Intentions in Domestic New Technology-Based Firms: A Comparison Between Immigrant and Non-immigrant Entrepreneurs	2019	Contributions to Management Science	0	EMA
De Luca, D., Ambrosini, M.	Female Immigrant Entrepreneurs: More Than a Family Strategy	2019	International Migration	0	SSD
Bettin, G., Bianchi, P., Nicolli, F., Ramaciotti, L., Rizzo, U.	Migration, ethnic concentration and firm entry: evidence from Italian regions	2019	Regional Studies	1	SSD

4 From integration to entrepreneurship: Sample overview

As stated above, one of the main objectives of this paper was to study the relationship between immigrant integration level and immigrant entrepreneurship, in order to explore factors relating to the host country that impact on the decision and the opportunities of immigrant entrepreneurship. As literature suggests, three main dimensions are taken in consideration in order to measure the immigrant integration in the Italian context: territorial attractiveness, social dimension and economic dimension (Golini, et.al., 2001; Cellini, and Fideli, 2002; CNEL, 2013). A system of integration indicators calculated on integrated data was constructed based on the indices suggested from the last CNEL report, (CNEL, 2013). Table 3 presents a summary of the dimensions, indexes and their measurement as well as the official sources from which the secondary data were collected.

Table 3. A system of immigrant integration indicators

DIMENSIONS	**INDICATORS (polarity)**	**SOURCES**
TERRITORIAL ACTRACTIVINESS DIMENSION (X1)	**Incidence of the foreign residents (+)**	
	the ratio of foreign residents on the total population in a given territory	ISTAT
	Indicator of migratory receptivity (+/-)	
	internal balance of foreign citizens (change of residence of foreign citizens from one province to another within the territory of the state)	ISTAT

	Foreigners Resident Density (+)	
	the number of foreign residents per square km (density) compared with the Italian residents per square km	ISTAT
	Stability Indicator (+)	
	The ratio of foreign minors residents among the total foreign population residents (population under 18 years old)	ISTAT
SOCIAL DIMENSION (X2)	**Indicator of accessibility to the real estate market (-)**	
	incidence (the ratio) of the average of the annual rental price for a 50 square meter house in the periphery of the metropolitan area	ISTAT
	on the average of the annual per capita salary of non-UE employees	
	Mixed marriage rate (+)	
	number of marriages with Italian citizens on the total of foreign marriages celebrated in Italy	ISTAT
	Stable residence indicator (+)	
	Number of EU residence permits compared to total residence permits for non-EU citizens	ISTAT
	The Italian language knowledge ratio (+)	
	It is detected by the number of EU residence permits	ISTAT MINT
	Non professional high school education indicator in % (+)	
	the ratio of non professional high school students on the total number of foreigners enrolled in high schools	ISTAT
	Fertility rate (-)	
	the average number of children per foreign adult woman, possibly compared with the same rate relative to natives - the closer the foreign fertility rate is to the general one, the more integration is considered- the more the difference of fertility rate among foreigners and Italians, less integration is considered.	ISTAT
	Naturalization indicator of foreign citizens	
	Number of foreign citizens who have acquired the Italian citizenship in 2017	ISTAT MINT
ECONOMIC DIMENSION (X3)	**Employment ratio indicator**	ISTAT ASIA
	The ratio of full-time not UE employees	
	on the total Extra UE employees (full time + Part Time) in%. The closer it is to a hundred, the more full-time employees are.	
	Employees income ratio	
	difference between gross remuneration per hour between not UE residents employees and Italian ones	ISTAT
	Work stability	
	the ratio of permanent employment contracts on total not-UE worker contracts	ISTAT

Legend	MINT = Ministry of Internal Affairs; LAV = Ministry of Work; ANAG = Demographic Registry Office ; MIUR=Ministry of Education, University and Research; ISTAT= Institute of National Statistics;	

The data set was referred to four levels: Italy as a whole country, geographic areas (northwest, northeast, centre, south and islands), regions and provinces. The outcome of interest was the measure of the relationship of the host country integration factors and their influence in the entrepreneurial activity of Extra EU immigrants in Italy. For this purpose, in addition to the above mentioned data, to the data set were added the number of immigrant enterprises, also for the four territorial levels. Data refer to the year 2017.

4.1 The Results

This section presents the results of the quantitative research used in this thesis. The multivariate regression model was estimated as follows:

over twenty Italian regions, indexed by i=1,2,…,20;

The outcome of interest was the measure of the growth of entrepreneurial activity of Extra EU immigrants in Italy, and its relationship with the integration factors based on three dimensions at territorial level. From the above dataset, the ratio of immigrant enterprises to the total ones was constructed and a logarithmic transformation to approximate its growth was used. In sum, a growth model was used to study the phenomenon over 20 regions.

4.2 The Model

The selection process of the regional model started with a saturated model, i.e., a model with a large dimensionality of independent variables. Then, the diagnostic tests and checks of the model, have facilitate possible exclusions of the insignificant variables, without affecting the functional form tests. The circle of estimation and diagnosis tests is repeated several times on different model specifications, narrowing down the number of explanatory variables and keeping the desired parsimonious principle, until the final model satisfies the assumptions and passes the selection tests. Further, the selection considers the economic implications of the model, i.e., the results should not be contradictory.

The regional model has the following specification:

$$\ln\left(\frac{Y^f}{Y^T}\right)_i = \alpha + \beta_1 \ln\left(\frac{N^f}{N^T}\right)_i + \gamma_1 \ln(fe^f - fe^I)_i + \gamma_2 \ln\left(\frac{M^{\text{mix}}}{M^T}\right)_i + \gamma_3 \ln\left(\frac{RP^u}{RP^T}\right)_i + \gamma_4 \ln\left(\frac{E^{HS}}{E^T}\right)_i + + \delta_1 \ln(w^I - w^f)_i + \delta_2 \ln\left(\frac{L_{nEU}^{full}}{L_{nEU}^T}\right)_i + \delta_3 \ln\left(\frac{C^p}{C^T}\right)_i + \epsilon_i$$

Where:

- $\ln\left(\frac{Y^f}{Y^I}\right)_i$ is the growth of the share of immigrant enterprises in region *i*;
- $\ln\left(\frac{N^f}{N^I}\right)_i$ is the growth of the share of foreigners in region *i*;
- $\ln(fe^f - fe^I)_i$ is the growth of the fertility gap among foreigners and Italians in region *i*;
- $\ln\left(\frac{M^{\text{mix}}}{M^T}\right)_i$ is the growth of the share of mixed marriages between Italians and foreigners in region *i*;
- $\ln\left(\frac{RP^u}{RP^T}\right)_i$ is the growth of the share of permanent residence permits in region *i*;
- $\ln\left(\frac{E^{HS}}{E^T}\right)_i$ is growth of the share of high-school enrollments in region *i*;
- $\ln(w^I - w^f)_i$ represents the growth in the wage gap between the hourly pay rate of Italians and foreigners in region *i*;
- $\ln\left(\frac{L^{full}_{nEU}}{L^T_{nEU}}\right)_i$ is the growth in the share of full-time non-EU employees in region *i*;
- $\ln\left(\frac{C^p}{C^T}\right)_i$ is the growth in the share of permanent contracts among foreigners in region *i*.

The estimated parameters represent the elasticity between the dependent variable and the independent ones, in a given moment. Before interpreting the results and their implications, it is important to discuss the diagnoses of the model.

First, missing data is often an issue in econometric models, and the set of regions and provinces selected in this work are no exception. Several indicators, including the share of foreigners, the share of non-EU full time employed and the share of mixed-marriages are missing for Trentino Alto Adige (and both provinces of this region). A common method of handling missing data is by imputation. Allison (2001) argues that in the case of multivariate analysis, if there are missing data on several predictors, it can be better to drop those cases (rather than do imputation). Little and Rubin (1987) suggest that if the cases for which the researcher faces missing data constitute less than 5% of the sample, then the researcher can drop them. At the regional level model, we report missing data only for Trentino Alto Adige, and since the 5% rule of thumb holds, then dropping this region from the observations set would still yield consistent estimates of the OLS model.

Imputation is not a common practice when using cross-sectional data as the ones used in this study. Hence, the regional model includes 19 out of 20 regions.

Starting the diagnostic checks with the functional form specification test, the results of the Ramsey Reset test (Table 4) indicate that at the 5% level, we fail to reject the null hypothesis of no-omitted variables, meaning that the functional form of the model is correctly specified. The F-statistic is 4.04 and Prob > F=0.06.

Table 4. Ramsey Reset test for functional form

```
. estat ovtest

Ramsey RESET test using powers of the fitted values of lR
       Ho:  model has no omitted variables
                   F(3, 7) =      4.04
                 Prob > F =      0.0584
```

The check for multicollinearity is performed through VIF (Table 5) and the index equals 6.66, which means that multicollinearity is not a severe problem in the model, i.e. it is not inflating variances of estimated coefficients. However, VIF indicates a high correlation between the share of foreigners and the share of mixed marriages. This means that a higher share of foreigners is associated with a higher likelihood of a possible marriage between a foreigner and an Italian citizen, which is something that could be expected.

Table 5. Variance Influence Factor (VIF)

```
. vif
    Variable |       VIF       1/VIF
-------------+----------------------
       lmarr |     13.59    0.073599
          fo |     12.55    0.079682
  fertility |      5.57    0.179578
         lnw |      5.38    0.186016
       lprof |      5.12    0.195423
         lRP |      5.06    0.197613
        lemp |      4.28    0.233531
        lper |      1.76    0.568497
-------------+----------------------
    Mean VIF |      6.66
```

Next, we formally test for the assumption of the constant variance. The Breusch-Pagan test suggests that at the 5$ level, we fail to reject the null hypothesis under constant variance (Table 6). The test statistic has a Chi-square distribution (as LM follows a Chi-square distribution) and has a value of 3.33 and Prob>chi-square = 0.068.

Table 6. Breusch-Pagan test for heteroscedasticity

```
. estat hettest

Breusch-Pagan / Cook-Weisberg test for heteroskedasticity
        Ho: Constant variance
        Variables: fitted values of lR

        chi2(1)      =     3.33
        Prob > chi2  =   0.0679
```

Despite the homoscedastic environment, Hansen (2018) argues that in contemporary econometric research the use of robust standard errors is recommended. The relatively low number of observations is an additional reason towards the use of robust standard errors. Hence, failure to reject the null hypothesis at 5% level, but not at 10%, is one more

reason towards the use of robust standard errors, so we use robust standard errors to make statistical inference.

The Shapiro-Wilk W test of normality was carried out (Table 7) in our model the W statistic is 0.905 with a p-value of 0.06. Hence, at the 5% we fail to reject the null hypothesis of residual normality.

Table 7. Shapiro-Wilk W test for normality of the residuals

```
. swilk R

                    Shapiro-Wilk W test for normal data

    Variable |        Obs        W           V          z       Prob>z
-------------+-------------------------------------------------------
           R |         19    0.90466      2.177      1.562      0.05911
```

Lastly, the histogram of residuals is roughly bell-shaped, indicating that residuals are probably normally distributed (Figure 2). The non-parametric estimation of the kernel density, is close to the normal distribution. Asymptotically the densities would overlap.

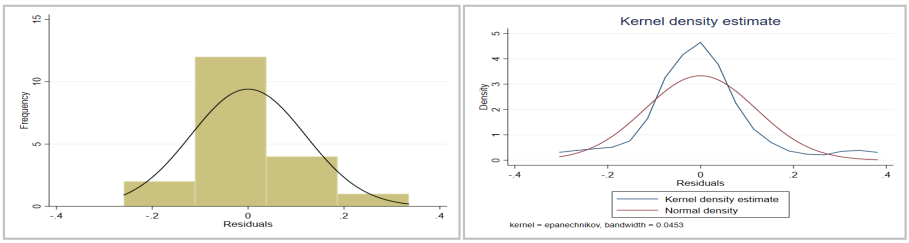

Fig. 2. Histogram and Kernel Density estimate of the residuals

Table 8 displays the results of the estimated regional model.

Table 8. Estimated regional model

Covariates	$\ln\left(\frac{Y^f}{Y^T}\right)_i$	**S.E**
Attractiveness		
$\ln\left(\frac{N^f}{N^T}\right)_i$	0.415	(2.39)**
Social Integration		
$\ln\left(\frac{M^{\text{mix}}}{M^T}\right)_i$	0.698	(0.57)
$\ln(fe^f - fe^l)_i$	0.745	(2.49)**
$\ln\left(\frac{RP^u}{RP^T}\right)_i$	1.596	(2.46)**

$\ln\left(\frac{E^{HS}}{E^{T}}\right)_i$	0.780	(2.69)**
Labor market		
$\ln(w^{I} - w^{f})_i$	0.577	(4.70)***
$\ln\left(\frac{L_{nEU}^{full}}{L_{nEU}^{T}}\right)_i$	15.915	(2.22)*
$\ln\left(\frac{C^{p}}{C^{T}}\right)_i$	0.493	(1.14)
Intercept	-85.732	(2.64)**
R^2	0.90	
N	19	

* $p<0.1$; ** $p<0.05$; *** $p<0.01$

Robust standard errors in parenthesis Source: Author's elaboration

The most striking result is the high R-squared. It indicates that the variation or the growth in the predictors explains around 90% of the variation in the dependent variable. While one could suspect that the predictors include some form of the outcome variable, in this model, we claim that although it is uncommon to have high R-squares in models using cross-sectional data, it is common to get a high R-square growth models using cross-sectional data. To support this argument, in the seminal work of Mankiw, Romer and Weil (1992), the benchmark Solow Growth model R-squared is around 0.6. When the model accounts for further factors, not necessarily predicted by the theoretical model, the R-squared increases, which is one of the main characteristics of the R-square measure of goodness of fit.

The relative growth of immigrant entrepreneurship in a particular country is likely to vary with the necessary conditions required to start a business activity, and the dynamics of the input markets. In our growth model, we have controlled for Labor-Market conditions, Social Integration and Territory Attractiveness.

Regarding the Labor market conditions, the growth of non-EU full time employers was considered. It was pointed out that an upward trend in the relative growth of non-EU full-time employees - keeping constant the other independent variables of the regression - would increase the relative growth of immigrant enterprises. This prediction is supported relatively well by the estimated model: an increase by 1% in the share of non-EU full time workers, increases the share of immigrant entrepreneurs by 15 percent, considering all the other predictors as constant. This result does not take in consideration the unemployment rate, which is not influenced. An explanation would be that in case of full time employment of family members, immigrant entrepreneurship would increase, as the entrepreneurs will be more inclined to take the risk, following greater guarantees in affording the daily life expenses offered by the employment of family members.

Further, we considered the wage differences between foreigners and Italians, in order to measure the wage discrimination between them. Micro evidence suggests that in some cases people cannot bare the discrimination and therefore might turn to self-employment (Piore and Doeringer, 1971; Bonacich, 1973; Zhou, 2004). In our model, the pay-gap elasticity is 0.6.

Social integration is another key determinant of the entrepreneurial activity of immigrants in the regional level. What most affect this result is the ratio of permanent resident permits in relation to total permits. A growth by 1% of this ratio, affects a growth of 1.5% of immigrant entrepreneurship. The higher this indicator is in a specific region, the more confident immigrants are to start commercial activities.

Fertility is another driving factor of the growth of foreign enterprises. Specifically, an increase of 1% of the fertility difference among foreigners and Italians, increases the share of foreign firms by 0.75%. Hence, the more fertile, relative to Italians, foreigners are, the higher is their business activity share. The more the difference of fertility rate among foreigners and Italians, and among foreigners and the Italian national fertility rate, less integration is considered.

Regarding mixed marriages, we would expect a positive and significant effect as mixed marriages would incentivize the foreign partner to start up a business as having an Italian partner would facilitate the entrepreneurial process. However, due to the elevated multicollinearity of this independent variable with the other, its results are not so reliable.

With regard to the territory attractiveness indicators, we found a significant elasticity between the growth of immigrant enterprises and the share of incidence of foreign residents. This result is logical, as immigrant enterprises grows when the foreign population grows. This scenario presents two possible solutions: (a) immigrant entrepreneurship would grow as a result of a growing demand for ethnic goods and services by other immigrants (Waldinger, et. al., 1990); (b) immigrant entrepreneurship would grow as a result of racial exclusion and discrimination that erects structural barriers to prevent immigrants from competing with the natives on equal basis in the mainstream economy. Consequently immigrants have two alternatives; to take jobs that natives do not desire anymore or to carve out market niches for themselves, meeting the potential demands for specific goods and services unmet by the mainstream economy (Bonacich, 1973; Clark and Drinkwater, 2000; Zhou, 2004).

5 Conclusions

This study contributes to immigrant entrepreneurship literature by deepening the knowledge of the factors that push immigrants towards entrepreneurship and offers useful cognitive insights to improve immigration integration policies, and policies aimed to support the development of immigrant enterprises and reduce barriers to productivity and growth.

The results have shown that the host country integration factors (Territory Attractiveness, Social Integration and Labour-Market conditions) are closely related with the immigrant entrepreneurship growth. Accordingly, attention has been paid to the mixed embeddedness approach, addressing both economic and socio-cultural factors.

The economic factors include the labour market condition, market accessibility, capital accessibility, competition and the impact of immigrant enterprises in their reference markets. The socio-cultural factors include integration factors as accessibility to real estate market, fertility rate indicator, permanent residence permit and acquisition of citizenship.

Findings pointed out a weak relationship between the set of immigrant enterprises and institutions, due to the limited resources devoted to integration and social inclusion of immigrants. Therefore, we argue that a well-structured, clear and specific regulatory framework on the integration of immigrants and, in particular, on immigrant entrepreneurship, in terms of facilitations in granting loans, incentives for start-ups, can positively contributes to create a solid socio-economic environment, both for immigrants and for native-run businesses.

Drawing from the state of the art of the immigrant entrepreneurship phenomenon, we underlined the limited contribution of management and accounting studies in deepening this topic. Considering the development of this phenomenon in the new era of globalization and the growing of recent flows of immigration in all continents, particularly in Europe, we claim for the need to fulfil this gap through further studies. In this regard, this empirical research provides useful insights in pointing out some research path to cultivate in the future.

However, we are aware that this study is affected by limitations. The quantitative research is affected by the limited amount of available data from the official sources on the phenomenon. The data on immigrant entrepreneurship may present some minor inconsistencies due to the fact that in the data-base held from the Italian Chambers of Commerce, immigrant enterprises are classified based only on the country of birth of the enterprise founders and/or the administrators. The risk is that there may be Italian citizens who, for different reasons, were born abroad, as well as immigrants of the second or third generations who were born in Italy. We argue that more accurate official data on immigration and immigrant entrepreneurship in general, and their integration in particular, would contribute to a better analysis of the phenomenon.

Despite the limits, this study contributes to fill the gap in the local literature, as pointed out by Arrighetti et, al. (2014: 772) who have recommended the inclusion of social and institutional factors in the study of immigrant entrepreneurship in general and multicultural hybridism in particular.

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Information and Communication Technologies (ICT) and Artificial Intelligence (AI) as Advantages for the Online-Learning in the Health Area: Experience Applied in the University of Guadalajara, Mexico

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Abstract

One of the main challenges was acceptance the use of information and communication technologies (ICT), in education and learning in the health field. And doing this multidisciplinary project, at different field like health, engineering, Marketing and International business.
Today, with the evolution of the digital era and the inclusion of artificial intelligent (AI) it's and advantage to use them.
Some authors like (Ross, 1989, Schank, 1982) said, that use case-based reasoning (CBR), it is the retention of experience and development of a learning theory and reminder based on retention
At this situation in the University of Guadalajara came out the project in our University the use of ICT and IA in education and apply it mainly in the health field for their multidisciplinary development, taking some knowledge management models (Kerschberg, Sandoval). With the support of data analysis and supercomputing center (CADS) and LEO ATROX computer

equipment of the University of Guadalajara, that provides a special technology place and support with courses
Taking multidisciplinary, interdisciplinary and transdisciplinary comparisons (Choi & Pak 2006)

Keywords - TIC. IA, ,CBR, multidisciplinary and learning

Paper type – Academic Research Paper

1 Introduction

This multidisciplinary, interdisciplinary and transdisciplinary project, that participate different careers, at first point health area (Neurology), followed by Engineer, International business and Marketing.

This with the objective to connect knowledge and applying at the same aim, which is integration of ICT and AI. In order to support knowledge and development in a health prototype, it is coeducation in learning and case study reasoning.

CADS provides: data and images processing, scientific application configuration, development and code optimization, knowledge management models (Kershberg y Sandoval).

Software parallelization is performed, big data volume solutions (big data), scientific visualization, consulting services for the development of research training. With LEO ATROX innovation and adoption is available

They are learning with some digital education models to integrate different areas and boost them at health area and then continue with more areas.

We are going to use reasons to cases, which we can use them to solved previous problems as we mentioned above by some authors.

"AI is going to transform deeply the education", said Audrey Azoulay, UNESCO general director, "teaching methods, learning process, knowledge access, teachers learning will be revolutionized"

Young and Norgard (2006) said that student realized support is the mainly factor to success in activities by ICT.

ICT, AI, CBR together are going to obtain a big advance in learning and get a good result to apply at health area.

With this support that are given in different areas, learning will lead to the new digital age

2 Problem, Hypotheses and Rationale of the Study

The problem is to accept ICT and AI at health area, because they use CBR and integrate it into multidisciplinary area.

H1. A bigger ICT knowledge, better result to AI application

H2. A bigger CBR, better ICT application.

H3, A bigger ICT, CBR and AI knowledge, better multidisciplinary application result.

3 Literature Review

Information and communication technologies (ICT)

Robles (2020) said, years ago, workers have been demanders whoa have teamwork, leadership, flexibility, continuous training and to improve their skills in ICT

It is one of the mainly factors to incorporate ICT in the University, classroom, we are taking in count the labor market, which demands knowledge in all areas and this will improve learning

Robles (2020) said some learning advantage with ICT

1.- Interaction without barrier
2.- Information diversity
3.- Self paced learning
4.- skill development
5.- Strengthening initiative
6.- Immediate correction

Artificial Intelligence (AI)

Figure 1.1 present some definitions of artificial intelligence; those definitions are from eight different textbooks. The ones at the top are about mental processes and reasoning, meanwhile the ones in the bottom are about behavior. The definition in the left measure success in terms of fidelity in the ways of humans to act, meanwhile in the right are about ideal intelligent concept, that we are going to call rationality. A system is rationality if it does the right thing, based on its knowledge

Systems that think like humans	**Systems that think rationally**
The exciting new effort to make computers think… machines with minds, in the broadest literal sense (Haugeland, 1985) The automation of] activities that we link with human thought processes, activities such as decision making, problem solving, learning...(Bellman, 1978)	« The study of mental faculties through the use of computational models ». (Char- niak y McDermott, 1985) «The study of calculations that make it possible to perceive, reason and act». (Winston, 1992)
Systems that act like humans	**Systems that act rationally**
"The art of developing machines with the capacity to perform functions that when performed by people require intelligence."(Kurzweil, 1990) «The study of how to get computers to perform tasks that, for the moment, humans do better.». (Rich y Knight, 1991)	« Computational Intelligence is the study of the design of intelligent agents ». (Poole *et al.*, 1998) « AI ... is related to smart behaviors in artifacts». (Nilsson, 1998)

Figura 1.1 Some definitions of artificial intelligence, organized into four categories
Russell, J., Norving, P (2004)

Case based on reasoning (CBR)

Case based on reasoning beginning thanks to the work of Roger Schank and their students at the University of Yale, in the early 80´s. Schank dinamic memoria model was a reference for the CBR early sistems. Another case based on reasoning school came out at the 80`s.

At 90´s, the interest in the case based on reasoning grown in the international community, all this beacuse on 1995 was a international conference about case based on reasoning, just like europe, germany, british, italians, and others workshop case based on reasoning. Case based on reasoning technolgy produced numerous success stories

Multidisciplinary

"Relative to involving various disciplines like Univiersities, industry, and goverment" (Alberta Inventor and Inventions, 2006), " brings knowledge of different disciplines but remains on the borders of those fields" (Natural Sciences and Engineering Research Council of Canada - NSERC, 2004), " a combination of various disciplines in research of a objective, it is no necessary work in a integrate or coordinate way" (International Rice Research Institute, 2005).

"Multidisciplinary projects are those which researchers from different fields contribute with methods and ideas of their respective disciplines, to analyze investigation questions" (Rosenfield, 1992), " multidisciplinary research, varierity of disciplines colaborate on a research program without concepts, epsitemologie, methodologies integration. The grade of integration between discilines are restringe for the investigation results" (Flinterman, Teclemariam- Mesbah & Broerse, 2001).

Interdisciplinar

Sciences and Engineering Research Council of Canada - NSERC, 2004), "La habilidad de analizar, sintetizar y armonizar los lazos entre disciplinas en un todo coordinado y coherente" (Canadian Institutes of Health Research, 2005). "Un equipo interdisciplinar aspira a un nivel más profundo de colaboración (que un equipo multidisciplinario), en el cual quienes constituyen diferentes acervos combinan su conocimiento mutuamente para completar distintos niveles de intereses planeados" (Bernard-Bonnin, Stachenko, Bonin, Charette & Rousseau, 1995), "La investigación interdisciplinaria es una colaboración de varias disciplinas, pero en este caso, conceptos, metodologías, o epistemologías son intercambiadas e integradas explícitamente, resultando en un enriquecimiento mutuo" (Flinterman, Teclemariam-Mesbah & Broerse, 2001).

Transdisciplinary

"An aproximity of new data and new interactions between disciplines, give us a new view of reality and naturality. Transdisciplinary does not strive to dominate more disciplines, its objective is to open all adisciplines that share and observe beyond them" (First World Congress of Transdisciplinarity, 1994) "a more specific way of interdiscipliny which the limits between disciplines are transcended and knowledge, and different prespectives from other cientific disciplines, just like non cientific sources are integrated" (University of Southampton, 2005).

Tabla 1. Comparation between Multidisciplinary, interdisciplinary and transdisciplinary

Multidisciplinary	***Interdisciplinary***	***Transdisciplinary***
	Working between several disciplines	Working across and beyond several disciplines
Involves more than two disciplines	Involves two disciplines	Involves scientists from relevant disciplines, as well as stakeholders,

		nonscientists, and non-academic participants
Members from different disciplines working independently on different aspects of a Project, working in parallel or sequentially	Members from disciplines working together on the same Project, working jointly	Members from different disciplines working together using a shared conceptual framework
Individual goals in different professions	Shared goals	Shared goals and shared skills
Participants have separate but-inter-related roles	Participants have common roles	Participants have role release and role expansion
Participants maintain own disciplinary roles	Participants surrender some aspects of their own disciplinary roles, but still maintains a discipline-specific base	Participants develop a shared conceptual framework, drawing together discipline specific bases
Does not challenge disciplinary boundaries	Blurring of disciplinary boundaries	Transcend the disciplinary boundaries
Summation and juxtaposition of disciplines	Integration an synthesis of disciplines	Integration, amalgamation, assimilation, incorporation, unification and harmony of disciplines, views and approaches
Additive, Integrative, Collaborative	Interactive, Integrative, Collaborative	Holistic, Trascendentantal, Integrative, Collaborative

Choi & Pak (2006)

Why Pursue Multiple Disciplinarity

To resolve a real world problem

Life is multiple disciplinary: disciplines are the result of artificial fragmentation of knowledge. Real worl problemw are realy confined to the artificial boundaries of academic disciplines (Krahn, 2006). Multiple disciplinar y research evolves to meet the demands of many societal, environmental, industrial, scientific and engineering problems that cannot be adequately addressed by single disciplines alone. (NSERC, 2006).

The requirement for mul tiple disciplinarity is emerging at a time when pace and complexity of science and technology is accelerating, such as in the fields of bioinformatics, hydrogen fuel cells, and broadband infrastructure (Mandel 2006).

With this disciplines, differents areas are going to evolve, just like health, engineer, and administrative cience to evolving for the same purpose.

MANAGMENTE KNWOLEDGE MODEL

It takes as reference two models

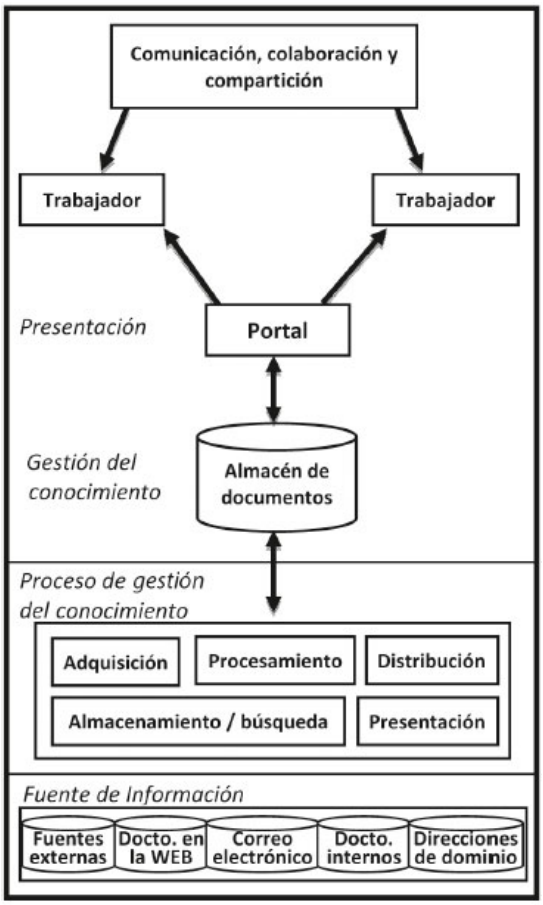
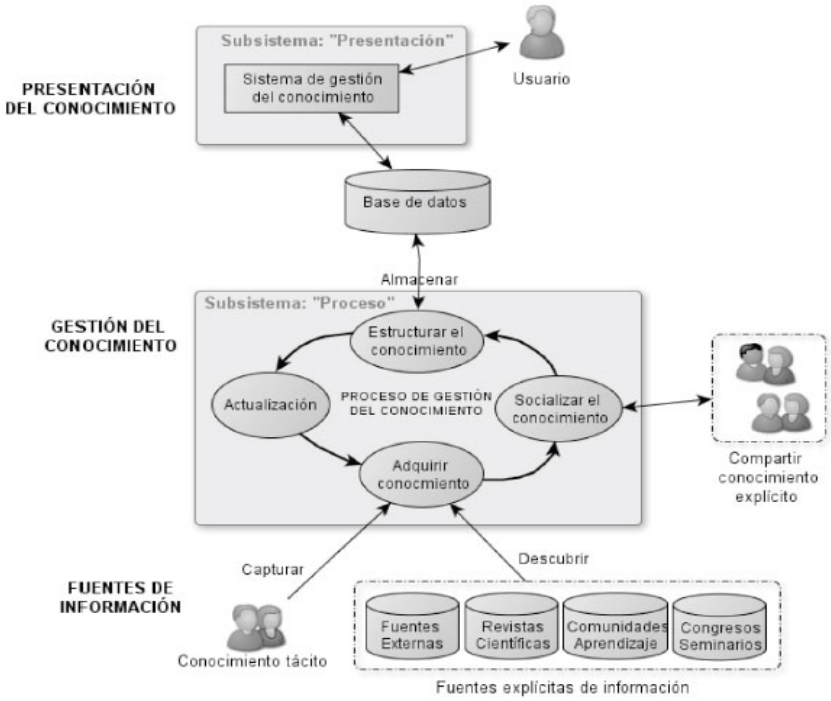


Fig. 1 Technological integration model by Kerschberg.

This model give us the knowledge generation, using ICT, it will help to take some parts of this model with the ontegration of AI and CBR.

For the multidisciplinary learning development and the application of each one.

The next knowledge model that we are using as reference, its by Capas de Sandoval (2013).



Elaborado: Sandoval 2013

Fig. 2 Sistem managment knwoledge model

This model is when you already obtain data or the cases obteined by health and we made the codification process, with the help of engineers, at the same time bussines and marketing sholud do a CANVAS model for the presentation.

4 Analysis of Results

This systems use case based on reasoning (CBR), like a solution problem method, to help to resolve new situations. CBR support their predictions, an example (cases) which are stored in the learning phase. A distance or similar function determinate cases that are the most similar to the new problem and give the solutions of the recovered cases are adapted to obtain a solution (Delgado 2005).

From January 2020 to March 2020, it has been analyse 45 cases of patients at Hospitals, this research is in charge of students of health science (neurology)

Patients with different characteristic, some of them with similar symptoms, we take tomography images and then we look at them.

We made a record of each one, with a basic database, we use the program excel, because this research also count with some questions to the patient.

Then this information, we give it to the engineer, and the engineer leads the record with the algorithm, then this information is in conjunction with CADS which helps us

with data and image processing, scientific application configurations, code development and optimization.

5 Conclusions

It is not possible to give a conclussion due to the pandemic, we are still working in the cases so they can be studied together with the MIT and University of Guadalajara and their health, engineer, marketing and international bussines areas.

6 Proposal for future research

Continue working with CBR and the introducction of ICT, AI, at the multidisciplinary learning and develop the planned prototype . At 2021 this research is going to obtain their first prototipe and continue with the diferent health, engineer, marketing and international bussines areas.

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New Technologies for Managing Knowledge in Education: a Framework for Knowledge Management

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Abstract

The importance of knowledge as a strategic resource is well realized in the corporate world. The educational markets are becoming global as universities adopt international curriculum, invite students from diverse backgrounds to enrol in their programs, and design the educational experience in a way that maximizes international exposure. This paper reviews the need for adopting knowledge management practices in the education sector, and elaborates on the knowledge creation process before suggesting a framework for implementation, and technological trends adopted by educational institutions worldwide. There is a variety of technologies and tools available today to capture, organize, and provide access to knowledge. Seamless resource access for instance, is possible with technology as students refer to online journals and publications on a smart device, then pick up on where they left off on another device. Technology brands like Apple iCloud, Google Drive and Amazon Kindle have enabled cloud services on their devices, which produce a seamless filing system. Augmented Reality (AR) is a fairly recent learning technology used to train students in a learning environment for medicine and manufacturing-focused skill sets. Students partake in simulations of real-life scenarios and receive sufficient training while also being prepared for mishaps and disasters.
In terms of technological evolution, knowledge management systems are moving from basic search and retrieval systems to sophisticated artificial intelligence-based technology that can be customized for individual user needs and preferences.

Keywords ─ Technologies, Education, Knowledge Management

1 Introduction

The importance of knowledge as a strategic resource is well realized in the corporate world. Knowledge Management gives them a sustainable competitive edge (Drucker 1993), and helps achieve long-term organizational goals as it is used to spur innovation, improve customer experience, achieve operational excellence and ultimately increase revenue.

According to Brown and Duguid (1996), profound changes in competition have made educational institutions strategize like businesses. The educational markets are becoming global as universities adopt international curriculum, invite students from diverse backgrounds to enroll in their programs, and design the educational experience in a way that maximizes international exposure. To attract talented students from all parts of the world, these universities offer some courses and certifications exclusively online.

Universities are developing such high-quality programs in response to the rapid change in technology, and demands of stakeholders.

This paper reviews the need for adopting knowledge management practices in the education sector, and elaborates on the knowledge creation process before suggesting a framework for implementation, and technological trends adopted by educational institutions worldwide.

2 The Need for Knowledge Management Technology in Education

In an electronic, global learning paradigm, knowledge management is a key element of the educational process. Just as employees are considered knowledge providers in an organization ((Tubigi & Alshawi, 2015), teachers, professors, instructors and trainers have a critical position in the knowledge management profession. How they create, build, translate, store, and transfer their knowledge to an ever-increasing population in need of education – from kindergarteners to C-level executives – is changing. Learning in a brick-and-mortar institution of education, while not entirely obsolete, is being challenged. Distance education programs, degrees via the web, corporate universities, virtual universities and other non-traditional means are some of the new methods of gaining education or training (Dutta, 2004). The need for education or training won't go away, but how students acquire it is changing.

The combined knowledge assets of our institutions of learning throughout the world consist of the largest repository of knowledge anywhere, and it is essential that we effectively manage and share this information with those willing to use it, no matter who they are and where they are located (Galbreath, 2000).

Unfortunately, much of this knowledge remains confined in the minds of professors and teachers (dispersed candidly only in the faculty rooms), stored in libraries and laboratories, and with the students who pass through local halls and classrooms. Granted, books and journals, lectures and conferences, and various presentations communicate knowledge and learning, but if I am a student working on a course assignment in "Foundations of Human Behavior" and want to find out the views of faculty and former students, let alone the behavioral scientists from around the world, how can I quickly and efficiently – regardless of where I am located or the time of day – find this information from a single source – from a single user interface? To make information accessible and useful, knowledge management technology is needed for educational discourse today.

3 Knowledge Management: A Definition

The following definitions guide our thinking in what knowledge management means in the corporate world:

[Knowledge management is] “the collection of organizational beliefs and practices, underpinned by ubiquitous supporting technologies, that facilitate the capture, manipulation, and global dissemination of information, which forms the core knowledge critical to that organization’s ability to compete in the Knowledge Age.” (Meta Group, 1998)

- [Knowledge Management is] “the best practices and processes of an organization. It is everybody’s bag of tricks, facts, procedures, and contacts.” (Forrester Research, 1998)
- “Knowledge management is defined as the acquisition, storage, retrieval, implementation, generation and review of an organization's knowledge assets in a controlled manner.” (Pathirage et al., 2008).
- “Knowledge Management is a discipline that promotes an integrated approach to the creation, capture, organization, access and use of an enterprise’s information assets. These assets include structured databases, textual information such as policy and procedure documents, and, most importantly, the tacit knwoeldge and expertise resident in the head of the individual employees.” (Gartner Group, 1999)

Applying these fundamentals to the education sector, we can create our own definition of knowledge management as follows:

- Knowledge Management combines the processes and application of technological tools to digitize, store, and make universally accessible, via electronic networks, the ongoing creation and transference of knowledge and wisdom throughout the educational experience.

4 Knowledge Management: The Technology

According to Galbreath (2000), in order to fully leverage the benefits of a knowledge management program, it is conducive to define an overall approach and process.

- **Create:** The activities that result in new knowledge.
- **Capture:** The activities required to capture and represent all types of knowledge in explicit form, thereby collecting knowledge from multiple sources and making it available to diverse users.
- **Organize:** The activities that classify and categorize knowledge for storage and retrieval purposes. This includes maintenance of knowledge data as well as the indices, maps and the processes that manage it.
- **Access:** The activities through which knowledge is disseminated to or requested by individual users.
- **Use:** The application of knowledge to educational activities, corporate decisions, and other opportunities.

In our institutions of education, not only is new knowledge being continuously created, but also, we have a body of existing knowledge that rivals the collection of any knowledge producer in the world. The challenge isn't in creating the knowledge, it is in capturing, digitizing, organizing, and making available this knowledge in electronic format to any and all who would choose to access and use it.

Knowledge that is created, captured, and organized for access and use can be categorized into two types: digital and non-digital data. Non-digital data would include such information as class lecture notes (prepared in handwriting by both instructor and student), research notes, paper documents, course handouts and materials, books, magazines, journals, and specific media such as analog video and audio tapes. Digital data on the other hand, would include information such as HTML (Web) pages, PowerPoint presentations, word-processing documents, reports generated through data visualization applications such as Power BI (.PBIX file), digital audio files (e.g., .wav files), CD-ROMS, research databases, message boards, digital video, and any information source in digital format.

One might view knowledge management in educational institutes as basically a closed-system approach to leverage both digital and non-digital data sources, to drive an institution's objectives. But as Galbreath (2000) rightly argues, one of the powerful advantages of using knowledge management systems in education is to leverage not only the knowledge capital of educational institutions from around the world, but also of the business community. As Metcalfe's law states, the value of a networked medium increases as the square of the number of users. Knowledge Management was designed as a networked medium, and its use in education should be designed, applied, and used accordingly.

There is a variety of technologies and tools available today to capture, organize, and provide access to knowledge. Seamless resource access for instance, is possible with technology as students refer to online journals and publications on a smart device, then pick up on where they left off on another device. Technology brands like Apple iCloud, Google Drive and Amazon Kindle have enabled cloud services on their devices, which produce a seamless filing system. Augmented Reality (AR) is a fairly recent learning technology used to train students in a learning environment for medicine and manufacturing-focused skill sets. Students partake in simulations of real-life scenarios and receive sufficient training while also being prepared for mishaps and disasters. Moreover, 5G technology which is a new mobile spectrum meant to replace 4G/LTE, is set to revolutionize education with increased bandwidth and connectivity. It is substantially faster than the home Wi-Fi and relieves campus Wi-Fi from the burden of data centers, laptops and numerous student cell phones. An important technology in education is adaptive online assessments which allow universities to evaluate students beyond theoretical knowledge. Online assessments are a vital component of knowledge management and collaboration tools used by institutions to improve practical knowledge of the students, making them industry oriented and practical.

5 Knowledge Management Systems

Technology provides a mechanism to store, index, and organize electronic documents for access over networks by groups and individuals. In terms of technological evolution, knowledge management systems are moving from basic search and retrieval systems to sophisticated artificial intelligence-based technology that can be customized for individual user needs and preferences. Knowledge management systems aim to efficiently utilize existing knowledge and implicit resources, to reproduce fresh knowledge and to achieve sustainable competitive advantage on the basis of these knowledge-based assets (Alavi & Leidner, 2001).

The effective application of knowledge management systems can give a business competitive edge over its competitors (Theriou et al., 2011; Johnny & Bolloju, 2005). Firms need to acquire and retain intellectual resources to pro-actively engage with the upcoming market trends and utilize them effectively (GarcíaLillo et al., 2018). With such interest in knowledge management as a weapon for competitive advantage in the corporate world, we can expect to see continued rapid advances in the technology and specialized versions for exclusive use in education, as this sector of the economy fully begins to exploit its position as the quintessential knowledge producer.

A high-level picture of a typical knowledge management system in an educational setting is as follows:

1. **Repositories:** These are the sources of digital and non-digital data, and comprise mainly of (but not limited to) class presentations, databases, libraries, CD-ROMS, and the internet.
2. **Process/Metrics:** Data from repositories is pushed into the knowledge management system through workflows defined by the institution.
3. **Transport:** Internet, WWW, Intranet, Extranet, LAN, and WAN facilitate the intake of data from various sources and transfer to intended user.
4. **Intelligence:** Agents, Filters, Broadcast, Search/Retrieval, Information Mining are some of the ways data can be customized for each intended user, in a way that is useful.
5. **Manage:** Data in a knowledge management system may be organized in a catalog or directory.
6. **Distribution:** Knowledge generated from the institution's sources may be published according to standards.
7. **Interface:** Knowledge may be delivered to users via browser and mailbox (email).
8. **Users:** These are the intended recipients of knowledge who may have requested for information.

A useful benefit of knowledge management systems that is often overlooked in educational settings is the ease of communication created through its implementation. Teachers can communicate administrative issues with the higher management, and may also receive evaluations and feedback from students anonymously. Over time, the knowledge management system becomes a database of best practices and strategies, that

can be transferred to new teachers to maintain consistency. Such a system strengthens the knowledge-sharing culture and builds harmony within the organization

6 Knowledge Management: Leveraging a New Technology in Education

The demand for education and training is ever-increasing. Given the dynamics of a highly competitive global economy, the need for lifelong learning, and a continued population expansion, countries as well as corporations have prioritized the provision of innovative means of education to ensure that every citizen or employee has access to a quality educational experience. Knowledge Management, while still a relatively nascent technology, is gaining traction as a medium to support and at times, even improve education at all levels.

Some recommendations on leveraging knowledge management in education is as follows:

- **Ownership:** At institutional level, there must be clear ownership of a knowledge management program. The owner is responsible for general oversight, without which the knowledge management program will be out of control, and out of sight.
- **Goals and Objectives:** The owner(s) of a knowledge management program must define why they want to implement the program and what they want it to accomplish. Goals and objectives should be clear and coherent, so as to provide new and innovative means of assessing and delivering education.
- **Organization and Process:** Once the goals and objectives are defined, owners must propose the ways to achieve them. Defining the organizational roles and responsibilities and the day-to-day processes of knowledge management facilitation is essential.
- **Cultural Considerations:** For lecture notes and class presentations to be available to remote learners, faculty and local students should be willing to share their resources with users of the knowledge management system. Their consent and willingness to contribute to the knowledge repository is critical to the success of such a program. Without knowledge producers, the users are limited in their access and use of knowledge and wisdom.
- **Standards:** Defining document standards, design standards, and permission levels of access, to name a few, are important to ensure coherency and consistency in "packaging" knowledge for use.
- **Technology Specifications:** Knowledge management cannot be accomplished without the use of software and communications technology. Defining a clear vision around the type of technology needed and the type of functionality required is critical in evaluating and selecting the right technology for the goals and objectives of a knowledge management program.

- **Technology Implementation:** To ensure that the selected technology is achieving desired results, it is imperative that the technology is implemented at optimum potential and capacity.
- **Maintenance and Support:** The technology implemented for knowledge management will require ongoing upgrade and maintenance, so that stakeholders can continue to benefit from it.

The following framework is a useful guideline for knowledge management creation:

- Knowledge creation begins at the individual level.
- Knowledge created by individuals is shared and exchanged at departmental level.
- Knowledge is exchanged between communities of interest. Communities of interest are departments that share common academic interests or disciplines, such as sales and marketing, or accounting and finance.
- Knowledge generated amongst departments is shared at institutional level. This is done through knowledge management networks placed across the entire institution.
- Knowledge created within an institution is shared with other institutions and corporates. This facilitates researchers with in-depth insight of the work done in similar departments of other institutions.

Knowledge in an organization is often built up and generated by small, informal, self-organizing network of practitioners (Senge 1990). Ultimately, knowledge is created to be shared and leveraged across a variety of constituents. The true value of knowledge management systems in education will be found beyond the walls of a single institution (Lave & Wenger 1991).

7 Conclusion

Knowledge management is becoming an integral component in the development and delivery of education. More than a process technology, knowledge management is a strategy and even a culture. From a financial view point, Weisberg (2010) theorized that explicit knowledge or data is not expensive because it can be conveniently transferred via IT. On the other hand, the tacit or implicit knowledge that is innate in the minds of the teachers and students, which is based on one's own insights, interpretations, experiences, is very hard to be extracted. The sharing of knowledge-based assets provides benefit to both sharer and receiver as it will expand their current knowledge base (Chiu & Veras, 2018).

Leveraging this technology in educational settings, while ensuring that it is productive, will not be easy. The fundamental components of building knowledge management programs are complex, time consuming and complex. The risk-reward ratio and return on investment considerations will need to be carefully evaluated against goals and objectives.

In the end, are the voluminous amounts of intellectual capital contained in any institution of education really something that can be digitized and made available to

anyone who would desire to access and use it? Should this knowledge be made available for free? What are the copyright issues? As institutions of education grapple with knowledge management issues, many questions will need to be raised and answered to determine the viability and optimum use of this new technology.

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The Management of Supply Chain Risks – Some Initial Insights

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Abstract

The paper aims to gather information about if and how organizations address supply chain risk management. To do so the paper provides findings of a pilot study involving Estonian and Swedish organizations and their approaches to supply chain risk management. More precisely, findings regarding how these organizations manage supply chain risks and what tools and methods are used to manage these risks are presented. This research continues with the main study involving both a larger sample and additional countries.

Keywords – Supply chain, Supply chain risks, Supply chain risk management, Risk management, Risks.

Paper type – Academic Research Paper

1 Introduction

Today's supply chains are exposed to a great number of risks, old ones, and completely new ones, such as COVID-19. Risks are inherent in complex systems created by humans, which could unintentionally emerge, as also unexpected consequences can arise based on couplings in the complex systems (Perrow, 1984). Supply chains can also be affected by risks consisting of malicious disasters and natural disasters. Moreover, the risks can arise from the external environment that can potentially cause more or less collapse of the global financial system and wars. These risks are triggered by a manifold of developments, such as the increasing digitalization and connectivity of supply chains but also political instability and aggressive actions of the big players in the market such as Amazon which give customers the appearance that goods are available anytime, anywhere; in fact, only a mouse click away. This combined makes supply chain operations increasingly fragile. To manage critical risks, any organization is advised to have a systematic and holistic approach to risk management (Smallman, 1996) so that it is in a better position to handle present and forthcoming risks. Recent research shows that organizations are also increasingly addressing so-called knowledge risks (Durst et al., 2019) in their risk management.

Organizations, in general, are advised to have a contingency plan at hand to be prepared for the possible occurrence of serious risks. This can reduce some risks by carefully selecting their customers and suppliers in the supply chain (Olson & Dash Wu, 2010), while with other risks, such as cyber risks emphasizing training and preparation can help to reduce those incidents that go back to human error, representing one of the main causes of cyber incidents (Allianz Risk Barometer, 2020).

Against this background, the authors of this paper see a clear need for obtaining an in-depth understanding of how organizations handle supply chain risks taking into account the rapid developments that have taken place in this particular environment.

Thus, the paper aims to gather information about if and how organizations address supply chain risk management. To do so the paper provides findings of a pilot study involving Estonian and Swedish organizations and their approaches to supply chain risk management. More precisely, findings regarding how these organizations manage supply chain risks and what tools and methods are used to manage these risks are presented.

2 Theoretical background

2.1 A brief introduction to the theory of risks

Risk often involves both physical aspects, such as ecological threats, physical infrastructure, land use considerations, etc., and social dimensions, including people's judgment about risk and likelihood (Macgill and Siu, 2005; Taylor-Gooby and Zinn, 2006).

Risk assessments were originally related to numerical evaluation and rank of the probability, and the potential impact, of a risk event, occurring using statistical data based on the studies of past occurrences or 'known' scientific knowledge. The social sciences rejected the notion that probabilities and consequences of adverse events are thought to be quantifiable, as they claim that risk is subjective and culturally dependent (The Royal Society, 1992).

Accordingly, social scientists have emphasized the variations in risk perceptions among technical experts, the general public, ethnic groups, and social demographics and individual and group preferences (Slovic and Weber, 2002). Experts have, for instance, a tendency to assign lower estimates to risks that fall within their area of expertise and responsibility, compared to the general public (Sjöberg 2002). Sjöberg assumes that this can be explained by the level of responsibility felt by experts about risk, as well as the level of knowledge. Experts tend, moreover, to be overconfident in the exactness of their estimates (Pidgeon et al., 1992). Activities are perceived as being riskier if the people or agencies managing them are perceived as untrustworthy. Also, information from trusted sources is given more weight than that from untrusted sources. Taylor-Goodby and Zinn (2006) point out that if the 'non-expert' perception of the strength of uncertainty, or threat caused by a risk differs from that of the objective scientific or 'expert' community, this is neither irrational nor uninformed.

People's sense of risk is related to numerous external factors. Three factors were found to be particularly important in influencing people's acceptance of risk according to Slovic, Fischhoff, and Lichtenstein (1979). These factors are known as uncommon risks or dread risks, unknown risks, and the number of people potentially affected. People tend to overestimate risks that score highly in terms of these properties and underestimate those they are more familiar with. A 'dread risk' is related to the controllability of risk or hazard; potentially catastrophic consequences, being irreversible, being involuntary and risks being inequitably distributed, etc. 'Unknown risks' have been linked to the characteristics of not being known at all, not known to science, new and delayed. Similarly, the acceptance of technological risks is based on multiple qualitative dimensions.

2.2 Risk and supply chain

According to Wieland and Wallenburg (2012), the management of supply chain risks (SCRM) is about reducing vulnerability from risks. Supply chain risks involve a variety of risks, as cash-flow risks, risks of a shortage of staff, and other resources, as well as other business disruption risks arising from within and without the supply chain. Thus, companies need to reduce costs and vulnerability and to ensure business profitability and continuity in their SCRM. The SCRM process has been suggested to represent four main stages, as risk identification, risk assessment, risk treatment, and risk monitoring (Fan & Stevenson, 2018).

The first stage in the SCRM process involves the identification of relevant risks, to recognize future uncertainties (Kern et al., 2012). Businesses need to make a judgment

about the relevance of each risk. This is an activity where potential supply chain threats and vulnerabilities need to be identified. The probability and the impact on the vulnerability need to be considered and could be dependent on other actors and/or partnerships in the supply chain (Li et al., 2015). Different methods and tools can support in identifying the risks.

Risk assessment is the second level in the SCRM process. Available data according to what constitutes a risk need to be subjectively judged of each analyst, formal or informal, and quantitative or qualitative, as well as in upstream and downstream relationships. Scenarios can also be used as a complement in the risk assessment (Cohen & Kunreuther, 2007). Supply chain risks also need to be prioritized, to consider the most significant risks and those risks that have a high degree of impact, as it is impossible to deal with all possible risks. Potential causes or sources of risks also need to be assessed in the supply chain (Wever et al., 2012).

In the risk treatment level, risk treatment plans can be designed to decrease or remove the probability and impact. Different generic risk treatment types can be used, as risk acceptance, risk avoidance, risk transfer, risk sharing, and risk mitigation. The risk acceptance is related to the willingness of a company to engage in risky behaviors and acceptance of risks, without ignoring the risk (Park et al., 2016). Risk avoidance is about eliminating activities that could trigger risks as if a supplier is unreliable the company could terminate the relationship (Hajmohammad & Vachon, 2016). To push the responsibility to another party in the supply chain is called risk (Diabat et al., 2012). In risk-sharing, another party is involved in sharing risks. Risk mitigation involves reducing risk to an acceptable level. This considers both the reduction of the probability of a risk event and the probability of its consequences, but this is dependent on the risk type and the company's budget (Norrman & Jansson, 2004). Therefore, companies should carefully evaluate the options for acceptance, avoidance, sharing, and transfer of risks, before selecting a mitigation strategy. Risk monitoring is the fifth level in the SCRM process, and it would be a continuous activity to be conducted to evaluate how risks are developing and if the treatment strategies or plans need to be changed. It is also about continuously collecting new information.

3 Method

3.1 Data

The data for our pilot study were collected between February and March 2020. The collection method was in the form of an online questionnaire, using the free online survey tool e-surv. To develop the questionnaire, we took advantage of previous research. In addition to the supply chain risks related questions, demographic data were collected, such as the year of organization foundation, type of organization as well as the number of employees.

To access possible participants, convenience sampling was used, which means two of the authors informed about the survey using their contacts to send out personal invitations

to the survey. The pilot study consists of responses from ten organizations located in Estonia and Sweden. The findings are presented in the following section.

4 Presentation of findings

4.1 General information about the participating companies in the pilot study

60% of the ten participating organizations reported that their organizations do risk management, while 40% replied in the negative.

In the following section, specific findings related to SCRM are provided.

4.2 Specific information about supply chain risk management

In order to gather information about the organizations' maturity level with regard to SCRM, the participating organizations were asked to assess a number of items. The findings are presented in Figure 1.

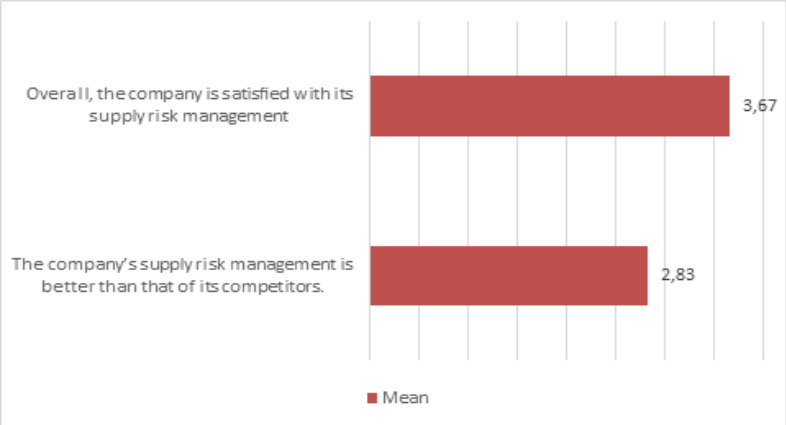
Range 1 (no, not at all) – 5 (yes, completely)

Figure 1. Supply risk management process maturity

From what can be seen in Figure 1, one can conclude that the maturity level of the companies shows potential for development in all mentioned areas. Either the companies have not put a special focus on SCRM to date or they have only recently begun to do so.

There were also two questions that addressed the issue of supply risk management performance. The findings are displayed in Figure 2.

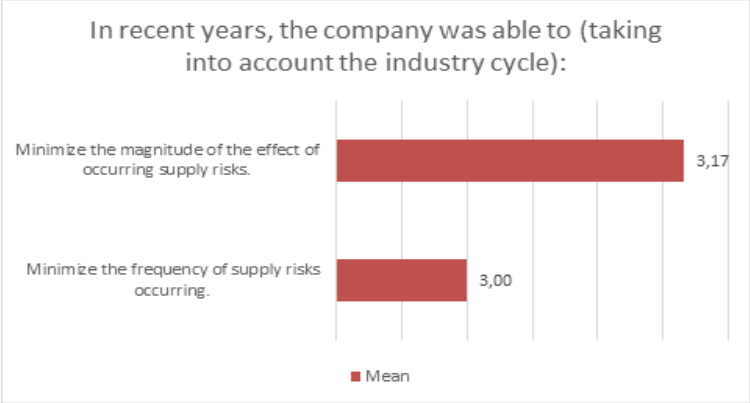
The companies seem to be satisfied with the performance of their supply risk management on an average level. The findings also suggest that the firms' SRM performance is comparable with those of other organizations.



Range 1 (no, not at all) – 5 (yes, completely)

Figure 2. Supply risk management performance

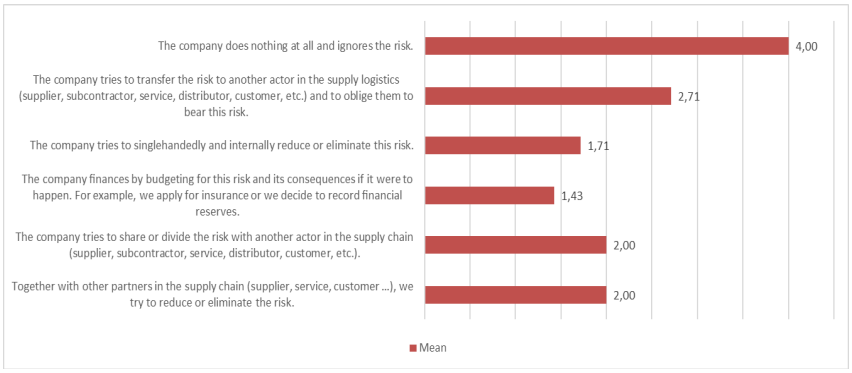
We were also interested in gathering information about whether the companies involved have improved their supply risk management over time. The findings are presented in Figure 3. In line with the previous findings, the activities conducted are on an average level.



Range 1 (no, not at all) – 5 (yes, completely)

Figure 3. Supply risk management over time

Next, we were interested in gathering information about what the organizations are doing when they are confronted with a crisis. To address this aspect, the organizations were asked to assess a number of different items. The findings are presented in Figure 4.

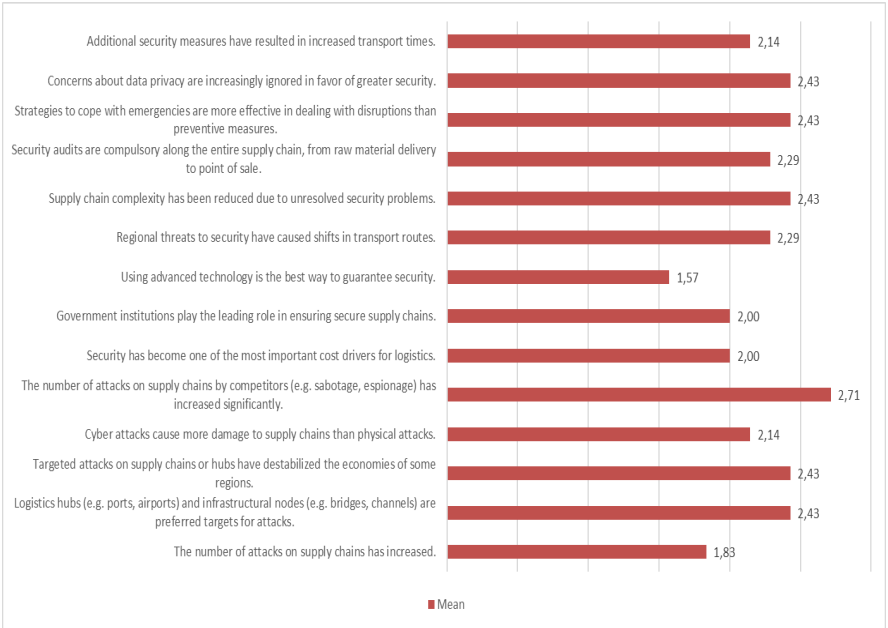


Range 1 (Strongly agree) – 5 (Strongly disagree)

Figure 4. Responses to risks exposures

The findings suggest that companies involved take proactive steps when being exposed to risks, thereby they seem to prefer internal solutions to supply chain risk management or risk management in general.

Additionally, the companies were asked to assess a number of additional items related to risks related to supply chains as experienced in their business operations and the environment they are working. The findings are outlined in Figure 5.



Range 1 (Strongly agree) – 5 (Strongly disagree)

Figure 5. Supply chain risk management and business environment

The participating organizations seem to have learned that the usage of advanced technologies can help them to better address security. One can also see that the organizations see an increase in attacks on supply chains. The overall findings indicate

that the business environment the organizations are operating in has become riskier and the aspect of security has increased in significance.

5 Conclusions

We have all learned that the world has become riskier and we are all facing new unknown risks. Taking the focus on risks related to supply chains. This paper presents some findings of a pilot study that gathered information about the management of supply chain risks in organizations from Estonia and Sweden. The findings indicate that organizations manage their supply chain risks to a certain degree, that is, on an average level. This finding is not surprising considering that only 60% of the participants stated that their respective organization do risk management. Moreover, the findings confirm that working in the sector has become more riskier which has primarily to do with security issues that in turn influence the companies' operations.

The pilot study which is part of a bigger research project involving a number of different countries has provided the necessary information for the authors to take the next steps. The overall research project aims at developing an in-depth understanding of supply chain risk management as well as how organizations, smaller organizations in particular, perceive current developments in the industry, their possible implications and what they are doing to tackle them. Developing this understanding is very important, especially against the background of the rampant pandemic which presents the topic of risk management with a new, hitherto unknown challenge.

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Job Crafting Behaviours in Healthcare: The Role of the Attitudes toward Technology

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Abstract

Responding to recent calls in literature, this article aims at investigating the effect of information and communication technologies (ICT) on job crafting, a proactive behaviour defined as work personalization or individual job redesign. More specifically, through a qualitative pilot study, we examine the attitudes toward technology – namely the individual's collection of beliefs which determines whether or not to engage in certain related behaviours – leading to these "do it yourself", unstructured, and self-targeted practices at work. This inductive qualitative research with 28 interviews suggests the mediating role of two variables in the smartphone usage and general social media usage. Implications for theory and practice, suggesting optimal behaviours and functioning within organizations arising from positive and proactive attitudes and traits of individuals, are discussed.

Keywords – Job crafting, Attitudes toward technology, Smartphone usage, Social media usage.

Paper type – Academic Research Paper

1 Introduction

The organizational culture and behavioural dynamics of the past 20 years have had to deal with a "do it yourself" (DIY), unstructured, and proactive approach toward work called job crafting (Wrzesniewski and Dutton, 2001). This can be defined as "work personalization" or "individual job redesign": these are changes made independently by workers to make their job more stimulating and motivating (Tims and Bakker, 2010), but also to improve work engagement and meaningfulness (Tims, Bakker, and Derks, 2013).

Job crafting captures "the physical and cognitive changes individuals make in the task or relational boundaries of their work" (Wrzesniewski and Dutton, 2001, p. 179). It consists of three proactive individual behaviours enabling employees to modify their jobs to fit more their natural skills, preferences, and inclinations at work. For example, a personal trainer behaves in task crafting when choosing a different environment from the usual gym to train customers (Grant, 2007), an accountant behaves in relational crafting when preferring to participate in social initiatives rather than focusing on the traditional job (Buonocore, de Gennaro, Russo, and Salvatore, 2020), and the cleaning staff of a hospital behaves in cognitive crafting when attributing to the own work a wider and more significant meaning in relation to the contribution made to the healing process of patients (Ghitulescu, 2007).

The literature on the topic has grown a lot together with the new organizational dynamics that have taken hold at work, but at the same time some points remain unsolved. First, the analysis of the antecedents of job crafting is still overlooked (Niessen, Weseler, and Kostova, 2016), even if job crafting literature examined personality, work, and demographic determinants such as proactive personality (Bakker, Tims, and Derks, 2012), general self-efficacy (Rudolph, Katz, Lavigne, and Zacher, 2017), and job performance (Gordon, Demerouti, Le Blanc, and Bipp, 2015). Moreover, despite it has long been predicted that information and communication technologies (ICT) are fundamentally changing the way we work and live (e.g., Beno, 2019), just few authors have dealt with issues related to ICT – such as the use of technology or other information systems to maintain increased flexibility (Sturges, 2012) – so scholars did not define any specific technology-related crafting forms and the contributions on the subject are scarce (Lazazzara, Tims, and de Gennaro, 2020). Furthermore, a shortcoming of current research concerns the overemphasis on the task and relational dimensions of job crafting and the little scholarly attention towards the cognitive one, as testified by the fact that most of the scales to measure job crafting do not even include items to measure the cognitive dimension (Weseler and Niessen, 2016). Finally, in our knowledge also studies in the public sector are scarce, except for a few examples (e.g., Bakker, 2015; Tuan, 2019), although they are prescribed jobs with well-defined tasks, expectations, and positions in which the behavioural practices of job crafting could creep in (Berg, Wrzesniewski, and Dutton, 2010).

To fill these gaps, this study aims at investigating job crafting in a "technological" perspective, that is to identify – within a central public administration of a region of southern Italy – how the positive attitudes toward technology affects these proactive

behaviours. Through a qualitative pilot study with 28 interviews, this study tries to shed light on the neglected relationship between ICT and job crafting, also contributing to literature by advancing research on antecedents and "digital" causes that can lead to changes in one's job and by considering all the three facets of job crafting. The mediating variables of this relationship, which emerged from the pilot study, suggest that the positive attitudes towards technology leads to job crafting behaviours through the use of smartphones and social media.

2 Theoretical framework and hypothesis

The job crafting expression was proposed in 2001 by two psychologists in an attempt to describe a possible magic: that of transforming the work you have into the work you love. It is about actions undertaken from a bottom-up approach that generates greater work engagement and higher performance (Tims *et al.*, 2013).

Job crafting is an activity that employees spontaneously undertake to meet their needs and preferences in the workplace (Kira, van Eijnatten, and Balkin, 2010). It's a behaviour that requires an adaptation to the challenges and to the constraints imposed by an employer (Berg *et al.*, 2010) and it represents a strategic advantage for individuals and for the organization as a whole, although these changes are not always in line with the organizational goals and needs (Van den Heuvel, Demerouti, Bakker, and Schaufeli, 2010). These are changes which can have a structural (physical or procedural), social, or cognitive form (Wrzesniewski and Dutton, 2001) and which are self-targeted and volitional (Tims, Bakker, and Derks, 2012).

Wrzesniewski and Dutton (2001) argued that individuals are motivated to engage in job crafting behaviours because they are guided by three types of needs: the control over work, the social relations individuals experience in the workplace, and the attractive image. Based on these needs, many scholars distinguish "personal/individual" and "contextual" antecedents of job crafting (Wang, Demerouti, and Bakker, 2016), i.e., respectively, the self-efficacy (Tims and Bakker, 2010) and the work context (Vera and Crossan, 2004). The personal/individual determinants affect person's behaviours, such as the Big Five personality traits and the proactive personality (e.g., Parker, Bindl, and Strauss, 2010); nevertheless, personal/individual factors influencing job crafting behaviour cannot do without contextual factors – such as leadership (Leana, Appelbaum, and Shevchuk, 2009) – referring to the environments condition where work activities take place.

Drawing on job crafting theory and responding to recent calls in literature (e.g., Lazazzara *et al.*, 2020; Lee and Lee, 2018) this study aims at identifying an antecedent of job crafting in technology, since behaviours could be oriented towards the technological aspect of work (Parker, Morgeson, and Johns, 2017). The advent of technology has changed the landscape so that almost all activities can be carried out via a portable device or with a laptop; for example, thanks to Wi-Fi, people can have access to the Internet, e-mails, and many different types of applications anywhere and at any time of the day, and this undoubtedly influences the way people carry out their work (Rosen, Whaling, Carrier, Cheever, and Rokkum, 2013). More specifically, the goal of this study is to

investigate the attitudes towards technology, and in this way to understand what are the digital tools and ways through which individuals behave like job crafters.

Attitude represents an individual disposition toward performing a certain behaviour (Davis, Bagozzi, and Warshaw, 1989) and it is influenced by the perception of utility and ease of use (Pynoo and van Braak, 2014). It is a concept of three-dimensional nature, involving cognitive, affective, and behavioural components (Breckler 1984). Among the studies on the topic, an attitude toward a concept, such as technology (Ankiewicz, 2018), is the individual's collection of beliefs which determines whether or not to engage in certain behaviours (Ankiewicz, van Rensburg, and Myburgh, 2001). Attitudes toward technology may include enthusiasm and at the same time boredom interest in the subject (Ardies, De Maeyer, Gijbels, and van Keulen, 2015) and this dual perception of the phenomenon translates into numerous contributions on the topic in the literature of the last years. Nevertheless, in our knowledge, so far it has not been studied in depth in relation to proactive behaviours.

3 Method

The proposed study represents the first of the two phases in which it was conceived. It is a qualitative pilot study useful for formulating hypotheses and subsequently measuring them with a quantitative methodology to be referred to the entire organizational population to give greater rigor to the results. The use of a pilot study is fundamental for a good study design as it can provide interesting and unexpected insights from a study object (Kim, 2011).

3.1 Data and procedures

In this pilot study, we adopted an inductive qualitative approach (Höglund, Holmgren Caicedo, Mårtensson, and Svärdsten, 2018), by employing a qualitative research method based on different sources in order to reduce the impact of potential biases (Bowen, 2009). In line with this, empirical data are based on formal documents, such as appointments decrees and job descriptions, which gave us an overall overview of the organizational and work situation of the public administration object of the study, and workshops and focus groups organized to develop our initial insights with a sample of volunteer workers involving 3 to 5 participants.

Data were collected through semi-structured interviews conducted with workers of a central public administration in southern Italy dealing with healthcare. Healthcare organizations in recent years embraced the digital paradigm and they are characterized by a high degree of complexity because of the heterogeneity of healthcare professionals' mindsets, networks, and decision-making processes (Karamitri, Talias, and Bellali, 2017). Since there is a growing awareness that recognizes the need for healthcare professionals to take a proactive role in shaping their future jobs to improve healthcare systems (Gordon *et al.*, 2015), this sample may be particularly interesting to investigate these behavioural dynamics.

As part of a work process reorganization study, it has been possible to recruit 28 participants including managers, employees, and interns. The average age of participants was 48.4 years (*SD*=8.74) and gender was almost equally distributed (13 women and 15 men). All interviews were audio-recorded and then transcribed for the qualitative analysis.

3.2 Coding and analyzing

We followed the Gioia Method (Gioia, Corley, and Hamilton, 2013), which is a systematic approach useful for bringing "qualitative rigor" of inductive/abductive research. The study's approach depended on a generic research question, i.e. "we wished to explore attitudes, beliefs, and behaviours about ICT and the use of technology at work". The interviews were administered without a structure of questions, but rather as if they were informal conversations within which it was possible to range over all the topics that concerned attitudes and working behaviours of public workers.

In analyzing the interviews, we adopted Gioia method (Gioia *et al.*, 2013), and this analysis process involved three phases. In the first stage, the focus was on finding recurring themes in interviews based on respondents' answers. Two researchers independently coded all the transcribed interviews and subsequently compared personal codes by engaging in a discussion when disagreements emerged. Then, we discerned patterns in the data with the aim of bringing out concepts and relationships and then of formulating them in theoretically-relevant terms, giving particular attention to nascent concepts that seemed to have no adequate references in the literature. Once we identified all the relevant first-order recurring themes and codes and the second-order concepts and relationships, we assembled them into a data structure that can be presented as a visual representation (Figure 1).

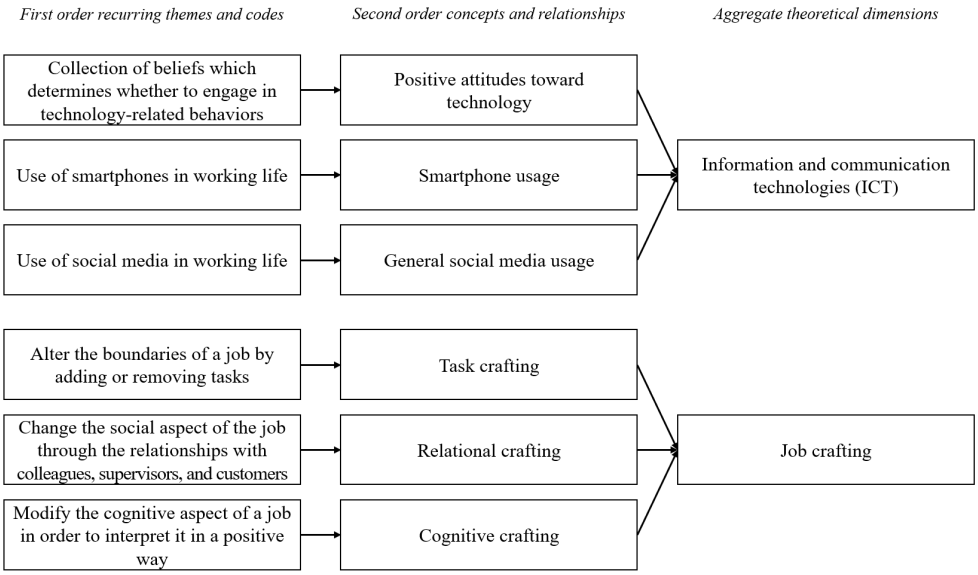

Figure 1. Data structure

4 Results

As above mentioned, none of the public workers interviewed was familiar with the concept of job crafting; however, the majority of them revealed to regularly engage in a series of proactive behaviours that were aimed at modifying some aspects of their job which fit with the task, relational, and cognitive techniques described by Wrzesniewski and Dutton in their seminal contribution (2001).

With reference to the attitudes towards technology, the interviewees showed different (and also diametrically opposed) opinions, without any particular correlation emerging on the basis of demographic variables:

> *I believe that technology is fundamental for our lives and for our work; to date it is unthinkable to live without! (Respondent #3, example of positive attitudes toward technology)*
>
> *The human mind is not replaceable by machines, indeed we should reclaim its centrality. (Respondent #8, example of negative attitudes toward technology)*

On the one hand, some interviewed workers claim to have positive attitudes toward ICT since they use these tools to improve their work; this positive approach refers both to the performance of work activities ("*e-mails, for example, make communication effective and eliminate barriers and distances typical of our bureaucracies*", Respondent #17), and to the place where these are implemented ("*I can practice smart working on certain days of the month and for me it is a very pleasant way of working*", Respondent #24). On the other hand, others prefer the "traditional" work that does not include technology, showing negative attitudes toward it. Although the latter do not present particularly relevant results from the point of view of job crafting, interestingly those who show a positive attitude towards technology are also those who modify their work proactively.

In line with the job crafting literature, findings indicate that workers were motivated to craft their job by the desire to increase the resources and relations at their disposal, to introduce new challenges to work activities that were considered as too "boring", and to seek improving the external prestige of their work that was particularly denigrated in recent years. Indeed, workers claimed to change the characteristics of their work thanks to technological tools according to approaches that are reminiscent of job crafting and it is interesting to note that almost every respondent talks about two main tools, namely social media and smartphones, in crafting his/her job:

> *Thanks to technology I am able to carry out activities other than traditional ones (...), for example I have set up a data archive that had never been put in order (...). Technology is also useful as it allows me to avoid many superfluous activities and sometimes with my smartphone I monitor the progress of tasks. (Respondent #27, example of task crafting)*
>
> *I think technology is fundamental (...), for example I can use the smartphone at any time of my day to interface with colleagues and experts and thus I can improve my work performance (...). I also use Facebook to follow groups of colleagues, take a cue, and answer questions. (Respondent #10, example of relational crafting)*

Citizens must be aware of the work we do (...). I often share my experiences and activities on social networks in order to make everyone participate in my work and feel myself even more appreciated. (Respondent #21, example of cognitive crafting)

The positive attitudes toward technology, therefore, could prove to be an antecedent of job crafting as the actors who show this cognitive and behavioural predisposition proactively modify the characteristics of their work to make it more stimulating and motivating. Moreover, since they are reported in almost all the interviews, smartphones, as a technological tool, and social media, as a virtual "place", appear relevant in this possible linear relationship and could represent mediating variables capable of explaining the previous relationship and ensure a greater understanding of the phenomenon. On the contrary, respondents who showed a negative attitude toward technology or who did not express themselves in this regard were found to be less proactive and not actively committed to changing the characteristics of their activities, relationships, and cognitive perception.

5 Discussion

The aim of the present study was to examine the relationship between the attitudes toward technology and job crafting. Using a qualitative method approach and laying the foundation for a quantitative validation, our results suggest the presence of a linear relationship, perhaps mediated by smartphone usage and general social media usage.

Our work offers several contributions to theory and research. First, we address the call from Zhang and Parker (2019) and Niessen and colleagues (2016) to provide new insight on both the antecedents of job crafting beyond individual dispositions and on cognitive crafting, a dimension that has been little examined in the job crafting literature. A study of all the components of job crafting helps investigate the behavioural dynamics that lead to a shift in work meaning, work identity, and emotions (Grant and Campbell, 2007). Moreover, in line with prior studies that have shown job crafting to be a contextually embedded phenomenon (Zhang and Parker, 2019), we have demonstrated that individuals' attitudes represent significant drivers of the entire job crafting process. More specifically, we demonstrated that workers who have a positive attitude towards technology are the same workers who reinvent themselves to modify their job and make it more pleasant. This insight can open up new avenues in research on antecedents of job crafting, as it is possible that the personal characteristics of individuals play a critical role in the changing process that has not yet been fully investigated.

Second, by integrating ICT into job crafting literature, we have demonstrated that the new organization of work and the new working practices evolve hand in hand with workers' trends and behaviours. Lazazzara and colleagues (2020) had already identified this literature gap, but no study had gone so far in investigating these dynamics. Interestingly, smartphones and social media have been shown to be critical tools and virtual places for practicing job crafting and some studies had already foreseen this future trend. An example is characterized by locational crafting, which has been defined as the possibility for an individual to carry out one's work tasks in different locations (Sturges, 2012; Van Wingerden, Derks, Bakker, and Dorenbosch, 2013).

Furthermore, the study of job crafting in a prescribed work context such as that of the healthcare public sector is also an interesting contribution for literature. Identifying a "stable" work as a sample, from the point of view of its characteristics and duration over time, is undoubtedly a rigorous way of doing research because it allows not to suffer distortions due to improper contextual factors.

5.1 Practical implications

Practically, this study suggests that a positive attitude toward technology makes workers more motivated and satisfied, so managers should increase their performance and well-being by facilitating job crafting behaviours and helping them developing digital skills, knowledge, and competencies needed to expand their tasks. Managers in fact play a critical role in motivating individuals to undertake proactive behaviours by supporting initiatives and experimentation or assisting them in pursuing their unanswered callings (Berg *et al.*, 2010). It could be also useful providing opportunities to participate in job crafting interventions and sharing "what works" could be the kick-off toward improving healthcare (Gordon *et al.*, 2015).

Furthermore, it has been shown that social support and organizational culture, also through appropriate and innovative solutions with employees (Van Wingerden *et al.*, 2013), are decisive for the implementation of job crafting, so leaving more autonomy to workers could generate positive consequences for the organization from the individual (Lyons, 2008) and collective (Mattarelli and Tagliaventi, 2015) points of view.

Finally, given the possibility of distraction and distorted uses of technology (e.g., Brooks, 2015), managers should pay close attention to these behavioural practices to ensure that they are in line with business objectives. When an individual perceives supportive personal factors (e.g., increased self-confidence), approach crafting is associated with positive experiences, such as meaningfulness, esteem-enhanced occupational identity, and job satisfaction (Meged, 2017); on the contrary, constraining personal/contextual factors along the job crafting process means that even job crafting may result in negative experiences (e.g., Van Wingerden *et al.*, 2013) or that people do avoidance crafting (Lazazzara *et al.*, 2020), i.e. limiting positive behaviours and refraining.

5.2 Limitations and future research

This study has several limitations. First of all, it is a qualitative pilot study which draws inspiration and formulation of the hypotheses from an exploratory and semistructured investigation, so that the results may appear to be partial and not theory-founded. Although there is a strong methodological rigor, it is indeed important to proceed with a quantitative investigation by developing the hypotheses and further deepening the concepts emerged in this first phase. Moreover, this study focuses on one of the aspects of technology, which refers to workers' attitudes, but does not deepen all its facets, such as issues related to the digitization of work. Furthermore, future research may measure the consequences of job crafting in terms of technology and digitalization, also by not

excluding any of the three components of job crafting to avoid partial studies. Finally, since the literature to date has mainly focused on the positive outcomes, not considering the dysfunctional consequences – such as the frustration resulting from not being able to meet proactive goals generates negative experiences (Meged, 2017) or the shift towards an interest in crafting in other domains (Sturges, 2012) – of job crafting (Lazazzara *et al.*, 2020), studies on the subject should not overlook these aspects, especially when it comes to technology.

6 Conclusions

To the best of our knowledge, this study is the first to respond to recent calls in literature by investigating the effect of ICT on job crafting via the attitudes of public workers toward technology. Through an inductive qualitative research with 28 interviews, it has been suggested the role of smartphone usage and general social media usage in this relationship. A subsequent quantitative analysis will try to give greater rigor to the present study, thus enriching the literature on the antecedents of job crafting in an ICT's perspective.

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Platform-Dependent Entrepreneurship: Entrepreneurial Roles on Digital Platforms

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Abstract

This paper investigates entrepreneurial roles on digital platforms and platform ecosystems. We draw on research on dozens of industry platforms and products to offer a framework for building a successful platform-dependent entrepreneurship built around a multi-dimensional platform ecosystem based on platform stack and on the digital value creation framework. The outcomes of the research could be used for planning, oversight, and control over ecosystem management and the use of digital platform entrepreneurship ecosystem's knowledge-related resources for research purposes.

Keywords – platform-dependent entrepreneurship, digital platform entrepreneurship ecosystem, business model

Paper type – Academic Research Paper

1 Introduction

Digital entrepreneurship is a phenomenon which arose through technological innovations and digitization (Elia et al., 2020). In general, any entrepreneurial activity that transfers an asset, service or major part of the business into digital can be characterized as digital entrepreneurship (Kraus et al., 2018). According to Hull et al. (2007) and Kraus et al. (2018), products, marketing activities and workplace are major differentiation criteria between digital and non-digital entrepreneurs. In recent decades, digital entrepreneurs with their new ways of doing business had a huge effect on the global economy. "Born digital" companies Google, Facebook, Amazon and Apple absolutely changed the business world. The operating models and capabilities of this generation of "born digital" platform organizations founded after 1995 are based on exploiting digital technologies and technological platforms as a core competency. They are:

- not just startups — Amazon and eBay are 25 years old,
- not just small — Google has about 100,000 employees,
- not just pure digital businesses — Tesla Motors makes cars,

- not just American — Alibaba Group is Chinese, Yandex and Mail.ru Group are Russian.

It should be further noted that two emerging trends have jointly changed the nature of entrepreneurship and especially digital entrepreneurship across industries and sectors: open innovation and platform transformation (Kraus et al., 2018). Platform transformation refers to the increasing importance of digital platforms as a venue for value creation and capture (Jacobides et al., 2018; Yablonsky, 2018ab). Together, open innovation and platforms have created numerous opportunities for entrepreneurs and their firms - from serving as ecosystems for platform firm innovation to participating as complementors on existing platform(s) for startups and SME (Jacobides et al., 2018; Yablonsky, 2019, 2020). Digital platforms and open innovation environments have provided numerous promising chances for entrepreneurs, in industries ranging from consumer software, entertainment, and home appliances to auto, health, and energy. To engage in those opportunities, however, entrepreneurs will need to achieve a deeper understanding of the factors that facilitate and constrain them.

2 Research design and methodology approach

While digital entrepreneurial opportunities and conditions have established themselves in rich and varied ways, understanding of these new forms of entrepreneurship has dropped behind. Objective of the paper is to bring a sharper focus on the following research questions:

- What digital activities (new business and social innovation processes) can be activated or enabled by a digital platform entrepreneurship ecosystem (or DPEE)?
- How digital platform organizations designed and implemented to favor the development of the DPEE?
- Who are digital actors of DPEE? What categories of individuals, groups and institutions may favor the development of successful DPEE? How the crowd can be actively and effectively involved into a DPEE?

Digital platforms often require contributions from various actors with diverse perspectives and goals (Jacobides, Cennamo, & Gawer, 2018; Nambisan et al., 2019). Though, governing a diverse set of actors to pursue activities and outcomes that are suitable to all can be especially challenging. Through the structuring of decision-making authority and control rights of entrepreneur's opportunities and roles, effective platform entrepreneurial governance can help align incentives, coordinate actions, mitigate conflicts, and foster a common identity and thus can be critical to platform performance (Mair, Reischauer, 2017).

3 Defining platforms and ecosystems

We should distinguish a technology platform from a business platform, which includes technology platform as a main block.

Definition 1. (Gawer, 2009)

A *technology platform* is defined as building blocks that act as a foundation upon which an array of firms (a business ecosystem) develop complementary products, technologies or services, proposing such requirements for a platform:

It should perform a critical function of the overall system or should solve a crucial technological issue of an industry,

It should be easy to connect to, ‘‘build upon’’ and provide space for new and unplanned usage.

Defenition 2. (Parker and Van Alstyne 2015)

A *network technological platform* or *network platform* is usually based on digital network(s) building blocks. Network platforms differ from product platforms because of stronger network effects, switching costs and multihoming costs.

Definition 3. (Eisenmann et al., 2011)

A business platform is a nexus of rules and infrastructure that facilitates interactions among network users.

Definition 4. (Parker and Van Alstyne, 2015)

A *business platform* is a published standard, together with a governance model, that facilitates third-party participation.

Platforms have unique characteristics, with one of the central features being the presence of network effects or externalities (Parker, Van Alstyne, Choudary, 2016)). The value of platform affiliation for a user depends on the number of other users. Most of today’s platforms are principally digital. They capture, transmit and monetize data, including personal data, over the Internet and other networks (Evans and Gawer, 2016). They may not be purely digital, but most successful digital platforms currently take advantage of the digital innovations and power of pervasive Internet connectivity in the hand of billions of users. A platform provides common standards, interfaces and tools to power core technologies in order to increase the productivity and profitability of a company, a set of companies, or users (Teece, 2017). Platform technologies are essential for coordinating suppliers and buyers to deliver consumer value.

Digital platform strategy becomes extremely complex as firms consider dynamic interactions of a multilayered business ecosystem (Teece, 2012). The concept of platform innovation can be widely defined as architecting new platform strategies and business models (or BM), making and promoting new platform products and services, developing new platform processes to facilitate platform activities, to interact with platform actors and to design new platform structures for industry institutions (Yablonsky, 2018ab, 2019).

Unlike a traditional business, with a clear inside and outside, a platform provides business with a foundation where resources can come together in different combinations - to create value. Some resources may be inside, permanently owned by the company; some may be shared; and some can come from an outside ecosystem. The value comes largely from dynamic connection of those resources and the actors, and the network effects between them. The generativity of digital platforms produces exponentially growing of platform ecosystems, thereby creating research objects that are several orders of magnitude larger than any traditional IS system (De Reuver, Sørensen, Basole, 2018).

Platform providers such as Google, Facebook, Amazon, Alibaba and eBay are transforming the Internet into de facto closed domains, implying that all relevant interactions take place outside the view of researchers (Eaton et al., 2015).

There is a rising interest in business platforms in the scholarly literature (McIntyre and Srinivasan, 2017). Digital technological platforms are altering phenomena over the entire information systems (IS) domain (De Reuver, Sørensen, Basole, 2018). Architectures of platform artefacts are changing as the modularity of digital platforms is replacing traditional monolithic approaches (Tiwana, Konsynski, Bush, 2010). As digital platforms are competing on multiple levels of the technical architecture, specifying the appropriate unit of analysis is becoming increasingly difficult (Yablonsky, 2018ab). To architect a digital platform-based business, organizations must lead their business to take a business driven, outside-in approach (Yablonsky, 2018ab,2019,2020).

Starting from Moore (1996) and Kauffman (1993), the ecosystem concept has been actively discussed in management studies.

Valkokari (2015) distinguished three different economic ecosystem types:

- *Business ecosystems* as well as *service or industrial ecosystems*, where the economic outcomes and business relationships between actors are highlighted.
- *Innovation ecosystems* and *regional clusters* focus on mechanism and policies fostering the creation of innovative startups around so-called regional hubs or clusters.
- *Knowledge ecosystems* have their main outcome in creation of new knowledge through joint research work, collaboration, or the development of knowledge base.

Definition 5. (Teece, 2012)

A business platform ecosystem contains a number of firms and other institutions that work together to create and sustain new markets and new products. An ecosystem may be anchored by a platform. The co-evolution of the ecosystem is typically reliant on the technological leadership of one or two firms that provide a platform around, which other system members that provide inputs and complementary goods align their investments and strategies with.

A business ecosystem contains a number of firms and other institutions that work together to create and sustain new markets and new products. Business ecosystems continue to advance, becoming the basis of innovative business models. In a digital business ecosystem main digital economic agents (humans, business and smart things/smart machines) can play any combination of roles, such as entrepreneur, customer, partner, supplier, employee or competitor.

A platform-based business ecosystem consists of

- Platform,
- Target Group of Customers,
- Target Ecosystem partners,
- Complementary products and services,

- Rival platform ecosystems, and competitive environment in which they exist, upstream and downstream parts of a platform value chain (Tiwana, 2014).

The co-evolution of the business ecosystem is typically reliant on the technological leadership of one or two firms that provide a platform around, which other system members that provide inputs and complementary goods align their investments and strategies with. Usually platform organizations exist in a "business ecosystem" — the network of other organizations that interacts to create shared value (Tiwana, 2014). Teece (2017) mentions that today the concept of "industry" as a group of firms performing similar activities and competing or cooperating with each other is less and less aligned with the way firms think about themselves. In the digital economy firms see their role less in industries and more in business ecosystems.

Platform by enterprise typology indicates (Evans, Gawer, 2016)

- *asset heavy enterprises* with heavy physical assets and *light platform business ecosystem* (example: Samsung with Tizen platform),
- *asset mixed enterprises* with heavy physical assets and platform business ecosystem (example: Apple with App store platform), and
- *asset light enterprises* with light physical assets and *heavy platform business ecosystem* (example: Uber with Uber app platform).

The main outcome of a *knowledge ecosystem* is a new knowledge, and it could be shaped by pointing out the network nodes where the knowledge is created and retained (Valkokari, 2015). Open source communities are a well-known example of this ecosystem type based on knowledge exchange (Koening, 2012) and therefore recent research highlights how colocation can also mean virtual proximity, like emotional closeness, between the actors.

The *innovation platform and ecosystem* approach emphasize fostering the creation of growth, interaction, and innovative startups around so-called knowledge hubs (Engel & del Palacio, 2011). Within the innovation ecosystem, the financial network that supports the actors (both companies and research institutes and other technology developers) has recently been identified as one of the key platform investment type (Evans, Gawer, 2016). Several concepts about value co-creation within open innovation, such as "collaborative", "democratized", "open", "networked" or "co-innovation" have been introduced (Yablonsky, 2020). The technology-intensive business organizations, from specialized startups to diversified multinational enterprises, increasingly participate within innovation ecosystems in different roles such as adopters and patrons of open platforms, and stewards and promoters of innovation communities (Muegge, 2011).

An open innovation process (Chesbrough and Rosenbloom, 2002; Chesbrough and Bogers, 2014) comprises several activities that involve resources within and beyond organizational boundaries, mostly human participants (Chesbrough et. all, 2018). The characteristics of the activities and resources within this process depend on the specific purpose of an open innovation platform (Abbate et al., 2015). Open innovation is a multi-dimensional phenomenon that should be described from different perspectives – cultural,

organizational, and technological spheres – have transformed significantly under the development of innovative network technologies.

As shown by Parker, Van Alstyne, Choudary (2016), platforms all have an ecosystem with the same basic structure, comprising four types of actors/player/roles:

1. *Owners* of platforms or platform *sponsors* control their intellectual property and governance. The owner sets the direction, controls the underlying platform technology and provides the overall organizing structure for the platform via rules, governance, and ecosystem support. It can assist the ecosystem work by helping participants see how they are better off by being part of the system rather than outside of it. This role can be performed by one or many firms.
2. *Platform providers* operate as a platforms' interface with users. Platform provider is the point of contact for common components, rules and architecture for the users of the platform. This role can be done by one or many firms.
3. *Users (supply side)* or *the producers* create their offerings. These are content and application developers. Producers provide specific items that attract users to the platform – music, games, information, services etc.
4. *Users (demand side)* or *the target consumers* of the platform solutions and services use producers' offerings. They can be individuals, businesses, organizations.

There is different logic of action in the different platform or/and ecosystem types (Clarysse et al., 2014; Valkokari, 2015) and the same actor can be involved and play different roles in each ecosystem. From the viewpoint of each individual actor, the interaction area between the platform and/or ecosystem types and their relationships are different. Thus, highly mobile actors, platform owners, or keystone companies are examples of actors boosting the interaction between the ecosystem types. On the other hand, a platform – an organization of things such as technologies or complementary assets (Muegge, 2013) – also may be the interconnecting factor between the ecosystems (Valkokari, 2015). Because of these interconnectivity actors and platforms, ecosystems do interact with each other and therefore are evolving and emerging next to each other.

A platform ecosystem usually goes through periods of competitive strength and weakness as external circumstances change, and these dynamics also need to be managed by the platform owner. Teece (2017) described a platform ecosystem lifecycle as consisting of four phases: Birth, Expansion, Leadership, and Self-Renewal. This model provides a useful framework for thinking about how platforms and dynamic capabilities interact.

There are several broad categories of platform/ecosystem value chain types:

- *Linear value chain ecosystem* orchestrates and optimizes the organization's value chain. It is a favorite type when multiple partners are involved in a complex value chain.
- *Platform-led ecosystem* mediates the ecosystem using a platform.
- *Decentralized ecosystem* is the business ecosystem itself, which defines and mediates the transactions among partners. Cryptocurrencies, such as Bitcoin, are well-known case of decentralized ecosystem.

These ecosystem types have resulted in different types of entrepreneurial roles and opportunities. In the value chain, the business ecosystem opens the reach and range of value. Today the platform ecosystems provide access to a wider range of partners with complementary capabilities, and the ability to create and coordinate these highly complex, demand-driven supply networks.

Each of mentioned ecosystem types has created its own business model opportunities. These opportunities require a change in perspective, away from a traditional, input/output process to a dynamic ecosystem perspective.

Most companies still focus on how value appropriation mechanisms work in linear value processes. To benefit from platform ecosystems, entrepreneurs not only need to develop an understanding of their own value creation and appropriation strategies, but rather how this strategy works in a platform ecosystem and influences the actions of other actors (Schmeiss et al., 2019; Yablonsky, 2020). For this, they need to understand their own role and the roles and contributions of other actors in this system. In enabling maximum openness to create joint innovation while guaranteeing value capturing for all actors Schmeiss et al. (2019) recommend three governance mechanisms embedded into the technical architecture of the platform, addressing the dimensions of access, control, and incentives.

Existing research on platform governance tends to take the perspective of platform owners and focuses on identifying governance mechanisms that can help platform owners realize their objectives (e.g., Reischauer & Mair, 2018). When we consider the perspective of platform owners, we may ignore the prosperity and business needs of other platform participants. As digital platforms become increasingly integrated into economic transactions and social activities, it is essential to examine platform governance not just from the perspective of platform owners but also from the perspectives of other stakeholders, for this study - entrepreneurs. It contributes to research in the strategic management domain by presenting a set of multi-dimensional frameworks that identify how digital platform business ecosystems improve entrepreneurial management within platform organizations. Strategy in this context must guide entrepreneurial roles in platform business models portfolios and related business ecosystems trajectories.

4 Entrepreneurial roles on platforms

From the most general point of view entrepreneurs' roles include roles of *platform leaders, complementors, and users* (Yablonsky, 2019a). These categories of entrepreneurs' digital actors for individuals, groups and institutions may favor the development of successful DPEE.

The sharp rise in the number of businesses offering platforms that connect users for communication or commerce creates platform-dependent entrepreneurship. Entrepreneurs as platform leaders are particularly drawn to these platforms because they create significant value and have modest operating costs, and network effects protect their position once established users rarely leave a vibrant platform (Edelman, 2015). But these businesses also raise significant start-up challenges. Every platform starts out empty. Platforms need to immediately attract not only many users but multiple types of users.

The following key stakeholders are the main entrepreneurs' actor roles along the platform value chain (Yablonsky, 2019ab):

- *User Enterprises* in all sectors, who want to improve/transform their services and products using innovative technology, data products and services;
- *Data Generators and Providers,* who create, collect, aggregate, transform and model raw data from various public and non-public sources and offer them to customers.
- *Technology Providers,* who provide tools and platforms that offer BD management and analytics tools to extract knowledge from ecosystem data, curate and visualise it;
- *Service Providers,* who develop applications on top of the tools and platforms to provide services to User Enterprises.
- *Entrepreneurs*, who build innovative businesses and services based on the demand and supply side;
- *Researchers and academics*, who provide access to state-of-the-art research in innovative technologies;
- *Policy makers*, responsible for establishing policy framework conditions that foster the adoption of innovative technology in various sectors.

It should be mentioned that entrepreneur's platform actors can play simultaneously roles of User Enterprises' owners, Data Generators and Providers, Technology Providers, Service Providers, and Policy makers.

The crowd can be actively and effectively involved into a DPEE by crowdsourcing types of digital platform organizations designed and implemented to favor the development of the DPEE. To meet the needs of potential target consumers, the platform entrepreneurs can adopt four major types of innovation ecosystem governance models (Kaganer et al, 2013; Yablonsky, 2019ab):

- *Facilitator*: connects suppliers and buyers directly through a bidding process; *case examples:* Freelancer, Elance, oDesk,
- *Arbitrator*: engages multiple suppliers through competitions; *case examples:* crowdSPRING, 99designs, MediaPiston, InnoCentive, Witmart,
- *Aggregator*: aggregates hundreds or thousands of microtasks performed by multiple suppliers; *case examples:* Mechanical Turk, MobileWorks, CrowdFlower, CloudFactory,
- *Governor*: provides project governance and certifies supplier quality; *case examples:* TopCoder, Trada, uTest.

The expansion of crowdfunding raises two related entrepreneurial questions: what type of platform suits each entrepreneur's project and how should existing platforms expand? The answer lies in analyzing the field of crowdfunding as a solution to four specific problems: gatekeeping, coordination, inexperience, and patronage (Younkin, Kashkooli, 2016; Yablonsky, 2016). Industry types of platforms also differentiate entrepreneurs' roles. For retail platforms like Amazon the most common roles are complementors and

users: User Enterprises' owners, Data Generators and Providers, Technology Providers, Service Providers.

While studying digital platforms is already challenging because of their distributed nature (Constantinides, Henfridsson, Parker, 2018), developments in the platform entrepreneurship pose even larger research challenges for scholars. The variance in company's digital business performance is a function of differences in the platform resources and capabilities of competing companies. A digital platform is a business-driven framework that allows a community of partners, providers and customers to share and enhance digital processes and capabilities or to extend them for mutual benefit (Burton and Basiliere, 2016). There has been a growing interest in utilizing more than one methodology and method possibly from different spheres of thought within the same intrusion of digital economy and digital platforms.

5 Conclusion

Given the growing dominance of digital platforms and the shared responsibilities of platform governance, studies along these lines can greatly improve our understanding of the characteristics, antecedents, and consequences of effective platform governance and may have important implications for the future development of the platform-driven entrepreneurship.

This paper investigates entrepreneurial roles on digital platforms and platform ecosystems. In the full version of this article to be published in the journal we draw on research on dozens of industry platforms and products to offer a framework for building a successful platform-dependent entrepreneurship built around a multi-dimensional platform ecosystem based on platform stack (Yablonsky, 2018a, 2020) and on the digital value creation framework. The proposed framework is related on our understanding of the emergent DPEE literature, and on the digital value creation cases. The outcomes of the research could be used for planning, oversight, and control over ecosystem management and the use of digital platform entrepreneurship ecosystem's knowledge-related resources for research purposes.

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Digital Transformation and Internationalization: a Complexity Approach

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Abstract

The digital economy has strongly impacted the complexity of the worldwide economy. The rapid advancement of digitization and the impact of digitalization have led to different dynamics of competition and new venture creation. The external environment moves so fast that companies can no longer rely only on their own forces to react and create an offer that is attractive. They need the support of an external, open, digital ecosystem to maintain a sustainable competitive advantage: open source becomes the best option to survive. Big data and the digital ecosystem make it possible for companies of all sizes to work and compete internationally and create scalable products. In this paper we observe the digital transformation through the lens of the "economics of complexity" proposing a new theoretical paradigm to study the phenomenon. Additionally, we analyze the relationship between digitalization and international entrepreneurship focusing on cognitive computing, artificial intelligence and data mining. We then introduce the Italian Cognitive Computing Community and suggests the need to re-shape traditional education contents and dynamics to develop new professional skills and keep firms competitive.

Keywords – Economics of complexity, Digital transformation, Cognitive computing, Digital ecosystems, International entrepreneurship.

Paper type – Academic Research Paper

1 Introduction

Diffusion of digital technologies (big data, artificial intelligence, internet of things, cloud computing and so on), far from being merely an IT evolution, is greatly impacting firm activities, business models, boundaries, cultures and value chains. Such effects are increasingly assuming an international dimension. This explains why the research field of digital transformation is emerging.

On the one hand, the new landscape strengthens the microenvironment of companies whose understanding of markets and input is improving day by day thanks to data. On the other, it increases the complexity of the external environment as it becomes faster every moment. This increased ability to read and interpret data has an impact on the external environment which, inevitably, becomes more complex. Large corporations and new start-ups must constantly adapt their business models as rapidly as possible to react to this change, which big data and artificial intelligence are imposing upon the market.

In this paper we observe the phenomenon of digital transformation through the lens of the "*economics of complexity*" (Section 2).

We start with analyzing the phenomenon, identifying its defining characteristics (section 3). Then we focus on three of the main – partially overlapping – elements of digital transformation impacting firm activities and the economy as a whole: cognitive computing, artificial intelligence and data mining (Section 4). Indeed, in the new era of digital transformation, companies' competitiveness depends no longer on whether they are digital but on whether they learn from their own data. We then introduce the Italian Cognitive Computing Community, aiming to promote the use of cognitive computing technologies and develop new professional skills in line with the digital transformation of the economy (Section 5), and digital ecosystems as the new prevailing organizational mode in the context of current digitalized scenario (Section 6). Finally, we conduct a literature review covering works and research perspectives dealing at the same time with the issues of digitazion/digitalization and internationalization (Section 7). This is followed by some concluding remarks.

2 The economics of complexity

The theoretical approach of this paper is to insert the phenomenon of digital transformation within the "economics of complexity"[1]. The latter term derives from observation of configurations that are based, on the one hand, on complexity of a phenomenological nature (such as that resulting, in the analysis in question, from digital systems and their applications) and, on the other, on an epistemological complexity, which envisions greater sophistication of epistemological views that are used to interpret

[1] *This approach is based substantially on Luhmann's theory on complex systems (found chiefly in Luhmann, 1984), integrated with some other theories on self-referential systems (von Foerster, 1960; Maturana, Varela, 1980; 1984), reflections on the epistemology of complexity (e.g. Morin, 1977; 1984), some concepts from organization studies, such as that of the enacted environment by Weick (1969), and several insights into method in the social sciences (Weber, 1922). For a broader reference to the economics of complexity see Mazzoni, 2007, p. 37 ff.; p. 317 ff.; Mazzoni, 2019.*

such phenomena. Hence digitalization may be observed from various perspectives and with different cultural backgrounds.

The various attempts to incorporate the situations under observation within a scientific-type vision leads to a multiplication of the decodification possibilities, with the consequence of adding to complexity of a phenomenological nature a no less significant epistemological complexity. The latter grows due to the progressive legitimizing of several perspectives which are often difficult to integrate, or rather, in some cases, inconsistent or even contradictory. There is no unifying perspective, no general law able to understand multiform phenomena. Pluralist epistemological views are given credit, in which the objectivity of the subject observed is lost, and the observer enters the phenomenon of knowledge with his/her subjectivity, with his/her values and cognitive maps. It is hard to decide whether the change influences the methodological renewal or whether the opposite is true.

Complexity lies at the basis of contemporary economics because the system in question (firm, network, district, team) is defined by a differential complexity compared with the environment that surrounds it (the environment is always more complex than the system, and the system is self-defined through this diversity). In its attempt to deal with external complexity, the system organizes itself into a structure. On the one hand, this involves an attempt to simplify the external inputs and relationships (as occurs using digitalization systems). On the other, it steers the system towards greater internal complexity (procedures, programs, equipment, and skills for effective digitalization). Moreover, the attempt made by the system to tackle the complexity of the environment produces a system configuration (e.g. through the functioning of digital ecosystems) which generates greater complexity also in the external environment where all the other enterprise systems are to be found (just think of competition phenomena induced by digitalization processes from a single network).

3 Digital Transformation

The term ‘digital economy’ refers to ‘the broader economy as it undergoes the process of becoming increasingly digital’, while ‘digitalisation involves the conversion of things (sound, shapes, information, etc.) into digital data, which can be infinitely (re)processed and stored at negligible marginal cost’ (Gestrin and Staudt, 2018). Digitization is the technical process, whereas digitalization is a socio-technological process of applying digitization techniques to broader social and institutional contexts that render digital technologies infrastructure (Sussan and Acs, 2017).

The diffusion of digital technologies, far from being merely an IT evolution, represents a phenomenon which impacts deeply firm activities, business models, boundaries, cultures and value chains. Thus, what is being called ‘digital transformation’ is affecting both, firms on a micro-level, and industries, markets and more generally the firm's task environment on a macro-level[2].

2 In the economics of complexity, the traditional categories of interpretation – firms as microeconomic entities and contexts as macro scenarios – no longer produce satisfactory analyses.

The digital transformation can be defined as 'the seamless, end-to-end connectivity of all areas of the economy, and as the way in which the various players adapt to the new conditions that prevail in the digital economy' (Roland Berger Strategy Consultants, 2015). It has four main levers (Figure 1).

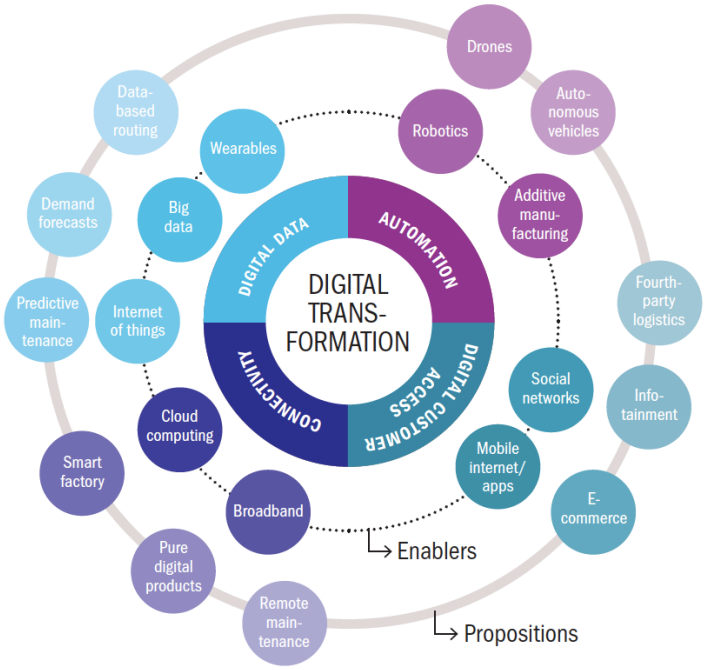

Figure 1: The four levers of digital transformation (Roland Berger Strategy Consultants, 2015) .

DIGITAL DATA. Capturing, processing and analyzing digital data, which allows better predictions and decisions to be made.

AUTOMATION. Combining traditional technologies with artificial intelligence, which is increasingly giving rise to systems that work autonomously and organize themselves, thus reducing errors and operating costs and increasing speed.

CONNECTIVITY. Interconnecting the entire value chain synchronizes supply chains and shortens production lead times and innovation cycles.

DIGITAL CUSTOMER ACCESS. The internet gives direct access to customers, thus globally enlarging their choice options.

This is leading to a new era, in which two phenomena in particular should be subject to scrutiny. First, systems able to self-learn, also *from their own data* (see the section below) and self-organize are being generated (von Foerster, 1960). Secondly, the value chain is being dismantled and redefined in circular and interactive diagrams (see for example the impact of digital transformation on the value chain of the automotive industry in Figure 2).

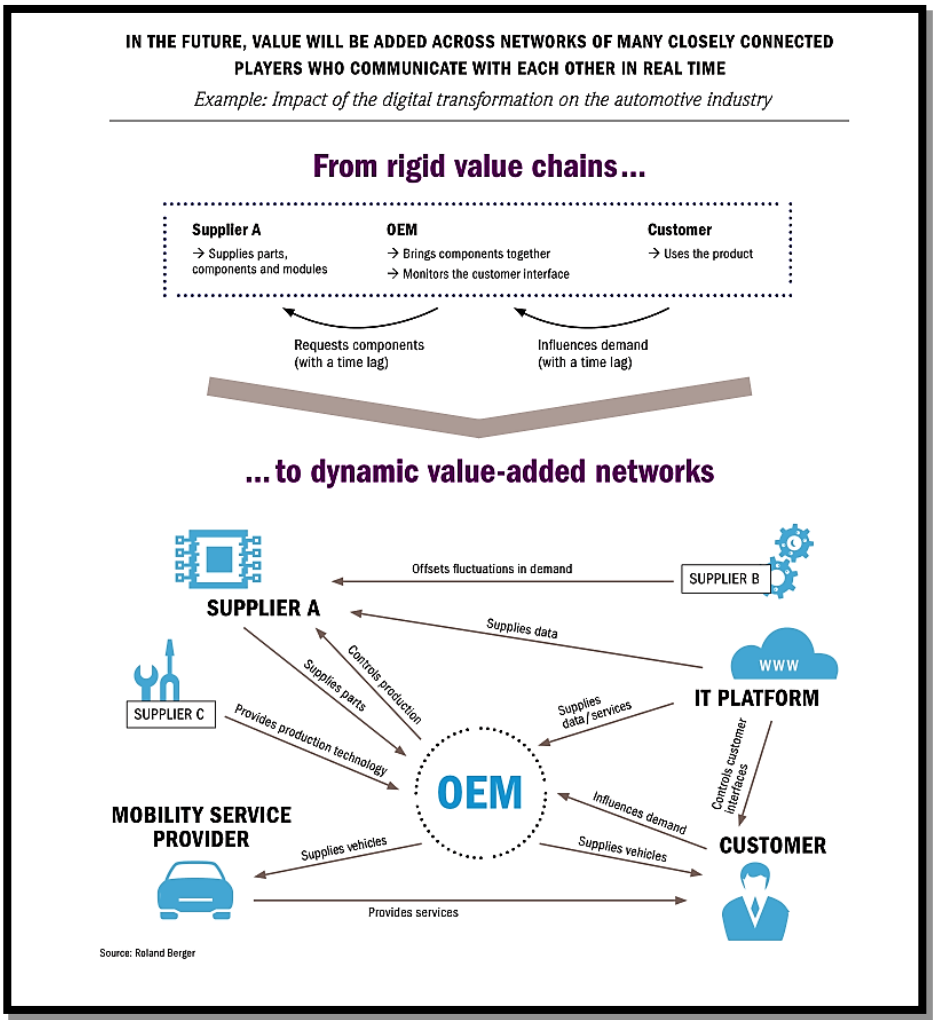

Figure 2: Impact of the digital transformation on the automotive industry (Roland Berger Strategy Consultants, 2015)

4 Cognitive computing, artificial intelligence and data mining

In the new era of digital transformation companies are no longer competitive because they are digital but because they learn from their own data. The new digital technologies aim to support the collection, analysis and processing of big data and thus sustain the decision-making process (Russo Spena and Mele, 2018). The advent and diffusion of cognitive computing (CC) and artificial intelligence (AI) is one of the main drivers of digital innovation. CC and AI enhance human-machine interaction, supporting collaboration.

Cognitive technologies are an evolution in computing that mimics some aspects of human thinking on a larger scale, while adding the ability to handle large amounts of

information and evaluate it without bias (thus surpassing the main limitations of human cognition) (Chen et al., 2016).

Cognitive computing arose as a model based on human beings' reason, whose application is transversal across several domains ranging from meteorology to economics, from the automotive industry to healthcare, from the block chain to retail, from smart cities to cuisine.

We are moving from the era of information to that of knowledge technology: cognitive computing introduces new methods to extract value from data and support decisions (Chen et al., 2016; Russo Spena and Mele, 2018). The definition of cognitive computing is a topic of debate in the computing community. It is often associated with artificial intelligence (AI), a field of technology that covers broad aspects of human intelligence (Chen et al., 2016). Indeed, cognitive computing uses machine learning algorithms to reproduce human thinking, and is thus employed in several AI applications, where AI designates a broad suite of technologies that can resemble human capabilities, particularly those involving cognition (reasoning and problem solving but also perception and the ability to manipulate objects) (Chen et al., 2016; Russo Spena and Mele, 2018).

The explosion of comprehensive data warehouses, which integrate operational data with the customer, supplier, and market data, has led to the release of an incredible amount of information. Therefore, competition requires timely, sophisticated and integrated analysis of such data, in order to identify useful information and react. Data mining tools and services are providing the necessary support to close the gap between more powerful data warehousing systems and the user's ability to effectively analyze and act (Kleissner, 1998).

Data mining offers automated discovery of previously unknown patterns as well as automated prediction of trends and behaviors. Its technologies are complimentary to existing decision support tools and provide the business analyst and marketing professional with a new way of analyzing business (Kleissner, 1998).

5 Perspectives and projects of the Italian Cognitive Computing Community (ICCC)

We are a sociotechnical, interconnected and mobile society, which produces fast, varied and numerous data. Indeed speed, variety and volume are the defining characteristics of big data. How can individuals and companies handle this data in order to extract value? Cognitive computing (CC) can support us in this challenge. Why CC? Because it is shaped on a human brain, it is based on the way human beings think but, at the same time, CC amplifies the power and the achievable results of our mind mechanism.

But how does the human way of thinking and elaborating information work? It is based on four phases: observe, use, evaluate, decide. We observe what is around us, we collect objective evidence, and we use our knowledge to interpret what we see. Then we formulate hypotheses and evaluate them to finally decide. As human beings we are neither too precise nor too fast, and this is where CC can help us and amplify our skills.

To promote the use of cognitive computing technologies and develop new professional skills in line with this digital transformation of the economy, the Italian Cognitive Computing Community (ICCC) was established on May 18, 2018 at the University of Naples Federico II (http://it-cogcom.com). The ICCC aims to promote the use of cognitive computing technologies and accelerate research in this field, thus becoming a point of reference in Italy. The community would like to accomplish, amongst other things, some more immediate goals: 1) to establish an ecosystem in which to share knowledge and growth; 2) to promote links between university research and industry; 3) to sustain research in the field. The actors in this community will be companies, professional organizations, professors, researchers and students who will need to be ready for the future jobs they face.

This revolutionary change leads to the need for the emergence of new skills, which will be based on the man-machine interaction. The process model will probably be that in which cognitive systems will have the ability to extract knowledge automatically from application domains and will be able to build useful knowledge for the professions of the future themselves (Coccoli et al., 2016). In short, the user will interact with cognitive systems directly and therefore will have to be trained to interact with systems with which "we speak" but will have to be able to understand much more complex architectures than those at present (Coccoli et al., 2017). The knowledge generation will be more efficient and rapid, and the transfer into the social world will be the fundamental key for business and the new professions. One of the goals of ICCC is to make this transition to the near future possible.

6 Digital ecosystems

As the organization of knowledge and relationships has become increasingly digital, thus consistently changing the cognitive environment in which companies work and individuals live, new ways of generating and employing knowledge have become feasible, while – as a consequence – previous organizational modes have become obsolete (Castellani et al., 2017).

Looking at interfirm relationships, digital transformation means a shift from more traditional value networks to digital ecosystems.

As the rapid advancement of digitization and the impact of digitalization increase, in order to stay competitive and execute strategies effectively, firms must rely on networks, consisting of multitudes of people and organizations to create innovation and commercialize products (Vasilchenko and Morrish, 2011). This need has led to the emergence of the digital entrepreneurial ecosystem (DEE) defined by Sussan and Acs (2017) as “the matching of digital customers (users and agents) on platforms in digital space through the creative use of digital ecosystem governance and business ecosystem management to create matchmaker value and social utility by reducing transactions cost”. At the same time, digital ecosystems (DEs) “transcend the traditional, rigorously defined, collaborative environments from centralised, distributed or hybrid models into an open, flexible, domain cluster, demand-driven, interactive environment. A digital ecosystem is a

newly networked architecture and collaborative environment that addresses the weakness of client-server, peer-to-peer, grid, and web services" (Boley and Chang, 2007).

The concept of digital ecosystems has been subject to many perspectives and interpretations. Yet despite the divergences, all agree on two foundation pillars of DE – digital technologies and people. Essential in DE is the idea that such an ecosystem is user-driven, bottom-up, and open source oriented (Dini et al., 2011), emphasizing the pivotal role that users play in the ecosystem. Companies need to be flexible, rapidly change their strategies, adapt their business model and react to market inputs. DE and more specifically DEE can support them in this attempt.

However, to come into existence and be effective, digital ecosystems today require the development of necessary "relational intelligence". Relational intelligence is the ability to share an innovative idea and make it practicable. It is the ability to connect those who possess resources (knowledge assets, financial resources, professional skills, products, relationships, etc.) with those who can usefully employ them for their requirements, which requires not only to imagine but also to design, convince, contract, organize the supply chain and reliably fulfill the obligations undertaken (Rullani, 2015). Relational intelligence is a connective resource that, in today's global and digital economy, is increasingly valuable, as the connections among the actors of the supply chain are no longer predetermined nor numerically contained; relationships must be constructed at a distance, choosing among a multiplicity of possible, varied solutions (Rullani, 2015). As the scenario becomes complex and the choice difficult for both suppliers and buyers, agents need to invest to create a substrate of relational intelligence, useful for interacting with the outside world, either directly or through intermediaries specialized in the supply of the relational intelligence supporting choices (Rullani, 2015).

This explains why the new digital competitive landscape has seen the rise of a new company type. Ever since the launch of Uber, Snapchat, AirBnB, Google, Amazon and Facebook, a new variety of company has emerged that uses digital technology, entrepreneurship and innovation to overturn industries on a global scale. These companies are called matchmakers (Evans and Schmalensee, 2016). Matchmakers connect members of one group with another. The core competencies of these companies are their ability to match one group of customers with another by reducing the transactions cost of the match. This trend is also reflected in the decline in the cost of computing, the rise of open-source software and the move to the 'cloud' (Sussan and Acs, 2015).

7 Digital transformation and internationalization

There are many mentions of the importance of 'the digital'[3] in supporting the globalization of production (Foster and Graham, 2017). Castellani et al. (2017) observe there exists an intrinsic synergy between digitization and globalization.

[3] *Foster and Graham (2017, p. 70) use the notion of 'the digital' to define 'the constellation of digital ICTs, connectivity, infrastructure, data and new digital resources that are increasingly crucial in all aspects of the economy'*

Internet-based digital technologies represent one of globalization's drivers, transforming work patterns and divisions of labor and, therefore, influencing the processes of value creation and power exercise. They contribute to shape modern global production networks (GPNs), which represent a key framework to explain linkages, power and structure in globalized production (Foster and Graham, 2017). Nonetheless, Foster and Graham (2017, p. 69) observe that 'while the literature often acknowledges that the digital plays an important role in tying together increasingly geographically dispersed production networks, it rarely explores the digital as anything more than an infrastructural component. There is a disparity between the relative absence of research and the fact that digital data flows and services are increasingly central to the efficient management and monitoring of global dispersed networks. Thus, they propose to better integrate 'the digital' into the GPN framework, as characterized by three main 'conceptual categories': embeddedness, value, and power. As shown in Table 1, they start from the state-of-the-art literature (second and third columns) to propose how the digital might be better integrated into GPN analysis (fourth column)[4].

Table 1: The three conceptual categories on relations in GPNs (elaboration from Foster and Graham, 2017)

Conceptul category	**Coverage in existing GPN literature**		**Conceptual category**
	Use in GPN literature	**Incorporating the digital**	
Embeddedness	Move beyond 'overterritorialized' focus to explore network embeddedness	Embeddedness	***Network diversity*** Problematizing network embeddedness – diversity of digital networks ***Digital (infra)structure*** The digital as an infrastructure in shaping network embeddedness
Value	Value distribution and the network mechanisms which support changes in distribution	Value	***Digitally-driven shifts in governance and value*** Critical approach to new value distribution enabled by digital – exclusionary, spillover effects, who are the winners and losers?
Power	Power mainly seen in terms of agency, but actor-network theory (ANT) offers ways of exploring complex networks in flux	Power	***ANT – Non-human actants*** Considering a central role of the digital in the constitution of actor-networks ***ANT – Translation processes*** Focus on translation processes to better explore power and circulation

[4] *'Embeddedness' refers to the durable relations and norms that guide economic activity. 'Value' identifies how the value is created, enhanced, and distributed in networks of firms. 'Power' refers to the shifting nature of control in networks, and the multiple scales at which they act (Foster and Graham, 2017).*

Thus, digital technologies have profound effects on the decentralization of channel structures and the development of interorganizational networks: they enable new channel partners to be found in foreign markets as well as new digital-only business models that easily cross-national boundaries (Watson et al., 2018).

In a cognitive perspective, it has been observed that digital transformation means new ways of producing and using knowledge assets, which in turn changes the function and importance of geographic proximity (Castellani et al., 2017).

By virtue of digital transformation an 'empowerment effect' is generated. SMEs can gain access to digital networks and interact with distant counterparts, differing from the usual ones based on proximity (Castellani et al., 2017). This is important given that, in today's fast-paced business cycles, early internationalization becomes imperative (Sapienza et al., 2006), especially for smaller born global firms, as windows of opportunities do not stay open for long (Vasilchenko and Morrish, 2011). In this perspective global value chains (GVCs) appear a means by which export-oriented production is operationalized in a globalized world (Foster et al., 2018). However, prior research yields contradictory results, as firms might benefit from connectivity through increased efficiencies and improved access to markets. Or vice versa, they might be further marginalized through increasing control of lead firms (Foster et al., 2018).

Interestingly, digital technologies have given rise to new businesses and international business models that allow firms to extend their presence globally without significant amounts of foreign direct investment (FDI) (Gestrin and Staudt, 2018).

The ability of firms to access international markets with smaller "asset footprints", thanks largely to the digital economy, has also been associated with the emergence of so-called micro-multinationals and born global firms that quickly attain global reach with minimal cross-border investment (Gestrin and Staudt, 2018).

From an international investment perspective, the main implication is that "the trade-off between exporting and market-seeking FDI as market entry modes for delivering products to host countries may be shifting toward exporting" (Eden, 2016, p. 6). While reasons for market-seeking and efficiency-seeking FDI are partially undermined by digitalization, other types of FDI are becoming more important, such as knowledge-seeking and financial and tax-driven FDI (UNCTAD, 2017).

While FDI continues to play an important role as a means of expanding internationally for firms in more traditional "bricks and mortar" industries (outside the digital economy), there has been a modest contribution of digital firms to overall cross-border investment flows: Digital firms only generated USD 153 billion of cross-border M&As in 2017 (13% of total cross-border M&As) and the 100 largest digital economy MNEs only accounted for USD 20 billion in cross-border M&As in 2017, about 1% of total cross-border M&A (Gestrin and Staudt, 2018).

However, recent trends suggest that the role of digital firms in international investment flows is growing as they are rapidly increasing their cross-border physical presence: Global cross-border M&As by digital firms since 2010 have recorded an average annual growth rate of 30% (against general 9% of global cross-border M&As) and the 100 largest digital firms grew their cross-border acquisitions on average by 90% annually over

the same period, a large share of this international investment going into digital infrastructure (Gestrin and Staudt, 2018). Also, knowledge-seeking FDI (e.g., cross-border acquisitions of software developers) has been an important driver of growth in cross-border digital investment. A key factor behind the recent rapid growth in M&As directed at acquiring digital assets is the sharp increase in cross-border acquisition of digital corporate assets by firms outside the digital economy: While until 2014 non-digital and digital firms were roughly equal in terms of their acquisition of digital assets, since 2015 the former have significantly increased their digital acquisitions (from acquiring USD 78 billion in digital assets in 2013 to acquiring USD 458 billion in 2016) (Gestrin and Staudt, 2018).

As previously observed, the effective use of digital technologies can facilitate valuable learning about foreign markets and potential international customers, including cultural, political, and economic contexts, impacting on international market entries (Watson et al., 2018).

On this point it is worth noting that there is ample scope for the practical application of artificial intelligence: Effectively implemented, AI systems are likely to outperform statistical-based tools for complex, qualitative, or difficult-to-program problems and decision making (Martínez-López and Casillas, 2013; Watson et al., 2018).

As shown by Fish (2006), AI can support international market selection (IMS). The study uses empirical data to demonstrate that an AI approach can assist the market screening phase of IMS, providing information that is not readily available by standard statistical techniques. The purpose of the screening process is to allow the firm to quickly focus efforts on the most promising foreign markets by identifying a group of markets that merit further research.

Fish (2006) applies artificial intelligence (AI) computing in the form of Kohonan Self-Organizing Maps (SOMs). Self-Organizing Maps organize data in a manner that is inspired by how the human brain organizes received external inputs. 'The salient benefit of the SOMs is their ability to take classes of vectors that are similar in high-dimensional space and display them in two-dimensional space, where humans more easily visualize them. In this regard they are a type of DSS model that is distinct and different from standard clustering techniques. The DSS is an easily interpretable map that displays markets which are very similar to each other in the same cells. Markets that are somewhat similar are grouped in neighboring cells and, markets that are very different are found in cells that are a great distance away on the map'. Moreover, it has been observed that SOMs can assist small firms in making decisions about optimal overseas market locations (Fish and Ruby, 2009).

Accordingly, Gnizy (2018) proposes big data (BD) as a key driver of strategic orientations, empirically finding that BD usage enhances international performance through strategic orientations.

8 Conclusions

The field of digital transformation is still new and emerging. At the beginning, scholars started to describe a phenomenon not fitting with pre-existing paradigms. Now that the

phenomenon has a more complete description, attention is shifting onto describing its existence and behavior, initially borrowing paradigms developed elsewhere, and then developing new frameworks (Sharon and Burney, 2008). Thus, investigation of the digital transformation is moving from the concrete description of the digitalization-digitization phenomenon to the attempt to develop theories to explain digital transformation and its consequences (Sharon and Burney, 2008).

In this vein, from a theoretical point of view this paper contributed to this emerging field by proposing the *economics of complexity* as a paradigm to observe and study the issue of digital transformation. On the one hand, tools and services of the digital transformation support either big corporations or small companies in dealing with the complexity of the external environment. Data mining, AI, and CC are all ways to simplify external and internal inputs, in order to reveal potential ways to react, which are otherwise impossible to identify due to the quantity of information and the speed of market changes. On the other hand, in such a complex scenario where the categorization of firms as microeconomic entities and contexts as macro scenarios no longer exists, digital ecosystems allow companies to participate, innovate and compete globally in a new and unexpected way.

Digitalization involves an attempt to simplify external inputs and relationships. However, it also steers the system toward greater *internal* complexity (procedures, programs, equipment, and skills for an effective process of digitalization). Moreover, the attempt made by the system to tackle the complexity of the environment produces a system configuration (e.g. through the functioning of digital ecosystems) that generates greater complexity also in the external environment where all the other enterprise systems are to be found.

In the new digital transformation era, venture management means rethinking existing business models and being ready to work in a global digital ecosystem, accepting and implementing new mechanisms of knowledge creation, sharing and management, and creating and using new skills. Moreover, the open source model on which the global digital ecosystem is based makes it necessary to further analyze and develop mechanisms of value appropriation within a new knowledge management paradigm.

As seen in Section 7 above, digital technologies intrinsically foster internationalization. Although some studies already deal with this issue, there is still a need to analyze the international dynamics of global digital ecosystems from a managerial point of view. Even though the adoption of digital technologies has been one of the most significant international business developments of the past 25 years, fewer than 3% of peer-reviewed research articles in the international marketing (IM) domain (comprising thousands of publications that study various aspects of the exchange between international buyers and sellers) examines digital topics (Watson et al., 2018). Looking at big data (BD), Gnizy (2018) argue that research on the use of BD and its effects in international firms is in its embryonic stage.

From a managerial and policy making point of view this suggests the need to re-shape traditional education contents and dynamics. A fairly common idea is that while some of the new skills will come from different domains (cognitive psychology, developmental

methodologies, education, social behavior, economics), many other professions will have to be re-grounded in skills such as communication, teamwork, problem-solving, creativity and resilience, leading to new professions such as cognitive system developers, cognitive system integrators, cognitive evaluators, cognitive trainers, etc., all needed along with data scientists and data integrators.

The following kinds of professional skills could be useful in this respect:

(i) Multi-disciplinary:

An integrated skill set that covers math, machine learning, artificial intelligence, statistics, databases, and optimization, along with an in-depth understanding of engineer-specific troubleshooting.

(ii) Multi-domain

Learning aware of the existence of contexts other than those in which it was generated, e.g. socio-economic, in sectors such as medicine, energy, the environment, finance, transport, etc.

(iii) Multi-empathic

Professionals will have to interact with

- Human beings: as data / generators of knowledge / consumers
- Cognitive systems: they will be instructed (not programmed)
- Human beings in augmented reality (assisted by devices and gadgets)
- Robotized systems
- Hybrid - a set of previous points

(iv) Multi-interaction and multi-communication between people and things.

As to who will have to produce all these new professional skills, there is no doubt that universities should take such tasks on board. Yet at the current rate of change we are constantly behind schedule, in deficit. Hence the question is how to anticipate change and turn the deficit into surplus. Cooperation between academia and industry will probably help to achieve the goal. The role of the academy will be different but always central: the university of the future will shift from the role of "*knowledge generato*r" to the role of "***generator of knowledge generators***", a "meta-model" vision in which all together, universities, organizations and companies, learn from each other by becoming "smarter" and more "cognitive". Knowledge must be generated more intelligently, and the new professions will become increasingly cognitive with new technicians to be trained and new skills.

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Strategic Airport Management Considering Digital Transformation Demands: Case Study Research at Fraport AG, Germany

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Abstract

The purpose of this paper is to grant insights into airport customers' perceptions regarding the use and appropriateness of digital features. It is worth to examine whether sharing these findings with experts in the context of knowledge management activities reveal strategies and processes to be adjusted on corporate level. The question is whether defined strategies always respond to actual customer expectations and if sharing digital intelligence on a collaborative level could prevent airports from choosing inadequate concepts and process optimisation models.

A qualitative approach has been applied to assess airport specific digitalisation features including airport staff s' expertise compared to the perception of airport passengers and their demands. In order to contrast realistic customer experience with internal views primary data has been collected in the form of airport manager interviews and passenger questionnaires.

Artificial Intelligence, Big Data, Machine Learning as well as Internet of Things being constantly developing and dynamic topics require organisations to exchange knowledge and data with customers. The main outcome revealed airport managers' assumptions differ from passengers' needs and interests.

Key findings of the paper revealed that top priorities perceived by passengers are not represented by entertainment and shopping facilities whereas airport professionals tend to focus a lot on these features. Process optimisation and simplification of check in and boarding activities play a much more important role to airport customers. This also implies that strategy definition processes can be performed more efficiently when considering and communicating consumer-oriented needs. Since the paper deals with strategic management and service operations these widely discussed and on-going topics are worth to be improved and optimised using knowledge management instruments within the organisations and its collaboration with customers.

Keywords – Knowledge Management, Digitalisation, Airport Industry, Customer Experience, Knowledge exchange in collaborations

Paper type – Academic Research Paper

1 Introduction

The fact that globalization favours the increase in passenger numbers to be transferred through airports in an efficient and time-saving way forces airport managers to rethink long-term strategies. Airports face the challenge of rising passenger transfers for a number of years and need to define and develop new strategies and concepts to be able to cope with changing demands and "to stay afloat" (Andreassen et al., 2015, p. 25). Another aspect is the intense technological progress and the requirement to keep pace with digitalisation demands of different target groups (Abdelaziz et al. 2010; Aloulou, 2019). In times of inevitable digital transformation and enhanced technology demands airports are forced to involve digital solutions to handle the mass of customers through more efficient processes (Bolton et al., 2018).

Digitalisation eases data collection and allows the use of remote control and automation features (Davidsson et al., 2016; Kauffman and Weber, 2018). A company such as Fraport AG in Frankfurt is an example of how passenger flows are managed successfully and what an organisation needs to take into account to satisfying its customers on the one hand and to comply with latest trends of the industry on the other hand.

Hence, it can be assumed that the analysis of passenger's perceptions and needs may reveal aberrations and discrepancies when comparing these to assumptions airport professionals and experts tend to have. The motivation was to gain knowledge about potential trends and misconceptions to enhance the performance of the case study company Fraport AG through process optimisation solutions and a better understanding and response to passenger needs.

The purpose of this study was to evaluate current and future challenges of airport specific management tasks regarding cost-effective transfer processes and efficient customer handling to recommend implementation approaches for Fraport AG by taking emerging digitalisation requirements into account. The underlying research question was as follows:

How to ensure a smooth customer experience at an airport through knowledge management while coping with process enhancements through digitalisation? - A framework of influencing factors and potential measures for information exchange.

To find answers to this question the following research objectives have been defined:

- To analyse current and future challenges of airports in managing successfully the increasing digitalisation demands in the air transportation sector

- To examine passengers' expectations regarding digitalisation requirements that enable information exchange at airports based on a knowledge management approach
- To reveal outcomes from customer satisfaction analyses to be implemented and considered in process optimisation through knowledge management
- To recommend customer related knowledge sharing means to be considered for the future implementation at airports

2 Critical Literature Review

2.1 Key challenges of the airport industry

Airports are associated with congestion issues, time intensive queueing and stressful security checks. In times of rising passenger numbers an airport needs to identify ways of structuring their processes in a more efficient way.

Firstly, the question will be how to ensure safety in an increasingly crowded environment with rising use of data and technology? Secondly, according to the Garcia (2018) digitalisation produces transparency and has the potential to dissolve boundaries. Often the airports processes mainly focus on peak time, times in which the highest volume of passengers and customers in general are transferred through the building and terminals as well as processed for boarding at the gates. Rothe (2018) and Zografos et al. (2017) stress that the rethinking towards a more sustainable capacity planning instead of peak-hour facility planning is essential.

One example is Frankfurt Airport whose terminal capacity of 64 million passenger per annum will be exceeded by 2021 (EOACQ, 2015).

2.2 Digitalisation at airports

According to Larsen (2013, p.3) "the primary aviation data sets include flight tracking data, airport operations data, weather conditions, airline information, market information, passenger information, aircraft data and air safety reports".

Digitalisation is assumed to referring to a major remodelling of societal aspects and relationships through the application of digital technology. Digital transformation of a company is a "multi- faceted phenomenon that originates from the synchronous adoption of the bundle of digital technologies" (Lanzolla et al., 2018, p. 379). The following technologies can be considered at airports:

- Artificial Intelligence are software algorithms to find solutions to complex problems
- Big Data from sources such as sensors, digitizers, scanners, numerical modelling, mobile phones and the Internet
- Block Chain are information blocks to exchange content among applications and data bases in real-time processes

- Automation of processes that are mostly performed automatically and controlled by an autonomous device such as Robotics (electromechanical or bio-mechanical device) and
- Combination of these technologies described as Internet of Things solutions.

These digitalisation elements offer a great potential but mean significant investments, a potential loss of work places due to automation solutions as well as the adjustment regarding data protection responsibilities (Parviainen et al., 2017).

In addition, the digitalisation can bring new business opportunities, change the roles and remove intermediates in the supply chain and leads to competitive advantage (Robinson et al., 2015; Gillen and Lall, 2004).

Process optimisation by applying digital solutions such as increased automation or self-service mechanisms for passengers in order to attract more end-users is in focus (Biehl, 2017). Responding to latest trends but at the same time being available for generations that might not be as familiar with digital features and devices is a key challenge (Woods and Davis, 2017). One example are information kiosks where passengers can get in contact with either an automated bot [1]or via real-time chats with an individual that provides support (Hwang and Seo, 2016). Singh et al. (2019) indicate this as 'supervised and unsupervised learning'.

Davidsson et al. (2016) refer to possibilities of collecting and categorizing data, tracking patterns, behavior and preferences with which airports have access to numerous sources of customer information .Machine-generated data is produced in much larger quantities than non- traditional data. It is moreover available in real-time and can be accessed through networks (Wilkesmann and Wilkesmann, 2017). Airports are therefore required to know how to manage this customer information in a compliant way (Gopalakrishnan et al., 2013).

2.3. Digitalisation as main driver for enhanced efficiency

Xiangmin and Li (2017) argue that accurately installed and used software can enhance the prediction in departure capacity and allow analysing passenger flows more accurately. Adler and Gellman (2012, p. 24) call it "computer-centric air traffic management" that require capacity restructuring but develop business model adjustment to be competitive.

There is a growing demand for customer centric service delivery and orientation for airports in order to meet the expectations of older generations and the desire of younger generations to experience a digital, easy and entertaining journey (Arif, Gupta and Williams, 2013).

The aspect of drones are usually associated with risks and dangers as well as being disruptive objects for all airport operations that have to be handled with anti-drone equipment accordingly (Penton Media, 2019) but drones are becoming relevant for

[1] *Chat bot = a computer program designed to simulate conversation with human users*

operational efficiency and security matters in particular (Norman, 2018). According to Labeodan et al., (2016) sensors help detect capacity shortages, improve occupancy-based lightning and also allocate resources in a better way.

Besides Flight Information Display System (FIDS) and its expansion to passengers' devices one can observe a rise in implemented self-service machines such as self-bag-drop solutions, check-in, boarding pass printer machines, electronic passport control checkpoints. According to the Passenger Terminal World Magazine (2018) such resources could then be positioned where elderly people require assistance from a human being.

2.4. Digitalisation as an enabler of knowledge sharing with customers

Digitalisation makes it easier than ever to access, modify and analyse data in order to use it in innovation or business process modelling procedures by applying knowledge management (KM). According to de Felice et al. (2019) the basis for innovation and therefore competitiveness is knowledge and its sharing with both internal and external parties. Social interaction becomes the centre of knowledge management in order to enhance customer satisfaction and process efficiency. By using the benefits of interaction with external relations such as partnerships and alliances, the success of firms – in particular during digital transformations – can be fostered. Another significant point of using a knowledge management approach is stated by Nezakati et al. (2015) who argues that travelling has become an information-intensive environment that enables organisations to understand and discover consumers' demands. Bolisani and Scarso (2019) refer to it as knowledge transfer or knowledge creation in order to incorporate outcomes of customer satisfaction activities into strategy definition. Through easily accessible apps and digital platforms, passengers create, share and exchange information and individual patterns. Those can be implemented to process optimisation procedures by the respective organization.

In the context of airport and airport lounge design Conforte (2017) confirms the significant impact customer satisfaction can have, when shared information regarding expectations, needs and interest are analysed and implemented by using empathy for the passenger. Gao et al. (2019) further argues that not only for customer satisfaction but also for overall organizational goals KM is highly important and is best achieved by activating the personnel's individual knowledge and knowledge sharing with stakeholders. Hence, using information and spread them through knowledge sharing may turn knowledge into "profitable industrial commodities" (Gao et al., 2019, p. 10). Since more automated process implementations together with the analysis of customer needs can lead to profitable business modelling the knowledge on this can be shared and further developed by e.g. online trainings (Kovynyov and Mikut, 2018).

In a very diverse and growing environment such as the travel industry and aviation related industries, Paschek et al. (2017) stress the importance of creating innovative opportunities and new skills through knowledge sharing in order to ensure one's

persistence on the market. Nonetheless, all used information and knowledge must be managed accordingly and in a professional and beneficial way as Stone et al. (2017) stresses.

3 Methodology and Methods

3.1 Case study research

The methodology is based on a qualitative approach when a specific case in-depth should be studied. The inductive exploratory approach was applied as an overall problem is transferred to a specific area.

Case study research explores a contemporary phenomenon in depth and within a real-world context (Yin, 2018). Since the research seeks answers to the research questions 'how' Fraport AG should handle future digital passenger requirement a single case study research with two primary data collections was used.

Yin (2018) posits that multiple case studies are popular to either compare deviating results for expected causes or suggest similar results within the cases. Grant et al. (2013) argue that especially the additional "user value of IT innovations" (p. 1507) can hardly be measured with traditional approaches..

3.2 Primary Data collection and analysis

For this study passenger surveys at three German airports (Frankfurt, Hamburg and Munich) took place to reveal insights of passengers' expectations that were not limited to the location and facilities of the case organisation Fraport AG.

According to Gall et al. (1996) 150 completed surveys represent reliable and credible research. Between February and early April 2019 anonymous surveys with a target group of business travellers and holiday travellers have been carried out at three airports as well as online via the survey platforms 'SurveyCircle.com' and 'EasyFeedback.com'. A number of 225 people received the survey from which 193 completed questionnaires could be achieved. The questionnaire consisted of 14 open and scaled questions covering the topics of digital habits of airport customers and digital features.

In addition ten semi-structured interviews were carried out within Fraport AG to analyse what directly involved aviation professionals think are the demands of passengers.

All of the selected interviewees are practitioners of the airport industry and employed at the case company Fraport AG (e.g. Head of Corporate Development, Head of IT Project Management, Head of Cleaning Services). The semi-structured interviews using mainly open questions were conducted on-site at Fraport AG in Frankfurt between the 11th March 2019 and 1st April 2019.

To present the results a qualitative content analysis with a matching of patterns as suggested by Yin (2018) was performed. Thereby, a frequency analysis was chosen in order to find out what nouns or codes were used by how many participants.

4. Findings

4.1 Efficient process optimisation

The top three missing elements at airports according to passengers are charging possibilities, a reliable and fast Wi-Fi connection and rest areas designed for working and relaxing while using digital features.

Asking for the satisfaction of elements at airports revealed that 54% of passengers miss a fast and failure-free internet connection. A significant portion of dissatisfaction (42%) is caused by insufficient charging options (see figure 1). In the context of the increase in the use of digital solutions this is a clear deficit.

For a better readability, passengers' responses 'very satisfied, 'rather satisfied' and 'satisfied' have been combined to 'Satisfied' in the graphic. The same applies to the dissatisfaction data 'very unsatisfied', 'rather unsatisfied' and 'unsatisfied'.

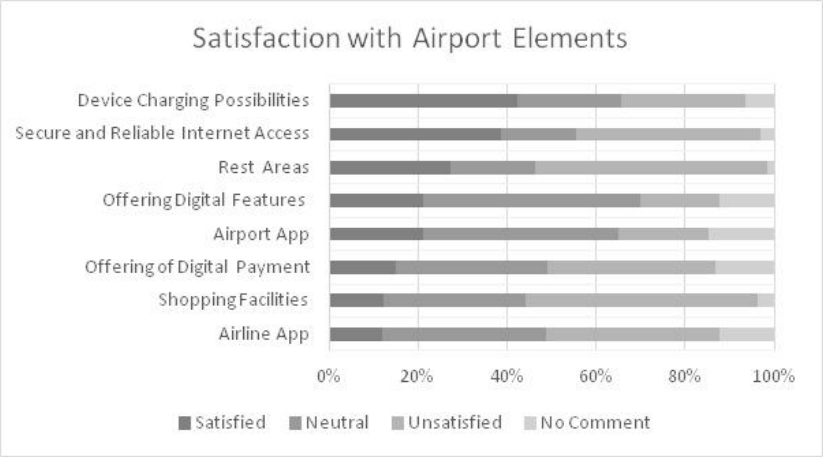

Figure 1: Passengers' satisfaction with airport elements

It became obvious that 67 % of the passengers of all generations rather agree to equip processes with more digital solutions such as electronic passport control or self-check-in to reduce waiting times and to increase efficiency. In regard to digital maturity, no clear attitude became obvious (see figure 2). For a better readability, the graded responses of the questionnaire were summarized to agreement and disagreement.

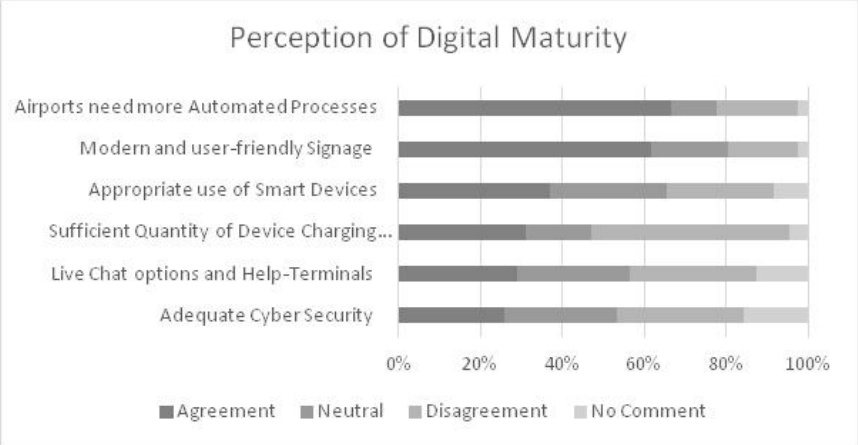

Figure 2: Passenger perception of the airports' digital maturity

While 60% of the Airport professionals agree that a fast internet connection is important only 40% realize that enough device charging possibilities are highly important for passengers. Nonetheless, the above mentioned lack of digital maturity were confirmed by the interviewed airport practitioners who agreed that additional digital solutions are required to handle current and especially future passenger transfer situations (Westerman et al., 2014).

Another interesting result is a deviating assumption of airport employees who think that passengers are significantly interested in digital entertainment solutions while the majority of 75% declared them as 'not important'. In addition, four out of ten airport professionals consider management strategies to be insufficient and need to be adjusted towards more technological advances to share data among stakeholders more extensively so that not only parts of information are passed on.

4.2 Managing increasing digitalisation demands

Passengers and airport professionals concluded that the increasing use of automated digital features at the airport will optimise passenger processing activities. More than 76% of passengers use the airport internet system which requires to be improved in regards to reliability and speed. About 42% use google maps extensively at the airport. This indicates to offer better navigation options at airports in order to make passengers use airport services rather than google maps. There are several features in the Fraport App but it lacks of self-explanatory design.

A significant amount of respondents (49%) stated that they don't use the airport app because the Wi-Fi connection is unsatisfactory. Moreover, one third (33%) of passengers does not even know about airport apps and digital services. Missing elements of airport apps demonstrated that passengers miss clarity and a user-friendly handling of help desks, emergency notification and live-chats with customer service. This leads to the number of

31% participants that would rather use the airline app than downloading the app of the airport.

In general, airport customers notice the challenge to manage rising passenger numbers. A central aspect is the reduction of waiting time and the offering of well-organized and functioning services that allows the passenger to use the time efficiently by accepting digital process optimisation.

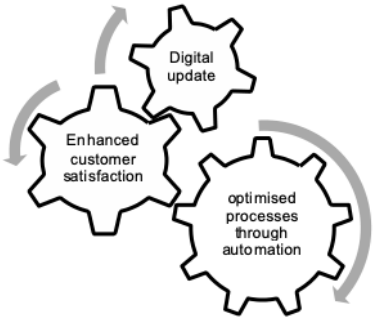

Figure 3: Interrelation of digitalisation and customer satisfaction

4.3 Potentials to avoid performance deficits

With the basis of 88% of passengers considering the airport Wi-Fi as 'important' the basis for implementing more digital services is given. Passengers indicated the interest in more assistance through apps. Whether it is the airport map that helps navigating through the area or a restaurant menu that helps spending waiting times with already choosing the restaurant for lunch, passengers request real-time data to be applied in order to ease and improve the stay at the airport. The likelihood for passengers appreciating additional digital services is high and needs investment. The phrase 'customer assistance', 'real-time help' or 'contact point' where mentioned several times with a frequency of 136 times checking this box in the survey or asking for this in comments.

Airports currently do not offer sufficient high quality working environments and tailored app features because airport practitioners deviate from perceptions of airport customers. Therefore, analysing passengers' needs remains important and digital offers as well as terminal equipment and architecture can be enhanced.

5 Discussion

5.1 Efficient process optimisation at airports

Customer service has to be organized in a highly efficient way to keep the travel time short and to ensure capacity for subsequent passenger flows. The findings show that

potential improvements exist internally when it comes to processing data and tasks to provide airport customers with all information. It shows that efficiency matters significantly but leaves room for the interpretation that more process optimisation and initiatives to familiarise with the new digital environment are required (Riedl et al., 2017 and Ramseook-Munhurrun, 2016).

However, especially holiday travellers try to escape from extensive technological use and digitalisation in their daily lives. Therefore, their interest in using digital services is limited to flight delay information and gate allocation. Business travellers more often appreciate a wide range of digital service and connectivity reliability. The growing popularity of the airport as the starting point for journeys increases the demand for latest technology implementation likewise (Dorndorf et al., 2007). Technological change and various stakeholders' needs demand the incorporation of digital features.

Another constraint of applying latest technological achievements is the fact that modern airport operations being equipped with digital features are unlikely to work effectively with outdated processes or mechanisms. Consequently, significant investment is required in order to process and use collected data from the passenger processes accordingly.

Nevertheless, digitalisation lack of financial resources needed for the implementation of a new digital business model. “The relative pessimism linked to budgets and business cases stems from the nature of digital projects as they deal with disruptive innovations and new business models for which there is limited or no past performance data and management heuristics” (Kotarba, 2017, p. 135). It therefore makes more sense for airport management to analyse and know customer needs in depth before adjusting processes in the context of value co-creation through customers (Majra et al., 2016).

Self-service check-in machines offer benefits such as optimised use of limited space within the airport, time savings for passengers and a decreased need for ground handling staff (Kovynyov and Mikut, 2018). Thus, airport management boards have to estimate and forecast customer needs and passenger requirements in an appropriate way. If data and internal processes or interaction are not effective false outlooks lead to deficits that should be improved (Pinon, 2012).

5.2 Managing increasing digitalisation demands

Fraport employees already support the common approach to put the customer in the centre of all activities to keep customer service excellence at a high level. A challenge is to know exactly the needs of all different passenger categories (business travellers, holiday travellers, different generations). The first issue is the offer when it comes to internet access and a secure and attractive connectivity. Additionally, services such as booking administration, online queries at customer service, online feedback possibilities are unlikely to be used if the internet access and availability is insufficient. The organisation of transfers and transportation of passengers via their smartphone

might reduce the number of passengers at information and service points (Kalakou et al., 2015).

A contrasting scenario is shown by passengers who are not interested in digital services. For those people personal contact points such as customer service, information kiosks and check-in counters will remain a relevant part of their travel (Hwang and Seo, 2016).

There are different opinions regarding the importance of the correlation between existing and well-functioning digital equipment and the future upgrade of airports. It is to question if airport management focus on relevant elements. The finding that 30% of airport customers do not even know airport apps leads to the recommendation that Fraport could promote their app in a better way. Also, digital solutions need to be extended to connect to passengers before they even reach the airport.

The majority of passengers expect an airport to be equipped with latest digital features that allow an easy connection of passengers, the airport, airlines and destinations (Mezghani and Aloulou, 2019). Any airport management approach should thus seek for ways to respond and fulfil this expectation to ensure an above average satisfaction and hence superior reputation (Manor, 2019). To conclude, investing time and money in the digital transformation of airports may be challenging but is a way to respond to customer needs

5.3 Potentials to avoid performance deficits

If airports introduce digital features such as automation for process support it is a matter of financial assets, political bias and societal demands. One example for efficiency improvement at airport premises derived from the interviews are extensive checks by facility management on buildings being replaced by drones. A lot more body scan machines could help to clear a higher number of passengers in less time.

Referring back to the airport app, airports are currently attempting to counter the fierce competition by entering into cooperation agreements with their retail business partners. By establishing joint ventures in the development of the airport app, they aim to ease the joint use of the airport app by customers at several airports. Examples are the airports in Singapore, Dubai or Paris. In the future it is required to apply commercial airport models. The case company Fraport AG is already working on exclusive commercial offers (e.g. extended Porter Service) in order to respond to such societal demands. Nonetheless, International Air Transport Association's (IATA) already works on an alternative solution that does on facilitating the efficient and smart use of existing capacity, space and buildings: Project NEXTT means 'New Experience in Travel and Technologies'. It covers off-airport activities, advanced processing of passengers and goods as well as the implementation of interactive decision-making models. Customers and their feedback and needs are required to be collected and managed in order to improving processes towards a more digital and hence more efficient way of working (Garcia, 2018).

6 Conclusions

With the knowledge derived from conducting interviews and surveys it can be concluded that deviating perceptions exist when it comes to digital entertainment and the adjustment of shopping facilities. This is a hint to a lack in knowledge management and information sharing activities since passengers do have the right channels to articulate their needs.

A special focus has to be laid on expecting passengers to increasingly take over responsibility for certain activities with their electronic devices. This require a self-explanatory and easy to use connectivity and data processing.

A shift of personnel away from tasks that can be performed by smart devices (machine learning, robotics, automation) and towards process support where technology takes over is much more likely to lead to savings and competitive advantage.

Further, analysing the different generations or age groups could reveal which generation is mostly present at the airport. The focus on specific needs and expectation could be rearranged to better respond to most important and urgent requirements. Linked to knowledge management this can be a real value-add in today's organisations.

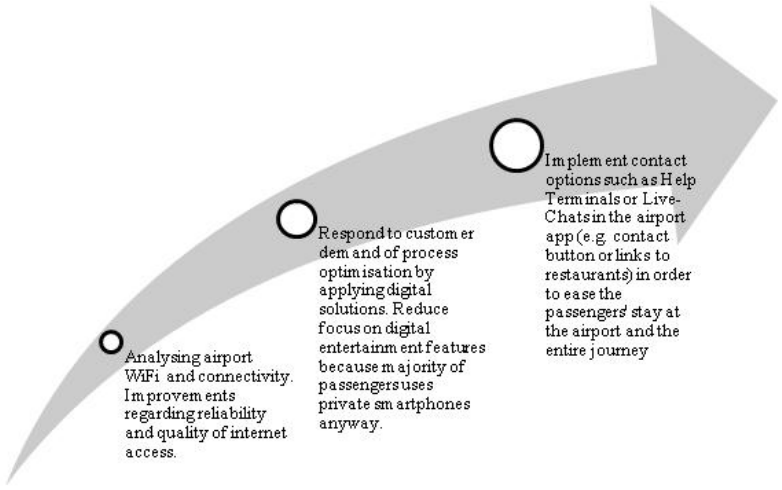

Figure 4: Potential action plan for airports

Since this study is limited to one case company it would be interesting to expand this research to compare the performance of airports on an international level, especially the more developed digital maturity of Far East airports for example. An investigation of passengers' experiences regarding the differences of airports such as Dubai or Qatar compared to German or European airports could reveal different results.

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Bridging the Knowledge Gap Using Design Science Research: the Design of a Case-Based Reasoning (CBR) Application for Source Water Protection in Environmental Decision-Making

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Abstract

In this paper, we share our experience in applying Design Science Research (DSR) for knowledge management and knowledge transfer in the context of source water protection (SWP) in the province of Quebec, Canada. This research is motivated by the challenges, faced by various stakeholders, of implementing Quebec's new provincial regulation for SWP, adopted in 2014. In fact, SWP implementation is complex due to multiple stakeholders, multiple jurisdiction levels, complex tacit and implicit knowledge and external factors (social, environmental, political contexts). Our goal as university researchers is to contribute to improving the general understanding of Quebec's water governance and to facilitating the knowledge transfer in environmental decision-making processes. In order to attain our goal, we focused on designing a knowledge-based decision support system (DSS) prototype using Case-Based Reasoning (CBR). The methodology included a

survey and interviews with over 200 respondents in order to identify knowledge sources, gather and structure knowledge and capture the requirements for a DSS.

Keywords – Design Science Research, Source Water Protection, Knowledge Management, Decision Support System, Case-Based Reasoning

Paper type – Academic Research Paper

1 Introduction

As *"an educational institution designed for instruction, examination, or both, of students in many branches of advanced learning"* (Oxford University, 2020), universities have always been a place to learn where knowledge is created and shared. From a knowledge management (KM) perspective, universities are seen as knowledge creators through three main functions: the education of students, the development and sharing of research, and their participation in social and economic development. This has led to the concept of entrepreneurial universities (Hermans & Castiaux, 2007) that emerged in a context where universities have new responsibilities to society, such as economic and social development, health service improvement, innovative technologies, etc. (Guerrero et al., 2006). Furthermore, the decrease in public research funds has forced universities to search for new sources of income by becoming involved in public-private consortiums or by developing research & development partnerships with public and private organizations. These organizations are often direct users of universities' research outcomes, including standardized questionnaires for social sciences, algorithms in computer science, new technologies in natural sciences and engineering, clinical procedures for health sciences, etc.

Unger et al. (2017) present various classifications of entrepreneurial universities including research-preneurial, techni-preneurial, inno-preneurial and commerce-preuneurial. Each of these has its own specificities that describe the interactions between the university and society. In this paper, we present an applied research project that fits within the boundaries of a techni-preneurial university. As a matter of fact, the research is conducted within a research center that focuses on applied multidimensional research, is mainly financed by public funds and is based on a strong partnership between stakeholders, be they researchers, public, associative or private organizations. Our project's focus is on a real decision-making issue through which the university can have a real impact on society, namely source water protection (SWP).

Since water is an essential resource for both ecosystems and human activities, the UN has adopted, in 2015, the Sustainable Development Goal (SDG) No. 6 for "Clean Water and Sanitation". Along with 16 other SDG aiming to promote a global framework for sustainable development, SDG nº6 sets ambitious targets for water pollution prevention (target 6.3), integrated water management and local stakeholder participation (targets 6.5 and 6.b) (UNESCO—IIWQ, 2016). However, in practice, the implementation of this SDG poses a major decision-making challenge since it is bound to involve several

stakeholders, decision-making levels and mobilize multidisciplinary knowledge. The complexity of this issue led our research team to formulate the following research question in the context of Quebec Province, Canada:

As academics who depend on public funds intended to help society, how can we help break down silos and bridge gaps within and between organizations (public, private) and contribute to knowledge transfer and exchange among stakeholders involved in source water protection?

The research presented in this paper was conducted within the Design Science Research (DSR) paradigm, a research approach for problem solving that has been widely used in information system (IS) research (Baskerville et al., 2009; Carlsson, 2007; Goos et al., 2010; Johannesson & Perjons, 2014; Peffers et al., 2007; Pirkkalainen, 2015). It focuses on the design and development of artifacts (algorithms, human/computer interfaces, design methodologies [including process models] and languages) with the explicit intention of helping people fulfill their needs (A. Hevner & Chatterjee, 2010). We illustrate our experience with DSR in the context of the collaborative environment of our research center which aim is not only to build bridges between researchers and stakeholders, but also, between the organizations.

This paper is structured as follows: in section 2, we present the background of our research and describe our research design, along with a situation portrait of the knowledge available around water management in Quebec. In section 3, we explain the methodological choices behind the development of a case-based reasoning (CBR) prototype as our knowledge-based decision support system for source water protection. In section 4, we discuss our experience of collaborations between research and practice as well as the influence of academics on decision-making processes as knowledge creators, knowledge organizers, and knowledge sharing facilitators.

2 Background

In Canada, while spatial planning is under the exclusive jurisdiction of provinces and territories (OECD, 2017), jurisdiction over water is shared between the federal, the provincial/territories and municipal governments (Canada Water Act [R.S.C. 1985, c. C-11]). To address the potential threats to water quality from anthropogenic activities, the federal and provincial governments created a multi-scale committee: The Federal-Provincial-Territorial Committee on Drinking Water of the Canadian Council of Ministers of the Environment (CCME). This committee has adopted, in 2002, a multidimensional approach to ensure safe, secure and reliable drinking water from the source to the citizen's tap (Federal-Provincial-Territorial Committee on Drinking Water [Canada] et al., 2004). One of the components of this approach is source water protection (SWP) that seeks to (1) reduce public health risks, (2) reduce drinking water treatment costs, (3) maintain or improve water quality, (4) protect aquatic ecosystems and adapt to the effects of climate change (Federal-Provincial-Territorial Committee on Drinking Water [Canada] et al., 2004; Quebec's Metropolitan Community [CMQ], 2016). To

achieve these goals, it is essential to acquire knowledge about the state of the resource (water quality monitoring), the associated territory (delineation of watersheds and aquifers) and the various natural or anthropogenic activities that could alter water quality (inventories of land uses and contaminants, vulnerability evaluation, risk analyses, etc.).

Furthermore, in order to integrate SWP into spatial planning and water regulatory frameworks, and thereby allowing stakeholders to act within the territory, the Government of Quebec adopted in 2014 the *Regulation on water withdrawal and protection* (Environmental Quality Act [EQA, chapter Q-2, r. 35.2]). However, implementing SWP entails some decision-making challenges du to water governance issues. Water governance, which refers to the "decision-making processes by which water is managed" (De Loe & Kreutzwiser, 2007 in McGregor, 2012), is a complex environmental decision-making process characterized by multidimensional factors including economic, political, ecological, cultural, and social factors (Ekroos et al., 2017; Kiker et al., 2005). Also, the decision-making process is multi-level, involving the national, regional and local levels (Elsawah et al., 2015) with multiple stakeholders having different values, powers, agendas and objectives (Martínez-Sastre et al., 2017), as well as possibly competing interests (Ascough et al., 2008). A real example of such a complex decision-making issue directly related to SWP is a case where a watershed organization projects to plan a protected area on a municipal agricultural land along a river to protect its water quality. The watershed organization must deal with the city, that prefers to sell the land to a real estate developer in order to raise recurring municipal taxes. In doing so, the city will also have to deal with non-profit organizations and regional authorities that support the watershed organization's project, organizations that promote agricultural activities because it is an arable land, as well as local resident groups that may be opposed to a real estate project. All these stakeholders create, share and use a diversity of knowledge (know-how, technical expertise, as well as their local knowledge) in order to support their interests. In this type of situation, water management issues require a wide range of interdisciplinary knowledge (such as politics, economics, biology, chemistry, etc.) (Medema et al., 2015, 2017; Orr et al., 2016; Tengö et al., 2014). However, stakeholders do not necessarily share their individual knowledge (Elsawah et al., 2015), or use it to its full potential (Kirchhoff et al., 2013) due to a possible lack of mechanisms for better access to or understanding of the knowledge created (Jager et al., 2016). This context could explain why organizational responses to environmental issues remain uncoordinated and difficult to achieve (Baechler, 2012; Nielsen et al., 2013).

In order to help address some of these challenges, our aim in this project is to promote the integration of source water protection by facilitating the knowledge transfer in environmental decision-making processes. In the next subsections, we describe the research design, provide methodological context and give an overview of the knowledge created for source water protection in the province of Quebec (Canada).

2.1 Research Design

As a means for knowledge transfer, we chose to design an information system (IS). IS can play a significant role in sustainable development by effectively providing knowledge to solve environmental problems (Brocke and Siedel in Peffers et al., 2012). From a methodological point of view, our research is conducted according to the DSR principles, which provide a rigorous cycle for developing an artifact (a usable research outcome) and promote research as a response to real-world issues (A. R. Hevner et al., 2004). This requires involving the stakeholders in the problem definition and the design of the functionality of the artifact (Johannesson & Perjons, 2014). DSR is centered around two main components: a research entry point and the various activities conducted to develop an artifact.

A DSR process may be initiated from four possible research entry points: Problem-centered initiation, objective-centered solution, design and development-centered initiation, and client/context initiation (Peffers et al., 2007). Our project has a problem-centered initiation research entry point, as it was defined within the context of the new Quebec regulation for SWP and the stakeholders' need to have access to water-related knowledge in order to implement this regulation.

We follow Peffers et al.'s (2007) design science research methodology (DRSM). This methodology is based on 6 activities (table 1) translated into an iterative process (figure 1) based on A. R. Hevner et al.'s (2004) work on DSR mental models.

Table 1—Activities of DSR

Activities	Description (based on Peffers et al., 2007)
1. Problem identification and motivation	Define the specific research problem to justify the value of a solution and to develop the artifact that can help provide a solution to the problem.
2. Define the objectives for a solution	Identify a solution from the definition of the problem, the knowledge of the problem and the feasibility of a solution to the problem. The choice of the type of the solution is to be defined in this activity.
3. Design and development	Develop the artifact by determining its functions and architecture, and then designing it.
4. Demonstration	Demonstrate the relevance of the solution proposed as an answer to the problem for which the artifact was developed. This can be carried out in a variety of ways such as experimentation, simulation, etc. Knowledge of how to use the artifact to solve the problem is necessary. This implies that users who test the artifact need to be trained.
5. Evaluation	Observe and measure the relevance of the solution proposed by the artifact. This can be done by comparing whether the solution meets the objectives identified in Activity 2, conducting a satisfaction survey, or objectively measuring the impact (if quantifiable) of the use of the artifact. If the objectives are not met, researchers may decide to repeat Step 3 to improve the artifact or leave it for future projects.
6. Communication	Communicate the overall DSRM process to the partners, stakeholders, users and the research community.

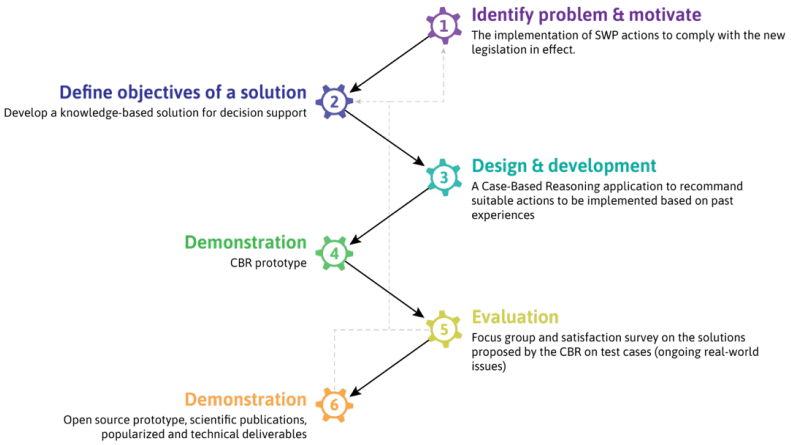

Figure 1 — Our DSRM adapted from Peffers et al. (2007)

2.2 Water Management in Quebec: A Portrait

The first step of our methodology was to draw a picture of the current situation in Quebec (intelligence gathering). We needed to gather knowledge to improve our understanding of Quebec's water management framework by identifying the decision-making challenges around water management and the implementation of SWP. To do so, we used an exploratory and descriptive approach based on the research survey methodology (Nardi, 2018) where we gathered data using an online survey. The complete methodology of this survey is described in Cerutti et al. (2020). Three dimensions were portrayed within this survey: 1) The profile of the stakeholders currently involved in water management; 2) the current knowledge created and shared in order to implement SWP; and 3) the decision-making processes followed by the stakeholders to implement SWP. In the final section of the survey, we also asked respondents to describe the decision-making problems they have faced in the past or are currently facing. Because our research center has strong ties to practice, we were able to count on a wide collaborative network to maximize the response rate of our survey by including important stakeholders in Quebec's water management such as: the Ministry of Environment and Fight Against Climate Change (MELCC); the Ministry of Municipal Affairs and Housing (MAMH); the Quebec Water Research Center (Centr'eau); The Quebec Groundwater Research Network (RQES); the NSERC Industrial Research Chair in Drinking Water (CREPUL) and Quebec's Watershed Organizations Association (ROBVQ). The survey was accessible from November 2018 to March 2019 and resulted in 208 completed questionnaires. The large majority of the respondents (n=154) belong to a governmental agency (ministries or regional bureau) or a local government (regions, cities). The remaining stakeholders (n=54) belong to parapublic (independent governmental agencies) or non-governmental organizations such as private companies or non-profit organizations (trade unions, watershed organization and environmental associations). The results of the survey

revealed a complex water governance framework where responsibilities are multi-scale and can be either shared or exclusive. The survey brought to light the presence of a set of public, private or parapublic stakeholders (including universities and research centers) that surround decision-making (Figure 2).

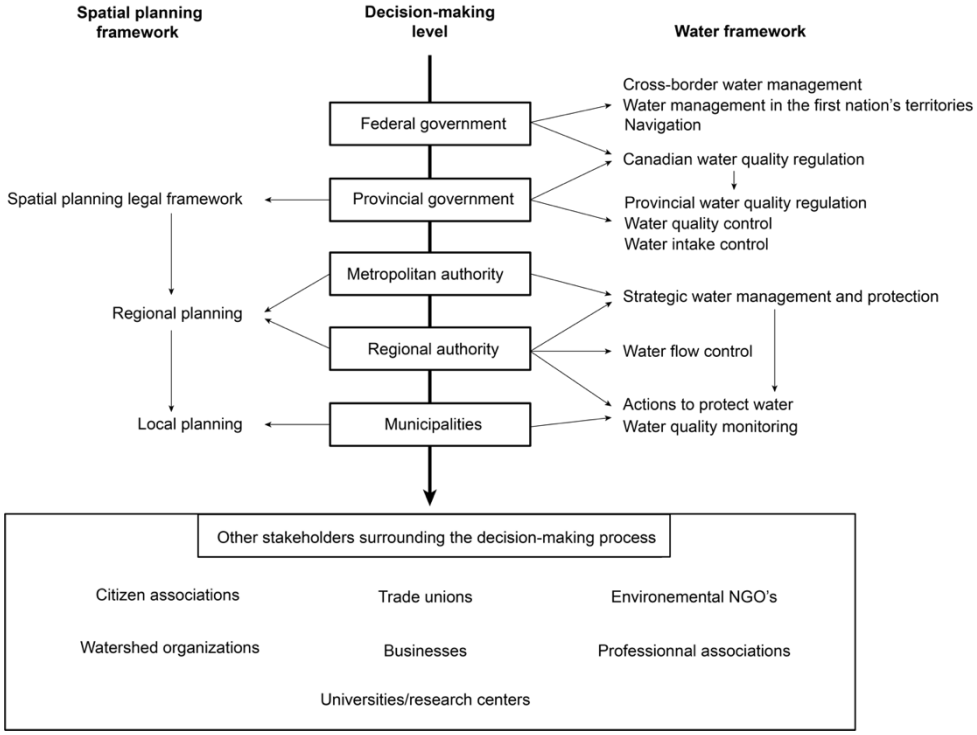

Figure 2—Overview of Quebec's water management in a decision-making context

The results of the survey also provided an overview of the knowledge available for decision-making when it comes to protecting source water. Based on more than 4000 answers from open-ended questions, we were able to structure the interorganizational knowledge by topics and subtopics using qualitative data analysis. By doing so, we contributed to the improvement of the general understanding of the available interorganizational knowledge that can be used for decision-making. We found that this complex water management framework comes with a great diversity and redundancy of knowledge (both in their forms [dataset, guides and reports, know-how] and their scale [local, regional and national knowledge of the territory]) (Table 2).

Table 2—What knowledge do we have and who produces it?

KNOWLEDGE TOPIC	SUBTOPIC	STAKEHOLDERS INVOLVED IN KNOWLEDGE PRODUCTION BY SCALE							
		Local	Regional		National				
		Municipalities	Regional authorities	Watershed Org.	Federal gov.	Provincial gov.	Private companies	Environmental asso.	Professional asso.
WATER RESOURCE	Territorial availability of water	X	X	X		X		X	
	Groundwater	X	X	X	X	X	X		X
	Surface water	X	X			X	X		
	Rainwater	X	X	X		X		X	
	Waterflow		X						
ANTHROPOGENIC	Municipal wastewater	X	X	X		X			
	Individual wastewater	X	X	X		X		X	
	Forestry impacts	X						X	
	Agricultural impacts	X	X	X		X		X	X
	Land-uses description	X	X	X	X	X	X		
	Water catchment	X	X			X	X		
	Water consumption	X	X	X		X			
ENVIRONMENTAL	Invasive species	X		X				X	
	Climate change					X			
	Wetlands	X	X	X					
	Erosion and sedimentation	X	X	X			X	X	X
	Flood-risk area	X	X	X					

Our results did not include knowledge production by universities since, surprisingly, no university researcher responded to the survey. This may be related to a limitation of our survey, as we focused the survey on the implementation of SWP and researchers may not have felt concerned by implementation issues. However, further analysis of the documentation available (reports, case studies, presentations, etc.) showed that universities are involved with all the topics and subtopics identified in the survey. Furthermore, open-ended questions allowed us to gather some clues about knowledge transfer issues that were faced by the stakeholders when it comes to the research versus practice dynamics. These are related mainly to the costs for accessing scientific

knowledge: “Scientific studies … sometimes with costs” and “Events … such as symposium with high registration fees” (Respondent 25); “Scientific papers only available under subscription for. e.g. publishing editors” (R.97). In addition, issues of language[1] in scientific knowledge (published in English) or support in understanding knowledge (overly technical language) were also raised by some respondents: “The translation of scientific studies.” (R.97); “Statistical studies … difficult to interpret” (R.25); “Accessibility and uniformity of reference data” (R.34); “Popularization of research/data to enable its ‘good’ use” (R.56); “Use of the results of the groundwater study” (R.140); “Meaning of scientific results of water analysis” (R.193).

3 A Case-Based Reasoning Application to Share Knowledge for SWP

The second step in our DSR methodology, which follows knowledge gathering and structuring for SWP decision-making, is to build a tool that can facilitate the SWP implementation by improving knowledge transfer between the stakeholders. To achieve this objective, we need a tool capable of managing multi-scale and multi-stakeholder knowledge transfer. For this reason, we focus on decision support systems (DSS), computerized information systems developed to improve the decision-making process (Gourbesville et al., 2016) by facilitating the organization of knowledge (Alyoubi, 2015). More specifically, we will use an environmental decision support system (EDSS) approach. This concept was defined by Rizzoli & Young (1997) as “DSS developed for use in environmental domains that integrate models, or databases, or other decision aids, and package them in a way that decision makers can use”. The main advantage we see in using an EDSS approach is to achieve a greater collaboration between research and practice. Indeed, the design of the EDSS invites researchers to involve end users and sets some objectives to be attained such as the ability to support policy and management decision-making, to cope with uncertainty, with a special attention to underlying software capabilities such as transferability, scalability and ease of maintenance (McIntosh et al., 2011).

Several types of DSS are reported in the literature that focus, to varying degrees, on five types of elements: communications, data, documents, knowledge and models (Alyoubi, 2015; Gourbesville et al., 2016; Power et al., 2015). Our project is centered around knowledge and uses knowledge-based DSS (KB-DSS). Liu et al. (2015) describe four approaches to a KB-DSS: Rule-Based Reasoning (RBR), Case-Based Reasoning (CBR), Network-Based Reasoning (NetBR) and Narrative-Based Reasoning (NBR). The main difference in these approaches is the way knowledge is gathered, structured, stored and used by the system. RBR uses decision rules to identify causal relationships in various decision environments. CBR uses subsets of similar or most reusable experiences previously encountered to solve a problem. NetBR uses probabilistic inference engines such as Bayesian networks or artificial neural networks. All three of them deal mainly with structured or semi-structured knowledge. In particular, NBR uses specific linguistic

[1] *The Quebec population is mainly French speaking, and its official language is French*

algorithms to identify hidden knowledge in unstructured narratives (stories, report, records, etc.).

In order to choose the most appropriate approach for the design of a KB-DSS prototype, we focused on its end use: decision support for implementing SWP. To this end, we collected data on the decision-making problems encountered by stakeholders in our survey (presented in section 2.2). The open-ended answers showed a great diversity of problems such as pollution from various types of contaminants (hydrocarbons, nitrates, iron, manganese, sediments, microorganisms, invasive species, etc.) or source water scarcity (illegal dams, climate-related droughts, or conflicting human uses [residential vs. agricultural vs. industrial]). Most of the problems identified are complex and ill structured and some may have repercussions that last for decades (e.g. a contamination from a crop field). Furthermore, they are context-dependent (because of the geographical specificities of each problem), involve or have involved different stakeholders over time, and are strongly influenced by the political factor, can make knowledge expensive (for example between governmental departments that have to pay a high price to exchange data and knowledge) and, above all, making knowledge confidential.

In light of our survey (and subsequent interviews conducted with some of the stakeholders), we chose to use past decision-making experiences as knowledge transfer opportunities to solve current problems, as they provide accessible (publicly available) knowledge and concrete examples of problem solving. This led us to exclude NetBR because we could not gather enough data. We also excluded RBR because no explicit rules could be identified, and we excluded NBR because the end users of our prototype come from different organizations and do not have the same language (expert vs non-experts). Consequently, we focused on CBR to design our prototype. CBR consists of a problem-solution (case) combination in which similarity of the current problem to past (solved) cases is computed based on a problem's attributes, i.e., their characteristics (Richter & Weber, 2013). This approach, considered to be very close to human reasoning (Richter & Weber, 2013) encourages learning from past experiences (Lamontagne & Lapalme, 2002). A CBR process consists of four phases: retrieve, reuse, revise and retain (Aamodt & Plaza, 1994). This process allows CBR systems to acquire knowledge (from user-introduced experiences) and reuse it by identifying all the main components of the problem-solving process (what were the objectives and resources available, who was involved, what knowledge was used, etc.). To illustrate how we plan to apply CBR, we use the following real-world decision-making issue identified in the survey. A municipality D is faced with water contamination by hydrocarbons in the intake of its drinking water plant (raw water). Based on the description of the problem (contamination by a chemical pollutant: hydrocarbons), and its context (such as the size of the city, the source water type, etc.) the CBR system can use its case base to identify that municipalities A, B and C faced a similar water problem in the past: the *presence of contaminants* (*hydrocarbons*) in the *intake of their drinking water plant*. Also, we learn that as a solution, municipality A decided to use an additional water treatment process

(biological activated carbon). Municipality B decided to issue a drinking water advisory (to not consume drinking water) and Municipality C used both solutions.

In order to gather the knowledge needed to construct our case base for the CBR KB-DSS, we used both answers obtained from the survey's respondents (in the survey and in subsequent interviews) and a web inventory of water-related actions elaborated by the Quebec Watershed Organization Association. The first model of our prototype contains attributes for computing similarities between current and past problem based on problem situations (such as water bodies description, territorial description [anthropogenic activities, distances, etc.] and decision-making context [stakeholders involved, knowledge available, etc.]). Since we gathered both quantitative and qualitative dimensions, we will be using a multi-criteria similarity measure. It should be noted that this CBR prototype is being designed, and will be validated, with the participation of an end-user group composed of stakeholders from governmental/parapublic and NGO experts, as described in section 2.2. Finally, tests will be carried out to evaluate and validate the relevance of the recommendations of the CBR approach for SWP actions.

4 Discussion and Conclusion

Through this research project where our aim is to design a case-based reasoning prototype as a knowledge-based decision support system, we see an opportunity for research to bridge practical knowledge gaps between organizations by sharing lessons learned and overcoming knowledge sharing issues (such as redundancy, confidentiality, cost or language).

This project highlights the multiple role of the university as a knowledge creator, knowledge organizer, and facilitator for knowledge sharing. First, universities are involved in knowledge creation to solve environmental problems. Second, universities can observe and explore dynamics between organizations and improve the understanding of decision-making processes. Third, universities have evolved in an entrepreneurial model that encourages researchers to be involved in guiding and improving decision-making processes by using techniques (such as designing KB-DSS, Multicriteria decision analysis processes, etc.) in private companies or public administrations. This research therefore illustrates how universities can bring together decision-making levels and various stakeholders by breaking existing silos between organizations in public, parapublic and private environments. In such a context, the university has the needed legitimacy to provide solutions to societal problems by remaining neutral and promoting dialogue between organizations in order to achieve a common goal: the protection of water.

Notwithstanding the many good intentions motivating collaboration between research and practice, many hurdles still exist. For example, it is increasingly difficult to transfer knowledge between science and practice due to the prerequisites of scientific publication that render research results inaccessible to practice. Some of the reasons cited by the respondents to our survey include the costs of scientific publications or an overly

scientific and methodological vocabulary. Second, as researchers developing this tool, we face the difficulty of transferring our tool to the main end users (public and parapublic stakeholders), due to several reasons related to the costs, the lack of material, administrative requirements (confidentiality or intellectual property for example) or the risk of implementing a tool that has not yet proven its mid/long-term effectiveness. Also, the issue of maintenance and training is a tricky one in public/parapublic contexts as they may not have the technical resources to maintain such a tool. It therefore might be easier to transfer research results to the private sector instead of the public sector, even though most of the research is publicly funded. The irony is that the public sector might ending up having to pay twice for the same product: once for the research and once again to acquire the research results from the private sector. This, in our opinion, is one of the main challenges facing the success of knowledge transfer from university to the public sector. How to ensure the usability and long-term viability of the knowledge products disseminated by university?

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Logical Connections between Stakeholders' Expectations and the Development of New Education Programs

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Abstract

A two-way dialogue between universities and public and private organisations, in the context of stable relationships and collaboration, enhances their processes and orients research and education programs.
Different mechanisms can be used to create and exchange knowledge but in practice some of them are not always feasible. For this reason, some specific approaches were implemented at the Politecnico di Torino.
The paper presents the main practices of knowledge exchange and share between this university and the territory stakeholders that were involved in the education process in the past. Now the COVID-19 emergency forces all of us to re-think procedures and processes on the basis of a solid past experience, a networking approach to the problem and the aid of the digital transformation tools.

Keywords – Knowledge creation, Cognitive mapping, University-industry collaboration, Higher education, Management engineering

Paper type - Practical Paper

1 Introduction

Stable relationships, a two-way dialogue and collaboration are required between universities and public and private organisations, to create and exchange knowledge that enhances their processes and orients research and education programs.

This two-way dialogue can include different mechanisms: collaboration in applied research, programs of technology transfer, participation of enterprises as partners in a university incubator and mentors in its services for the start-ups, or as actors of career days and meetings with students.

Enterprises and public administrations host the students, who get an internship during the courses, and select them, after their degree, master degree or PhD, testing their competencies in relation with their requirements for specific (and often new) job positions.

Some enterprises become members of the advisory committees the universities create to involve the socio-economic actors of the territory. Others are involved in specific PhD programs and projects.

Good practices of collaboration are essential to create and exchange knowledge but they are not always feasible. The advisory committees always and explicitly propose their expectations, in terms of new education profiles, which sometimes are linked to interesting but not realistic visions of the university life. The advisory committee members often have a limited knowledge of the bureaucratic and economic constraints that control the university innovation processes and this fact can limit the organisation of an effective collaboration.

For this reason, a new approach was implemented some years ago, when new engineer profiles were created at the Politecnico di Torino. A set of simple tools was used to propose virtual or practical collaborations. When the digitalization processes were step by step activated, communication became always easier.

The first section of the paper presents the main processes of knowledge exchange and share, between this university and the stakeholders that are involved in the education process in the territory. Some processes started in the past and developed, and some of them have to be changed and improved in the present phase of the COVID-19 emergency. The second section describes an analytical procedure that started to be used some years ago to acquire knowledge from the stakeholder expectations, and its use to improve education and the relationships between the actors of the generated network. Some remarks on how the digitalization process, which has changed the university administrative procedures, can stimulate new dynamics of knowledge acquisition and sharing are proposed in the conclusions.

2 Processes and tools of knowledge exchange

Collaborations between university and industry, but also non-profit organisations, government and, in general, the territory, are studied, above all in terms of effectiveness of these interactions, needs and desires in the different contexts and impact on the academic research productivity (see for instance Agrawal, 2001; Charles, 2003; Perkmann et al, 2013; Garcia et al, 2020). Joint research centres of the university and industry, European research projects that always include university and other organisations, research spin-offs and university spin-out companies are some examples of the growing interaction and knowledge exchange between university and territory.

Another kind of university-territory collaboration is oriented to create a shared knowledge on the competences that an educational system should develop and a work context needs, to improve the processes and generate innovation (see Aasheim and Li, 2009; Schneider-Störmann et al, 2020). Sometimes, a clear picture of the work practice is not present in the academy, while the students perceive their future work in technological contexts that are not often available in practice.

When the management engineer profile appeared in Italy, it was so new that most of the enterprises did not understand the nature and potentiality of this technical profile.

The students, getting an internship or working on true problems to write their theses, became the main channel to present the innovativeness of the new profile to enterprises or public administrations. Students and new graduates sometimes became the stimulus and stakeholders of innovation processes.

A set of simple tools was used, in the last ten years, to create a continuous and structured link between the Politecnico and its territory and to exchange knowledge about innovative technologies and specific work environments that are mainly oriented to innovation. Two questionnaires, one for the students and another for the host organizations, had always to be filled, but they can only be useful to detect the very few critical situations. An e-mail, sent every year to thank all the old and new organizations that have hosted our students, turned out to be more useful. A frequent result was a call from the new host organisations to confirm an actual interest in a stable relationship, but also to inquire whether the management engineering students acquire some specific competences and/or can use them in contexts where in general the engineers are not present (while there is a predominance of jurists, economists or psychologists).

The same e-mail was used to announce and describe another occasion of knowledge exchange, a meeting at the Politecnico to allow the students (and teachers) to connect with the host organizations. Internship opportunities and thesis projects became the occasion to better know each other. The number of the participants increased every year, from a two days meeting we passed to a three days, while in 2019 a multiplicity of different meetings was organized, in relation to each different engineering branch.

More than 2500 students of the Politecnico get an internship every year and more than 500 tutors, in the host organizations, are contacted every year from the College of Management engineering. When the number of students getting an internship became sufficient to list more than 300 education projects in the College of Management engineering, a new analytical approach was implemented, in order to obtain and organize knowledge from this process and to use these elements as inputs for the development of new courses or the inclusion of these stimuli in the previous education programs. This analytical approach is described in the next section, together with some results.

On-campus company presentations became very frequent, not specifically for recruiting (the Career days are more oriented to it) but to involve teachers and students in innovative projects, or in change management processes, by means of a formal collaboration with the Politecnico.

The digitalization processes allowed the direct access of the enterprises to the web portal www.polito.it. The career services of the Politecnico di Torino put students and graduates in contact with the labour market through the creation of direct relations between the university and companies. Thanks to tailor made strategies and the consultancy of Carrier service staff, companies can choose and modulate various recruiting and employer branding tools. Contact and selection of the profiles that best suit the recruitment needs are facilitated by an online access of the companies to a list of

potential preselected candidates, while a direct contact is possible in recruiting events. Targeted communication plans with partner companies are built using tools, such as direct mailing, university web site, electronic monitors, social networks. Targeted actions are implemented inside the Campus to help any specific company to communicate its employer branding strategy and attract the requested profiles. The Career service team, which meets new employers every day, can guide them in understanding the university context and the procedural complexity of the different activities. The team guides the companies in exchanging the knowledge, of the course catalogue of the university and the career paths in the enterprises, to identify services and activities the students and graduates can carry out.

In addition to the digital media, a direct communication between any host organization and the team in charge of the internships for a specific College is facilitated by a good relationship between the teams of the different Colleges of the Politecnico. An effective network was created and any request of an engineer profile that is not so consistent with the branch of a College or a specific contact with experts is immediately re-directed at the team of the correct College. The network involves some central services (above all the Career service and the ICT service) and the Rector's Delegate for Alumni and Career orientation, together with the most active teams (Automotive, Aerospace, Electronic, ICT, Mechanical and Management Engineering). The main external to the university actor is the Public administration, above all the Regional Government, together with all the private and public host organisations.

The role of this network is even more important now, when every day university and Regional Government have to negotiate the action space. The COVID-19 emergency changed our work and the communication processes. Urgent decisions transformed the life of the Politecnico at the end of February 2020: remote work and online lessons and laboratories. Some events were postponed and others cancelled. Any direct contact between the Politecnico and its territory became impossible.

Now the situation starts to change, the next 10th of June the students can activate new internships and work in presence and not only remotely. New events are presented on the site https://careerservice.polito.it/, and include virtual presentations, visual storytelling experiences and courses on the firm's platforms, but also the first recruiting days of some enterprises at the Politecnico.

Clearly, the conditions of any work environment have to be changed and this may be an important occasion for our students. The network is studying a new and coordinate way of contacting the enterprises and proposing a direct connection where the enterprises indicate their needs and the students, with the aid of their academic tutors, design specific answers to their requirements. In this new situation, the network coordinates the work and creates relationships between students and tutors of the different Engineering Colleges. This project can be an important answer to the urgent needs of some enterprises and, meanwhile, an occasion to analyse how new education programs can include the new expertise.

3 How to acquire knowledge from the communication between the Management Engineering College and territory

Each student getting an internship works in relation to a formalized Education project. An internship has, as a first aim, the possibility of knowing real production processes and seeing which are the main dynamics of the true organisations. The students of Management engineering start working in relation to the declared Education project but often pass from an activity to another, because of (and thanks to) their non-specialized competences.

Therefore, the team in charge of the internships for the Management Engineering College explains to the students that an Education project is sometimes the indication of a specific need of a host organization and not a plan for a project, and that often an enterprise postpones the decision on a specific task because of the versatile nature of their profiles. Meanwhile, this high number of formalized Education projects allows a deep analysis, to identify which competences the host organisations aim to find in our students, to verify if there is correspondence between our education objectives and the profiles the host organisations need, and to obtain information on specific requirements and organize and use these elements of knowledge in the internal education processes.

An analytical approach was implemented for the first time when the number of formalized Education projects of a specific academic year (2014-15) was 300, all in relation to the students of the bachelor course in Management engineering. They were analysed manually by means of a cognitive mapping approach (see for instance Eden, 2004). The texts were analysed and their number was reduced to 185, by means of the elimination of texts that only included long lists of tasks without any description of a project, or an indication of an enterprise department or a specific activity without any definition of an education project. The texts were synthesized by means of the elimination of useless elements, such as the descriptions of the host organisations, and coded. A first tentative code was defined in relation to a distinction of the Education projects into two main clusters, in relation to our two paths of the bachelor course in Management engineering (industrial specialization or computer science), plus a cluster of generic requests.

At this point, a new textual analysis of the data was implemented. Any recurring word, concept or sector was identified and used to define another coding element, the “ambit of work”. Some examples of “ambit” are logistics and accounting office, or acronyms such as SAP, CRM or WCM, or tasks such as data analysis, client portfolio management or inventory handling.

More than one ambit was sometimes identified in relation to the same Education project. When a clear ambit was not identified, a warning was associated with the project, and the same warning was used when a project description was present but incomprehensible. After this first coding activity, the results were analysed by the complete team and some difficult interpretations were clarified. An iterative process was activated because any new interpretation of a project ambit often changed some codes of

other Education projects. In relation to the most complicated interpretations, a direct contact with the academic tutor of the student in internship allowed a clarification.

After these activities of data testing and coding, the Education project texts that resulted associated with the same specialization (industrial, computer science or non-specific) and ambit (or ambits) were grouped and re-analysed. A logical similarity between components of a group was defined and used to link them, translated in conceptual nodes of a logical graph (Norese and Salassa, 2014). A lot of graphs were created and comparatively analysed. Several analysis steps of the team reduced the 18 graphs to 12 (8 for the only industrial specialization) and then to 7 macro typologies of internship, in two cases with a limited correspondence with the competences acquired in the courses.

These results were used to better define the aims of some courses and their programs, and to clearly describe the management engineer professional profiles in the institutional documents and presentations for Open days and other events.

The analytical approach activated some years ago is becoming an annual procedure that aims to create and update a knowledge base that informs the College on which are the expectations of the territory stakeholders, in order to combine these expectations with the education objectives of our courses and to re-orient some of them towards new competences.

This analysis can be facilitated by machine learning techniques, such as Topic Modeling (Papadimitriou et al, 1998) or Probabilistic Latent Semantic Analysis (Hofmann, 2000), that the team is testing now, by means of some algorithms applied to 1799 Education projects, that is the total internship number of the last four academic years, which includes students of the Bachelor or the Master in Management Engineering.

4 Conclusions

University and multi-stakeholder partnerships can be facilitated by a dialogue that uses the digitalization approaches and processes as important tools. But the dialogue has to be generated, fed and improved by practises of networking, at different levels, both internal to the universities and in interaction with the territory stakeholders.

Knowledge can be obtained, used and shared in the networks that involve universities. The main result is a learning process that involves different stakeholders and produces a continuous upgrade of the university system, in terms of programs of the courses but also procedures, which have to control any risk without bureaucratise the processes, and a new language that generates a local and effective culture.

The COVID-19 emergency limited the knowledge exchange dynamics and heavily impacted any process. But the present constraints could and should become a new occasion to create and share knowledge. A quick development of the digitalization processes allowed the activation of several internships in remote. The word that was used to define these situations is “smart working”, but the next months should be used to understand the actual nature of these smart works, not only for the internships but also for

our society that adopted this way of working as the only urgent answer to the pandemic lockdown.

At the same time, the internal procedures of a university changed and only a parallel use of different communication tools allowed the decision process development in the last months. The questions become: how can these new dynamics improve internal and external communication, and are these tools something that slows down any decision process and makes the work heavier than in the past, or an important occasion for the future? There is a wide research space for all of us.

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A Dynamic GIS for the Sustainable Economic Development of the Ivrea UNESCO Site: Potentialities and Constraints of a Knowledge Exchange Process

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Abstract

The UNESCO site "Ivrea, industrial city of the 20th century" is a large urban area designed and developed under the leadership of Adriano Olivetti. It consists of more than 100 private buildings, valuable examples of Modern Heritage, and more than 60 elements related to public and private infrastructures and green areas. Currently the whole site necessitates to be redeveloped: the assets are mostly unused or underused and the streets and green areas condition does not foster the acknowledgment of the site's value, as well as its accessibility and enjoyment. Its enhancement and future management is a great challenge for the Municipality of Ivrea and a dynamic GIS developed, improved and implemented by the Politecnico di Torino over the last few years may effectively support this delicate phase. The aim of this paper is to highlight how the activation of a knowledge exchange process between the Politecnico di Torino and the Municipality of Ivrea may support the sustainable economic development of the Ivrea UNESCO site. In particular, it wants to demonstrate some potentialities of the GIS not only for the Knowledge Management, but also for the cost management of a series of redevelopment projects concerning both the buildings and the grey and green infrastructures of the UNESCO site. The redevelopment projects of streets, squares, car parks and public green areas constitute urgent and priority actions that the Municipality may quickly and directly activate in parallel with the ongoing mediation process with the buildings' private owners and other territory stakeholders. The positive impacts that the redevelopment of these infrastructures could generate go beyond the site's enhancement. Their improvement is able to foster the real estate market trends, supports the economic operators that currently operate in a rather fragile context and produce benefits for all the citizens (in terms of increase of the welfare, urban services equipment and the environmental condition).
The Municipality of Ivrea could steer numerous strategic actions in this direction by investing in public projects able to generate positive impacts on the community. To achieve this important and

ambitious goal, a knowledge exchange process should be activated between the Municipality of Ivrea and the Politecnico di Torino, which aims to be ever more proactive in its third mission activities, to further customize the current version of the GIS. By this way, the case of Ivrea could become a best practice of territory sustainable development and an example of fruitful collaboration between Public Administrations.

Keywords – Knowledge Management (KM), Geographic Information Systems (GIS), Economic-financial sustainability, grey and green infrastructures, Ivrea UNESCO site *(max 5 words)*

Paper type – Practical Paper

1 Introduction

The site "Ivrea, industrial city of the 20th century", inscribed in the UNESCO World Heritage List since July 2018, is a large urban area designed and developed under the leadership of Adriano Olivetti, in order both to expand his typewriter company and to create a model of a modern industrial city. It consists of more than 100 private buildings, valuable examples of Modern Heritage, and more than 60 elements related to public and private infrastructures and green areas. Currently the assets are mostly unused or underused, streets and green areas present lack of routine maintenance and the whole site necessitates to be redeveloped. The knowledge of the built heritage and its surroundings is rather fragmented and continuously changing, and it is hardly updatable with information about the buildings' and infrastructures' condition, transformation interventions and the subjects involved in the redevelopment processes.

The enhancement of this large unitary urban system of high historical, architectural and environmental value, represents a current big challenge for the Municipality of Ivrea, that is called upon to outline innovative governance strategies based on the constant monitoring and coordination of different redevelopment projects and by creating strategic partnerships and networks with numerous territory stakeholders and actors.

The creation, circulation and management of knowledge is an important condition for the enhancement of cultural heritage (Baca, 2003; Meyer et al., 2007; Dragoni et al., 2011; Eppich and Garcia Grinda, 2015; Sobrino et al., 2016; Soler et al., 2016;). When the analysed elements are buildings integrated in their surroundings and socio-economic contexts, the spatial dimension has to be used to support the Knowledge Management (KM). In the literature, several studies demonstrate the effectiveness of the integration of GIS in a KM finalized to the management of cultural sites (Kurtener and Badenko, 2000; Alavi and Leidner, 2001; Belsis et al., 2004; Balram, 2006; Jennex, 2008; Noor et al., 2019). A KM consists of the tools, techniques, and processes to collect, retain, analyse, organize, improve, and share understanding about data and information, and to use that understanding towards meaningful action (Wang et al., 2001).

Over the last few years the Politecnico di Torino studied the case of the Ivrea UNESCO site and designed a KM in order to lessen the issues that arise due to loss or lack of knowledge. In particular, during a Master of Science course in "Architecture for Heritage preservation and enhancement", it created and implemented a GIS, as a dynamic

system able not only to collect and visualise data at different territorial levels, but also to support the enhancement projects developed during the course (Barreca et al., 2017; Curto et al., 2018). The GIS was developed with the aim of structuring the knowledge base related to the UNESCO site, in order to:

investigate opportunities and weaknesses of the territory of Ivrea by analysing data on the physical characteristics of the built environment, as well as data on the territorial, socio-economic and cultural context;

analyse and monitor impacts and outcomes of possible redevelopment projects concerning the buildings located in the UNESCO site and the surrounding infrastructures and green areas;

support the Public Administration and the stakeholders in developing enhancement strategies, policies and actions.

Currently the Politecnico di Torino completed the knowledge structure of the GIS (Phase 1 of the KM - "Identification of Knowledge") and almost finished the implementation of a Knowledge Data Base (KDB) (Phase 2 of the KM - "Knowledge Generation"). Therefore, now it may transfer the GIS to the Municipality of Ivrea and effectively support the Public Administration in this pivotal phase for the UNESCO site enhancement and its future management (Phase 3 of the KM - "Knowledge delivery").

The aim of this paper is to highlight how the activation of a knowledge exchange process between the Politecnico di Torino and the Municipality of Ivrea may effectively support the sustainable economic development of the Ivrea UNESCO site. In particular, it wants to demonstrate some potentialities of the GIS not only for the knowledge management, but also for the cost management of a series of redevelopment projects concerning both the buildings located in the UNESCO site and the surrounding infrastructures and green areas. In this paper a particular attention is focused on the GIS potentialities in supporting the Municipality of Ivrea in the redevelopment and future management of streets, places, car parks (Elements of grey infrastructures) and public green areas (Elements of green infrastructures). In fact, they currently represent urgent and priority interventions that the Municipality may quickly and directly activate to foster the acknowledgment of the site's value and its accessibility and enjoyment (Curto et al., 2020). Moreover, it is worth mentioning the presence of the Virtual Museum of Modern Architecture of Ivrea (MAAM - http://www.mamivrea.it/), whose presence is currently not so evident in the site due to the lack of marked cycle-pedestrian routes, effective signs and suitable equipped areas. The redevelopment of the buildings of the site, which are almost all private assets, constitutes a crucial process that the Municipality of Ivrea has already started by dialoguing with the private owners and different stakeholders; nevertheless, it represents a big challenge that may be faced in parallel with the improvement of the surrounding infrastructures and green areas.

Today, the GIS developed by the Politecnico di Torino could effectively support this process, if the knowledge exchange process will be activated. The wealth of information that the KDB now contains enables a wide range of analyses finalized to describe the current situation, highlighting redevelopment potentialities and weaknesses. Moreover,

the GIS could also support future strategic development actions, such as the management of the costs necessary for the redevelopment and maintenance of the infrastructures and public green areas or the design and implementation of green infrastructure projects. The attention towards the redevelopment of grey and green infrastructures is fundamental to agree to the guidelines of the European Green Deal and to implement some principles of Green Economy and nature-based solutions (EC, 2019; Loiseau et al., 2016), By this way, the Municipality of Ivrea could concretely improve the environmental quality of the UNESCO site and, consequently, fostering its enjoyment, creating job opportunities, contrasting the negative trend of the real estate market and increasing the citizens' health, socio-economic condition and quality of life.

The paper proceeds as follows: Section 2 introduces the case of the UNESCO site "Ivrea, industrial city of the 20th century". The methodological approach is described in Section 3, while Section 4 discusses the results. The conclusions and discussion are presented in the final section.

2 The UNESCO Site "Ivrea, industrial city of the 20th century": an unitary urban system to be known, managed, enhanced and enjoyed

During the XX century Adriano Olivetti expanded the famous typewriter company founded by his father Camillo and created a model of a modern industrial city by redeveloping an extended urban area of the city of Ivrea, near Turin (Italy). His project was based on the innovative idea of "community" (Olivetti, 1945) and included not only the factory but also a series of residential buildings for the workers and managers, nursery schools, a leisure centre with playgrounds, a company canteen and a social services centre. Adriano Olivetti commissioned the works to famous architects, representative of the Italian "Modern Movement", with the idea of realizing high quality buildings closely integrated with their surrounding public spaces, green areas and infrastructures. The World Heritage Committee recognized the exceptional value of this large urban area, which in July 2018 became the 54th Italian UNESCO site, namely "Ivrea, industrial city of the 20th century" (see http://whc.unesco.org/en/decisions/7143).[1] Currently this site consists of more than 100 well-preserved buildings, which mainly need to be redeveloped or reused by changing their original functions. The 98% of them belong to private owners, except for two assets that are public properties belonging to the Municipality of Ivrea. Although the most part of the assets is private, the role of the Municipality of Ivrea

[1] *The candidacy process started in 2008, when the Adriano Olivetti Foundation, in collaboration with the Municipality of Ivrea and the Politecnico di Milano, promoted the inclusion of this site in the UNESCO WHL. In 2012 the site was included in the UNESCO Italian Tentative List of candidate sites and the UNESCO World Heritage Office of MIBACT set up a Steering Committee, which worked for four years to prepare the Application Dossier and Management Plan. The Steering Committee included the Municipalities of Ivrea and Banchette, the Adriano Olivetti Foundation, the Guelpa Foundation, the Piedmont Region, the Metropolitan City of Turin, the Superintendence of Archaeology, Fine Arts and Landscape for the Metropolitan City of Turin, the Regional Secretariat of MIBACT for Piedmont, the General Directorate for Architecture and Contemporary Art and Associated Organisations, private partners and owners or managers of the assets, cultural institutes of national relevance.*

is central, since it is responsible for the future management and enhancement of the UNESCO site. The great challenge, mandatory for UNESCO, is to enhance the cultural, architectural and environmental value of this outstanding tangible and intangible heritage by preserving the relationship between these three main components that constitute this large unitary system:

1. The architectural heritage: the UNESCO site includes numerous high quality buildings, which represent expressions of Modern Heritage (Galuzzi, 2016). The former Olivetti factory and all those buildings originally devoted to offices and to different types of services for the workers represent assets with large spaces, currently unused or underused, which need to be enhanced by identifying new compatible functions and by evaluating their economic and financial feasibility. Moreover, the site includes also several residential buildings, which require different enhancement strategies, mainly based on the buildings' preservation and on the improvement of the energy efficiency (Coscia and Curto, 2017).
2. The infrastructure and green areas systems: the architectural heritage of the site was progressively developed along Jervis street, in conjunction with the expansion of the Olivetti company during the XX century. Jervis street currently represents one of the most important and busiest road connection of the town. Public and private green areas, car parks and parks are all around buildings: some of them quite recently transformed the plan developed under the leadership of Adriano Olivetti, others, on the contrary, still highlight his original ideas. This is the case, for example, of the "Tribunette" area, where tennis courts and bowling greens are still present, and the park near the Company canteen, where Olivetti's employees could take advantage of fitness trails. It is worth mentioning that some green areas of the site constitute landscape heritage, such as the park designed by Pietro Porcinai, Annibale Fiocchi and gardeners of the Vivai Canavesani company in 1963-64, thus they already represent tourist attraction hubs.
3. The intangible heritage: the cultural and political Community Movement, founded by Adriano Olivetti, strictly influenced the setting up of the entire urban system. For this reason, additional intangible values of this heritage can be recognized as a testimony of his innovative approach and progressive vision about work, culture, society and human conditions.

The exceptionality of this site deserve to be enhanced and transmitted by considering buildings, green areas, infrastructures and their tangible and intangible values as integrated and not-separable elements in order to preserve and maintain the identity of the site.

3 Methodological approach

The enhancement of the whole UNESCO site, considered as a unitary system of buildings, green areas, infrastructures and tangible and intangible values, is possible only

by managing its complexity by means of a structured knowledge system. A research group from the Politecnico di Torino developed a KM based on three main phases.

During the first phase ("Identification of Knowledge") the Politecnico di Torino built the knowledge structure of the GIS, while during the second phase ("Knowledge Generation") created and implemented the Knowledge Data Base (KDB) (Barreca et al., 2017, Curto et al., 2018). This knowledge base supported the enhancement projects developed by students during the course "Architecture for Heritage preservation and enhancement", which was focused on the enhancement of this UNESCO site for three years (a.y. 2016/2017, 2017/2018 and 2018/2019). The results achieved at the end of the second phase now lay the ground to the third phase ("Knowledge delivery") that could be activated in order to transfer the GIS to the Municipality of Ivrea as a tool that could effectively support the Public Administration in this pivotal phase for the UNESCO site enhancement and its future management.

Each phase of the KM consists in different progressive steps, as Figure 1 shows. Each step is detailed below.

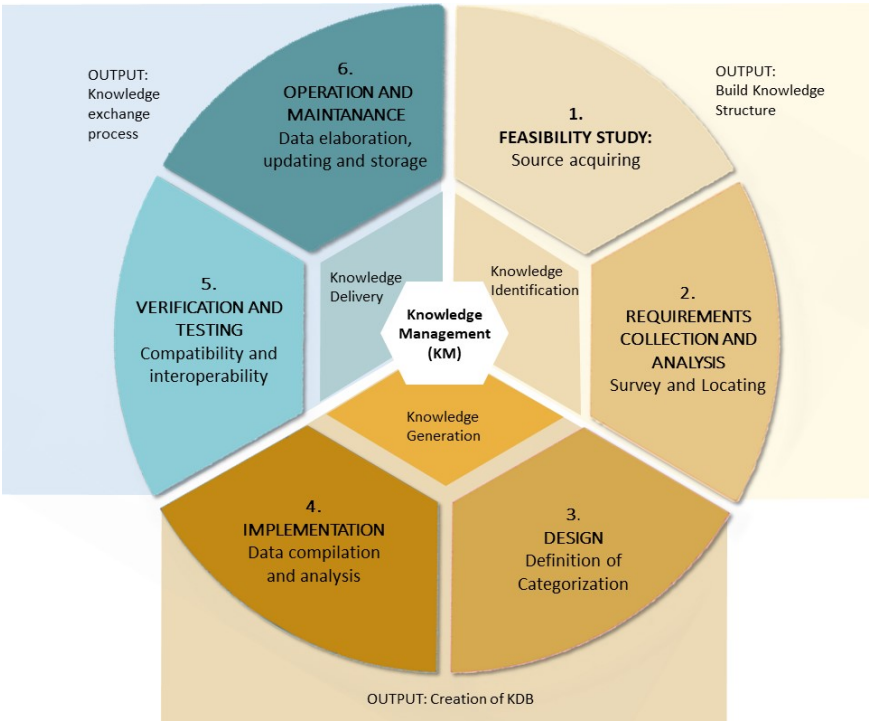

***Figure 1**: Knowledge Management Architecture for the implementation of the GIS developed by the Politecnico di Torino (Source: Authors' elaboration from Piccoli, 2007).*

3.1 Identification of knowledge

The initial identification of knowledge represents a crucial operation to guarantee a correct initial setting of the KM, to preliminary evaluate its feasibility and to analyse the main related requirements.

Step 1 - Feasibility study

The available data related to the UNESCO site and its surrounding territorial and socio-economic context were initially investigated (source acquiring) in order to evaluate the feasibility of the GIS development. Numerous existing data sources were consulted in this first preliminary step, such as the Geoportal of the city of Turin, the Geoportal of the Piedmont Region, the Real Estate Market Observatory of the Agenzia delle Entrate (OMI), and the Italian National Institute of Statistics (ISTAT). Moreover, other more specific data sources were consulted, such as the GIS of the Municipality of Ivrea, and a series of open data were downloaded and integrated into the KM.

Step 2 - Requirements collection and analysis

Important requirements to be considered for the future enhancement of the UNESCO site have to be investigated, collected, georeferenced and analysed (survey and locating). On this regard, the Management Plan for the UNESCO candidacy proposal constitutes a fundamental reference point (Municipality of Ivrea, 2012). Great part of the data and information reported in the Management Plan supported the creation of the knowledge structure and were included into the GIS. In particular, these data have to be analysed to formulate the Action Plans provided by the current MIBAC methodology (MIBAC, 2005) and necessary for the future management of the site: the Knowledge Plan, the Protection and Conservation Plan, Valorisation/Promotion Plan and Communication Plan.

3.2 Knowledge Generation

Once the knowledge base is preliminary identified and analysed, it is important to design and implement the KDB in order to generate a structured knowledge able to effectively support the site enhancement projects and processes.

Step 3 - Design

The identification of the site and off-site boundaries is the first necessary operations to design the KDB. Subsequently the most crucial step is the identification of the territorial classes and their mutual relations (definition of categorization). Some territorial classes were taken from the abovementioned Management Plan (the Buffer Zone, the Core Zone and Urban Contexts), while others were added by the Politecnico di Torino (Buildings, Cadastral Parcels, Elements of grey infrastructures, Elements of green infrastructures, Energy retrofit, Projects, Green and grey infrastructures projects and costs). The Buildings were assumed as the smallest territorial class and each element belonging to

this class was connected by means of a unique ID to an Urban Context and to a Land Parcel (Barreca et al, 2017). Moreover, each element was not considered separated from the others, but integrated in the unitary urban system that the UNESCO site represents.

Step 4 - Implementation

In order to implement the KDB it was firstly necessary to define its structure in detail, create a geodatabase and set up the data sheets. After that, a preliminary data compilation was possible, followed by the link of additional information and analyses, such as the survey of state of degradation and materials or archive documents (data compilation and analysis). An initial set of data (regarding only the Urban Contexts) was extracted from the abovementioned Management Plan (Municipality of Ivrea, 2012) and significantly expanded with additional information related both to the territorial and socio-economic context and to the buildings. A formal synthesis of many data on the different and heterogeneous urban elements of the site is very fruitful to set a new path of KM, to share knowledge with the actors who accept an involvement in the site enhancement process, to foster and monitor sustainable enhancement projects and to set performance and risk indicators. Therefore, the implementation included also a set of possible redevelopment projects with detailed analyses finalized to evaluate their economic-financial feasibility.

3.3 Knowledge Delivery

The third phase of the KM is fundamental to manage and control the knowledge exchange process between different subjects and systems, dealing with the complex issues related to interoperability, testing and data maintenance.

Step 5 - Verification and testing

After the KDB implementation, it is possible to proceed with its verification and testing of the integration of the new GIS with another existing structured knowledge base, such as the existing GIS of the Municipality of Ivrea (that currently does not include all the data related to the UNESCO site, which rather the Politecnico di Torino collected and analysed). An effective knowledge exchange is possible only if in the feasibility study the technical compatibility set is verified and a series of integration issues are tested and solved (interoperability).

Step 6 - Operation and maintenance

The KM becomes operational when queries, elaborations and updating of the data are properly manageable. In this phase all data can be integrated and jointly analysed for example by means of thematic maps or indicators calculation. The ongoing maintenance of the system is fundamental to guarantee its constant functionality, the access control and the storage and security process.

4 Results

The GIS was conceived in 2016 as a component of a structured knowledge base able both to accurately and preventively provide updated information about all the assets of the site and to support the governance of the urban area. It is a dynamic relational system able not only to collect and analyse geographical data concerning the territorial, socio-economic and cultural context and data related to the physical characteristics of the built environment (Urban Contexts, Cadastral parcels, Buildings, Elements of grey infrastructures, Elements of green infrastructures), but also to analyse, manage and monitor redevelopment projects and their impacts and outcomes over a long period of time.

The potentialities of the first version of the GIS were acknowledged by the Municipality of Ivrea in 2017, when it was used to support the candidacy proposal of the UNESCO site for the final evaluation, before the nomination.

Today, after three years, the GIS implementation has been considerably improved, so that it may be adopted by the Municipality of Ivrea to develop strategies, policies and actions for the enhancement and the governance of the whole UNESCO site.

In addition, to provide a complete, structured and updated knowledge of the actual buildings condition (owners, uses, fragmentations, structural and energy efficiency, restoration), the GIS could also support the management of administrative and cadastral practices, as well as of all those documentations useful for the regional UNESCO periodic reporting.

In this paper the attention is focused on the GIS potentialities in supporting the Municipality of Ivrea in the redevelopment and future management of streets, places, car parks (Elements of grey infrastructures) and green areas (Elements of green infrastructures). In fact, they currently represent urgent and priority interventions to enhance and to foster the acknowledgment of the site's value.

The results concerning these aspects are illustrated below, with a particular evidence on:

- the improvement of the structure of the KDB;
- the implementation of the KDB;
- analyses and future strategic development actions.

4.1 The improvement of the structure of the KDB

The conceptual framework of the GIS was defined in 2016 when the "Identification of knowledge" phase started (Barreca et al., 2017). The effectiveness of the structure of the KDB was generally confirmed, even if some improvements were made in the last three years during the "Knowledge generation" phase (Figure 2).

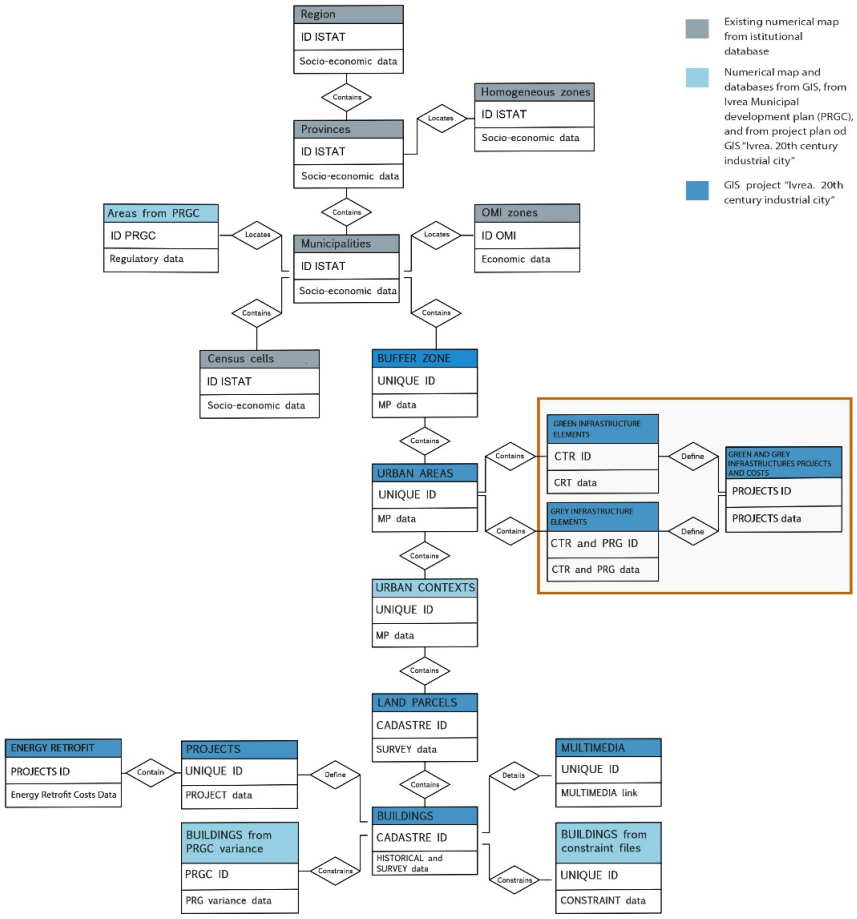

Figure 2: Conceptual framework of the GIS. (Source: Authors' elaboration).

In particular, some entities were added and joined to the Buildings, Elements of grey infrastructures and the Elements of green infrastructures, in order to better specify and manage important emerging issues. A particular attention was paid to improve the structure of the "Elements of grey infrastructures" and "Elements of green infrastructures" classes: several data were included in order to both to analyse the typologies of the single elements, their condition and the presence of car parks, sidewalks, playgrounds, equipped areas, street furniture and lighting. The improved metadata of these two classes are illustrated in Appendix A and Appendix B.

Furthermore, an important improvement was made by creating the new entity "Green and grey infrastructures projects and costs" with the aim of monitoring and managing the grey and green infrastructures redevelopment and maintenance projects and their related principal costs. Numerous aspects are to be considered for these purposes: in addition to the necessary specifications on the classification of the project type and its extension, it is

important, for example, to consider if the projects might reconnect the existing ecosystems or enhance the ecological corridors. Furthermore, it is strategic to identify and specify all those green urban features able to enhance the green percentage or to assist species movement (as compensation measures after the construction of a grey infrastructure), as well as all those multifunctional areas that can be openly accessed and enjoyed (kids playgrounds, equipped training areas, free Wi-Fi zones, recreation areas, areas with digital infrastructures, biodiversity protected areas, etc.). A particular attention was focused on the economic-financial aspects. On the one hand the main costs related to the grey and green infrastructures redevelopment projects were considered (for example: demolitions, excavations, consolidations, hydraulics works, technological plants, road signage, urban furniture) and on the other their principal maintenance costs (for example: one-off and ongoing costs, masonry, steel, protective coatings, road superstructures and pavements, road safety barriers, winter services, sowing and soaking, cutting, weeding, processing and various treatments). The metadata of this new entity are illustrated in Appendix C, while a possible future use of these data is illustrated in paragraph 4.3.

4.2 The implementation of the KDB

The infrastructure system of the UNESCO site was originally divided in 47 elements including streets, squares and car parks, while the system of green spaces was divided in 38 elements including both public and private green areas. Currently, at the end of the "Knowledge generation" phase, numerous data and information related to those elements were collected and joined into the GIS. The implementation results are synthesized in Table 1.

Table 1: Implementation results (Source: Authors' elaboration).

Entity	**Elements**	**Data implementation percentage**
Elements of grey infrastructures	47	89%
Elements of green infrastructures	38	79%
Urban contexts	29	55%
Buildings	114	76%
Cadastral parcels	93	80%

This structured, detailed and updated data collection represents an important result that could effectively support the Municipality of Ivrea in the future management of the UNESCO site. In particular, this data could be not only effectively integrated into the GIS of the Municipality of Ivrea, but it can also support a series of analyses and future strategic development actions aimed at enhancing and fostering the acknowledgment of the site's value.

4.3 Analyses and future strategic development actions

The wealth of information that the GIS developed by the Politecnico di Torino now enables a wide range of analyses finalized to describe the current situation, highlighting redevelopment potentialities and weaknesses related to the different abovementioned constituent elements of the UNESCO site (urban contexts, cadastral parcels, buildings, green areas, infrastructures, etc.). Figure 3 shows, for example, a possible analysis of data related to the presence of street furniture in the green areas and of the road signage in the grey infrastructures and may support the identification of the less equipped areas and to orient public investments to improve them.

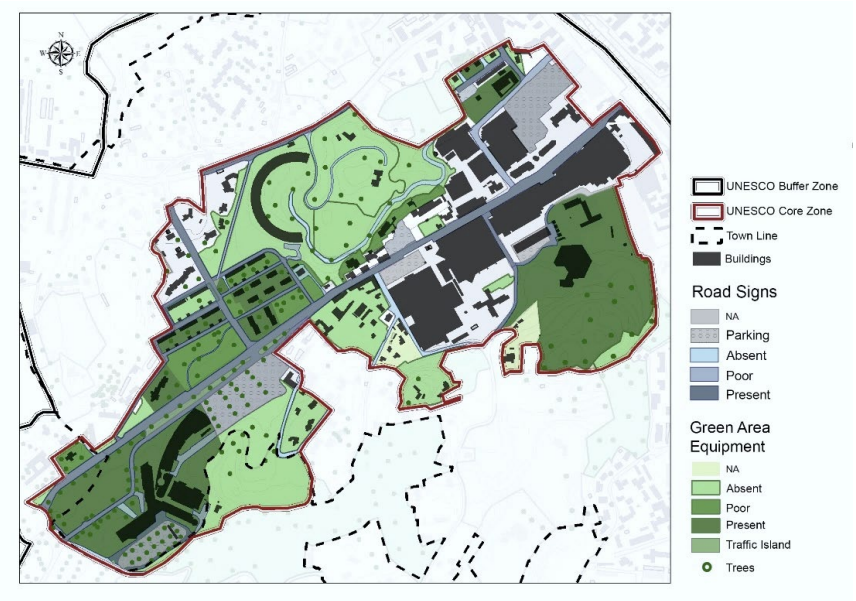

***Figure 3**: Analysis of the presence of street furniture in the green areas and of the road signage in the grey infrastructures: thematic map (Source: Authors' elaboration).*

In addition to these descriptive analyses, the current improved version of the GIS, with a particular reference to the new entity "Green and grey infrastructures projects and costs", enables also more specific and strategic development actions, such as:

- the management of the necessary redevelopment and maintenance costs related to the infrastructures and public green areas;
- the design, implementation and evaluation of green infrastructure projects.

Infrastructures design cost and value management

The creation of the new entity "Green and grey infrastructures projects and costs", illustrated above, laid the ground to important analyses that the Municipality of Ivrea may run in order to monitor and manage the principal costs related to the redevelopment and

maintenance of the elements of the grey and green infrastructures. These costs represent important items in the budget of a Public Administration, but in Ivrea a punctual and georeferenced estimation of their amount, at least at our knowledge, is currently absent. Therefore, the GIS may effectively support the Municipality of Ivrea not only in quantifying and in optimizing the necessary investments for each considered element of the UNESCO site, but also in estimating and managing the related future maintenance costs, respecting the current municipal regulations (Municipality of Ivrea, 2015; Municipality of Ivrea, 2017). The optimization of the public economic-financial resources is not the only benefit achievable through the GIS: in fact, this tool may also support the practical management of the redevelopment works and the future maintenance interventions, by optimizing the scheduling of the necessary activities and the involved resources. A rational scheduling and planning of actions has to be necessarily based on the uniqueness and transparency of the knowledge of each object and subject involved, over years, fostering accountability, efficiency and economic-financial sustainability of the enhancement interventions to be made in the site.

Furthermore, these data may also support the updating of the UNESCO site Management Plan, which currently includes an amount of 5000 Euro to be allocated for the public spaces maintenance (Municipality of Ivrea, 2017), while recent studies demonstrated that these costs are supposed to be much higher (Naumann et al., 2011; Pacella and Vianzone, 2019). The GIS may support an accurate estimation of the necessary works and also highlight the relation between the investment costs and all the positive impacts that those interventions may generate from the UNESCO site to the whole city of Ivrea.

Green infrastructures projects

Basic redevelopment projects to improve the current condition of the public infrastructures and green areas of the UNESCO site are certainly necessary but not sufficient. More specific and detailed green infrastructures projects may be promoted by the Municipality of Ivrea in order to concretely follow some green economy principles and deeply improve the quality of the public spaces and, consequently, foster the enjoyment of the assets located nearby these areas and the environmental quality (Loiseau et al., 2016). Green infrastructure is a strategically planned and delivered network of high-quality green spaces and other environmental features. It should be designed and managed as a multifunctional resource capable of delivering a wide range of environmental and quality-of-life benefits for local communities. Green infrastructure includes parks, open spaces, playing fields, woodlands, allotments and private gardens (European Environmental Agency, 2011). This network can deliver a wide range of ecosystem services such as air quality, water purification, space for recreation and climate mitigation and adaptation and therefore improve citizens' health and wellbeing.

Monitoring and evaluation are useful tools to assess a project’s success in terms of its achievement of the original objectives, benefits produced and cost-effectiveness. The

main drivers behind these actions are to assess the efficiency of the project (weighing the costs against the benefits obtained).[1]

In this perspective, the Municipality of Ivrea could promote strategic actions in order to generate positive impacts on the community of Ivrea, by opening public tender calls for the realization of protected areas, restoration zones, sustainable use areas, green urban features, natural connectivity features, artificial connectivity features and multifunctional zones (Naumann et al., 2011).

The new entity of the GIS "Green and grey infrastructures projects and costs" was created also for this purpose: by means of all the considered data (Appendix C) the green infrastructures elements can be analysed, monitored and evaluated. A possible influence generated by a hypothetical realization of a green infrastructure project is represented in Figure 4: a single scarcely equipped green area of the site, if properly redeveloped, is able to positively impact a whole residential neighbourhood (Castellamonte) and one of the iconic building of the UNESCO site (Olivetti new offices building).

***Figure 4**: Hypothetical realization of a green infrastructure project: positive influence on the Castellamonte residential neighbourhood and on the Olivetti new office building (Source: Authors' elaboration).*

[1] *A clear potential to integrate and boost green infrastructure projects throughout the EU is offered by spatial planning policies which, at the EU level, are comprised inter alia of the Strategic Environment Assessment (SEA), Environmental Impact Assessment (EIA) and Environmental Liability Directive (ELD). The SEA and EIA are considered as the most important legal instruments of horizontal European environmental policy.*

5 Conclusions

The enhancement and future management of the site "Ivrea, industrial city of the 20th century" is a great challenge for the Municipality of Ivrea, which is currently dialoguing with the private owners of the assets in order to coordinate the redevelopment projects, coherently with the Management Plan drawn up for the UNESCO nomination proposal. This delicate phase, as well as the future management of the site, could be supported by a structured and complete knowledge base about all the elements located in this area and to the environment and socio-economic context of Ivrea.

In this perspective, a fruitful collaboration between the Municipality of Ivrea and the Politecnico di Torino could start in the context of the third phase of a KM ("Knowledge delivery") activated over the last few years. The GIS developed, improved and implemented by the Politecnico di Torino could be transferred to effectively support the Public Administration in analysing different kinds of data, in identifying potentialities to strengthen or criticalities to solve over the whole site and in communicating with public and private stakeholders (Mason and Dragicevic, 2006). Several future developments of the GIS will be possible in order to address specific services for citizens, operators and the Public Administration itself (for example a collaborative GIS platform to interact with different stakeholders or specific operative tools able to support public policies for the land administration or the real estate taxation).

Focusing the attention on the grey and green infrastructures of the site, today it is evident a lack of routine maintenance: their condition does not foster the acknowledgment of the site's value, as well as its accessibility and enjoyment. The redevelopment of streets, squares, car parks and public green areas could be the driving force able to foster the enhancement of the whole UNESCO site. Therefore, these interventions constitute urgent and priority actions that the Municipality may quickly and directly activate in parallel with the ongoing mediation process with the buildings' private owners and other territory stakeholders.

Nevertheless, the positive impacts that the redevelopment of these infrastructures could generate go beyond the site's enhancement. Their improvement is able to produce benefits for all the citizens, in terms of increase of the welfare, urban services equipment and the environmental condition (air and water quality, ecosystem services, biodiversity, etc.). An improved quality of the surroundings positively impacts also the property values and, as a consequence, fosters the real estate market trends and supports the economic operators that currently operate in a rather fragile context. Therefore, strategic redevelopment actions on the grey and green infrastructures could indirectly improve the socio-economic equity and trigger important measures to contrast the current economic crisis.

Special attention deserve the design and implementation of green infrastructure projects, which are able to improve both the attractiveness and the environmental quality of the site. The Municipality of Ivrea could orient numerous strategic actions in this direction by investing in public projects able to generate positive impacts on the community: a network of healthy ecosystems compensates the construction of grey

infrastructures, offering benefits for all citizens. Furthermore, according to the carbon tax regulations, projects like the planting of trees generate both benefits and incomes for the Public Administration (green compensation for redevelopment works). Therefore, future researches can be addressed towards the cost-benefit evaluation of the green infrastructures projects, in order to support the Municipality of Ivrea not only in the management of the redevelopment and maintenance costs, but also in assessing the positive impacts that strategic enhancement projects could generate from the UNESCO site to the whole territory of Ivrea. To achieve this important and ambitious goal, a knowledge exchange process should be activated between the Municipality of Ivrea and the Politecnico di Torino to further customize the current release of the GIS. By this way, the case of Ivrea could become a best practice of territory sustainable development and an example of fruitful collaboration between Public Administrations.

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Appendix A - Metadata for "Elements of green infrastructures" class (Source: Authors' elaboration).

Elements of green infrastructures				
data structure	**data content**	**data value**		**source**
Field name		**vocabulary**	**levels**	
GREEN ELEMENT ID	Identifier of the element of the system of green spaces	closed	VR001, …, VR026	DB
URBAN CONTEXT ID	urban context to which GE belongs to	closed	UA001,…UA029	DB - Unesco Management Plan
LAND PARCEL ID	urban context to which GE belongs to	closed	LP001,…,LP093	DB - Cadastral plan
TYPOLOGICAL CLASSIFICATION BDTRE	typological classification based on regulatory coding BDtre	closed	codes	BDTRE
TYPOLOGICAL CLASSIFICATION	Classification	closed	park, garden, equipped green areas, free area, …	compiler - PRGC, BDTRE
OWNER TYPE	definition if the area is public or private	closed	public, private	DB
OWNER NAME	name of area's owner	open	text	DB
DESCRIPTION/ REGULATORY AREA	general description of the green area	closed	VA - public and equipped green area, TAC - hill landscape values area, …	PRGC - or if protected - superintendence
AUTHOR	name of the original designer of the element	open	text	compiler
TERRAIN SLOPE	definition of terrain	closed	sloping area, hillside, plain, …	compiler
IDENTIFICATION	identification of the neighbouring areas that determine the perimeter and the boundaries of the green area	open	text	compiler
LIGHTING PRESENCE	current level of lighting presence	closed	good, discreet, sufficient, poor, bad	compiler
URBAN FURNITURE PRESENCE	current level of the presence of street furniture	closed	good, discreet, sufficient, poor, bad	compiler
CHILDREN EQUIPPED AREA PRESENCE	current level of the presence of playground equipment	closed	yes, no, NA	compiler
ACCESSIBILITY	current level of the presence of accessibility	closed	yes, no, partial, NA	compiler
VISIBILITY	current level of the presence of visibility	closed	yes, no, partial, NA	compiler
LEVEL OF USE	current level of use	closed	in use, underutilized, unused, NA	compiler
LEVEL OF MAINTENANCE	description of the state of maintenance of the element at the time of the investigation	closed	buono, discreto, medio, scarso, pessimo	compiler
ECOSYSTEM LEVEL	based on the measurement of the indicators for urban ecosystem quality	open	numeric indicator	Compiler - MAES report
TOTAL AREA	expressed in square meters	open	numeric	compiler
PERIMETER	expressed in meters	open	numeric	compiler
QUALITY CONSIDERATIONS	other characteristics of the area that can determine its quality / non-quality	open	fruit plants, flowering plants, monumental trees, ...	compiler
REDEVELOPMENT	description, if any, of the redevelopment project	open	text	compiler
references	sources used, bibliography	open	text	compiler
name of compiler	name of record compiler	chiuso	GR01, …, GR20	compiler
date	date record compiled	open	text	compiler
note	any other information that does not fall within the official fields for compilation	open	text	compiler

Appendix B - Metadata for "Elements of grey infrastructures" class (Source: Authors' elaboration).

ELEMENTS OF GREY INFRASTRUCTURES				
data structure	**data content**	**data value**		**source**
Field name		**Vocabulary**	**Levels**	
GREY ELEMENT_ID	Identifier of the element of the system of grey infrastructure	closed	IN001, …, IN027	DB
URBAN CONTEXT ID	urban context to which GE belongs to	closed	UA001,…UA029	DB - Unesco Management Plan
LAND PARCEL ID	urban context to which GE belongs to	closed	LP001,…,LP093	DB - Cadastral plan
REFERENCE SYSTEM	system of belonging of the single element	closed	road, river, rail, fortifications, ...	compiler
OWNER TYPE	definition if the area is public or private	closed	public, private	DB
OWNER NAME	name of area's owner	open	text	DB
TYPOLOGICAL CLASSIFICATION BDTRE	typological classification based on regulatory coding Bdtre	closed	codes	BDTRE
TYPOLOGICAL CLASSIFICATION	definition and classification. "New highway code", legislative decree April 30, 1992 n. 285 and subsequent amendments	closed	A - Motorways, B - Main suburban roads, C - Secondary suburban roads, D - Urban roadways, E - Urban neighbourhood roads, F - Local roads, F-bis. Cycle and pedestrian itineraries, or parking, median area, …	compiler - PRGC, BDTRE
NAME	current name	open	text	compiler
ROAD SECTION	road section that is analysed, beginning and end, salient sections	open	text	compiler
DESCRIPTION	description of the element at the time of the investigation	open	text	compiler
FIRST OPENING DATE	date of the first opening / construction of the element	open	date, year	compiler
AUTHOR	name of the designer of the first opening / construction of the element	open	text	compiler
LIGHTING PRESENCE	current level of lighting presence	closed	good, discreet, sufficient, poor, bad	compiler
URBAN FURNITURE PRESENCE	current level of the presence of street furniture	closed	good, discreet, sufficient, poor, bad	compiler
SIDEWALK PRESENCE	definition of the presence or absence of sidewalks on the sides of the roadway	closed	yes, no, partial, NA	compiler
PARK PRESENCE	definition of the presence or absence of parking on the sides of the roadway	closed	yes, no, partial, NA	compiler
LEVEL OF USE	current level of use	closed	in use, underutilized, unused, NA	compiler
LEVEL OF MAINTENANCE	description of the state of maintenance of the element at the time of the investigation	closed	good, discreet, medium, poor, bad	compiler
ROAD SURFACE	description of the state of maintenance of the road surface	closed	to be reviewed, good, NA	compiler
HORIZONTAL SIGNAGE	definition of the presence or absence of horizontal signage	closed	good, poor, bad	compiler
VERTICAL SIGNAGE	definition of the presence or absence of the vertical signage	closed	good, poor, bad	compiler
LEVEL OF USE	current level of use	closed	in use, underutilized, unused, NA	compiler
QUALITY CONSIDERATIONS	other characteristics of the area that can determine its quality / non-quality	open	fruit plants, flowering plants, monumental trees, ...	compiler
ACCESSIBILITY	current level of the presence of accessibility	closed	yes, no, partial, NA	compiler
VISIBILITY	current level of the presence of visibility	closed	yes, no, partial, NA	compiler
PREVALENT HORIZONTAL MATERIAL	definition of the prevailing horizontal coating material	closed	asphalt, porphyry blocks, stone slabs, …	compiler
REDEVELOPMENT	description, if any, of the redevelopment project	open	text	compiler

references	sources used, bibliography	open	text	compiler
name of compiler	name of record compiler	chiuso	GR01, …, GR20	compiler
date	date record compiled	open	text	compiler
note	any other information that does not fall within the official fields for compilation	open	text	compiler

Appendix C - Metadata for "Green and grey infrastructures projects and costs" class (Source: Authors' elaboration).

GREEN AND GREY INFRASTRUCTURES PROJECTS				
data structure	**data content**	**data value**		**source**
Field name		**vocabulary**	**levels**	
GREY ELEMENT ID	Identifier of the element of the infrastructure system	closed	IN001, …, IN027	DB
GREEN ELEMENT ID	Identifier of the element of the system of green spaces	closed	VR001, …, VR026	DB
PROJECT ID	project identifier	closed	PR001,…,PRn	DB
PROJECT NAME	Title/name of the project	open	text	compiler
PROJECT DESCRIPTION	brief description of specific project	open	text	compiler
PROJECT TYPE GENERAL	brief general classification of type of project	open	Restoration, New Plan, Management project, …	compiler
PROJECT TYPE	brief specific classification of type of project	open	Protected areas projects, Sustainable use promotion, Green urban features, Natural connectivity features, Artificial connectivity features, Multifunctional zones, …	compiler
PROJECT MAIN FUNCTION (USE)	definition of main function	open	text	compiler
CHANGE IN FUNCTION (USE)	from area's current function	closed	yes, no, NA	compiler
PROJECT REFERENCE BUILDINGS	if the project deals with the refurbishment / defunctionalisation of the external areas belonging to a private/public building (ID)	closed	ED001,…,ED114	DB
GUFA PROJECT (ha)	gross usable floor area of project (ha)	open	numerical	compiler
PROJECT SIZE	indication of the extension of the project with respect to the total extension of the park, green area, territorial unit to which it belongs	closed	single whole area, portion	compiler
PROJECT LOCALIZATION	indication of which portions of the total area are affected by the project	open	text	compiler
PROGETTO A FASI SUCCESSIVE DI SVILUPPO	indicate if the project described is part of a larger project of which it is only a development phase, or it is the entire project for the functionalization of the building / area	closed	yes, no, NA	compiler
PROJECT DEVELOPMENT PHASE	if yes, indicate which of the various stages of development you are describing	open	Beginning, Phase number, completion of works, etc.	compiler
PROJECT OWNER TYPE	definition if the area will be public or private following the implementation of the project	closed	pubblic, private	compiler
PROJECT OWNER	owner of the area/space following the realization of the project	open	text	compiler
PROJECT AREA RESTORATION INTERVENTION	Intervention related to the restoration and the reconnection of existing the ecosystem in a green urban area	open	Reforestation zones, increased foraging areas, new areas of habitat for ecosystem services; conversion of a habitat back into its original form, etc.	compiler
PROJECT AREA GREEN URBAN FEATURES	Features designed specifically to enhance green percentage in urban area, which can result from compensation measures as a result of grey infrastructure construction	open	parks, gardens, grassy verges, green walls, green roofs	compiler
NATURAL CONNECTIVITY FEATURES	Definition/recognition of ecological corridors	open	steppingstones, riparian river vegetation, hedgerows, wildlife strips, etc.	compiler

ARTIFICIAL CONNECTIVITY FEATURES	Features designed specifically to assist species movement, which can result from compensation measures to recreate a physical connection which has been lost or compromised as a result of grey infrastructure construction (e.g. a motorway)	open	green bridges, eco-ducts, wildlife passages, etc.	compiler
PROJECT AREA MULTIFUNCTIONAL ZONES	Zones created to balance various uses and promote enhanced public access to the landscape particularly adjacent to existing and planned settlements	open	kids playground, equipped training areas, open access, recreation, biodiversity, etc.	compiler
AVAILABILITY OF FINANCING	availability of financing for type of project proposed (ref. Fundraising)	closed	yes, no, NA	compiler
FINANCING TYPE	brief description of possible financing for implementation of project	open	non-repayable public or private financing, capital grants low interest loans, etc.	compiler
PRIORITY	priority of project evaluated according to urgency, costs and existence of available financing	closed	high, medium, low	compiler
TOTAL CONSTRUCTION COST EUROS	cost of project (euros) (ref. BOQ) included: safety costs, transport and fuel costs, taxes, payments, etc.	open	numerical	compiler (Anas)
COSTS OF PROVISIONAL AND SEMI-FINISHED WORKS	costs (in Euro) expected for temporary works, rent, work machinery, etc. (ref. BOQ)	open	numerical	compiler (Anas)
DEMOLITIONS and EXCAVATIONS COSTS	costs (in Euro) expected for demolitions (ref. BOQ)	open	numerical	compiler (Anas)
STRUCTURE CONSOLIDATION COSTS and NEW CONSTRUCTIONS	costs (in Euro) expected for structural consolidation works (ref. BOQ)	open	numerical	compiler (Anas)
GREEN AREAS WORKS COST	costs (in Euro) expected for green works (ref. BOQ)	open	numerical	compiler (Anas)
HYDRAULICS WORKS COSTS	costs (in Euro) expected for plumbing/hydraulics works (ref. BOQ)	open	numerical	compiler (Anas)
TECHNOLOGICAL PLANT COSTS	costs (in Euro) expected for the installation / replacement of technological systems (ref. BOQ)	open	numerical	compiler (Anas)
ROAD SIGNAGE COSTS	costs (in Euro) expected for site signage (vertical and horizontal) (ref. BOQ)	open	numerical	compiler (Anas)
URBAN FURNITURE COSTS	costs (in Euro) expected for installation/replacement/ refurbishment of urban furniture (ref. BOQ)	open	numerical	compiler (Anas)
TOTAL COST OF INVESTMENT EUROS	cost of investment including (in Euro): Planning, surveys, preparatory studies, Communication and consultation, Project management and administration, Spatial planning, Land purchase, **Compensation payments**, One-off compensation payments, Purchase of livestock, Land management and restoration works, Creation of connectivity features, etc.	open	numerical	compiler
LAND CADASTRAL VALUE	Acquisition value of the area (in Euro) subject to the intervention	open	numerical	compiler
ESTIMATED TOTAL DURATION MONTHS	Estimation of duration of works (ref. Timetable)	open	numerical	compiler
ONE-OFF COSTS (TOTAL/YEAR)	extraordinary maintenance costs (in Euro/per year/month): potholes, repairs, floods, bacteria / parasites emergency interventions, etc... (ref. Management plan)	open	numerical	compiler
ON GOING COSTS (TOTAL/YEAR)	recurrent annual maintenance costs (in Euro/per year/month)(ref. Management Plan) including: Costs of management agreements, Transport equipment and fuel, Project management and administration, Communications and education, Research and monitoring, Material tests and geognostic investigations, surveys, environmental monitoring	open	numerical	compiler (Anas)
CONSTRUCTIONS	costs (in Euro/per year/month) of masonry, steel,	open	numerical	compiler (Anas)

MAINTENANCES	protective coatings maintenance			
ROADS MAINTENANCE	costs (in Euro/per year/month) road superstructures and pavements maintenance	open	numerical	compiler (Anas)
OTHER MAINTENENCE WORKS	costs (in Euro/per year/month) of reclamation of slopes, purging of ditches, containment, cleaning of eyelashes, fences, reclamation, waste	open	numerical	compiler (Anas)
GREEN MAINTENENCE	costs (in Euro/per year/month) of sowing and soaking, cutting, cutting, weeding, processing and various treatments	open	numerical	compiler (Anas)
SAFETY BARRIERS MAINTENENCE	costs (in Euro/per year/month) for maintenance of road safety barriers	open	numerical	compiler (Anas)
ROAD SIGNAGE MAINTENANCE	costs (in Euro/per year/month) of replacement of various signs, cleaning of signs, temporary signs	open	numerical	compiler (Anas)
RENTS, EQUIPMENT	costs (in Euro/per year/month) of rent, other equipment, freight, supplies, emergency interventions	open	numerical	compiler (Anas)
WINTER SERVICES	costs (in Euro/per year/month) of winter services clearing snow and anti-ice	open	numerical	compiler (Anas)
TECHNOLOGICAL PLANT MAINTENANCE	costs (in Euro/per year/month) of various technological systems, lighting, fans, fire detection	open	numerical	compiler (Anas)
references	sources used, bibliography	open		compiler
name of compiler	name of record compiler	chiuso	GR01, …, GR20	compiler
date	date record compiled	open		compiler
note	any other information that does not fall within the official fields for compilation	open		compiler

Strategy Indicators and Performance Measurement as Part of University Knowledge Management System

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Abstract

Universities play a crucial part in maintaining, creating and sharing knowledge in different ways for the society. Nowadays the amount and complexity of information required from different stakeholder groups for universities is increasing. In this context universities should be leaders in managing the knowledge within the institution. One way of doing that is to align the universities strategic priorities with the demands of the society, industry and government.

In this research paper the authors are focusing on understanding what is Knowledge Management (KM) in the university perspective, how it can be integrated in the university development strategies and how KM elements are structured and measured beyond universities. The purpose of this research paper is to find out how KM elements can be integrated into university strategic management systems.

The authors have conducted a literature review on KM, by analysing different definitions formulated by researchers. The definitions have been analysed in the context of university's role as a contributor to creating and sharing knowledge. The authors have analysed the main outcomes from integrating KM elements into university strategic management. In addition, the authors have contributed to this research by analysing strategic management trends of universities in Latvia and how they integrate KM elements, by analysing their institutional strategies.

The research includes universities in Latvia, at the European level only the requirements of the EUA were analysed and at the global level the requirements of THE World Rankings, QS World Rankings and U-Multirank were taken into account. This limitation was based on the availability of the necessary information and the scope of the study. Another limitation regarding the research is that only university strategic performance indicators were selected for in-depth analysis in this paper.

The research includes the analysis of previously defined KM definitions by researchers, compiles the main positive outcomes from KM integration in university strategies and gives insights to the

analysis of performance based indicator groups at the national, European and global levels. While identifying how KM elements are integrated the research also provides more insight into higher education strategic performance measurement systems.

Keywords – University, Performance measurement, Performance indicators, Knowledge management, Strategic knowledge management

Paper type – Academic Research Paper

1 Introduction

In the past decades universities have transformed and adapted to external factors showing their high capacities of change (Gibbons *et al.*, 1994). The changing role and scope of university impact is evolving. Universities as a significant contributor to the society and the economic development are still looking for new ways how to transfer the created knowledge within the institution to the industry more efficiently (Geuna and Muscio, 2009). For example, university and industry collaboration nowadays play an important role for the regional development (Gibbons *et al.*, 1994). As universities are faced upon new changes and challenges, those universities that are more flexible and adaptive has the most advantage. Researchers emphasise that universities which are keen on collaboration with the industry are more likely to adapt to change than those who do not (Gibbons *et al.*, 1994).

From the educational perspective the importance of KM in universities is being considered as linking created knowledge in education with practical implementation in the industry (Straujuma *et al.*, 2018). Nevertheless, from the strategic and operational perspective - developing, acquiring and applying KM activities can help to develop strategic and action-oriented goals for organization (Quintas, Lefrere and Jones, 1997). On the one hand, universities can be seen as knowledge-based organizations where knowledge creation and transfer occur, but on the other hand it can be used as a strategic advantage by introducing KM in an operational level at the university. Researchers emphasise that the KM that includes performance measurement analysis and benchmarking data has been considered as a strategic resource for the organization (Gonzalez and Massaroli De Melo, 2018). From the perspective of process management KM is beneficial for process innovation, re-engineering of processes to achieve continuous improvement for the organization (Quintas, Lefrere and Jones, 1997). Universities that are paying additional attention to how their KM system is being developed, how it integrates the analysis of the performance and how it resonates with the stakeholders, can be a beneficial source for sustainable development and competitive advantage of the university.

In the first part of this research the authors analyse the main contributions of KM to university strategic management. The second part of the research is dedicated to understanding how KM is integrated in university strategies and whether the groups of

strategic performance indicators reflected in the university strategies resonate with information requested and analysed at the national, European and global levels.

2 Defining Knowledge Management in Universities

To understand more in depth how KM activities are being defined in universities the authors compared different researcher interpretations of the definition of KM. Furthermore, indicating what positive benefits universities can gain from integrating KM in an operational level. These definitions allow understanding the importance of KM more comprehensively (see Table I).

Table I.

Year	Author (s)	The definitions of KM
1997	(Quintas, Lefrere and Jones, 1997)	KM is the process of continually **managing knowledge** of all kinds to meet existing and emerging needs, to **identify** and **exploit** existing and acquired **knowledge** assets and to develop new opportunities.
2000	(Mårtensson, 2000)	KM is considered a **prerequisite** for higher productivity and flexibility.
2001	(Alavi and Leidner, 2001)	KM involves distinct but interdependent processes of **knowledge creation, storage** and **retrieval**, **knowledge transfer**, and **application**.
2005	(Dalkir, 2005)	KM is the deliberate and systematic coordination of an organization's people, technology, processes, and organizational structure in order to add value. This coordination is achieved through **creating, sharing**, and **applying knowledge**.
2010	(Hung *et al.*, 2010)	The elements of KM are **knowledge creation, knowledge storage, knowledge transfer** and **knowledge application**.
2015	(Girard and Girard, 2015)	KM is the process of **creating, sharing, using** and **managing the knowledge** and information of an organization.
2020	(Dei and Bingle van der Walt, 2020)	The management of processes that govern the **collection, creation, storage, dissemination**, and **utilisation of knowledge** by merging the appropriate technologies, organisational structures and people to create the most effective and efficient learning, problem-solving, and decision-making in an organisation.

KM is being considered as the basis of operational performance (Mårtensson, 2000) as it plays important role in resource management (Dalkir, 2005). Researchers agree that KM is considered as an ongoing process that consists of using knowledge in different ways such as knowledge creation, storage and transfer (Quintas, Lefrere and Jones, 1997; Alavi and Leidner, 2001; Dei and Bingle van der Walt, 2020). Using the resources to create, share and apply knowledge (Dalkir, 2005; Hung *et al.*, 2010; Girard and Girard, 2015) is crucial part of the foundation of universities.

As universities are considered as an important player for knowledge creation and knowledge transfer to meet the social-economic needs (Geuna and Muscio, 2009) these definitions show the importance of KM as an integral process in the operations of the university. Overall the KM concept has evolved from meeting the existing and future needs (Quintas, Lefrere and Jones, 1997) to enhancing resources and technologies to ensure strategic decision-making and organizational learning (Dei and Bingle van der Walt, 2020). Most often researchers are discussing knowledge *creation, application, storage, transfer and sharing* as integral part of the KM activities in universities. Furthermore, by analysing the literature, the authors discovered the most commonly mentioned positive outcomes from developing the KM system.

2.1 Thriving innovation

KM within the orgnaization is being considered as a integral part of process of creation and innovation (Antunes and Pinheiro, 2019). Researchers have found that knowledge creation, integration, and application can facilitate innovation in the organization (Mardani, Nikoosokhan and Moradi, 2018), as nowadays universities play additional role in the society for knowledge transfer and creating innovation (Hu, Hou and Chien, 2019) it is considered as a beneficial opportunity. Researchers have found that the positive relationship between KM and organizational performance enhance innovation and open innovation in the organization (Lopes *et al.*, 2017; Mardani, Nikoosokhan and Moradi, 2018). Furthermore, KM in a organisational function perspective can improve innovation performance and by using different approaches enhance innovation even more (Ode and Ayavoo, 2020).

2.2. Performance effectiveness

KM that is linked with the organizational strategy and processes is considered as effective (Davenport and Prusak, 1998). There have been found links between KM activities such as knowledge creation and knowledge integration positively impacting organizational performance (Mardani, Nikoosokhan and Moradi, 2018). Furthermore, researchers mention that Strategic Knowledge Management system is beneficial for universities as it allows to manage knowledge more effectively and productively (Dei and Bingle van der Walt, 2020).

Some researchers discuss the positive impact of integrating KM with Total Quality Management (TQM) practices to manage knowledge throughout all levels of the organization (Grover and Davenport, 2001). Researchers also address the raising importance of KM integration with TQM being crucial part of organizations operations and innovation (Hung *et al.*, 2010).

2.3. Strategic advantage

Already in the 90ies KM was discussed to be a potential source for advantage for organizations (Quintas, Lefrere and Jones, 1997). Knowledge is defined as one of the most strategically important resources that systematically managed can be used as an organizational strategic advantage (Antunes and Pinheiro, 2019; Hu, Hou and Chien, 2019).

As nowadays universities are understanding more in depth their socio-economic impact on stakeholders (Geuna and Muscio, 2009) the management of stakeholders becomes crucial. Researchers also emphasise that Strategic Knowledge Management gives advantage for managing and leveraging the internal and external stakeholders. (Rubenstein-Montano *et al.*, 2001). Some researchers define knowledge within the KM as sustainable advantage, because it continuously gives and generates new returns for the organization (Davenport and Prusak, 1998).

2.4. Organizational sustainability

As organizational sustainability is the basis of any university strategic view, some researchers argue that there still has been little research on how universities through KM influences sustainable development and impact their stakeholders (Hu, Hou and Chien, 2019; Martins *et al.*, 2019). Although there have been researched links between KM, organizational sustainability and innovations as crucial part of sustainable development and innovations in the organization (Lopes *et al.*, 2017). Nowadays, KM is being mentioned as potential for universities to contribute more to achieving sustainable goals by managing and generating knowledge and innovation (Martins *et al.*, 2019).

From the literature review there have been identified four most commonly mentioned positive outcomes for universities which have implemented and continues to develop their KM system. These outcomes are:

- *Thriving innovation;*
- *Operational and process effectiveness;*
- *Strategic advantage;*
- *Organisational sustainability.*

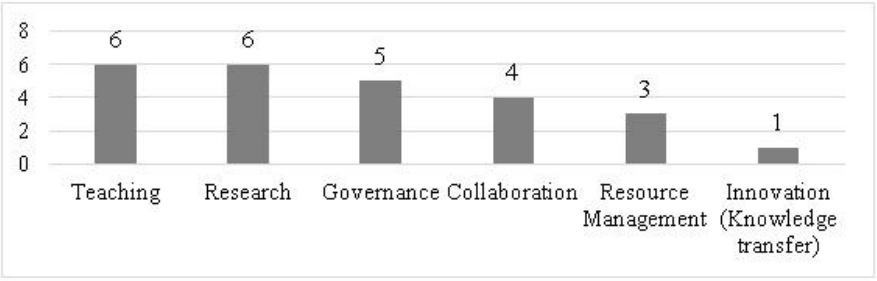
Previously identified positive outcomes are a result of KM integration within the university strategies. From the literature review it is concluded that by introducing KM system universities could enhance their performance in a variety of ways. The authors

continued the research to understand more in depth how universities nowadays are integrating KM elements in their development strategies.

3 Integrating Knowledge Management in university strategy and beyond

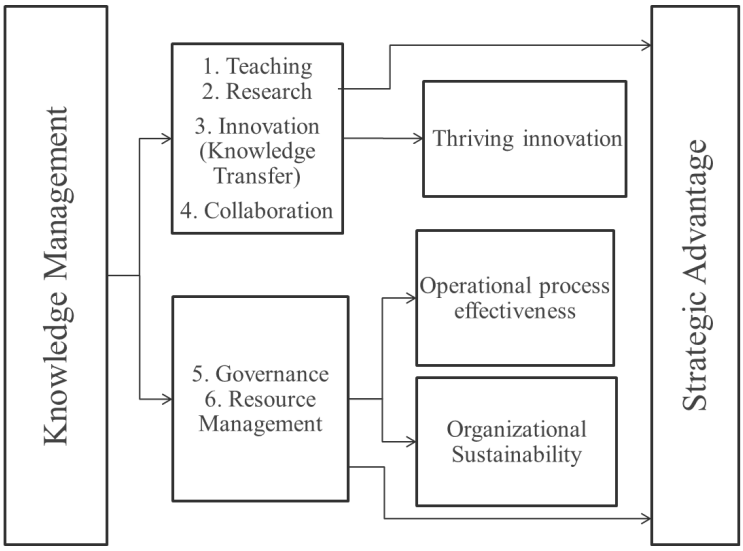
The competition, KM and quality assurance issues in the higher education sector in the world are increasing (Zheng, Yang and Mclean, 2010; Seyfried and Pohlenz, 2018). The competition in the Latvian higher education sector in the past years has increased, together with university autonomy and accountability (Broucker, Wit and Leisyte, 2016). This has led to the responsibility of universities to measure, analyse and report a variety of data and information, not only at the national but also international level. As in the previous chapter it was discussed that KM system can give positive impact on university organizational performance researchers find performance measurement part of that system. Universities are recognising the importance of well-structured knowledge management systems with accurate performance measurement indicators. The capacity of the system to process data into needed information is highly valuable for the university (Martins *et al.*, 2019).

In this research the authors analysed how previously researched KM elements are integrated in the university development strategies. Firstly, comparing the indicator groups defined, measured and reported in the strategies of Latvian universities with indicators required from universities at the national, European and global levels. At the national level the authors analysed the indicators and information required by the Latvian Ministry of Education and Science, at the European level – the European University Association (EUA) requirements and at the international level – Times Higher Education (THE) World Rankings and QS World Rankings indicators.



Graphic I. Latvian university strategic priorities (sorted by frequency)

As the graphic shows most emphasis in the development strategies is being put on the main university processes – teaching and research. Only one university in Latvia has included additional strategic priority – innovation in context of knowledge transfer and collaboration with the industry. The authors identified links between comparing the university strategic development priorities with previously identified positive outcomes from KM activities (see Picture I).



Picture I. KM link between university strategic priorities and positive outcomes

Universities that integrate KM within the strategic priorities can manage their resources and strategic priorities in a way that results in well-grounded and stable strategic advantage (Antunes and Pinheiro, 2019; Hu, Hou and Chien, 2019). From the operational view KM helps to continuous improve processes (Quintas, Lefrere and Jones, 1997). Furthermore, KM allows to manage university stakeholders in such way that ensures strategic advantage (Rubenstein-Montano *et al.*, 2001).

By analysing in depth the results, authors compared the university strategic priorities with priorities defined in three levels - country, European and international. In the country level the authors analysed Latvian Ministry of Education and Science annual reports for teaching and research; in the European level – European University Association (EUA) institutional evaluation program; international level - methodologies of the U-Multirank, Times Higher Education (THE) World University Rankings and QS World University Rankings. For each level there are identified indicators for which universities need to collect data and information. After identification the indicators were grouped and sorted in relevance. Each identified group contributes to understanding how KM elements are measured from university to international ranking levels (see Table II).

Table II. Indicator group comparison through different levels

University level	Country level	European level	World level		
University development strategies	**Ministry of Education and Science**	**European University Association**	**U-Multirank**	**THE WUR**	**QS WUR**
Teaching	Teaching	Teaching and Learning	Teaching and Learning	Teaching	Teaching
Research	Research outcome; income	Research	Research	Research influence	Research output
Governance	N/A	Governance; Quality Culture	General management of the university	N/A	N/A
Collaboration	Industry income	Internationalisation	Regional Engagement; International outlook	International outlook	Reputation; International outlook
Resource Management	Academic and research staff	N/A	N/A	N/A	N/A
Innovation (Knowledge Transfer)	Knowledge Transfer	N/A	Knowledge Transfer	Knowledge transfer	N/A

The table shows that teaching, research and collaboration activities are measured through each of the three levels, in contrast such priorities as university governance, resource management and organizational innovation are not. Governance as a priority is measured in all levels except country level, indicating gap between information flow from universities and government. Resource management is being considered as regional measurement, but organizational innovation consists of different indicators in each level, that could possibly duplicate with Research output measures. From the perspective of KM university teaching and learning, research and collaboration activities resonate with measurement of *knowledge creation, application, storage and sharing.*

The analysis of the groups of indicators also show that there is a weak link between performance indicators that results in variety of data and measures needed for university. The problem with data assessment is also identified in other countries where researchers see contradictions and wide gap between assessments in different levels (Turri, 2013). Other researchers argue that universities are focused on external evaluations and compliance to the requirements that lets them to forget about the university's strategic priorities (Sursock, 2012).

4 Conclusions

KM is being considered as a crucial part of university role and impact to the socio-economic development. The literature review identified that the most often discussed elements of KM are knowledge - *creation, application, storage, transfer and sharing.* Furthermore, by analysing the literature the authors compiled the main outcomes for universities which have implemented KM in their strategic management. Successful integration of KM for university could give the following positive outcomes - *Thriving innovation; Operational and process effectiveness; Strategic advantage* and *Organisational sustainability.* The authors identified links between Latvian university strategic development priorities and previously identified positive outcomes from KM activities.

The results of the research show that not only universities in Latvia define different performance indicators, but different performance measurement requirements also exist at the national, European and international levels. Only some of the previously defined groups of indicators can be identified in each of the levels.

Further research opportunities could be linked to analysing in depth the indicator groups to identify how diverse is the data and information collection. In addition, further contribution is needed for analysing the factors influencing successful integration of KM elements in different types of universities. As the second part of the research was based on analysing only strategic priorities and groups of indicators of Latvian universities it shows further research is possibilities by analysing different country example.

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Analysing the Impact of Organizational Models on the Performances of Regional Blood Supply Chains

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Abstract

Blood Supply Chains (BSCs) are a complex set of actors, facilities and relationships, whose role is to manage the entire flow of blood units, from donors to patients, and to ensure that the total demand of blood is met (i.e. the self-sufficiency goal). To this end, the support of Voluntary Associations (VAs) is crucial, as they contribute to new donors' recruitment and, possibly, can perform collection activities. In Italy, BSCs operate within the national health system. Data provided by the Central Government reveal that significant differences, in terms of self-sufficiency, exist across regions. In such a context, the scope of this paper is to investigate what are the organizational factors that can affect BSCs performance at the regional level. In particular, we focus our attention on two main aspects: i) the adopted organizational model, which can vary in dependence of the role played by VAs; ii) the spatial distribution of BSCs over the territory. Indeed, as blood is donated on a voluntary and non-remunerated basis, it is likely that the spatial organization of BSCs is fundamental to attract donors. With these aims in mind, we realize a field analysis, by interviewing regional managers from the main Italian association of donors. As a result, we identify the organizational models currently adopted by a sample of Italian regional BSCs. This classification is then used to perform a quantitative whose results highlight that regions adopting an Associative model, i.e. where VAs actively contribute to collection activities, tend to achieve better operational performances. Moreover, some preliminary findings from a spatial analysis seem to confirm that these performances are positively affected also by a widespread diffusion of collection

facilities over the regional territory. In practice, ensuring good accessibility conditions to potential donors, through an appropriate and coordinated organization of all the actors involved in the BSC, emerge as a consolidated recommendation to decision and policy-makers.

Keywords – Blood Supply Chain, Organizational models, Spatial Accessibility, Service availability, Public Service.

Paper type – Academic Research Paper

1 Introduction

Blood represents a vital resource in the context of national healthcare systems as it can be used for several medical treatments. Its efficient and effective collection, processing and distribution are, therefore, fundamental tasks. Countries throughout the world are facing serious challenges in making sufficient supplies of blood and blood products, while ensuring their quality and safety (Williamson and Devine, 2013). These aspects assume an even higher relevance in consideration of the scarcity of such a commodity and the necessity to serve the increasing needs of an ageing population (OECD/EU, 2018).

The Blood Supply Chain (BSC) manages the whole flow of blood products, from donors to patients. It is intended as a complex set of actors, facilities, and relationships whose main goal is to assure that blood components are readily available wherever and whenever they are needed. Worldwide, BSCs typically comprise public bodies belonging to the national health systems. In some cases, specific legislations and budget lines imposed by the Government may encourage third-parties' funding (WHO, 2016).

In this work, we specifically focus on the case of the Italian BSCs, whose organization is ruled by the Central Government (D.lgs. n.19/19.03.2018) in accordance with the guidelines set by the EU (European Commission, 2016). At the regional level, BSCs are articulated in two main types of facilities: i) *Blood Centers (BCs)*, performing blood collection and processing activities; ii) *Blood Stations (BSs)*, performing collection activities only. The main goal of regional BSCs is to ensure the satisfaction of the local demand of blood (*self-sufficiency*). To this end, regional BSCs are supported by *Voluntary Associations (VAs)*, i.e. private bodies that are essentially asked to increase people's awareness towards donations and are responsible for new donors' recruitment. Possibly, VAs can perform collection activities.

Clearly, blood collection performances can vary in dependence on their organizational models and, in particular, on the role of VAs. Indeed, regardless the fact that national self-sufficiency has been constantly guaranteed in the five-year period 2014-2018, data provided by the Central Government (Centro Nazionale Sangue, 2019) reveal that various regions are not able to satisfy their own demand of blood. In any case, the contribution of VAs is crucial in order to achieve the target of self-sufficiency: recent evidences report that VAs accounted for more than 1.3 million members and more than 2 million blood units collected, corresponding to almost 80% of the overall national need (AVIS, 2019). Therefore, in this work we try to understand the organizational aspects that influence the

system performances. These aspects include the adopted model and the actual territorial distribution of the facilities devoted to the collection process. In fact, as blood is drawn on a voluntary and non-remunerated basis, it is likely that the spatial organization of BSCs, as well as of VAs, may influence potential donors' willingness to donate blood.

In summary, the present study has a twofold aim: the first one is to identify the organizational models adopted by regional BSCs; the second is to investigate whether the spatial distribution of BSCs' facilities affect their operational performances.

To these ends, we realize a field analysis by interviewing regional managers of the main Italian VA, namely AVIS (Associazione Volontari Italiani del Sangue). Based on the retrieved information, we classify the organizational models currently adopted within a sample of Italian regional BSCs. Then, we introduce some quantitative indicators and perform a spatial analysis in order to evaluate, under the light of the identified organizational setting, the accessibility conditions of donors to BSCs' facilities: in particular, given the available data, we consider a restricted sample of Italian regions comparable in terms of territorial extension and population, as our case study. Chosen regions adopt similar models but present different performance levels.

We note that, in the extant literature, several methodological approaches have been proposed to measure spatial accessibility with applications to a wide spectrum of healthcare services (Neutens, 2015). However, despite the great research interest that the topic has stimulated in recent years (Bruno et al. 2019; Piraban et al. 2019), to the best of the authors' knowledge there are no papers dealing with the evaluation of spatial accessibility to BSCs. Moreover, we found no studies attempting to analyze spatial accessibility towards complex services, characterized by a plurality of actors, in dependence of the function they perform within different organizational models.

This aspect represents, undoubtedly, the main contribution of the present work. Finally, we also believe that the obtained findings may fruitfully support decision and policy makers in identifying proper strategies to manage BSCs, as well as and the interplay among all the involved actors, in a more cost-effective way while guaranteeing the fulfilment of the self-sufficiency goal. The remainder of the paper is organized as follows. In Section 2, we describe the current organization of the Italian BSC. In Section 3, we introduce the proposed framework for the classification of BSCs organizational models. Then, in Sections 4 and 5 we present the results obtained from quantitative analysis on a sample of Italian regions. Conclusions and directions for future research are outlined in Section 6.

2 The organization of the Italian BSC

In Italy, BSC is part of the national health system and its role is to ensure the availability of blood supplies to patients needing transfusions, in compliance with the European and National legislations (D.lgs. n.19/19.03.2018, European Commission, 2016). It is organized according to a three-layered structure, that we detail next. At the national level, the so-called *Centro Nazionale Sangue* is the public body, within the

Ministry of Health, leading the coordination and technical and scientific control of the entire BSC. Among the others, its main function is to define the yearly need of blood that every region has to achieve (i.e. the self-sufficiency goal). At the regional level, operational performances are supervised by coordination bodies, named *Strutture Regionali di Coordinamento*, whose role is to ensure that objectives of quality, safety and self-sufficiency of blood are achieved, by planning intra and inter-regional flows of blood units and derivatives, if needed. Finally, at the local level, *Transfusion Centers* oversee blood collection and processing activities. More specifically, they are articulated in two kind of branches: *Blood Centers (BCs)*, performing blood collection and processing activities; ii) *Blood Stations (BSs)*, performing collection activities only.

A deeper look into the performance of regional BSCs is given in Table 1, where we report the differences between the total production and the total consumption of blood units in the time span 2014-2018 (Centro Nazionale Sangue, 2019). As we can observe, strong asymmetries emerge across regions: some, like Lazio and Sardegna, exhibit significant shortages whereas others, especially the northern ones (Lombardia, Piemonte, Emilia-Romagna and Veneto), are strongly self-sufficient. Overall, we note that the self-sufficiency goal is reached in Italy: this evidence highlights the importance of inter-regional flows of blood units to counterbalance local deficiencies.

The above described scenario is completed by the presence of *Voluntary Associations (VAs)*, who help accomplishing the institutional purposes of the National Health Service through the promotion of blood donations and the protection of donors. Moreover, they can also carry out the collection of blood among their own members. In Italy there are various organizations of this kind: we focus, in particular, on AVIS (Associazione Volontari Italiani del Sangue) that is acknowledged as the largest voluntary association of blood donors. Indeed, AVIS is present throughout the national territory with a very articulated hierarchical structure, comprising one national office, 22 regional offices, 91 provincial offices and, approximately 3,400 municipal offices. Its crucial role is testified by the data reported in Figure 1, where we report, for each region, the percentage of donations coming from AVIS' associates over the total demand of blood. As we can see, AVIS contributed to 80% of the total national demand of blood in 2018. Notably, in some regions, its contribution was sufficient to satisfy the local self-sufficiency. Depending on the role played by Voluntary Associations and on the administrative level of the office eventually responsible for collection activities, various organizational models arise within regional BSCs. In the need of clarify these aspects, we performed a field analysis by interviewing regional VAs' managers whose results are reported in the next section.

Table 1. Self-sufficiency in regional BSCs (souce: Centro Nazionale Sangue, 2019)

Region	**2014**	**2015**	**2016**	**2017**	**2018**
Abruzzo	176	-1,045	-966	-1,113	-2,578
Basilicata	689	541	-1,176	-30	-1,105

Calabria	-1,082	-976	196	-85	1,111
Campania	1,862	-716	1,877	-791	-5,952
Emilia-Romagna	1,092	2,039	2,545	8,213	10,982
Friuli Venezia Giulia	8,775	9,151	8,233	7,174	8,142
Lazio	-28,410	-23,842	-28,140	-25,822	-25,014
Liguria	277	836	-1,418	1,805	1,033
Lombardia	9,472	8,188	11,842	14,332	21,121
Marche	21	523	134	1,546	2,282
Molise	-193	565	215	586	-186
Piemonte	27,672	25,222	29,664	23,573	26,129
Puglia	-2,150	-679	-1,322	-363	2,277
Sardegna	-31,881	-29,153	-29,393	-25,314	-27,979
Sicilia	-3,162	-4,116	-1,292	-4,387	-2,666
Trentino Alto-Adige	3,973	6,820	6,430	8,663	8,394
Toscana	-1,294	-3,486	-4,226	-1,060	-724
Umbria	-46	11	-973	227	1,082
Valle d'Aosta	1,303	1,335	938	958	1,479
Veneto	11,964	11,959	10,392	9,831	10,051
ITALY	-942	3,177	3,560	17,943	27,879

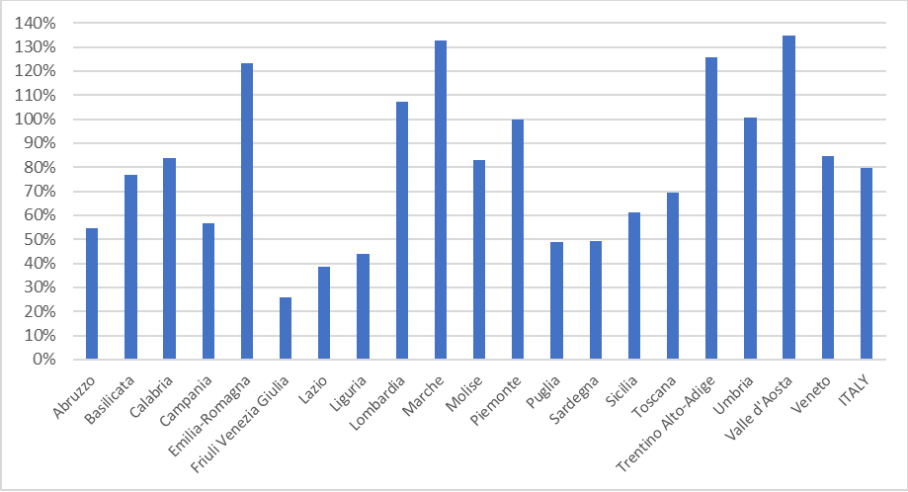

Figure 1. VAs' contribution to the regional demands of blood (source: AVIS, 2019)

3 A classification framework of BSCs' organizational models

At this stage, our analysis involved ten regions, i.e. ten regional managers from AVIS, who agreed to participate in the study. Details about the sample are reported in Table 3. All the semi-structured interviews were realized by telephone in June 2019.

It is worth reminding that Voluntary Associations (VAs) can perform two main kind of functions: sensibilization and new donors' recruitment, on the one hand; collection and donors' retention, on the other.

According to Saturni et al. (2013), their organizational models differ, in practice, with respect to two main dimensions: the first concerns the actual performance of the collection activities. In this sense, we therefore distinguish between: i) *Public models*, where only public facilities (BSs and BCs) collect blood units; ii) *Associative models*, where VAs actively support the collection phase.

The second lies in the in administrative level of the VA (municipal vs. provincial) responsible for each of the aforementioned functions. In particular, in the case of Associative models, we can further identify: *Decentralized models*, where all the activities (sensibilization and collection) are delegated to municipal VAs; *Centralized models*, where only provincial VAs perform collection operations. In this case, both provincial and municipal VAs perform sensibilization. A third model, that we denote by *Mixed*, emerges when there is a clear separation of these activities: provincial VAs perform collection, whereas municipal VAs are only in charge of sensibilization. We underline that, regardless the specific setting, collection is performed by special branches called *Collection Units*.

A similar distinction applies in the case of Public models. In this case, however, the third type (Mixed) does not hold. In summary, we identify five organizational models that are summarized in Table 2. In that Table we report, for each actor within regional BSCs, the operation they are responsible for (✓): Sensibilization (S) and/or Collection (C). The organizational model is then derived as a combination of the considered dimensions.

Table 2. Organizational models of regional BSCs

Actors	**Functions**									
	S	**C**	**S**	**C**	**S**	**C**	**S**	**C**	**S**	**C**
Transfusion Centers		✓		✓		✓		✓		✓
Provincial VA	✓				✓	✓				✓
Municipal VA	✓		✓		✓		✓	✓	✓	
Model	Public - Centralized		Public - Decentralized		Associative - Centralized		Associative - Decentralized		Associative - Mixed	

In Table 3, we detail the characteristics of the regions involved in our analysis. In particular, for each region, we show the number of Transfusion Centers (TCs), the total number of Voluntary Associations' (VAs) offices and the adopted organizational model,

according to the proposed framework. The reported data are useful for the quantitative analysis that are presented in the next section.

Table 3. Characteristics of the analyzed regions

Region	Population	Area $[km^2]$	No. of TCs	No. of VAs	Model
Campania	5,826,860	13670,95	17	67	Associative - Mixed
Emilia-Romagna	4,452,629	22452,78	12	332	Associative - Mixed
Friuli Venezia Giulia	1,216,853	7924,36	5	48	Public - Decentralized
Liguria	1,556,981	5416,21	10	64	Associative - Mixed
Lombardia	10,036,258	23863,65	42	661	Associative - Decentralized
Marche	1,531,753	9401,38	12	144	Associative - Mixed
Puglia	4,048,242	19540,9	21	134	Public - Decentralized
Toscana	3,736,968	22987,04	14	185	Associative - Decentralized
Umbria	884,640	8464,33	4	65	Associative - Decentralized
Valle d'Aosta	162,202	3260,9	1	22	Public - Decentralized

4 A deeper look into regional BSCs

In this section we deepen our analysis into the characteristics of regional BSCs, in light of the presented classification framework. Our goal, in fact, is to understand whether the organizational aspects, i.e. the adopted model and the spatial distribution of the facilities, affect the systems' performance. To this end, in the following, we discuss the results obtained by the calculation of some quantitative indicators.

In order to get a better understanding of the role of Voluntary Associations (VAs) within regional BSCs, in Figure 2 we depict the relative fraction (in %) of the donations coming from VAs' associates on the regional demand of blood in 2018. Actually, these values are those already shown in Figure 1: however, they are now restricted to the ten regions of the sample and thematized with different colours in dependence of the adopted organizational model. We recall that these values do not represent the actual amount of blood units collected by VAs; the latter, in fact, would be equal to zero in regions adopting a Public model. As expected, we can observe that the contribution of VAs is typically higher in regions characterized by an associative model (in green and cyan) rather than a public one (in red). In particular, we also note that higher peaks are reached in regions, like Emilia-Romagna and Marche, employing a mixed model (in cyan): this evidence seems to testify the relevance of a joint sensibilization effort by both municipal and provincial VAs. This result assumes an even higher relevance when comparing the number of VAs to regions like Lombardia. The above findings are confirmed also when looking at the so-called *donation rates*, i.e. the number of donations coming from VAs' donors, per 1,000 inhabitants. Indeed, from Figure 3, we note that a more capillary presence and a stronger engagement of VAs into collection activities seems to foster a higher propensity to donate blood.

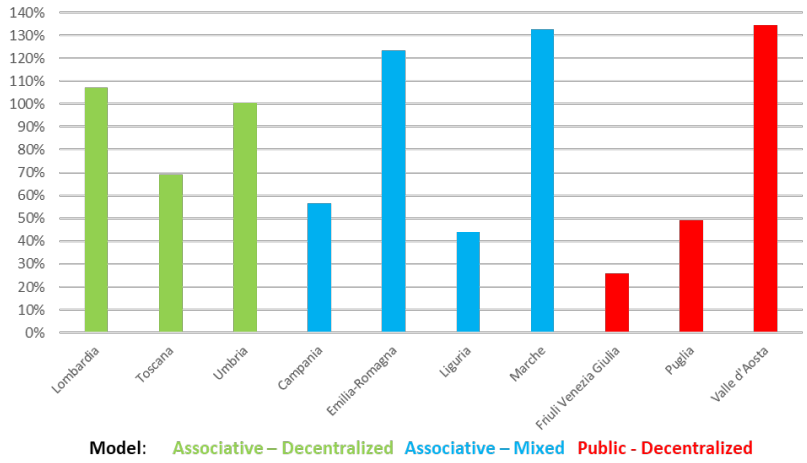

Figure 2. VAs' contribution to the regional demands of blood in the analyzed regions

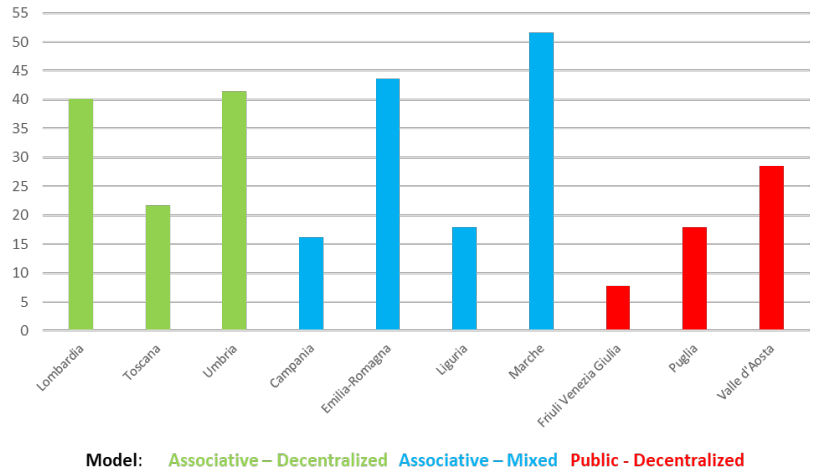

Figure 3. Donation rates in the analyzed regions

In such a context, an exception is surely represented by Valle d'Aosta: this result, however, can be reasonable explained if we consider that this region shows the highest number of VAs per 100,000 inhabitants, as we can observe from Figure 4. In the literature, this indicator represents a common accessibility measure which is typically referred to as *Provider-to-Population Ratio (PPR)* or *Container Index* (see Talen and Anselin, 1998). In that figure, each region is displayed as a point in a bi-dimensional space having the above indicator, calculated with reference to Transfusion Centers (TCs) and Voluntary Associations (VAs) on the axes. Besides, it is also worth noting that, in most of the cases, regions adopting an associative model tend to occupy the "northern" area in the graph: in practice, they are characterized by a higher availability of VAs, in

proportion to their population. In other words, they provide potential donors with a better accessibility, in terms of number of available facilities, to VAs.

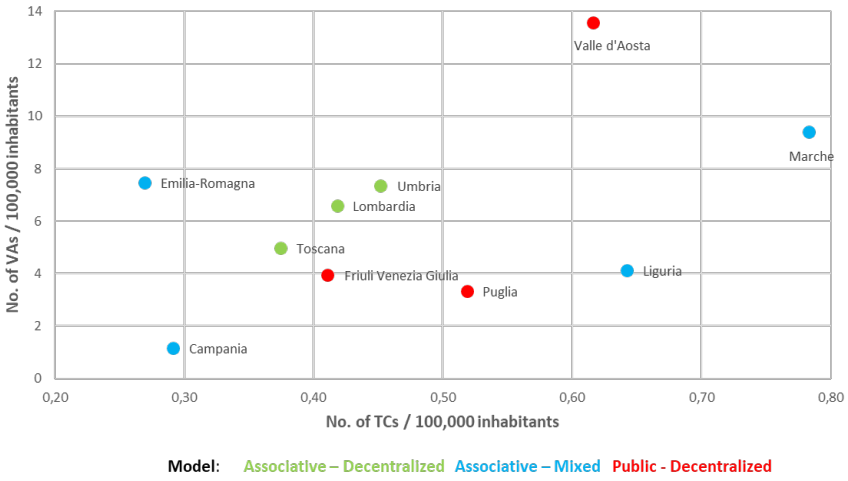

Figure 4. Provider-to-Population ratios in the analyzed regions

A similar analysis is reported in Figure 5, where we calculate two *spatial density* indicators, expressing the number of VAs and TCs per 1,000 km^2. These indicators offer a synthetic overview on the spatial distribution of these facilities over the regional territories.

What we note is that Campania keeps being the region with the lowest density of VAs, despite the organizational model adopted. This evidence may explain why this region is not able to reach the self-sufficiency goal (see Table 1).

The overall analysis is summarized in Table 4. For each region, we report: the adopted model; the fraction of donations (in %) collected by Voluntary Associations (VAs); the donation rate (number of donations per 1,000 inhabitants); the provider-to-population ratios (per 100,000 inhabitants) and the spatial density indicators (per 1,000 km^2), calculated for both Transfusion Centers (TCs) and Voluntary Associations (VAs); and, finally, the difference between the total production and the total consumption of blood units in 2018 (self-sufficiency). The latter indicator, if positive, indicates that a region is self-sufficient. Other than Campania, we observe that also Toscana does not satisfy its own demand of blood: interestingly, it presents an associative model and values of the calculated indicators that are in line with more virtuous regions. These results suggest a deeper look into the spatial organization of these regional BSCs, that is what we try to accomplish in the next section.

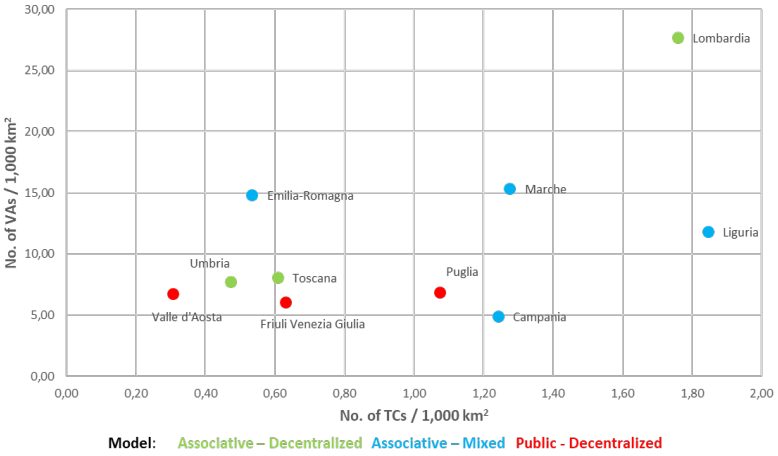

Figure 5. Spatial density indicators in the analyzed regions

Table 4. Results on the analyzed regions

				PPR		Spatial density		
Region	**Model**	**VAs contribution**	**Donation rate**	**TCs**	**VAs**	**TCs**	**VAs**	**Self-sufficiency**
Campania	Associative - Mixed	57%	16,20	0,29	1,15	1,24	4,90	-5952
Emilia-Romagna	Associative - Mixed	123%	43,57	0,27	7,46	0,53	14,79	10982
Friuli Venezia Giulia	Public - Decentralized	26%	7,70	0,41	3,94	0,63	6,06	8142
Liguria	Associative - Mixed	44%	17,86	0,64	4,11	1,85	11,82	1033
Lombardia	Associative - Decentralized	107%	40,12	0,42	6,59	1,76	27,70	21121
Marche	Associative - Mixed	133%	51,57	0,78	9,40	1,28	15,32	2282
Puglia	Public - Decentralized	49%	17,94	0,52	3,31	1,07	6,86	2277
Toscana	Associative - Decentralized	69%	21,65	0,37	4,95	0,61	8,05	-724
Umbria	Associative - Decentralized	101%	41,43	0,45	7,35	0,47	7,68	1082
Valle d'Aosta	Public - Decentralized	135%	28,48	0,62	13,56	0,31	6,75	1479

5 Spatial analysis

In this section, we realize a spatial analysis with the aim of highlighting key differences in the spatial organization of regional BSCs. In what follows, we first give some preliminary definitions on the concept of accessibility and on its measure. Then, we present the selected case study and the results obtained from the performed analysis.

5.1 Healthcare accessibility

The concept of *accessibility* refers to the relationship between the location of suppliers and the locations of clients, involving both spatial (e.g. travel times, distances) and non-spatial factors (e.g. demographic and socio-economic variables). More specifically, *spatial accessibility* expresses the relative easiness of a client to reach a facility from a given location (Wang, 2012). The literature is teeming of contributions dealing with methodological proposals to measure it (see Neutens, 2015). Among them, we refer to the distance from the closest service (Apparicio, 2008, Bruno et al. 2020): indeed, in the context of the present study, it is reasonable to assume that a donor is attracted by the nearest facilities to donate blood. In order to adopt this measure to the purpose of our work, some notation needs to be introduced. In particular, with reference to a generic study area, we assume the presence of a discrete set of nodes, say I, where potential donors are located. We denote by d_i the number of donors associated to each node $i \in I$. Then, we consider various sets corresponding to the actual locations of the facilities belonging to regional BSCs, namely: J_{TC}, representing the current locations of Transfusion Centers (TCs); J_{CU}, corresponding to the locations of Collection Units (CUs), i.e. facilities where blood collection are performed by Voluntary Associations; J_{VA}, corresponding to nodes where Voluntary Associations' offices (VAs), that do not perform collection activities, are located. Finally, we denote by c_{ij} the distances between each pair of donors' nodes and facilities. Therefore, the accessibility of donors $i \in I$ to a generic set of facilities K, can be assessed by means of the following indicator: $A_i = \min_{j \in K}\{c_{ij}\}, \quad i \in I$. Clearly, various accessibility indicators can be calculated in dependence on the set K. In the context of the present study, the latter can correspond to the specific sets above introduced (J_{TC},J_{CU},J_{VA}) or to their combinations (e.g. $J_{TC} \cup J_{CU}$, etc.).

5.2 Case study

We now present the data test used to perform our spatial analysis. In particular, we selected three regions, namely Campania, Tuscany and Emilia-Romagna as our case study. The rationale behind this choice lies in the results shown in the previous sections: these regions adopt a similar organizational model but present significant differences in their performance levels.

In order to perform our study, we apply the methodology proposed by Barbarisi et al. (2019). Accordingly, we discretized the study area by extracting the centroids corresponding to the regional census tracts (ISTAT, 2011), where we assumed that potential donors are concentrated. Then, we mapped the actual locations of the considered facilities based on data retrieved from our interviews and/or freely provided by official sources. Finally, the distances c_{ij} between the centroids and the facilities were determined as the shortest paths on the road network. Details about our study area are given in Table 5, where we present, for each region, the following parameters: the living population, the

number of census tracts (i.e. $|I|$), the number of Transfusion Centers (TCs, $|J_{TC}|$), the number of Voluntary Associations' offices (VAs, $|J_{VA}|$), and the number of Collection Units (CUs, $|J_{CU}|$).

Table 5. Characteristics of the regions under analysis

Region	Population	No. of census tracts	No. of TCs	No. of VAs	No. of CUs
Campania	5,826,860	21,050	17	53	14
Emilia-Romagna	4,452,629	35,551	12	172	160
Toscana	3,736,968	25,728	18	178	7

5.3 Analysis of the results

In order to better evaluate the spatial accessibility conditions of potential donors, we calculate the cumulative distributions of users' distances from the closest facility within each regional BSC. In practice, we define an accessibility function $\gamma = f(c) \rightarrow [0,1]$, representing the percentage of users γ having a distance from their closest facility not exceeding c. Conversely, $c = f^{-1}(\gamma)$ represents the accessibility condition of a given percentage γ of users, i.e. the distance c at which these users have at least one facility. In Figure 6 we report the accessibility distributions obtained by considering only the distance to the closest Transfusion Center (TC). As we can see, in the case of Campania, 70% of the population has the closest TC within 10 km ($\gamma(c = 10.00) = 0.70$). Within the same distance, only 40% of potential donors have the closest available facility in Emilia-Romagna. Overall, we can observe that the distribution obtained in Campania and Toscana dominate the one yielded in the case of Emilia-Romagna, which denotes better accessibility conditions to TCs in the first two regions. This is also reflected by the values of the average accessibility distances, reported in Table 6. In that table, we also show the accessibility distances corresponding to certain fractions of donors (i.e. $c(\gamma = \{0.25,0.50,0.75,1.00\})$).

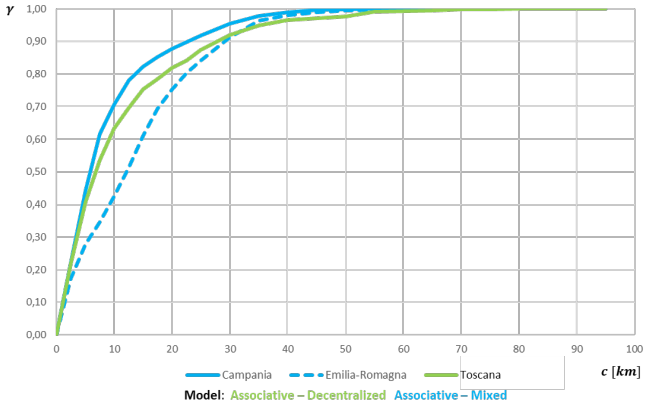

Figure 6. Distribution of the accessibility distances to Transfusion Centers

Table 6. Accessibility distances by fraction (γ) of donors

Region	$\gamma = 0.25$	$\gamma = 0.50$	$\gamma = 0.75$	$\gamma = 1.00$	Average accessibility [km]
Campania	2.77	5.80	11.37	63.46	8.93
Emilia-Romagna	3.93	12.13	19.84	71.31	13.63
Toscana	2.85	6.73	14.77	86.26	11.18

This scenario is completely reversed when considering donors' accessibility to both Transfusion Centers and Collection Units. As it also detailed in Table 7, we note that, in Emilia-Romagna, potential donors should travel, on average, only four km to donate blood; this value increases up to more than seven and 10 km in Campania and Toscana, respectively. Table 7 reports also information on the accessibility to Voluntary Associations (VAs) that only perform sensibilization activities. These values testify, again, a very dense presence of VAs in Emilia-Romagna. Ultimately, the obtained results seem to demonstrate that an effective spatial distribution of facilities over the territory, well-coordinated among the different actors of the healthcare ecosystem, can positively affect the operational performance of regional BSCs.

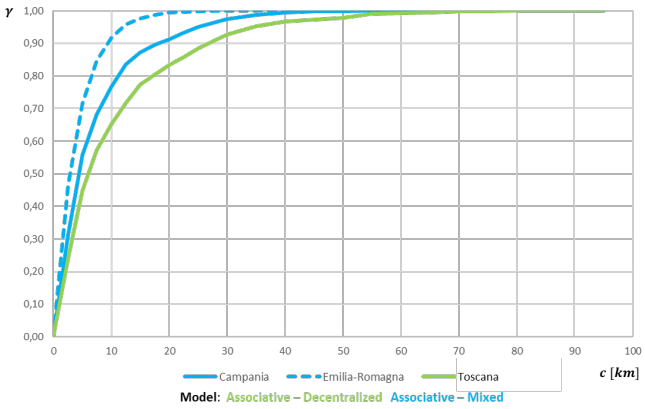

Figure 7. Distribution of the accessibility distances to Transfusion Centers and Collection Units

Table 7. Accessibility distances by fraction (γ) of donors and set of facilities

Set of facilities	Region	$\gamma = 0.25$	$\gamma = 0.50$	$\gamma = 0.75$	$\gamma = 1.00$	Average accessibility [km]
Transfusion Centers	Campania	2.77	5.80	11.37	63.46	8.93
	Emilia-Romagna	3.93	12.13	19.84	71.31	13.63
	Toscana	2.85	6.73	14.77	86.26	11.18

Transfusion Centers and Collection Units	Campania	2.02	4.21	9.40	63.46	7.21
	Emilia-Romagna	1.17	2.77	5.53	30.60	4.00
	Toscana	2.57	5.86	13.72	86.26	10.51
Voluntary Associations	Campania	1.58	3.05	6.23	58.03	5.24
	Emilia-Romagna	0.80	1.93	3.48	19.85	2.39
	Toscana	1.18	2.45	4.44	48.67	3.24

6 Conclusions

Blood Supply Chains (BSCs) are a complex set of actors, facilities and relationships, whose goal is to manage the whole flow of blood and its derivatives, from donors to patients. As blood is donated on a voluntary and non-remunerated basis the organization of this service on the territory is fundamental in order to attract donors and satisfy the demand of blood (i.e. self-sufficiency). In this paper, we tried to understand what are the organizational aspects that can affect the Italian BSC performance at the regional level. These aspects include: the organizational model adopted and the spatial of distribution of the facilities. With these aims in mind, we realized a field analysis, by interviewing regional managers from the main Italian association of donors. As a result, we classified regional BSCs within a framework comprising five different organizational models. The latter was then used to perform a quantitative analysis which highlighted that regions adopting an Associative model, i.e. where Voluntary Associations perform collection activities, tend to achieve better operational performances. Moreover, some preliminary findings from a spatial analysis seemed to confirm that these performances are positively affected by a widespread diffusion of BSCs facilities over the regional territory.

The present work, that is not free from limitations, opens to various further developments. First, it would be necessary to collect more real data and extend our study to other regional contexts in order to better validate the insights we obtained from our analysis. The spatial analysis could be enriched by employing and comparing various of the methods known in the literature, and by trying to account also for non-spatial factors, relevant to model donors' behaviors. In this regard, regression models could be exploited to explain BSC performances on the basis of a larger set of factors. Finally, novel strategies for the reorganization of existing BSC and/or for a more effective orchestration of their resources in regional contexts, could be also modelled and tested.

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A Digital Innovation in Supporting Clinical Decision Making: the Role of IntercheckWEB in Polytherapy Management

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Abstract

The presence of comorbidities and multiple chronic diseases, and the related prescription of complex medications, as well as concerns in therapies changes, present many professional challenges in the clinical decision-making process. Multiple medications' use (i.e. polypharmacy),

is common in this population, and could be associated to adverse outcomes and presence of drug-drug interactions.
The present study aims at investigating the variables impacting on the clinical choice, and the potential support of digital innovation and other knowledge asset, such as InterchecкWEB and/or guidelines, to optimize the prescription decision making process in older and frailer patients, in polytherapy.
A review on the topic is performed for revealing the principal social and clinical factors, impacting on the clinicians' propensity to chance the patients' therapy. An observational study was conducted, involving head physicians and clinicians (N=35) referring to the Internal Medicine wards, of five Italian medium size hospitals. In June 2019, each clinician completed a questionnaire, aimed at evaluating 15 clinical cases, thus defining if in case of specific information derived from IT systems (such as INTERCheckWEB), they would have changed the patient's current therapy, during an Internal Medicine hospitalization.
Data were analysed considering three methodological approaches. i) Relationships between variables, were investigated to test the existence of correlations among them. ii) A hierarchical sequential linear regression model was implemented to define the predictors of the clinician propensity to change therapy. iii) A Qualitative Comparative Analysis – QCA, was implemented, in order to complement previous statistical approaches, with a comparative-configurational one.
Results reported that patient's age ($\beta = 0.505$, p-value = 0.000) and autonomy ($\beta = 0.303$, p-value = 0.000), as well as clinician's perception with regard to IT ease of use ($\beta = 0.298$, p-value= 0.043) and seniority ($\beta = 0.087$, p-value = 0.009), number of drugs assumed by the patients ($\beta = 0.541$, p-value= 0.000) and number of concomitant diseases ($\beta = 0.302$, p-value = 0.000) are factors influencing a potential change in the current therapy.
The QCA-crisp confirms the regression models results, highlighting that the number of drugs is a necessary factor being an active variable in all different configurations analysed.
The findings provide insight into factors influencing clinical assessment decisions, how a combination of them is related to the outcome, in order to suggest mechanisms to foster translation of research, into clinical practice.

Keywords – Deprescribing, real-world data, clinical decision-making, Intercheckweb, polytherapy

Paper type – Academic Research Paper

1 Introduction

Clinical decision-making is the process of defining an informed judgment about the diagnostic and treatment pathways necessary for the patients (Hardy & Smith, 2008), and it represents the key point of health policy and medical practice (Kaplan 2005). Because health outcomes are probabilistic, most decisions are made under conditions of uncertainty: in particular, clinical decision-making is "a complex process involving information processing, evaluation of evidence, and application of relevant knowledge to select the appropriate interventions that provide high-quality care and reduce risk of patient harm" (Miller et al., 2020).

In this regard, the presence of comorbidities and multiple chronic diseases, and the related prescription of complex medications, as well as concerns in therapies changes, present many professional challenges in the clinical decision-making process. This is particularly relevant, since older adults (accounting for the 40% of outpatients - Olmos et

al., 2012; Maher et al., 2014) have a higher prevalence of multiple chronic health conditions, for which multiple medications are recommended as treatment (Charlesworth et al., 2015; Hajjar et al. 2007; Gurwitz et al., 2004). Consequently, multiple medications' use (i.e. polypharmacy), is common in this population, and could be associated to adverse outcomes (Field et al., 2004), such as drug-drug interactions (DDI) or drug-related adverse events. Approximately half of the elderly population is prescribed a non-suitable or non-desirable drug, this happens more frequently in polypathological patients: in some cases, the prevalence of potentially inappropriate medications can reach 71% in frail elderly people (Bjerre, et al., 2015; Récoché et al., 2017).

Difficulties in the management of such patients often happen in the clinical practice, since clinicians must monitor also drugs prescribed by other healthcare professionals. Usually, the clinical decision-process is guided by the knowledge assets based on experience and expertise of healthcare professionals that continuously look for new information and interprets it, to reassess the accuracy of his/her decision (Rudolph et al., 2009). Analysing the main decision strategies, with respect to task complexity and effort needed for accurate decisions, Payne et al. (1990) finds that individuals "selectively process a subset of the available information and/or selectively apply operations to that information that are easier to perform" (p. 4). It emerges that the decision-making process relies on effort reduction, since it examines fewer cues, integrates less information and examines fewer alternatives (Shah and Oppenheimer, 2008).

In the decision-making process the digital solutions can support the clinical process and the exchange of knowledge, in the evaluation of the therapy appropriateness. The above demographic changes put in evidence how a reduction of potentially inappropriate prescriptions for elderly patients in polytherapy, represents a relevant topic.

The knowledge assets of healthcare professionals' experience and expertise can be integrated by other knowledge assets, such as digital innovation and guidelines to support the clinicians towards an appropriate prescription. Digital innovation and guidelines could avoid that clinicians' judgment can be influenced by irrelevant information that can lead the individual to misinterpret the situation and make a wrong decision.

Although the availability of digital innovation to support the decision-making in polypharmacy, it remains poorly explored the factors that could prompt the clinicians to leverage on this digital solution to make a prescription for elderly patients in polytherapy. Given the multidimensional and complex nature of clinical decision making for treatment prescription in elderly patients, factors influencing it, may arise from multiple source, including both clinicians' behaviour and characteristics (individual factors) and non-clinical variables, such as task complexity (Smith et al., 2008).

The present study aims at investigating the factors impacting on the clinical choice, and the potential support of digital innovation and other knowledge assets, such as guidelines, to appropriately support the prescription decision making process, in older and frailer patients, in polytherapy. One of the most outstanding digital innovation is INTERCheckWEB, a Computerized Prescription Support System (CPSS), for helping

clinicians during their routinely clinical practice, improving the appropriateness of drugs prescription (Ghibelli et al., 2013). INTERCheckWEB is a user-friendly interface, enabling the clinician gather information on a specific drug or DDI and facilitating the evaluation of any possible therapy switches or changes. INTERCheckWEB stores useful information with regard to potentially inappropriate medications, anticholinergic burden and dose adjustment in case of renal disease and modality for drug withdrawals, thus relying on the most recent versions "Beers", and "START and STOPP" criteria (O'Mahony et al., 2015; AGS, 2019).

Coherently with these premises, the study addressed the following research question: "Which are the key factors determining the change in the treatment options in frail patients in polytherapy, in presence or in absence of specific information deriving from IntercheckWEB and guidelines?".

2 Research design and theoretical background

The factors affecting the decision-making in polypharmacy are grouped in variables related to clinicians and variables related to task complexity. Based on a literature review, we infer then main factors impacting on the clinicians' choice to change the patients' current therapy, in the management of elderly and polypathological patients, thus identifying a theoretical framework with the following hypotheses.

Clinicians' behaviour towards guidelines and clinical protocols

Despite the growing number of guidelines, their use in practice is slow and complex, and often not applied (Sheldon et al., 2004). In general terms, clinicians are prone to use guidelines and recommendations: they should be aware of a guideline and need to have some knowledge of their contents. Clinicians' knowledge and reliability of the guidelines influences attitudes, and attitudes affect clinical practice behavior (Welke et al., 2003). In the current clinical setting, the more the clinician is aware with regard to the quality of guidelines and clinical protocol information, the more he is influenced in changing the current clinical practice.

According to the above, the following hypotheses were developed.

Hp 1. The negative clinicians behaviour towards guidelines and clinical protocols has a negative impact on the clinical choice to change the patients' current therapy.

Hp 2. The positive clinicians behaviour towards guidelines and clinical protocols has a positive impact on the clinical choice to change the patients' current therapy.

InterCheckWEB usefulness

In the routine practice, the clinicians tend to use any innovative technology, such as InterChecWEB, only if they believe IT could improve daily activities and the proper use of the tool itself, aiming at the best quality and safety, for the patient (Venkatesh et al.,

2010; Holden et al., 2010). Hence the IT usefulness perceptions increase, the more the probability that this tool will help the clinician to make the most appropriate choice (Davis, 1989, Holden et al., 2010).

HP 3. INTERCheckWEB perceived usefulness has a positive impact on the clinical choice to change the patients' current therapy.

InterCheckWEB ease of use

InterCheckWEB ease of use should be defined as the lack of effort in understanding its functioning, thus leading the clinician to use this tool in the routinely clinical practice, in his/her decision-making process concerning the patients' therapeutic treatment (Davis, 1989, Holden et al., 2010). In particular, the greater the INTERCheckWEB ease of use, the greater the willingness to make different choice given the tool suggestions, with regard potential DDI.

HP 4. INTERCheckWEB perceived ease of use has a positive impact on the clinical choice to change the patients' current therapy.

Clinicians' seniority

Literature stated that clinicians with a longer seniority are more likely to use guidelines to address their clinical practice (Bochud et al., 2002). Additionally, the more the clinicians know about guidelines and protocol, the more the clinicians learn about the potential development of drug-drug interaction or adverse events, thus to a possible change of the current patient's therapy (Fried et al., 2011). In fact, literature stated that the clinical decision-making process is affected by several factors, such as clinicians' experience and ability, in making decisions regarding a given pharmacological treatment (Smith et al., 2008).

HP 5. The clinicians' seniority has a positive impact on the clinical choice to change the patients' current therapy.

Patients' polytherapy

Polytherapy refers to the use of multiple medications. Specific combination of various drugs administered to a single patient has the potential to result in an interaction (Montamat et al., 1989): as number of medications increase, the potential for drug interactions increases. In this view, the number of drugs administered could be an interesting topic to change the patients' current therapy, by stopping medication and thereby improving the patients' wellbeing (Pizzini., 2018; Schuljng et al., 2012).

HP 6. Polytherapy has a positive impact on the clinical choice to change the patients' current therapy.

Comorbidities

Patients suffering from multiple and concomitant diseases present a higher possibility to develop drug-drug interactions (Pizzini, 2018, Nobili et al., 2011), thus leading the

clinicians to deprescribing activities. Literature stated that multi-morbidity would suggest the clinicians to change the current therapy, in order to avoid the development of adverse events (Pizzini, 2018).

HP 7. Patient concomitant disease has a positive impact on the clinical choice to change the patients' current therapy.

In addition to the direct relationships between the above-mentioned independent variables and the clinical propensity to change the patients' current therapy (playing, instead, the role of dependent variable), the proposed framework also includes three moderators (two of them acting also as independent variables): patients' polypharmacy, quality of available patients' data, and clinicians' seniority.

With regard to patients' polypharmacy, literature (Vehoof et al., 2000) stated that the higher the number of concomitant diseases of a patient, the higher the number of drugs that the patients should assumed for the satisfaction of his/her health need. In this view, the number of drugs is assumed to strengthen the relationship between patients' comorbidity and clinician's propensity to change the current therapy.

HP 8. Polypharmacy positively moderates the relationship between patients' comorbidity and clinicians' propensity to change the current therapy.

The quality of available patients' data could be defined as the quality, appropriateness, and the presence of a large amount of detailed and complete information, recorded for a given patient. The lack of clinical information concerning a patient, or the absence of some anamnestic or comorbidities data, or the presence of potential errors in their collection, do not allow the clinician to identify a correct pharmacological treatment (Sorensen et al., 1996). This aspect is particularly relevant within the proposed setting, related to the patients in polytherapy management. According to the above, the following hypothesis concerning the moderator effect of the quality of available patients' data is displayed.

HP 9. The quality of available patients' data positively moderates the relationship between polytherapy and clinicians' propensity to change the current therapy.

In conclusions, clinicians' seniority, in terms of increasing experience over time, would strengthen the relationship among *i)* the positive clinicians behavior towards guidelines and clinical protocols; *ii)* INTERCheckweb ease of use; and ii) INTERCheckweb perceived usefulness, and the clinicians' propensity to change the current therapy. On the one hand, the higher the clinicians' seniority, the greater his/her knowledge with regard guidelines and protocol, with relevant consequences in terms of therapy changes (Smith et al., 2008). On the other hand, clinicians with a greater experience could present a low-level IT systems knowledge, thus negatively influencing INTERCheckWeb ease of use, and usefulness (Melas et al., 2011, Mohamadali et al., 2010).

HP 10. Clinicians' seniority positively moderates the relationship between positive clinicians' behavior towards guidelines and clinical protocols and clinicians' propensity to change the current therapy.

HP 11. Clinicians' seniority negatively moderates the relationship between INTERChekWEB ease of use and clinicians' propensity to change the current therapy.

HP 12. Clinicians' seniority negatively moderates the relationship between INTERChekWEB usefulness and clinicians' propensity to change the current therapy.

Furthermore, it should be noted here that for the creation of a comprehensive framework, the following set of control variables was assumed: patient's age, patient's autonomy and patient's body max index (BMI).

A synthesis of the research framework is proposed in the following Figure 1.

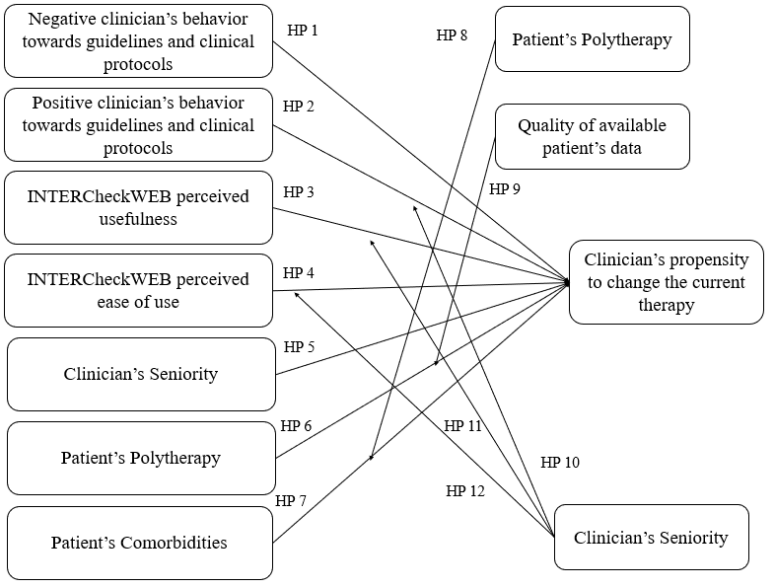

Figure 1 – Framework

3. Methods

3.1 Data collection

The study involved head physicians and clinicians (N=35) referring to the Internal Medicine wards, of five Italian medium size hospitals. In June 2019, each clinician completed a questionnaire, aimed at evaluating 15 clinical cases, thus defining if in case of specific information derived from INTERCheckWEB, they would have changed the patient's current therapy, during an Internal Medicine hospitalization.

At first a specific focus group (Basch, 1987; Beaudin, 1996; Rabiee, 2004) – composed of 6 clinicians and 2 researchers - was conducted, in order to define both the clinicians to be involved in the study and the clinical cases to be investigated.

On the one hand, the clinicians were determined on the basis of their seniority and their working position, thus selecting those who mainly are used to make clinical decisions under stressful and emergency conditions. On the other hand, the clinical cases were selected based on their clinical condition in terms of number of concomitant diseases and number of drugs administered to hospitalized patients (De Riu et al., 2013), assuming the time-horizon of 60 days before the institution of the focus groups.

After the selection of clinicians and clinical cases, a specific questionnaire was created, that was completed by all the professionals involved in the study, through an interview.

Besides the clinical information related to each patient (BMI, age, autonomy, number of concomitant diseases, number of drugs assumed, potential interactions emerged before INTERCheckWeb support), the questionnaire was composed to different evaluation scale aimed at gathering information with regard to the clinicians behaviour towards guidelines and protocol, as well as the INTERCheckWeb ease of use and usefulness. Once the clinician completed this first part, the results derived from INTERCheckWeb, in terms of development of potential interactions and adverse events, were shown to the clinicians in order to understand if this additional information would determine a possible change of therapy.

3.2 Statistical Analysis

Data were assessed by means of three methodological approaches.

- Relationships between variables, were investigated to test the existence of correlations among them.
- A hierarchical sequential linear regression model was implemented to define the predictors of the clinicians' choice to change the current therapy, establishing the impacts of independent variables and moderators respectively, previously defined. Three models were defined:
    - Model 1: Model composed of only the control variables.
    - Model 2: Model composed of Model 1, with the inclusion of the independent variables.
    - Model 3: Model composed of Model 1 and Model 2, with the inclusion of the moderator variable.
- A Qualitative Comparative Analysis - QCA (Ragin, 1987, Ragin 2000) was implemented, in order to complement previous statistical approaches with a case-oriented model that gives insights on the effects of variables in the context of investigated cases, and not in isolation, assuming the non-linearity of phenomena under investigation and basing on the principle of causal complexity.

QCA is an analytic technique that investigates about casual relationships through systematic comparisons. The aim is not to offer a single solution but to explain and discuss the complexity of the investigated phenomenon. QCA is an approach that operates

at the level of observed cases and processes each case as a holistic configuration of factors (Rihoux and Lobe, 2009). The basis of QCA's configurational approach is the analysis of sufficient and necessary causes to produce an outcome. A condition is necessary if it is present in all instances of the outcome. One condition will suffice if a particular outcome emerges whenever the condition is present (Ragin, 2008). However, there might be other conditions that lead to the same result; in other words, there could be multiple sufficient causes (Ragin, 2008).

In this work, a crisp QCA is applied. The criteria adopted in this research to dichotomize the factors, are based on the average value of each variable. What is important in this study is the set of combinations that can provide the output. We are looking for the features of variables that provide the output and for the combinations of inputs that do not provide the output.

4. Results

4.1. The sample under assessment

With regard to clinicians (N=35), the sample was mostly composed of females (63%). The average age of the clinicians involved was 45.23 years old, with a working experience of 16.14 years.

With regard to patients (N=15), the sample was mostly composed of females (60%), with an average age of 78.41 years old (range: 65.93). In general terms, the patients at the hospital admissions assumed on average 9 different drugs.

4.2. Results from the inferential analysis

The clinicians' behaviour towards guidelines and clinical protocols, INTERCheckWEB perceived usefulness and ease of use, clinician's seniority, patient's polytherapy and patient's comorbidities, were deeply analysed, in order to define their positive or negative impact on the dependent variable (clinician's propensity to change the current patient's therapy). In this view, both the strength and the linear relationship between variables were described.

Table 1 depicts all the potential relationships between variables.

It emerged that a higher clinician's propensity to change the current patient's therapy was strictly related to patient's age ($\beta = 0.110$, p-value = 0.011) and BMI ($\beta = 0.548$, p-value = 0.000). Furthermore, a significant negative relationship was reported between the negative behaviour towards guidelines and clinical protocols and the propensity to change the current therapy ($\beta = - 0.098$, p-value = 0.024). A clinician is more likely to change therapy if the patients assumed a greater number of drugs ($\beta = 0.211$, p-value = 0.000), as if the patients suffered from a higher number of concomitant diseases ($\beta = 0.511$, p-value

= 0.000). The moderator variables related to patient's data quality and polytherapy impacted on the clinical choice to change therapy.

Focusing on the relationships among the control variables and the independent variables, the following considerations emerged.

- Patient's age was strictly related to the development of concomitant diseases (β = 0.283, p-value = 0.000) and to polytherapy (β = 0.191, p-value = 0.000). In particular, the older the patients, the greater the number of comorbidities, and consequently the number of drugs assumed.
- A higher BMI was reported in patients suffering from multiple diseases (β = 0.568, p-value = 0.000) and assuming a greater number of drugs (β = 0.596, p-value = 0.000).
- A low-level of autonomy emerged in patients with a higher number of comorbidities (β = - 0.245, p-value = 0.000) and drug (β = - 0.486, p-value = 0.000).
- Clinician's seniority presented a negative relationship with the negative clinician behavior toward clinical guidelines and protocol (β = - 0.208, p-value = 0.000), as well as lower perceptions of INTERCheckWEB usefulness (β = - 0.094, p-value = 0.031) and ease of use (β = - 0.137, p-value = 0.002).

A regression analysis was conducted to test the hypotheses (Table 2). Inferential analysis demonstrated that younger patient's age (β = - 0.073, p-value = 0.048), autonomy (β = 0.303, p-value = 0.000) and BMI (β = 0.505, p-value = 0.000), as well as clinician's perception with regard to IT ease of use (β = 0.298, p-value= 0.043) and clinicians' seniority (β = 0.087, p-value = 0.009), number of drugs assumed by the patients (β = 0.541, p-value= 0.000) and number of concomitant diseases (β = 0.302, p-value = 0.000) are factors influencing a potential change in the current therapy. The moderator effects of both the data quality and polypharmacy (β = -0.661, p-value = 0.001), and the number of drugs and the number of comorbidities (β = -0.370, p-value = 0.000) were confirmed. The above aspects explained the 53.7% of the clinician's choice variance, to modify the prescription, reducing the number of treatments to be administered to the patients.

Table 1 – Relationships between variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Clinician's propensity to change the current therapy (1)	1															
Patient's age (2)	.110*	1														
Patient's autonomy (3)	-.034	.073	1													
Patient's BMI (4)	.548**	.080	-.045	1												

Negative clinician's behaviour towards guidelines and clinical protocols (5)	-.098*	.000	.000	.000	1											
Positive clinician's behaviour towards guidelines and clinical protocols (6)	-.026	.000	.000	.000	.000	1										
INTERCheckWEB perceived usefulness (7)	.041	.000	.000	.000	-.235**	-.003	1									
INTERCheckWEB perceived ease of use (8)	.082	.000	.000	.000	-.281**	.003	.825**	1								
Clinician's Seniority (9)	.084	.000	.000	.000	-.208**	-.032	-.094*	-.137**	1							
Patient's Polytherapy (10)	.579**	.191**	-.486**	.568**	.000	.000	.000	.000	.000	1						
Patient's Comorbidities (11)	.211**	.283**	-.245**	.596**	.000	.000	.000	.000	.000	.513**	1					
Patient's Polytherapy X Patient's Comorbidities (12)	.511**	.216**	-.432**	.688**	.000	.000	.000	.000	.000	.931**	.782**	1				
Quality of available patient's data X Patient's Polytherapy (13)	.520**	.295**	-.416**	.613**	.000	.000	.000	.000	.000	.936**	.720**	.959**	1			
Clinician's Seniority X Positive clinician's behaviour towards guidelines and clinical protocols (14)	-.005	.000	.000	.000	.097*	.883**	-.005	-.052	.010	.000	.000	.000	.000	1		
Clinician's Seniority X INTERCheckWEB perceived usefulness (15)	.014	.000	.000	.000	-.222**	-.006	.889**	.791**	-.015	.000	.000	0.000	.000	-.087*	1	
Clinician's Seniority X INTERCheckWEB perceived ease of use (16)	.038	.000	.000	.000	-.213**	-.050	.713**	.892**	-.092*	.000	.000	.000	.000	-.161**	.875**	1

Table 2 – Regression model

	Model 1	Model 2	Model 3
Control variables			
Patient's age	0.068*	0.031	-0.073*
Patient's autonomy	-0.015	0.203*	0.303*
Patient's BMI	0.542*	0.383*	0.505*
Independent variables			
Negative clinician's behaviour towards guidelines and clinical protocols		-0.060	-0.061
Positive clinician's behaviour towards guidelines and clinical protocols		-0.024	-0.104
INTERCheckWEB perceived usefulness		-0.089	-0.084
INTERCheckWEB perceived ease of use		0.150*	0.298*
Clinician's Seniority		0.083*	0.087*
Patient's Polytherapy		0.599*	0.541*
Patient's Comorbidities		-0.283*	0.302*
Moderators			
Patient's Polytherapy X Patient's Comorbidities			-0.370*
Quality of available patient's data X Patient's Polytherapy			-0.661*
Clinician's Seniority X Positive clinician's behavior towards guidelines and clinical protocols			0.083
Clinician's Seniority X INTERCheckWEB perceived usefulness			-0.035
Clinician's Seniority X INTERCheckWEB perceived ease of use			-0.134
R^2	0.305	0.516	0.550
Adjusted R^2	0.301	0.506	**0.537**
F value	76.236*	54.751*	41.555*
ΔR^2	0.305	0.211	0.035
$F(\Delta R^2)$	76.236*	31.954*	7.859*

4.3. Results from the QcA

QCA allows to analyse the outcome (change the therapy) considering also possible combinations of causal conditions. Table 3 contains the truth table generated for our model. Truth tables list the logically possible combinations of causal conditions and the outcome associated with each combination (Ragin and Sonnett, 2005).

Truth tables also indicate the proportion of cases in each configuration that are consistent with the outcome ("Consistency"). Consistency indicates how well the empirical cases are in line with the hypothesis that a condition (or a set of conditions) is necessary or sufficient for the outcome. Investigators select consistency thresholds for their analyses, based on their understanding of theory. We use 0.85 according to Ragin (2006).

In the Table 3, the column "out" indicates the output of the model (clinicians' propensity to change the current therapy).

Table 3 – Truth Table of the proposed model results

Clinician	Patient	Clinician experience	Usefulness	Easy of use	n. drugs	Positive behavior	Negative behavior	OUT
1	3	1	0	0	1	1	0	1
2	1	0	0	0	1	1	1	1
3	3	0	1	1	1	1	1	1
	7	0	1	1	1	1	1	1
4	3	0	0	0	1	1	1	1
5	3	0	1	0	1	0	1	1
	9	0	1	0	1	0	1	1
	12	0	1	0	1	0	1	1
6	1	1	0	0	1	1	0	1
7	3	0	1	0	1	0	1	1
8	1	0	0	1	1	1	0	1
	3	0	0	1	1	1	0	1
	9	0	0	1	1	1	0	1
	12	0	0	1	1	1	0	1
9	1	0	0	0	1	0	0	1
	3	0	0	0	1	0	0	1
	7	0	0	0	1	0	0	1
10	1	0	0	0	1	1	1	1
	3	0	0	0	1	1	1	1
11	1	0	1	1	1	1	1	1
	7	0	1	1	1	1	1	1
12	1	1	1	1	1	0	1	1
	3	1	1	1	1	0	1	1

13	1	0	0	1	1	1	0	1
14	1	1	1	1	1	1	1	1
15	1	1	0	0	1	1	1	1
	3	1	0	0	1	1	1	1
	9	1	0	0	1	1	1	1
	12	1	0	0	1	1	1	1
16	1	0	1	0	1	0	1	1
	3	0	1	0	1	0	1	1
17								
18	1	0	1	1	1	1	1	1
19	3	0	0	0	1	0	1	1
20	1	0	0	0	1	1	1	1
21	1	0	0	0	1	1	0	1
	3	0	0	0	1	1	0	1
22								
23	1	1	0	0	1	0	0	1
	3	1	0	0	1	0	0	1
	4	1	0	0	1	0	0	1
	5	1	0	0	1	0	0	1
	7	1	0	0	1	0	0	1
	9	1	0	0	1	0	0	1
	10	1	0	0	1	0	0	1
24	3	1	0	0	1	1	0	1
25	3	1	0	0	1	0	0	1
26	1	0	1	1	1	1	1	1
	3	0	1	1	1	1	1	1
	9	0	1	1	1	1	1	1
	11	0	1	1	1	1	1	1
27	1	0	0	0	1	1	0	1
	3	0	0	0	1	1	0	1
28	1	1	0	0	1	1	0	1
	3	1	0	0	1	1	0	1
	7	1	0	0	1	1	0	1
	9	1	0	0	1	1	0	1
	11	1	0	0	1	1	0	1
29	3	1	1	1	1	0	1	1
	7	1	1	1	1	0	1	1
30	1	0	0	1	1	0	1	1
	3	0	0	1	1	0	1	1
	9	0	0	1	1	0	1	1

	12	0	0	1	1	0	1	1
31	1	0	0	0	1	0	0	1
	3	0	0	0	1	0	0	1
	9	0	0	0	1	0	0	1
	10	0	0	0	1	0	0	1
32	1	0	0	0	1	0	0	1
	3	0	0	0	1	0	0	1
33	1	0	1	1	1	0	1	1
	3	0	1	1	1	0	1	1
	7	0	1	1	1	0	1	1
34	1	0	1	1	1	0	1	1
	3	0	1	1	1	0	1	1
35	1	0	1	1	1	0	1	1
	3	0	1	1	1	0	1	1
	7	0	1	1	1	0	1	1
	9	0	1	1	1	0	1	1
	11	0	1	1	1	0	1	1

The Table 3 reveals interesting insights. Patients 1 and 3 are the most interested to the change therapy. These patients need a higher degree of polytherapy with respect to other patients. Moreover, the age and the autonomy of the patients are necessary factors in our analysis.

With regard to configuration, Table 4 clarifies that clinician's perception with regard to IT ease of use and seniority are factors influencing a potential change in the current therapy. Finally, number of drugs assumed by the patients, is a relevant factor due to it assumes positive value in all different configurations showed. Furthermore, a significant negative relationship was reported between the negative behaviour towards guidelines and the propensity to change the current therapy.

Table 4 - The configuration with clinician's propensity outcome

Configuration	**Clinicial Experience**	**Usefulness**	**Easy of use**	**Number of drugs**	**Negative Behavior**	**Positive Behavior**	**Output**	**Frequency**	**Consistency**
1	0	1	1	1	0	1	1	10	0,66
2	***1***	***0***	***0***	***1***	***1***	***0***	***1***	***9***	***0,93***
3	0	1	1	1	1	1	1	9	0,6
4	0	0	0	1	0	0	1	9	0,6
5	1	0	0	1	0	0	1	7	0,47
6	0	1	0	1	0	1	1	6	0,4

7	0	0	1	1	1	0	1	5	0,4
8	0	0	0	1	1	1	1	5	0,33
9	1	1	1	1	0	1	1	4	0,27
10	1	0	0	1	1	1	1	4	0,27
11	0	0	1	1	0	1	1	4	0,27
12	0	0	0	1	1	0	1	4	0,27
13	1	1	1	1	1	1	1	1	0,07
14	0	0	0	1	0	1	1	1	0,07
Sufficient configurations are in bold. The necessary configurations are in italics. The Frequency cutoff: 1.00 Consistency cutoff: 0.93									

Concerning the consistency and coverage, central measures within Qualitative Comparative Analysis (QCA), the table z shows that the configuration "Clinicians experience*Useful*˜Easy* *˜Positive Behavior" is the best consistent configuration. Authors would like to precise that coverage delineates the empirical relevance of a consistent solution. Furthermore, the symbol ˜ indicates that the factor is not present.

Table 5 - Best consistent configuration

		Raw Coverage	**Unique Coverage**	**Consistency**
Sufficiency	Clinicians experience*Useful*˜Easy* *˜Positive Behavior	0,13	0,13	0,93
Overall Solution		0,13		
Necessity		0,22	0,22	0,84
Overall Solution		0,22		

The consistency score of 0.93 indicates that 93% of the cases with this configuration have data consistent with the predicted outcome. Ragin (2006) holds that consistency scores below 75% undermine claims that a subset relationship exists, so this consistency score is encouraging.

Necessity analysis identifies the causal conditions without which a particular outcome will not occur.

The necessary condition explains 22% of the outcomes in the dataset, and 84% of the cases with this configuration have data consistent with the predicted outcome.

5 Discussions and Conclusions

Deprescribing is a new and emerging theme in the care of older adults living with multiple concomitant diseases, thus also including frail conditions. From a clinical point of view, deprescribing requires a comprehensive review of risk and benefits of a medication in the context of the quality of remaining life and patient and family priorities and preferences. More than 90% of inpatients are taking at least one inappropriate medication and up to 43% of medications taken by older patients lack a clear indication. Moreover, 5 to 11% of medications may be unintentionally prescribed for the same indication (Hanlon et al., 2004).

The present study investigated the setting of hospitalized patients, given the fact that approximately 45% of hospitalized older patients are discharged with five or more medications (Hajjar et al., 2005; Gamble et al., 2014). In this, view, it emerged that the clinical choice to change therapy is becoming relevant to decrease the incidence of drug-related adverse events and improve the adherence to medications, reducing the economic burden on the patient as well as on the health care providers. Despite the availability of many tools to minimize drug therapy-related problems, there is little guidance for the process of deprescribing, in general clinical practice.

In the investigation of the potential factors impacting on the propensity of the clinician to change the current patients' therapy (with a deprescribing approach), it emerged that having an IT system easy to use would be a facilitator to the clinical choice. Furthermore, the number of drugs and the number of concomitant diseases affecting a patient, play a key role in the potential current therapy changes (Figure 2). These results are confirmed by QCA analysis. In further research the analysis will be performed according to Fuzzy QCA.

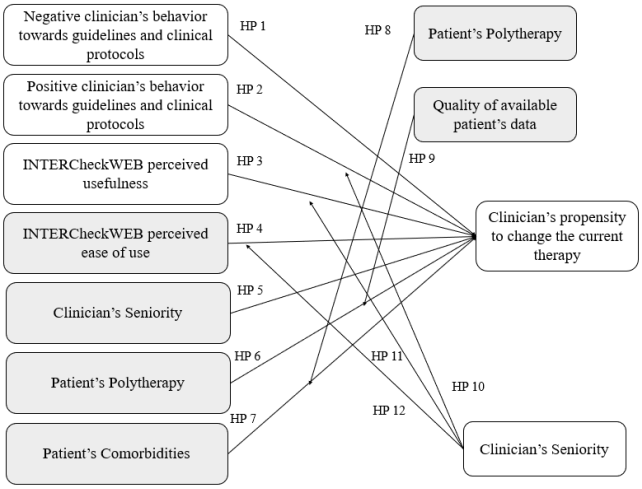

Figure 2 – Framework with verified hypotheses

The QCA confirms and complements these results, identifying the configuration "Clinicians experience*Useful*˜Easy* *˜Positive Behaviour" as the best consistent configuration.

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Forecasting the Healthcare Public Tender Complexity Leveraging on Knowledge Assets Based on Digital Solutions

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Abstract

In recent years, the National Healthcare Services worldwide are forcing to implement spending review processes, to improve inefficiency areas and free up economic resources. Thus, the purchasing process, which have been centralized at regional and national level, require an in-depth optimisation. The present contribution aims at investigating the knowledge assets that might influence the design of a Complexity Index for Tender Procedures (CITP), useful to manage this topic in the public healthcare sector.
A literature review was performed for the identification of all the relevant assets to be considered in the design of a model for the CITP in healthcare. At first, a focus group, with 7 domains experts and 3 academic researchers was conducted, in order to define the variables affecting the CITP. A Delphi method was also implemented, to decline the variables and their relationships, thus defining the contribution of each variable and item, useful to develop the CITP framework. Once having created the CITP construct, a hierarchical sequential linear regression model was implemented to define the predictors of the dependent variables and validate the model. The evaluation of the robustness of CITP result was assessed by means of a bootstrapping approach.
According to the above, the presence of a tender preliminary phase, the number of batches and companies involved in a tender procedure, as well as the award criteria and the tender economic amount, were the main knowledge assets impacting on the CITP design. Results show the robustness of the CITP framework developed, with an Adj R^2 always higher than 80%: in particular, the tender preliminary phase, the number of companies, the economic amount, as well as the moderator effect of the criteria award on batches dependent variable and number of companies, mostly explained the complexity of tender. The CITP could be a useful support for any kind of technological batch tenders, given the variation lower than 5%, for any typology of batches. The

present study also confirmed the possibility to create validated scales by means of sum of items explaining the same topics as happened in other operational and innovation settings.

Keywords – Complexity Index for Tender Procedures, tender procedure, contracting authority, healthcare technology

Paper type – Practical Paper

1 Introduction

In recent years, healthcare systems have faced major organizational and costs challenges, particularly in the public sector. Hence, Governments worldwide launched programs of spending reviews aimed at cutting budgets, improving inefficiency areas (Radaelli et al., 2014).

Despite value-based healthcare, focusing on patient outcomes and costs of delivering these outcomes, can address both challenges, in this virtuous cycle, public procurement, in particular in Italian context, could represent a major barrier. In this view, the purchasing processes for public tender have been identified as a key component, for the improvement of healthcare systems performance (Busse et al., 2007), thus requiring an optimization.

Most hospitals and healthcare systems purchase medical products—including devices, supplies, and equipment—primarily, on the basis of the "up-front" purchase costs. The major concern related to the price-based approach to procurement, is that it addresses neither quality, nor the total cost of patient care. This failed to focus their attention on the needs of other stakeholders, such as patients, providers, healthcare systems, and society. Another technique used within the healthcare procurement process, is the Most Economically Advantageous Tender (MEAT), a value-based procurement framework, that paved the way to the introduction of outcomes, benefits, clinical and patients' point of view, significantly modifying the factors influencing pricing. By choosing the MEAT approach, rather than the cheapest option, decision-makers could be supported, in the procurement process, by a larger number of criteria, with a vision based on the entire care pathway efficiency.

In addition, another key element for improving the public tender efficiency and optimization, is represented by the centralization of purchasing processes at regional, and national level. Centralized procurement could be able to improve the achievement of many benefits through economies of scale (Karjalainen, 2009), decreasing the duplication of resources invested by different stakeholders. This approach enables for more efficient inventory control, reducing human resources and overheads costs. As result, a centralised purchasing process could affect the procurement tender speed, products' quality control and process flexibility (Racca, 2015).

Despite the growing interest in the role that strategic purchasing could theoretically have in empowering the cost-effective provision of healthcare services, while

simultaneously maximizing population health (Figueras et al., 2005), little is known with regard the aspects that could impact on its proper management, leveraging on complex and multifactorial issues.

In this regard, the Technical and Administrative Regional Supporting Agency – ESTAR (Tuscany Region, Italy) showed the need to define the complexity of each individual tender procedure, stratified according to the different product categories (administrative services, economic assets, medical devices, IT solutions, drugs and laboratory diagnostics and healthcare equipment). Moving on from these premises, the present contribution aims at investigating the knowledge assets that might influence the design of a Complexity Index for Tender Procedures (CITP), useful to manage this topic in the public healthcare sector. According to the above, the following research question was developed: "Which are the main factors leading to a higher complexity in the management of a tender procedure?".

2 Research design and methods

For the achievement of the above objectives, a theoretical framework with dependent and independent variables was accordingly developed.

A research design composed of the following phases was developed.

a) Identification of the variables affecting the complexity of tender procedures.

The identification of all the relevant variables to be considered in the design of a model for the CITP in healthcare was conducted, starting from a structured literature review (Tranfield et al., 2003) and an analysis of the purchasing processes items proposed in European and Italian laws (Directive 2014/23-24-25/UE; Legislative decrees 163/2006, 50/2016).

According to the above, a focus group (Dey et al., 2009) was conducted, involving 7 public tender experts and 3 academic researchers, in order to validate the pilot variables influencing CITP and derived from European and Italian laws. A Delphi method (Okoli and Pawlowski, 2004) was also adopted, to decline, quantify and create consensus concerning the list of variables and their relationships.

Thus, the tender complexity depends on all the variables that may have a dependent or independent influence on the following factors: *i)* the number of batches, *ii)* tender preliminary phase, *iii)* the economic amount and *iv)* the number of companies involved. Furthermore, the moderator effect of the adjudication criteria was identified (in terms of the lowest price, or the most economically advantageous tender – MEAT – as mentioned in the Directive 2014/24/EU of the European Parliament, Legislative Decree no. 50 of 18 April 2016), and studied as variable that could strengthen the relationships between the following variables: Batches Dependent Variable, Batches Independent Variable, Tender Preliminary Phase and Number of Companies, and the complexity of tender procedure.

b) Validation of the variables affecting the complexity of tender procedures and creation of the framework

A nominal group technique (Delbeq, 1975) was also implemented, involving 108 experts, to create consensus on the above assets, and to define their contribution in the development of the CITP framework, in terms of strength in their relationship. Once having defined the assets impacting on the CITP and their relative weights, the CITP was assessed using a sum approach as described in literature for other similar constructs (Wulf et al., 2010; Lubatkin et al., 2006), considering the tenders procedures related to the Technical and Administrative Regional Supporting Agency – ESTAR Tuscany, for the year 2018.

A synthesis of the research framework developed is proposed in Figure 1.

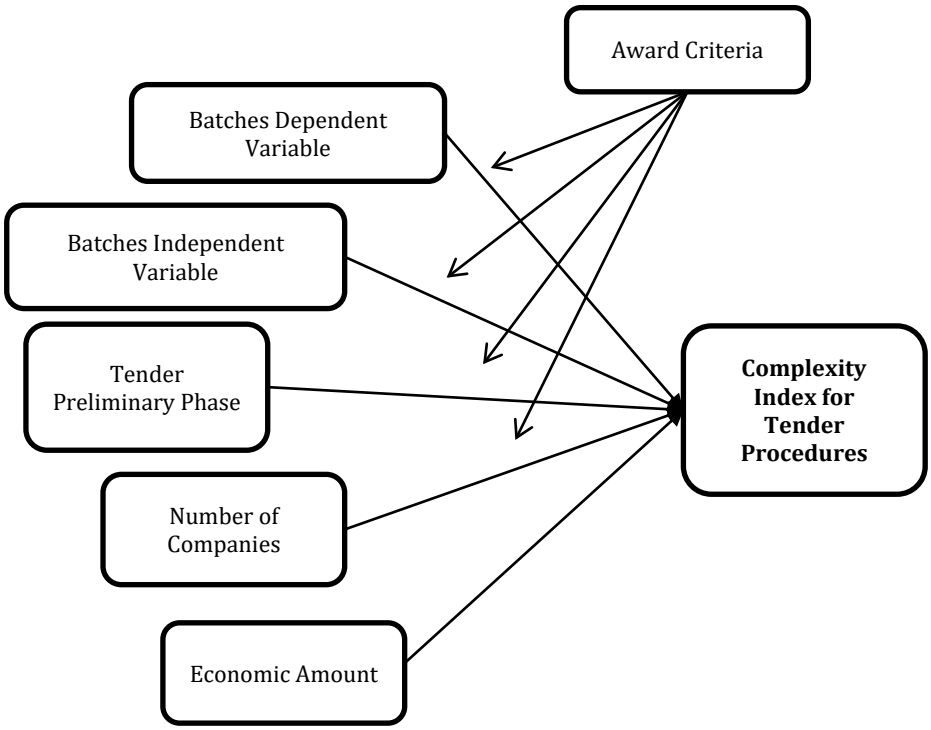

Figure 2 - Research framework

In the followings, the measures used for the creation of each variable are detailed. It should be noted here that all the variables and items considered in the study, are represented by scales with an incremental numerical value: the higher the value of the variable, the higher the related complexity with regard to the single item composing the general value of CITP:

Number of batches - Dependent Variables

- *Territory*, in terms of regional (2), local (1) and hospital (0) setting. The result ranged from a minimum of 0 (hospital context), to a value equal to 2 (regional).
- *N. hospitals involved*, in terms of number of hospitals involved in the tender process.
- *Technological and process innovation*: this variable identified the type of innovative technology for which the tender has been created, considering a scale ranging from 1 (services innovation), to 5 (innovative drug or service).
- *Sampling Exam*, in terms of number of sampling tests carried out on the product during the entire tender process.
- *Tender edition*, thus considering if the tender is a first edition (2) or not (1).
- *Presence of disposable device*: this item measured the presence of consumables or other services related to the life cycle of the product/service for which the tender has been created. The result ranged from a minimum of 0 (absence of consumables or other services), to a value equal to 2 (presence of consumables or other services).
- *N. of user points*, in terms of number of hospital departments requiring the specific tender object.

Number of batches - Independent Variables

- *Interoperability of Systems and Technologies.* This variable measured how much the technology/service can be integrated with the systems and technologies available in the hospital that required it. This item was evaluated, considering a scale ranging from 1 (high level of integration), to 3 (low level of integration).
- *Innovation Level,* in terms of technology degree of innovation. The result ranged from a minimum of 1 (obsolete technology), to a value equal to 3 (early stage technology).
- *High interference,* this variable would analyse how much the lack of a specific product could affect the routinely healthcare activities. The above item considered a scale ranging from 0 (absence of lockout of activities), to 3 (lockout of activities).
- *Reliability of Requirements*, for which both the quality and reliability of the requirements, were considered, ranging from a minimum of 1 (high-level of reliability), to a maximum of 5 (low-level of reliability).
- *Ease to find Requirements,* in terms of detailed information availability with regard to the requirements, according to an evaluation scale, ranging from a minimum of 1 (reporting a higher availability of requirements, reporting a low level of complexity), to a maximum of 5 (reporting a lower availability of requirements, with the highest level of complexity).

- *HTA Assessment,* on the basis of the need to conduct a prior Health Technology Assessment to compare and evaluate the technology. The variable considered a scale ranging from 0 (no need of HTA assessment), 2 (need of HTA assessment).

Preliminary phase of tender – Variables

- *Presence of Technical Commission*, in terms of presence (1) or absence (0) of the any Technical commission.
- *Preliminary consultations*, considering the number of preliminary consultations conducted. This variable was measured using the following scale: 0 (no preliminary consultations), 1 (one preliminary consultation), 2 (more than one preliminary consultations).
- *Presence of mixed contracts,* based on five characteristics: *i)* supply, *ii)* supply and services, *iii)* supply and installation, *iv)* services and installation, *v)* supply, services and installation.
- *Type of procedure, Acquisition Modality and Type of contract, in terms of the different arrangements for awarding the contracts performed by* the Technical and Administrative Regional Supporting Agency – ESTAR (Tuscany Region). Thus, multiple contracts are available in the Italian Setting, different based on their complexity to be managed.

Furthermore, the following variables were evaluated in terms of presence (1) or absence (0), with regard to i) aggregator able to unify the needs derived from several hospital; ii) social clause, in terms of social impact of the technology; iii) compliance with regional laws and iv) interreference risk assessment document, The variables were evaluated, considering a scale ranging from 0 (absence of the specific item), 2 (presence of the specific item).

a) *Validation of the CITP framework*

Once the framework was created, a hierarchical sequential linear regression model (with enter methodology) was implemented to define the explicative power (Adjusted R^2) of the variables considered, measuring the CITP derived from a prevision ("forecast CITP") of tender procedures, not yet awarded.

The robustness of the results was also verified, using the Bootstrapping technique (Efron et al., 1993). The sensitivity analysis was performed, in order to verify: *i)* the variation between "forecast CITP" and "final CITP", calculated after the tender adjudication; and *ii)* the possibility to implement the CITP for any kind of healthcare technologies, requiring a tender procedure (medical devices, drugs, ITs, administrative services, *etc*…).

In particular, for the forecast CITP and of the final CITP calculation, 376 and 41 calls for tender, respectively, were collected from the Tuscany Region in the year 2018.

All the analyses were conducted with a significant level of 0.05.

3 Results

The results of the nominal group technique revealed that the presence of a tender preliminary phase, number of batches and companies involved in a tender procedure, are the main dependent variables to be considered in the design of CITP, as reported in Table 1. In particular, the perceptions about the variables' priority in the definition of CITP revealed that the tender preliminary phase assumed the higher weight (0.4), followed by number of batches (0.3), economic amount (0.2) and number of companies involved (0.1).

Table 1 - Priority of the main variables of the framework

Main Variables	Priority	Weight
Tender preliminary phase	1	0.4
Number of batches	2	0.3
Economic amount	3	0.2
Number of companies involved	4	0.1

The above main variables were also declined, in detail, into other sub-variables or scales, as reported in the Methods Section (Table 2).

In particular, the perceptions about the specific variables' priority in the definition of CITP revealed that the territorial context phase assumed the higher weight among the dependent variables (0.25) and the integration of the awarded product or service with the systems and technologies available in the hospital assumed the higher weight among the independent variables (0.29). The presence of technical commission (0.18) and the request of one or more preliminary consultations (0.16) were the most relevant variables among the variables relate to preliminary phase of tender.

Table 2 - Priority of the sub-variables of the framework

	Priority	Weight
Number of batches - Dependent Variables		
Territory	1	0.25
N. hospitals involved	2	0.21
Technological and process innovation	3	0.18
Sampling Exam	4	0.14
Tender edition	5	0.11
Presence of disposable device	6	0.07
N. of user points	7	0.04
Number of batches - Independent Variables		
Interoperability of Systems and Technologies	1	0.29

Innovation Level	2	0.24
High interference	3	0.19
Reliability of Requirements	4	0.14
Ease to find Requirements	5	0.1
HTA Assessment	6	0.05
Preliminary phase of tender		
Presence of Technical Commission	1	0.18
Preliminary consultations	2	0.16
Mixed contracts	3	0.15
Type of procedure	4	0.13
Presence of Aggregator	5	0.11
Presence Social Clause	6	0.09
Acquisition Modality	7	0.07
Type of contract	8	0.05
Compliance with Regional Law	9	0.04
Presence of Interference Risk Assessment Document	10	0.02
Economic Amount		
< 500,000 €		
from 500,000 to 1,000,000 €		
from 1,000,000 to 5,000,000 €		
from 5,000,000 to 10,000,000 €		
from 10,000,000 to 20,000,000 €		
> 20,000,000 €		
Number of companies		
1		
from 2 to 5		
from 6 to 10		
> 10		

Once having defined the priorities and the weights related to each single variable and item, the method of calculation used to measure the CITP value was defined, as detailed in Table 3.

Table 3 – Method of calculation

1. Score of Dependent Variable: Weight * Value * Number of batches	**∑ Variables (1,2,3,5) * Value of Criteria of adjudication + ∑ Variables (4)**
2. Score of Independent Variable: Weight * Value	
3. Score Tender Preliminary Phase Weight * Value	
4. Score of Number of Companies Weight * Value	
5. Score of Economic Amount Weight * Value	

The results of the regression analysis, focusing on the "forecast CITP" indicated that difficulties occurring in a tender preliminary phase (β=0.138), a higher number of companies (β=0.245), a higher economic amount (β=0.278), as well as the moderator effect of the criteria award on batches dependent variable (β=0.499) and number of companies (β=0.283), were independent predictors of the complexity of tender procedure, thus explaining the 88.2% of the CITP variance. The same trend emerged considering the "final CITP", on the adjudicated tender procedures, reporting the robustness of the framework developed, with an Adjusted R^2 always higher than 80%.

Table 4 - Validation of the CITP framework

	Model 1	**Model 2**
Independent variables		
Batches Dependent Variable	0.260*	-0.095
Batches Independent Variable	0.174*	0.037
Tender Preliminary Phase	0.091*	0.138*
Number of Companies	0.259*	0.245*
Economic Amount	0.577*	0.278*
Moderator variables		
Moderator effect of award criteria on Batches Dependent Variable & CITP		0.499*
Moderator effect of award criteria on Batches Independent Variable & CITP		0.110
Moderator effect of award criteria on Tender Preliminary Phase &CITP		-0.177
Moderator effect of award criteria on Number of Companies & CITP		0.283*
R^2	**0.795**	**0.885**
Adj R^2	**0.792**	**0.882**
F Value	**286.126***	**313.000***
AR^2	**0.795**	**0.090**
F (AR)	**286.126***	**72.014***

Focusing on the "forecast CITP", the most difficult tender to manage is related to medical devices (value = 14.32), whilst the lowest CITP was assessed for IT system

(value = 4.83). Focusing on the final value of the tenders that were accordingly adjudged, it emerged that the most complex tender is related to Administrative Services (value = 13.25), followed by Economic Assets (value = 10.03) and Medical Devices (value = 10.25). Statistical analysis revealed the absence of statistically significant differences between the "forecast value" and the "final value" of the CITP (p-value > 0.05), confirming the robustness of the model. However, this showed the generalizability of the proposed CITP framework, as well as its effective predictivity.

Table 5 - Results

Priority	Types of goods to purchase	Median final value CITP	Median forecast CITP	p-value
1	Administrative Services	13.25	7.12	0.197
2	Economic Assets	10.03	8.84	0.119
3	Medical Devices	10.25	14.32	0.107
4	IT System	7.17	4.83	0.540
5	Drugs and Laboratory diagnostics	6.32	8.91	0.150
6	Healthcare equipment	5.56	7.66	0.164

Furthermore, bootstrapping technique confirmed, for both CITP values, the possibility to implement the framework for any kind of healthcare technologies, with a range of variability always lower than 5%. Hence, we concluded that the CITP could also be a useful support for any type of technological lot offer.

Table 6 – Bootstrapping Analysis

Technological Batch Tenders	Average Δ %	Minimum Δ %	Maximum Δ %	
Administrative Services	-2.80%	-3.95%	1.79%	**Δ % always lower than ± 5%**
Economic Assets	1.13%	-2.25%	2.96%	
Medical Devices	-0.56%	-2.55%	2.31%	
IT System	1.57%	-3.67%	4.93%	
Drugs and Laboratory diagnostics	-0.58%	-3.06%	2.71%	
Healthcare equipment	-0.22%	-2.21%	1.85%	

4 Conclusions

A centralized procurement authority exhibits a higher volume of procurement actions, both in terms of quantity and budget, due to aggregated demands as well as a more numerous and higher trained staff that arises from localization at one place and a related need for procurement specialists (Arnold, 1999). In this regard the Technical and Administrative Regional Supporting Agency – ESTAR (Tuscany Region, Italy) showed the need to define the complexity of each individual tender procedure.

Academically, public procurement has been a neglected area of study even though governmental entities and public procurement practitioners have diligently worked to improve public procurement practices (Thai, 2001), supported by methodological and structured approaches.

The present study could be considered as the first attempt to define an aggregate index, that could easily and effectively calculate the complexity of a tender, in terms of resources and time spent. In this view, the results provide practitioners with a CITP, raising new awareness on the variables that affected tender procedures and suggests interventions for its appropriate management, until its beginning, in terms of necessary resources, organization and communication, thus supporting the entire process.

Figure 2 depicts the CITP framework with verified hypotheses. According to the following, it emerged that the most important variable to be managed, in order to simplify the entire public procurement process in healthcare, could be represented by the tender preliminary phase, the number of companies involved, as well as the economic amount of the entire tender.

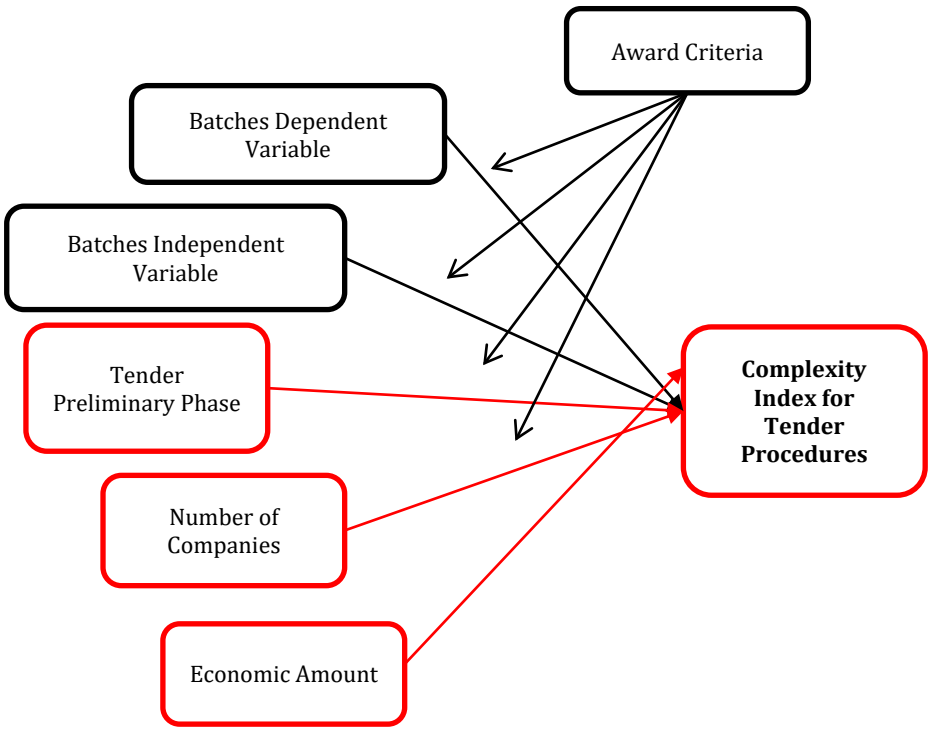

Figure 2 - Research framework with verified hypotheses

The CITP may also be useful in order to define realistically the standard schedule for each phase, in relation with the different complexity and product categories. The adoption of the CITP could support a more realistic planning of activities for contracting authorities' organization, thus identifying all the potential resources useful for the management of a tender process, with a degree of transparency not only towards the contracting authority, but also towards the staff who directly have to work on the tender. The ability to identify the process complexity at early stage, would provide better understanding, thus reducing risks and achieving a successful project management, due to better anticipation (Woord, 2008). This approach enables for more efficient process control, reduced human resources and overheads costs, as stated in literature (Cunningham, 2014). According to the above, it is possible to evaluate all the organisational and human resources management aspects, in order to include in the CITP development also these factors, forecasting the entire process complexity, and hypothesizing the time required to conduct all the necessary activities, forecasting the full time equivalent needed to implement and verify the tender procedure. The future logical step, useful for the contracting station, is to translate the complexity index, in an organizational complexity index.

According to the CITP robustness and replicability, thus being a useful support for any kind of technological batch tender, it should be noted that the present framework could be used by each Contracting Authority, in the definition, and in the scheduling of all the activities required for the tender procedure, thus forecasting the proper human resources, tasks and time needed to achieve the objectives. In this context, the Technical and Administrative Regional Supporting Agency – ESTAR (Tuscany Region, Italy) is implementing an informative tool to evaluate the complexity of each individual tender procedure, and to plan all the activities of its employees according to the amount of workload forecast. This tool is integrated with the ESTAR information system, in order to calculate the CITP automatically, when a tender is launched and after its award, as well.

From an empirical point of view, the results confirmed the possibility to create validated scales by means of sum of items explaining the same topics (i.e. batches dependent variable; batches independent variable; tender preliminary phase), as happened in other operational and innovation settings (Wulf et al., 2010; Lubatkin et al., 2006), thus creating a construct being more robust, solid and empirically superior. In accordance with the cited stream of literature, the CITP was created as the sum of multiple variables, thus being more consistent with the topic of research, in terms of creation a multidimensional synthetic indicator for tender complexity measurement combining more aspects.

The findings could contribute to enlarge the existing research, with regard to the use of real-world data in the healthcare sector, within the specific setting of the public procurement.

In conclusion, the adoption and the proper use of the CIPT framework could leverage on the, thus improving the internal processes, with important benefits, for Contracting Authorities, in terms of efficiency and effectiveness.

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Incorporating Professionals' Knowledge in Predicting Technology Obsolescence in Hospitals

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Abstract

In the last years, with the overwhelming explosion of medical devices and lack of resources in healthcare among scholars there has been an emerging and growing interest towards the medical equipment inventory management in hospitals. This paper aims at designing a tool of Replacement Priority Index (RPI) to measure the technical variables "technical RPI" through the development of a digital tool and the clinical opinions of users through the development of "professionals' Knowledge RPI" by means of structured elicitation of experts' judgement (clinicians). The technical RPI is based on literature review considering: *support availability; reliability; maintenance expenses; age; functional criticality.* The RPI based on professionals' knowledge of medical equipment resulted into an index consisting of information about the status (performance, quality, urgency), criticalities (uniqueness; faults; functional criticality), degree of use (frequency of use; volume of performance), ease of use (knowledge; degree of learning; interface), new equipment impact (staff availability, advancement of technology). The RPI tool has been pilot applied in a leading Italian hospital. The study offers an original and relevant contribution to the development of domain-specific knowledge and, as such, to fostering the diffusion of studies about Technology management in hospital in particular to facilitate the Investment Plan and guarantee the improvement of quality and safety of care.

Keywords – Technology obsolescence, Replacement priority index, RPI, Hospital, professionals' Knowledge.

Paper type – Academic Research Paper

1 Introduction

In the last years, with the overwhelming explosion of medical devices and lack of resources in healthcare among scholars there has been an emerging and growing interest towards the medical equipment inventory management in hospitals. There is a growing need to manage through automation processes the large amount of data in order to support with standardised procedures the process of decision making about the entire life cycle of the technologies. Some scholars emphasized the need of implementing predictive models for maintenance activities through a significant integration between technical performance evaluation and economic assessment (Seiti et al., 2019). In this context, the knowledge of professionals becomes essential during decision making process.

Despite its undoubted relevance and the growing awareness of the need for a systemic approach to medical equipment management in hospitals among practitioners and policymakers, in practice we are a long way from this approach. In fact, the initiatives and tools developed to manage the entire lifecycle of technology within hospitals have proved to be isolated, fragmented and not standardized.

The importance of professionals' Knowledge is particularly relevant for the phase of replacement of medical equipment. Among the different phases of the management of medical equipment in hospital, the one of replacement has always been one of the most critical because, unlike the others, it has not been systematized, nor have been established univocal criteria for general validity. Several authors encouraged the application of Replacement Priority Index (RPI) to medical equipment in hospital, recognising the benefits it brought to measure the urgency of decommissioning and renewal (Fennigkoh, 1992). However, the literature on RPI in healthcare is still scanty, and shows significant gaps at methodological level. First, there is no standard about what technical and organisational variables needs to be considered; second, only a very a limited number of RPI studies have implemented professionals' opinions (medical equipments' users) within an RPI tool which appear to be essential for an appropriate decision about replacement (Maggi, 2019).

2 Methodology

Literature review was used to identify and select the preliminary list of variables to be considered in the "technical RPI" and the "professionals' knowledge RPI". In the first phase, Scopus, PubMed and Web of Science are selected as scientific literature databases, being considered the systems with the highest number of articles in engineering and healthcare. A field study was carried out to develop, test and validate the RPI tool. The field study has been conducted in a leading Italian hospital in Lombardy. Moreover, the

tool has been validated through focus group and individual interviews with clinical engineers of the hospital.

For the professionals' knowledge elicitation, the questionnaire method was chosen to get responses from a large number of experts, and the data gathered may therefore be seen to generate findings with higher consistency and potential for generalisation. Moreover, the questionnaire allows to obtain new data that cannot be obtained from the technical evaluation, parameters that allow to objectify the real needs of each department considered.

3 Results

3.1 Development of RPI based on technical information

The literature shows a constant choice regarding the final formula of the IPS; in fact, as also shown in the first model proposed by Fennigkoh (Fennigkoh, 1992), the index is calculated as the sum of the scores of each criterion or sub-criterion, multiplied by its weight. The RPI can then be expressed as a linear combination, such as shown in the following formula (fig.1):

$$\text{RPI tech} = \sum \left(\sum_{i=1}^{n} \; \sum_{j=1}^{m} S_j \cdot w_j \right) \cdot W_i$$

Figure 1: RPI formula

where n and m are equivalent to the number of criteria and sub-criteria (if any) respectively chosen, Sj the score of the j-th criterion, while wj and Wi relatively the weight of the sub-criterion and the criterion. At this point, each parameter of the formula must be defined. It is convenient to start with the criteria and sub-criteria, since the attributes are actually indicative of the technical characteristics of each medical device. The development of a new classification algorithm, obtained the integration of existing models, with the introduction of some new criteria and measures. From literature review, 5 recurring categories have been identified: Availability of support", "Reliability" or "Downtime", "Maintenance Costs", "Age" and "Functionality" of the equipment. These criteria are then selected for the new model as the most representative for assessing the status of a medical equipment. In addition, it can be noted that for some criteria, such as "Age" or "Maintenance Cost", there are different calculation methods proposed by different studies, which differ for "Measure" and "Value." Therefore, it is necessary to choose the condition and the best scores for each parameter, justifying that decision. In the new model, it is preferred to adopt a fuzzy, non-binary methodology for use an approach that characterizes as much as possible the variables by selecting the conditions that offer the highest number of intervals and assignable scores. It is emphasized that this

part of the study should be carried out by comparison and aid from engineers and technicians, being aware of the specific hospital context, and its dynamics, the equipment present, the usable data and the measurements reasonable to use in a context of specific hospital.

For example, with regard to the age parameter, the assignment of more specific criteria is offered by the Capuano model (Capuano, 2010) with six intervals proposed i.e. 0, 3, 5, 10, 15 or 20 years or more. Nevertheless, comparing it with engineers' opinions, it is established that on average a piece of equipment can still be considered to be new up to five years to live. For this reason, the age ranges between 0 and 3 years are eliminated, maintaining the other ranges recommended by Capuano (2010). Before proceeding with the display of the new model, it is necessary to establish the value of each weight w and W. Among approaches identified during the literature review is identified as the best model Analytical Hierarchy Process (AHP) and fuzzy logic (Dondelinger, 2004). Among the articles that offer this type of procedure, the model of Faisal and Sharawi (Faisal and Sharawi, 2015) has been taken as reference because on the one hand, it proposes clear and available technical evaluation criteria which coincide with the 5 previously selected parameters. On the other, this model, compared with other AHP MCDMs, such as the Capuano (2010), Osman (2018), Taghipour et al. (2011) and Nobre (1999), offers a tested and precise study for as regards the allocation of incidence coefficients. In fact, as Faisal et Al. (2015) reports, in order to obtain the weighting of each criterion and sub-criterion yes comparative matrices are used, constructed on the basis of questionnaires placed with four decision-makers between clinical engineers, technicians and doctors. In addition, to strengthen the results there is also the consideration of the correlation between the various criteria. Here we reported the criteria chosen to be included within technical RPI:

Support Availability

As described by Faisal et al. (2015), "the availability of support is the most important indicator in the developing countries for replacement decisions'. The literature analysis shows that this criterion is assessed on the basis of the end-date life, called "End Of Life" (EOL), i.e. the "date defining the end of maintenance economic, engineering support or the further development of a product by the producer". As a condition none of those proposed in the literature is representative, since all assume that the date of EOL for each individual device is known, when in reality this is rarely provided by the manufacturer.

Reliability

A device can be considered reliable if it guarantees the correct operation, is based on its technical and manufacturing characteristics. This parameter, as emerged from literature, is measured through downtime, quantified in days, hours or number of failures in a specific time frame. In the new model this factor is divided into two sub-categories, as proposed by Faisal (2015). The criterion called "Efficiency Coefficient" remains unchanged.

Maintenance expenses

The maintenance expense is the total cost of maintenance and repair of each device. It is also considered reasonable to adopt the calculation offered by Faisal, i.e. by comparison with the purchase cost. The model proposes as a condition that, for optimal spending "the costs of maintenance over the last three years should not exceed 25% of the purchase cost of a device" (Faisal, 2015), a fact demonstrated in T. Clark's book "Health Care Technology Replacement Planning" and assumed in the new PRI model.

Age

In most of the models presented in the literature there is a parameter representative of old age. In fact, as Capuano writes, "the age in years of an equipment is an important factor because the components of the device can become susceptible to failure based on wear and age" (Capuano, 2010). As with the "Reliability" criterion, there are two sub-criteria for "Age". The first one, called "Age of the Device" is simply calculated as the difference between the current date and the test date. It represents the old age and therefore the score to the criterion is assigned according to its range, based on the ranges proposed by Capuano (2010), as previously mentioned. The second sub-criterion instead is presented by Coppola (1999) and the "Average Age", which compares the years of life of the individual machine with the average age of the devices of the same type, also called functional age and calculated according to the formula that follows:

$$\text{Functional Age} \quad \frac{\sum \text{Age}}{\#\ \text{medical devices}}$$

Functional Criticality

The function or application of the device may have a high effect on the decision substitute, as reported by many bibliographical articles, first of all by Fennigkoh (1992). Looking, for example, at life support devices which, regardless of the necessities, they almost always tend to receive preferential consideration over the other equipment. There are therefore 4 categories of devices with decreasing priority: lifesaving (e.g. defibrillator, kidney dialysis machine, electrosurgical device, etc.), therapeutic (e.g. laser, lithotripter, etc.), diagnostic (e.g. electrocardiograph, monitor, etc.). multi-parameter) and support or laboratory (e.g. centrifuge, printer, laboratory microscope, etc.).

3.2 Development of RPI based on professionals' Knowledge

This two-stage approach is not completely innovative but draws on the methodology first suggested by Caimmi et al. (2001), which was then taken up by other authors more recently (Maggi, 2019). The RPI based on Professional Knowledge, do not find a real explanation and analysis in the literature. What can be identified in the literature are general cues or topics on which to construct the questions to be asked to health care

personnel; however, to the best of our knowledge, there are no models dedicated. Evidence of literature gap can be taken, for example, from the article by Armisi et al. (2013), which proposes among the Professional Knowledge criteria the "Criticality of company management", described as "indicative parameter of the criticality on the basis of the indications of the company management, on the basis of which it is possible to facilitate certain Hospital Units compared to others, by virtue of the health policy orientation adopted" (Armisi et al., 2013). As can be seen, this explanation is theoretical and does not clarify how to obtain the parameter and how to evaluate it. The same applies to the publication of Topfer et al. (2016) which proposes as a subjective parameter the "Impact on health structure in case of equipment failure", without providing any explanatory information on this clinical criterion. These are the reasons why we decide to develop RPI based on Professionals' Knowledge model from scratch, starting with the framework, through to the formulas and the final calculation. First of all, it was decided to use as a means of data collection a questionnaire, addressed to hospital staff. The questionnaire provides the opportunity to obtain a homogeneous classification of the data collected, as the model is uniform for each interview and allows to ask the same questions in the same sequence.

At this point, it is necessary to choose the formula with which to obtain the RPI based on Professional knowledge. Considering that the calculation of the technical index previously presented by linear combination is practical and reasonable, it is decided to replicate it also for the subjective parameter, obtaining the following formula:

$$\mathrm{RPI}_{\mathrm{PK}} = \sum \left(\sum_{i=1}^{z} \; \prod_{j=1}^{k} V_j \cdot p_j \right) \cdot P_i$$

Figure 2: Formula for RPI based on Professionals' Knowledge

where z and k are respectively the number of criteria and questions, Vj the score of question j-th, while pj and Pi relatively the weight of the question and criterion. Also, in this case, as in the model of the technical RPI, the higher the value of the index, the higher will be the level of urgency to replace the device and therefore the new subjective and objective model can be considered consistent and aligned. Then it is necessary to define each element of the $\mathrm{RPI}_{\mathrm{PK}}$, from the criteria, the questions to be asked, the scores (V) of each answer, up to the choice of the weights to be assigned to each object (p, P). It should be noted that each professionals' knowledge "PK" data is chosen at the moment in which it identifies a new characteristic inherent to the device, information that cannot be obtained from the technical data available. Along with the selection of these criteria, it is necessary to determine the questions through which extract the data of interest. In order to understand how best to formulate these questions and to be understood by doctors, nurses and auxiliaries. Literature suggests study of Day et al.(2015) which offers some

interesting insights, including the fact that the data of interest can be obtained with several distinct formulations of the same question. In fact, if the question is too direct, there is the risk that the respondent understands the parameter to be extracted and is therefore influenced by his personal interest in answering it. Moreover, the cited article states the importance of explaining the details that might intuitively seem obvious to each question, in order to avoid any kind of misunderstanding or misinterpretation of the question. The only publication from which questions that can actually be used in the new questionnaire are those of the study of Ewertsson et al. (2015), concerning nursing practice. In particular, the aim of the article is to describe the new role of the nurse, who carries out activities of "technical competence and manages medical devices in different contexts", also going to "investigate their possibilities of continuous learning in this field".

Therefore, especially with regard to the criteria of "Impact" of the new technology and "Ease of use", Ewertsson provides an inherent tool. In all this, the comparison and continuous review of the questionnaire with engineers and technicians is indispensable, since they are aware of the useful subjective data that could be obtained through the questionnaire and the best approach to deal with medical staff, choosing together the best way to present the questions and make themselves understood. Here are reported in detail all the criteria chosen, with the related sub-attributions within the RPI based on Professionals' Knowledge:

Device status

The criterion that expresses the condition of the instrumentation because, although an evaluation of its state is already defined by means of the technical IPS, you need to know how the user believes it works. In order to develop this concept and acquire it by means of a questionnaire, 3 aspects are identified in particular: the "performance", i.e. whether or not the purpose for which the device has been produced, the "quality" of the result and the speed with which it arrives there and the level of 'urgency' of replacement attributable to the equipment, in the opinion clinical. Furthermore, in this last sub-criterion, it is possible to ask why it is considered a device to be replaced, in order to investigate deeper into the root causes that bring an equipment to the end of its life, according to the user's vision.

Criticality in the department

The second criterion identified is the "Criticality" in the department, with regard to both the risk related to the activity for which it is used, both the level of complications that can be come and create in case of failure or malfunction. Even if the technical data of "Functional Criticality", indicative of the relevance, exists of the scope and represented by the risk class (life-saving, therapeutic, diagnostic or analytical), it is considered necessary to introduce this new clinical parameter to assess the subject more specifically and precisely. This deepening can be explained through the 3 sub-attributions of which the criterion of "Criticality" is composed. The first of these is described as the "Uniqueness" of the device and allows you to record the number of equipment similar to

the one under examination actually available in the department, thus giving information about the backup equipment present. For the answer to this question, it is assumed that if there are no spare devices then the situation is critical and therefore the maximum score awarded, if there are more than 2 there should tend to be no risk of danger. The second sub-criterion is called "Fault" and expresses the degree of criticality in the department in the event of equipment failure, considering the possible consequences on the patients and user safety. Finally, the last sub-attribute coincides with the "Functional Criticality", parameter already entered in the technical model. However, it is also decided to put it as one of the arguments of the questionnaire to check what use is actually made of the device because it is not always coinciding with the risk class assigned in the technical documents.

Frequency of use

One criterion that cannot be evaluated using usable data is the degree of use, fundamental parameter to determine the wear of the instrumentation but which is not objectively available. It is therefore necessary to question the hospital staff, introducing a new subjective parameter, concerning the "Frequency of use", evaluating it from the point of view of the hours of use and volume of patients involved daily.

Ease of use

With the criterion called "Ease of use" we intend to collect in particular two aspects inherent in the interface between the user and the medical device. On the one hand, we want to record a factor that represents the operator's mastery in the comparisons of the equipment, through a self-assessment of its "Knowledge" to the regard and the way in which it arrived at it, through the sub-criterion of "Learning." On the other hand, the respondent is asked to comment on the "Interface", judging whether or not it is easy to use.

Impact of New Equipment

The last criterion you choose to evaluate is the "Impact" of a new equipment within a department, taking into account in the sub-attributions the "availability" of the personal in relating to an advanced and probably unknown instrumentation and of the "advancement of technology". In this last sub-criterion an open question has been inserted, asking the clinician if it is who knows of replacement models to suggest. This question does not have a score but may be of particular use to Clinical Engineering in order to better understand the needs of the staff and be able to invest in the appropriate and required equipment.

3.2.1 Weight assignment for the RPI based on Professionals' Knowledge

As far as the weights of the criteria are concerned, the contribution of all health professionals is of paramount importance. In fact, in order to attribute the weights to the various parameters it is decided to record the judgment of two engineers, one clinical engineering technician, one nurse and one doctor, so that they can express their own opinion on the matter.

Criteria	Weight
Status	0,3
Criticity	0,35
Frequency of use	0,2
Ease of use	0,1
Impact of new equipment	0,05

Figure 3: Weights assignment for the RPI based on Professionals' Knowledge

It appears that the greatest burden is placed on the "Criticality" and the "Status", the parameters, although deriving from a subjective opinion, they are indicative of the actual condition of the device. Then follows, at the level of relevance, the "Frequency of use" with a minor value. In fact, if we consider the pulmonary ventilators, we will have different equipment conditions comparing two contexts such as the operating rooms, where it is also used several times a day, and paediatric radiology, where it is used only on special occasions, tending to calm the patient, on average 2 or 3 times a month. Finally, the last 2 criteria are the least accidents, being considered the most subjective and easily changed and improved in case of bad judgment.

For both the "technical" and the "RPI based on professionals' knowledge" the algorithm is based on the weighted average of the assigned criteria, producing as output a ranking of equipment priorities.

3.3 Pilot application of the developed RPI tool

The technical RPI was tested for the entire medical equipment inventory, i.e. 8,153 medical devices, 7,723 "non-urgent", 375 "recommended" and 55 "urgent" for replacement. Therefore, analysing the 430 resulting "recommended" or "urgent" equipment, it is considered reasonable to use for the validation phase the equipment belonging to the most critical departments, i.e. Intensive Care, Neonatology and Neonatal Intensive Care, Anaesthesia, Dermatology, Gastroenterology and Endoscopy and finally Radiology. 81 questionnaires from expert clinicians in different hospital departments were then used for the quantification of the "RPI based on professionals' knowledge" for 68 medical equipment.

Once the RPI based on professionals' knowledge of the selected machine inventory had been calculated, the validity of the technical model was verified through the graphical comparison of the various results.

The comparison between the tools revealed that 69% of the devices considered have similar results for both RPIs. Nevertheless 31% showed differences. The investigation of these differences shows the relevance of tracing not only technical variables but also those related to users' clinical opinion. Indeed for 68 medical equipment, the "total PRI" has been calculated as a linear combination of the technical RPI and the RPI based on professionals' knowledge.

4 Conclusions

The study offers an original and relevant contribution to the development of domain-specific knowledge and, as such, to fostering the diffusion of studies about medical equipment inventory management in healthcare and in hospital in particular to facilitate the Investment Plan and guarantee the improvement of quality and safety of care. A future development that could be implemented, starting from the RPI model, can therefore be an assessment, carried out together with the Hospital Management, to establish what are the minimum standards of technology devices for each department, meeting the needs of each hospital's units, in terms of devises number and quality to be delivered to patients. Moreover, in addition to being a fundamental support for Technology Management in hospital, can be employed in other areas. It could in fact be used for the logistical management of warehouses to compare different technologies or to understand realistically the various needs of each hospital department.

The study suffers some limitations which open for further research endeavour. Although it has been developed thanks to the field study in hospital, the model needs a validation with a panel of experts.

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Individual and other Person Factors Affecting Short-Lived Co-Creation

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Abstract

The present study investigates individual improvisation and perceived other person's affective passion and cognitive passion as predictors of short-lived co-creation in a dyad. The study takes a quantitative survey research strategy. Suggested research model was tested utilising SEM-PLS analysis with the dataset comprising 336 respondents. The data were collected from twelve co-creative events during 2017-2019, in which participants conducted a highly creative co-ideation task within limited time in dyads. The results show support for our hypotheses. Specifically, we find that individual improvisation and perceived affective and cognitive passion directly affect co-creation. In addition, we found that cognitive passion moderates between improvisation and that moderation is negative. We discuss theoretical and managerial implications of our results.

Keywords – Improvisation, Affective passion, Cognitive passion, Co-creation, Dyad

Paper type – Academic Research Paper

1 Introduction

Most knowledge creation and creative outcomes are collective endeavors. In the interconnected world, organizational members need to throw into various knowledge creation teams and events, in changing compilations of people, and often within limited time. Such a creativity is emergent and unfolding and relies of situational interaction and dynamics between participating individual (e.g. Bechky, 2006; Elsbach & Kramer, 2003; Cook & Brown, 1999; Nonaka et al., 2000). It is clear, that interpersonal dynamics between individuals rises as a fundamental source of new knowledge (e.g. Sawyer and

DeZutter, 2009). Earlier research on group creativity suggest that group characteristics and composition are important determinants of creative process and outcomes (e.g. Woodman et al., 1993; Gilson and Shalley, 2004; Cohen and Bailey, 1997). Despite the increasing research interest on collective knowledge creation (Harvey, 2014; Harvey, 2013; Hargadon and Bechky, 2006) and creativity as a process (Drazin et al., 1999; Gilson and Shalley, 2004; Thompson, 2018; Sawyer and DeZutter, 2009), we lack clear understanding on interpersonal determinants of temporary co-creation, that is, aspects that enable individuals to engage in joint creative process in order to integrate knowledge for a shared course within limited time.

We take an individual's perspective and investigate, which individual and other person factors affect co-creation in very short-lived face-to-face co-ideation event. A short-lived co-ideation differentiates from the long-term co-creation in terms of the given time as well as goals. The long-term co-creation aims to construct synthesis between diverse perspectives (Harvey, 2014), whereas short-term co-creation refers to collective improvisation and brainstorming to generate novel ideas within limited time. In this study, we investigate effect of individual improvisation and perceived affective passion and cognitive passion on dyadic co-creation. The co-creation is an individual's experience about the shared co-creation, and it describes the extent to which an individual experienced it to be participative and mutual. We suggest, that co-creation experience derives from both individual and perceived other person factors. Specifically, we investigate influence of individual improvisation and perceived other person's affective passion and cognitive passion as predictors of co-creation experience. We therefore ask, *what is the impact of individual improvisation, perceived affective and cognitive passion on co-creation in dyads*.

To test the research model, we applied a survey research strategy. We collected data (N=336) via survey instrument from twelve co-ideation events, in which participants conducted a highly creative co-ideation task within limited time in dyads. We used stimulated workshops to study factors affecting short-lived creative co-creation in dyadic interaction, because dyads are simplest target to study interpersonal dynamics (Bakeman and Beck 1974). The workshops were planned to mimic circumstances of temporary and unfolding co-creation.

Our study contributes to the research on knowledge co-creation by shedding ling on individual and other person factors affecting short-lived co-ideation in face-to-face dyadic interaction. Capacity and skills to engage into variety of co-creation in the digital era is central for all individuals, not to mention higher educated experts, who are potential entrepreneurs as well.

2 Theory and hypotheses

Theoretical bases of our study are on literature on collaborative creativity (Hargadon and Bechky, 2004; Sawyer, 2004; Harvey, 2014; Sawyer and DeZutter, 2009; Thompson, 2018; Drazin et al., 1999) and knowledge creation (Cook and Brown, 1999; Nonaka et al.,

2000). Specifically, we target our research on within interaction aspects of co-creation and exclude contextual aspects of creativity. We assume that in short-lived co-creation the within interaction aspects are in particularly central, as in an unfolding co-creation both the process and outcome are collectively built by the participating individuals, while they mutually contribute by sharing their ideas, perspectives, emotions, and building on other's ideas.

A short-lived co-creation is a specific kind of knowledge creation process, which lack a common frame of reference, past practices, familiar relationships, and shared group processes (e.g. Nisula and Kianto, 2016). Hence, we understand co-creation as a collective and unfolding process of knowledge creation. It occurs under interdependent, mutual relationship, in which participants can equally contribute to the course of event, and thereby engage in building the shared creative outcome (Vera and Crossan, 2005; Gray, 1989, Sawyer and DeZutter, 2009). Hence, both individual and other person factors affect the co-creation process, that is, interpersonal dynamics play important role in such a co-creation. While earlier studies relying on interactionist theory (Woodman et al., 1993) have investigated both individual and work environment factors affecting team creativity in organizations, the within interaction dynamics of temporary, short-term co-creation have received less research attention. Such a co-creation can take place only when participating individuals are willing to contribute to the course of co-creation.

A short-lived co-creation demands and is built by improvisation. Improvisation is spontaneous action, in which thinking and doing unfold simultaneously (Weick 1996). As such, an improvisation represents the most dynamic nature of human behaviour, that is, individual's ability to respond to unexpected events on the spot, which is a necessity in temporary co-creation. Indeed, in such a dynamic individual behaviour intuition, creativity and expertise converge in a moment, and enable immediate response emerging stimulus. In co-creation, improvisation is individual's contribution to creative endeavour and an important building block of creative process. Hence, we posit the following hypotheses:

H1: Individual improvisation is positively related to short-lived co-creation.

Co-creation is social process, in which participating individuals mutually influence and become influenced by one another's behaviour (Sawyer and Deutter, 2009; Kiesler, 1983), whether they are verbal or non-verbal (facial and bodily) behaviours. Specifically, perceiving one another behaviour individuals build beliefs for their own contributions. We suggest that perceived other person passion, constituting of affective passion and cognitive passion, provides important information about the other persons' engagement and interest in creativity endeavour at hand and therefore plays central role in short-lived co-creation.

Cognitive passion can be perceived in a dialogue as a coherence and logic of the content of speech (Chen et al., 2009). It is seen to refer to passion on the task or idea being explored and therefore cognitive passion reflects an individual's task-related

positive and intense engagement and attunes (Chen et al., 2009). In contrast, affective passion can be perceived in an individual's physical and non-verbal mirroring, like in cues, eye contact, facial echoes and bodily movements (Chen et al., 2009). We propose that in short-lived co-creation perceived affective passion and cognitive passion provide important social information about the other persons participation and engagement in creative endeavour at hand and thereby affect individual's experience of the co-creation. While perceived affective passion provides information about other persons enthusiasm and positive affect, perceived cognitive passion provides social information about other person's knowledgeability and task-related engagement. Thus, both affective passion and cognitive passion positively relate with co-creation. We therefore posit the following hypotheses.

H2: Perceived affective passion (a) and perceived cognitive passion (b) are positively related with co-creation

In addition to main effect, we propose that perceived affective passion and cognitive passion moderate the relationship between individual improvisation and co-creation. When an individual perceives other person enthusiastic and engaged (affectively passionate) and/or knowledgeable and engaged in task at hand (cognitively passionate) it might strengthen the relationship between improvisation and co-creation. Specifically, we propose that the higher the perceived other person affective passion and cognitive passion are the stronger the relationship between individual improvisation and co-creation will be. Therefore, we posit the following hypotheses:

H3: Perceived affective passion (a) and perceived cognitive passion (b) moderates the relationship between improvisation and co-creation

3 Methodology

3.1 Data collection

The data (N=336) were collected via survey instrument from the twelve co-ideation events, in which participants conducted a highly creative task within limited time in dyads. Specifically, we used stimulated workshops to study factors affecting short-lived co-creation in dyadic interaction, because dyads are simplest target to study such an interactional, within interaction, dynamics (Bakeman and Beck 1974). The structure and implementation of the workshops were planned to mimic circumstances of temporary and unfolding co-creation. Likewise, they were equal throughout the all cases.

The share of respondents in terms of demographic characteristics was as follows. Out of the 336 respondents, 62.2% ($n = 209$) were male, and 34.5% ($n = 116$) were female 3.3% (11) were missing values. A clear majority of the respondents, 77.7 % (n=261) said they had a master's level university education. Of the respondents 43.8% (n=147) had a

five or more years work experience, and 54,5 % (n=183) had a work experience less than five years. (1.7 % (n=6) were missing values.

3.2 Measurements

We used multi-item measures for the constructs, with a seven-point Likert scale (*1 = strongly disagree*, *7 = strongly agree*) for each construct, based on existing measures in the literature.

Improvisation was assessed with the individual improvisation scale by Magni et al (2009). We assessed *co-creation* with six-item scale adapted from Vera and Crossan (2005). The items were assessed in the form 'we', to target attention to dyadic, shared creativity within a dyad. We assessed *affective passion* and *cognitive passion* using the scales adapted from Chen et al. (2009), in which affective passion was composed of six items and the cognitive passion of five items.

In addition, we controlled for gender and age diversity in a dyad, as some scholars suggest that in short-lived interactions people draw draw from observable demographic characteristics, like age and gender (Levin et al., 2006; Harrison et al, 1998) and consider similar others more collaborative (Brewer, 1979; McAllister, 1995). Specifically, we controlled dyad members sameness/diversity in terms of gender (1=same gender, 2 = different gender) and age (1=same age and 2=different age), variables of gender, age, education, and nationality to rule out their influence on knowledge worker creativity on a virtual platform. Gender (1 = female; 2 = male). Age was assessed as a categorial variable (1 < 20; 2 = 21-30; 3 = 31–40; 4 = 41–50; 5 = 51–60; 6 > 50). Education captured the following education degrees, with the categories 1= basic education, 2= upper secondary education (vocational and matriculation examination), 3= higher education.

3.3 Analysis Methods

We used SPSS and partial least squares (PLS) (version 3.2.7 of SmartPLS; see Ringle et al., 2015) and the related procedures suggested in the literature (see, e.g., Hair, Sarstedt, Hopkins, and Kuppelweiser, 2014) for analysis and to test the hypotheses.

4. Results

4.1 Measurement model validation

We applied PLS for confirmatory factor analysis to assess the reliability and validity of the measurement model. Specifically, assessment of internal consistency and discriminant validity indicated that the model demonstrated good validity and reliability for the operationalization of the concepts of interest.

First, the construct reliabilities (CR) for all our constructs (Table 1) were above the threshold of 0.7 (Bagozzi, Yi, and Phillips, 1991). Second, the factor loading of each item was high and statistically significant, indicating that they were all related to their specific underlying constructs, verifying the relationship posited among the indicators and constructs (see Appendix I). Third, the values of the average variance extracted (AVE) exceeded the cut-off point of 0.5 (e.g., Fornell and Larcker, 1981) for all of our constructs (Table 1). In addition, each construct's squared AVE (diagonal in Table 2) was greater than the correlation between other constructs. This indicates a high level of discriminant validity (see Chin, 1998). In summary, considering the above discussed aspects of measurement reliability and validity, the measurements used met the necessary requirements for further analyses.

Table 1: Construct Statistics

Construct	Mean	SD	Cronbach's Alpha	CR	AVE
Co-creation	4.3776	.52063	0.869	0.902	0.607
Improvisation	3.6025	.61927	0.665	0.798	0.498
Affective passion	3.5584	.71086	0.881	0.910	0.627
Cognitive passion	3.9682	.59243	0.812	0.868	0.570

Note: SD = standard deviation; CR = construct reliability; AVE = average value extracted

Table 2: Latent Variable Correlations and Discriminant Validity

Construct	1.	2.	3.	4.
1. Co-creation	0.779			
2. Improvisation	0.245**	0.706		
3. Affective passion	0.297**	0.202**	0.792	
4. Cognitive passion	0.352**	0.212**	0.334**	0.755

4.2 Main effect model

We used structural modelling to test our hypotheses. First, we estimated a path model reflecting the posited direct relationships between the independent variables of improvisation (H1), affective passion (H2a), cognitive passion (H2b) and co-creation. The model was analysed with regression coefficients, and their significance was assessed with t-values obtained with a bootstrapping method (e.g., Chin, 1998). Our initial research model was able to explain 19.6% of the variance in co-creation. The results show that improvisation, affective passion and cognitive passion all effected co-creation.

4.3. Moderation model

We estimated a path models reflecting the posited moderation of affective passion (H3a) and cognitive passion (H3b) in relationship to improvisation and co-creation. As expected in Hypothesis 3b (Table 4), the moderating effect of cognitive passion was statistically significant (B = -0.117, $p < 0.036$). What is more, against our expectation the moderation effect was negative. Against our expectation in Hypotheses 4 moderation of affective passion was nonsignificant. Table x provides collected results of this study.

Regarding the effect of control variables, we found that the effect of the control variables was insignificant on the relationship between improvisation and co-creation. The model was able to explain 20.0% of variance in co-creation.

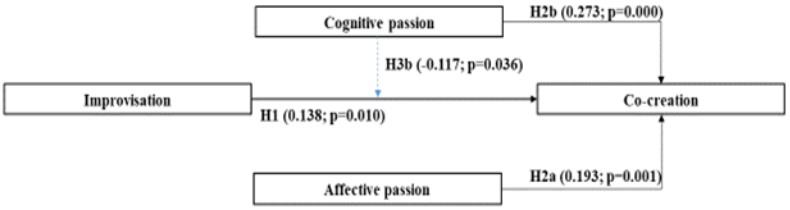

Figure 1: Results

5 Discussion and conclusions

The goal of this study was to extend the understanding of within interaction factors affecting short-lived dyadic co-creation. Building on literature on collaborative creativity, we took an individual perspective and focused on individual and perceived other person factors. In particular, we suggested that in short-lived co-creation individual improvisation and perceived other person's affective passion and cognitive passion affect co-creation, that is, the degree to which an individual considers co-creation being mutually participative, inspiring and successful. The empirical findings supported our hypotheses and showed that improvisation, perceived affective and cognitive passion positively and significantly affect co-creation. In short-lived co-creation participating individuals draw information for their contributions from other person's non-verbal and verbal behaviour. Such an interpersonal dynamics either build sufficient climate for individuals to contribute to the shared course or in worst case inhibits its. This is particularly important in unfolding creative endeavours, in which process the within interaction aspects are central sources of creativity.

We also investigated joint effect of cognitive passion and individual improvisation and found that cognitive passion moderates the relationship between individual improvisation and co-creation, and that moderation was negative. Thus, perceived high cognitive passion weakens the relationship between improvisation and co-creation, whereas low

level of cognitive passion strengthens the relationship between improvisation and co-creation. The finding can be explained by the nature of improvisation, that is, as a spontaneous and intuition dependent creative behaviour improvisation may suffer from task-oriented and rational attunement of another person. In contrast, low cognitive passion leaves room for improvisation and affects positively co-creation.

While focusing on within interaction aspects of short-lived unfolding co-creation, the findings of this study provide important contributions to the research on creativity as well as management of unfolding creativity. By showing the individual and other person factors, indeed, build temporary co-creation, this study adds to earlier research on short-lived co-creation and collective creativity (Drazin et al., 1999; Sawyer and DeZutter, 2009). Specifically, this study highlights the role of interpersonal dynamics of creativity, and suggest that individual's participating in joint creativity, should bear in mind, that positive and enthusiastic attunement is important driver of co-creation.

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Financial Capabilities and Profitability in Ecuadorian Food and Beverage Service Companies: Comparison between Sierra and Coast Regions

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Abstract

This paper is examining investment and financing structures' effect on the return over equity. It also compares relevant financial indicators of the Ecuador Coast and Sierra regions. We analyze this effect from the resource-based visión (RBV). For this proposal, we use a sample of Ecuadorian food and beverage service companies. Different methods have emerged about potential factors that condition investment and financing structures. These conditions have a regulatory effect on profitability. Empirical evidence has shown that those theories are complementaries. Yet, financial management is systemic, and it follows the main aim of optimizing profitability.

To answer research questions, we use an unbalanced panel data sample of 146 companies into a period 2011-2017, specifically food and beverage services, located in Ecuador. We take data from reports published by the Superintendence of companies, securities, and insurance (SC) of that country. We test the hypothesis using multiple linear regression through the STATA program. Ecuador is an emerging country with little research around financial management, which seeks to boost private investment in the tourism sector as a development strategy.

This research helps to understand how the management of assets and financing structures influences the financial performance of the companies in the sector studied, exploring the behavior of their economic indicators over a specific time contrasting them according to the geographical location of the companies. Following other research focused on the effect of resources on business, we hope that the results will contribute to the theory of resource-based vision in the context of Latin America's emerging economies, specifically Ecuador.

By establishing the level of determination of the assets and financing structures on profitability, the importance of financial capital and the return on equity in differentiated areas, this research provides valuable information to both entrepreneurs as well as to domestic and foreign investors exploring financial performance trends to make investment decisions.

Keywords – Knowledge governance mechanisms, ICT, ACAP, Innovation Performance, Knowledge management practices.

Paper type – Academic Research Paper.

1 Introduction

The resource-based vision (RBV) refers to business capabilities as a complex system of knowledge and skills applied to use productive assets in a coordinated way to achieve goals (Wernerfelt, 1984). Wernerlfelt (1984) argues that resources in each company are variable, and capabilities reflect different levels. Therefore, the sustainability of a company depends on the managerial ability to manage the system of resources and capabilities (Peteraf, 1993). In this way, the RBV into a firm leads to better financial performance through its resources and capabilities (Bharadwaj, 2000).

Gastronomy as a tourist attraction has taken on research relevance in recent decades. Nowadays is one of the main components that determine the experience of tourists (Sánchez-Cañizares & López-Guzmán, 2012). Research in the field of restaurant management service companies is diverse. On the one hand, there is research on menu design, quality of service, consumer behavior. So, there is research on business models, infrastructure, and finance (DiPietro, 2017). However, a preliminary review shows little research on financial capabilities as an asset structure and sources of financing, and their influence on profitability.

Empirical evidence sows that theories related to investment, financing, and profitability are complementary to each other (Reich, 1993), and try to explain the determinants of corporation development (Kumar, Colombage, & Rao, 2017). These theories have, in common, improve resource management. Research in the field of restaurant management has diversified, covering aspects such as menu design, business models, strategic management, human talent, quality in the service, including finances (DiPietro, 2017). However, a preliminary review by the authors shows research slightly about financial capabilities as assets structure and financing sources, and their influence on profitability.

We are more interested in contrasting the relationship between the assets and financial structures with profitability in the Coast and Sierra Ecuadorian regions because different contexts drive companies operating in different circumstances and resource disposition.

This article focuses on examining the importance of the assets and financing structures and their effect on the return on equity from the resource-based vision (RBV) approach, contrasting the two regions indicated. Therefore, we have established the following research questions: How does asset financing and profitability behave in Ecuadorian food and beverage services companies? Are there financial management differences between companies located in the Sierra and Coast Ecuadorian regions?

2 Conceptual background

2.1 Implications of the resource-based vision in Ecuadorian food and beverage services companies

Most emerging countries in the world try to improve tourism by emphasizing culture and gastronomy as relevant attractions. However, the food and beverage service business demands a set of resources that operate to make a synergy to strengthen tourism activity whit sustainable development.

Ecuadorian gastronomy is peculiar and different among its regions. A tour of the gastronomic routes makes it possible to know the commitment of Ecuadorian chefs to present the best dishes, raising competitiveness and culinary quality.

As culinary knowledge is an intangible resource, it needs other intangible and tangible support to create value for the food tourism business, like marketing, operation, productive assets, and financial capabilities (Bharadwaj, 2000; Kamboj, Goyal, & Rahman, 2015) and others. Business skill in managing the set of resources, including their self-experience and knowledge reflects the business culture of a country or region and influences its tourism positioning.

Capabilities are the basis of the company's success, and the organization processes its resources to generate value that contributes to sustainability, growth, and competitive advantage (Dierickx & Cool, 1989). In this way, assets and financial structures create value for companies by increasing return on capital, under specific activity scenarios, and adequate levels of operating profit (Assaf, Deery, & Jago, 2011), showing financial capabilities.

Despite the gastronomic richness of Latin America, some emerging countries as Ecuador show slow food tourism growth due to insufficient infrastructure and investment conditions. Due to geographical, socio-economic, and business integration characteristics, Ecuadorian companies could follow different financial behave in their quest to optimize productive resources to generate profits and increase capital. The combination of the asset structure, the level of activity of these, and the financial leverage should aim to maximize the capital returns (Mao & Gu, 2008).

CEO's perception of the environmental conditions and opportunities influences the management of the financial resources (Seo, Kim, & Sharma, 2017). The restaurant business, for its characteristics, demands continuous short-term financial decisions, exhibiting the influence of corporate decisions over market dynamism (Reich, 1993). Therefore, different contexts will have not similar economic indicators (Singal, 2015), and not identical financial management model.

As for long-term decisions, the food and beverage services sector is intricate to the location, indicating that investments in land and buildings are the most significant resources of the business (Lee & Jang, 2012; Seo et al., 2017), but could not be a constant in emerging countries. In Ecuador, investing in land and buildings depends on multiple

factors; frequently, the level of urbanization has an on-hand price that affects decisions. That implicates differences in capital needs and consequently affects the financing structure, assets structure, and the returns of investment.

2.2 Ecuadorian context of food and beverages service companies

Tourist spending is an essential economic indicator in destination countries. From this, it is known the economic spill that tourists generate during their stay. In 2018, UNWTO reported that international tourism revenues in destinations reached USD 1.448 billion. They estimate that 30% of tourism expenditure corresponds to the food and beverage segment (OMT, 2012). In Ecuador, tourism revenues reached USD 2,398.1 billion at the end of 2018 (MINTUR, 2019).

The cadastre of Ecuador's Ministry of Tourism (2019) registers 16,717 food and beverage service companies. This amount represents 67.6% of the total companies engaged in tourism activity. These companies are distributed in the four natural regions of the country. 47.2% are located in the Costa region, 47.8% in the Sierra region and the remaining percentage is distributed in the Amazon and Galapagos.

Regarding the distribution of spending in urban and rural households, Ecuadorians spend 22.6% of their food and beverage spending (INEC, 2012). 8.1% of the expenditure is spent on restaurants and hotels. These figures reveal the opportunity to enter and invest in food and beverage companies.

During the period 2012 to 2018, 40% on average corresponds to food and beverage companies. This average places them as the largest economic sector. On the other hand, when analyzing the country's business structure, we find that micro-enterprises account for 90.81% of the total existing enterprises, followed by small businesses representing 7.13% (INEC, 2019). This data places us in the context in which A&B companies in Ecuador are developed.

2.3 Financial factors derived from capabilities

The relationship between asset financing and profitability has transcended since the theoretical proposals placed forward by Modigliani and Miller (1958). From there, other specific theories developed on potential factors that condition the financing structure and have a regulatory effect on profitability (Ardalan, 2017; Wong, 2015; Bandyopadhyay and Barua, 2016). However, companies must demonstrate borrowing capability and then manage the financing resources according to their purposes and circumstances.

No less important is the working capital that must maintain the continuity of the operation. Consisting of current assets and short-term liabilities, the dynamism with which these resources move will justify fixed asset investments, external financing, and equity. This justification is reflected directly in the profitability of the transaction, leading to liquidity management.

We explore corporate financial indicators as a reflection of the CEO's decisions from different perspectives under RBV. The industry's financial indicators establish the characteristics that enable companies to compete in a specific context. Therefore, it is required to have a generalized view of some financial components through specific indicators (Mao & Gu, 2008). For this study, we selected a set of financial ratios associated with the resources management efficiency to generate profitability through the assets structure and the combination of long-term liabilities with capital. With those, we establish the following hypotheses:

H0: The region in which companies operate doesn´t influence their financial objectives.

H1: The region in which companies operate influences their financial objectives.

3 Research Methodology

3.1 Sample

Our study focuses on food and beverage service companies that reported operations for at least five years within the 2011-2017 period. The sample consists of 146 food and beverage service companies, 68 in the Coastal region, and 78 in the Sierra region. We obtain the information from the database of the Superintendence of Companies, Securities and Insurance of Ecuador, collected in February 2019.

We limit the sample to Ecuador-based corporate companies, which do not have lost data, are three years old at the beginning of the period observed, and have at least four years of operation in the same period. Economy deceleration from 2016 led to the suspension of activities of different companies (BCE, 2018; INEC, 2017), accentuating in the following years, an aspect that explains the difficulty of integrating a larger sample.

3.2 Main variables definition

Financial leverage

This ratio demonstrates the corporation's ability to manage long-term external financing and lenders' confidence in the business (DiPietro, 2017). A high level of financial leverage is adequate when increasing operating returns exceed the cost of debt (Fosu, 2013). The use of leveraged must be reasoned and depend on the level of operation and the cost of external financing (Öztekin, 2105). The relationship between financial leverage and business profitability has to be direct.

Liquidity

Corporate liquidity decisions are aimed at maintaining a level that ensures the continuity of the operation, avoiding the excess of current resources that could be considered unproductive (Chathoth & Olsen, 2007). Therefore, the relationship between liquidity and business profitability is inverse.

Assets turnover

The corporation expects to make the highest speed in producing and selling for profit using fewer assets (Shafi, Raza, & Zaheer, 2018). The relationship between asset turnover and profitability has to be direct.

Tangibility

Any company follows the objective of optimizing its fixed assets reducing idle production capacity due to investment and maintenance costs (Seo et al., 2017). The relationship between tangibility and profitability has to be inverse.

Operational margin

It reflects the corporation's ability to manage operating costs and expenses, reducing them until they do not adversely affect sales (Assaf et al., 2011). The relationship between operating margin and profitability has to be direct.

Return Over Equity

CEOs focus their efforts on overall value for companies through increasing the value of stocks, achieving that when the ROE is positive, sufficient, and growing (Hoskisson, Hitt, Johnson, & Moesel, 1993). However, this financial goal may behave differently due to each company's business context.

Because asset rotation directly influences the operating margin, and both variables don´t represent asset structure or financial structure, we create the multiple control variable called Moderator_1. We also include the variable dummy Region to measure its impact.

We describe the financial ratios and other indicators representing the dependent, independent, and control variables in Table 1.

Table 1. Variables description

Code	Name	Measurement	Type
ROE	Return Over Equity	Net margin / Equity	Dependent
E_LEV	Equity Leverage	Long term liabilities / Equity	Independent
OPER_M	Operating Margin	Operating margin / net sales	Independent
LIQ	Liquidity	Current assets / Current liabilities	Independent
ASSET_T	Sales turnover	Net sales / Total Assets	Independent
TANG	Tangibility	Fixed assets / Total Assets	Independent
Mod_1	Moderator_1	OPER_M x ASSET_T	Control
r1	Region	Coast = 1; Sierra = 0	Dummy

3.3 Method of analysis

We use a model in a data panel (unbalanced) to capture unobservable heterogeneity between study agents. We apply the following model of multiple line regression to estimate the impacts of the explanatory variables on the explained variable; in this case, it is ROE.

Model specification

$ROE_{i,t} = \beta_0 + \beta_1 E\_LEV_{i,t} + \beta_2 OPER\_M_{i,t} + \beta_3 LIQ_{i,t} + \beta_4 ASSET\_T_{i,t} + \beta_5 TANG_{i,t} + \beta_4 MOD\_OPERM\_ASSETT_{it} + \varepsilon_{it}$

Where i represents each observation; t represents each year of the period; β_i is the coefficient of each explanatory variable; ε_{it} is the error which is assumed to have a normal distribution.

4 Results

4.1 Descriptive Statistics

Table 2 show descriptive statistics. We calculate the average of each region and apply the *t*-test to determine the significance level of the differences.

Table 2. Descriptive statistics

			Differences	
Variable	**Coast mean** *(A)*	**Sierra mean** *(B)*	*(A-B)*	**p value**
ROE	0.4092118	0.3583008	0.050910	0.05
OPER_M	0.0576921	0.0518820	0.005810	0.32
E_LEV	2.8543376	3.1717186	-0.317380	0.09
ASSET_T	3.5686248	3.3334418	0.235182	0.13
LIQ	1.9353293	1.6451592	0.290170	0.05
TANG	0.3264936	0.3734197	-0.046926	0.02

The differences in the variables representing the asset structure (ASSET_T and LIQ) are significant at 95%. The variable representing the financing structure (E_LEV) shows a significant difference at 90%. The explained variable representing performance (ROE) shows a significant difference at 95%. Differences in variables related to the operation level (OPER_M and ASSET_T) are not significant. From another approach, in the Costa region, leverage is lower, while liquidity is higher. The alternative hypotheses H1 are not rejected because of significant differences.

Table 3 shows the results of the multiple linear regression. The t-statistic indicates that almost the independent variables seem statistically significant at a 1% significance level, other variables are significant at 5%, and r1 are significant at10%.

Table 3. Econometric model

ROE	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
OPER_M	0.7892193	0.15717	5.02	0.0000	0.480761	1.097678
E_LEV	0.0385275	0.0040928	9.41	0.0000	0.0304951	0.04656
ASSET_T	0.0403501	0.0052869	7.63	0.0000	0.0299741	0.0507261
LIQ	-0.0116909	0.0051716	-2.26	0.0240	-0.0218405	-0.0015412
TANG	-0.0986021	0.037895	-2.6	0.0090	-0.172974	-0.0242302
MOD_1	0.3501049	0.0506151	6.92	0.0000	0.2507689	0.4494409
r1	0.0398038	0.022558	1.76	0.078	-0.0044679	0.0840755
_cons	0.0617505	0.0366906	1.68	0.093	-0.0102577	0.1337586

The variable E_LEV positively affects ROE, an increase of 1% will generate 3.8% in ROE. The LIQ and TANG variables negatively affect ROE, increases of 1% would generate reductions in ROE by 1.2% and 9.8%, respectively. Finally, MOD_1 positively affects ROE, an increase of 1% would increase by 3.9% in ROE. R1 represents the variable that differentiates the region. This variable is significant at 10%, implying that there are differences between regions. This variable positively affects ROE, indicating that the location in the Costa region generates higher profitability. Therefore the alternative hypothesis H1 is accepted.

All variables behave with expected, positive, and negative effects. We consider that the management of financial resources in the companies studied is consistent. The contrast between the Costa region and the Sierra region shows that the Costa region has a better effect on profitability.

5 Conclusion

The purpose of the study was to examine the importance of the asset and financing structures on the financial profitability of food and beverage services companies contrasting two Ecuadorian regions. With this, we make an original contribution to hospital management literature under the RBV theory. The analysis was done through financial indicators in two phases, in the first, we applied the student test to observe the differences between regions, and in the second, we used multiple linear regression.

The analysis shows that both assets structure and financial structure are significantly different between Ecuadorian regions studied. Although the Sierra region shows greater leverage, profitability is lower than the Coast. It could explain the difference in profitability between regions.

Besides, the study shows that the region has a significant effect on profitability behavior, showing a 4% greater in the Costa region. The sector studied reflects a margin of operation with an extremely high coefficient on profitability, demonstrating the high

sensitivity of financial profitability to operational management. These implicate that slight changes in operating profit produce significant changes in business profitability, either positively or negatively.

Also, the asset structure represented by tangibility and liquidity has a more significant effect than the financing structure measured by the impact of leverage, denoting trend to use less fixed assets, and caution or difficulty in the use of external financing as a strategy to improve profitability.

These findings are significant because it establishes the importance of regional contexts in business performance, strengthening resource-based vision theory regarding management capabilities to optimize available resources based on background.

We encourage investors and managers involved in this business segment to delve deeper into the analysis of asset and financing structures to identify substantive differences in financial management models that improve profitability.

The main limitations of this research are the sample size, and on the other hand, the type of business expressly referred to by corporate companies. The sample used may reflect instability in partner relationships, resulting in short periods of existence of such companies. In contrast, the non-inclusion of single-person enterprises is mainly due to the difficulty in obtaining the data.

It is possible that the limitations indicated will influence the results. However, a preliminary exploration of the overall business context between the regions studied suggests that the business dynamics in the Costa region is broader than in the Sierra.

Due to the difference in results between the study regions, we recommend future studies to use cross-sectional samples that can facilitate a larger sample size and period time.

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Women's Role in Long-Lasting Family Businesses: an Analysis of the Narratives

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Abstract

Long-lasting family businesses are usually equipped with dense storytelling about the foundation and the development of the firm. These narrations are implemented through various techniques and carry on much information about heritage, values and people who made the longevity and the success of the firm. From the cultural point of view, family businesses are particularly interesting organisations as their operations are strictly linked to personal stories of owners and founders. In this vein, we performed a qualitative analysis to understand how women's role is described in narratives of firms.

The research aims to analyse such narrative information to (1) verify the presence of a description of women's role, (2) individuate the temporal location of women's role narratives (period and/or business phase), (3) understand which values (e.g. ethical, human, etc.) are currently linked the women's role.

The first step of the research consists in the selection of a panel of long-lasting family businesses. For this purpose, we considered Italian firms associated with the Henokiens (https://www.henokiens.com/index.php) an international association between bicentenary family companies. The Henokiens Association has been founded in 1981 to promote the concept of family businesses as a viable alternative to multinational corporations; it currently gathers 49 members (12 Italians, 15 French, 9 Japanese, 4 German, 3 Swiss, 2 Dutch, 2 Belgian, 1 English and 1 Austrian).

The (qualitative) research is designed as a multiple case study by using secondary sources (websites, papers, newspapers, magazines, etc.).
Limitations: The research only considers firms that are associated with the Henokiens Association but other long-lasting family businesses (at least bicentenary firms) may likely exist over the countries represented in the association.
Further perspectives: The research considers Italian family businesses. Further developments may include an analysis of the other countries' perspective as well as a comparison between them.

Keywords – Long-lasting family businesses; women; successful; narrative

Paper type – Academic Research Paper

1 Introduction

The study of family firms has been an object of profound efforts by scholars involved in the study of SMEs. Such companies have great adaptation aptitudes to market changes, thanks to their creativity and flexibility (Mustier, 2018). However, relational dynamics of the family can disrupt balances and compromise the business; indeed, one of the most critical phases of family businesses is that of succession, a step that is essential for lasting for a long time (Le Breton-Miller and Miller, 2009; Lumpkin and Brigham, 2011).

With this contribution, we aim to understand which is the role played by women within the long-lasting family business. Moving from the belief that long-lasting firms should provide consistent information about their story and their heritage, we seek to collect narrative information about women's role concerning the following points: (1) verify the presence of a description of women's role, (2) individuate the temporal location of women's role narratives (period and/or business phase), (3) understand which values (e.g. ethical, human, etc.) are currently linked the women's role.

Following a qualitative approach, we performed a narrative analysis of data presented in the form of stories (Pentland, 1999; Riessman, 1993; Dawson & Hjorth, 2012; Merriam, 2009). We considered Italian firms member of the Henokiens (https://www.henokiens.com/index.php), an association among bicentenary family companies. Data are collected from company websites, newspapers, magazines, videos, interviews and social networks.

Findings are consistent respect to our aim and show that in 4 of the 12 firms investigated, women play a relevant role in the management of long-lasting firms, also by successfully managing the generational transaction.

After the introduction, section 2 reviews the relevant literature, section 3 synthesize the methodology, section 4 presents our findings and 5 presents discussion and conclusions.

2 Literature review

Family firms are considered fundamental, both in terms of numbers and capacity to adapt more easily to market changes, thanks to their creativity and flexibility (Mustier, 2018). From what has been said, it can be stated that family business is vital to the well-

being of an economy (Hisrich and Fülöp, 1997). But, during the life of a Family Firm, some events can compromise the business. One of the critical phases of family business' life is represented by the succession, sometimes considered as a major problem (Hnátek, 2012); indeed, it is also defined as a strategic challenge (Scranton, 1992). The succession is necessary to assure the continuation of the life of the company, as well as to concretize the possibility that these of lasting for a long time; furthermore, this is one the main concerns of the family (Le Breton-Miller and Miller, 2009) because this type of firms typically have a long-term orientation (Lumpkin and Brigham, 2011). Consequently, such conditions led to a relevant focus on succession or generational transaction in the family business (Cadieux et al., 2002).

To adequately manage the transition, a key role is played by the proper planning of the ownership shifting to the next generation. Indeed, in this type of companies, is extremely important to consider some peculiarities: these companies are a reflection of its founder, and frequently there is a coincidence between ownership and management (Cesaroni et al., 2017); furthermore, it is necessary to take into account the emotional perspective of the owner influencing the decision-making process (Hnatek, 2012).

Usually, the succession is divided into four different phases (Cadieux et al., 2002), that are: i) choice of who will be the successor (Matthews et al., 1999); ii) owner-manager brings his or her successor into the business; iii) official entry of the successor into the business (Stravou, 1998); iv) official retirement of the predecessor and the complete transfer of responsibilities (Churchill & Hatten, 1987). As can be guessed from the synthetic description of the sentences, what is relevant for this study and which can be considered the critical phase is the first one, that is the moment in which one identifies and chooses who will be called to succeed in the management company. It is common that, in family businesses, the choice of the successor falls on male children, leaving the female daughters in the shadows or involving them in marginal activities (Dumas, 1992; Curimbaba, 2002; Garcia-Alvarez et al., 2002; Vera e Dean, 2005; Hamilton, 2006; Haberman e Danes, 2007; Cesaroni e Sentuti, 2014; Cesaroni and Paoloni, 2016). Very often, this choice is conditioned by the stereotypes of the society (Kubíček and Machek, 2018) in which, towards women, various biases are foud, (Galiano and Vinturella, 1995) and for any person, there is an incompatibility between the "family" and the "business" role (Cole, 1997). But the decision to let a man rather than a woman take control and run a firm could be a mistake because women could represent strength for family businesses (Salganicoff, 1990) as they can make a unique contribution to family businesses, especially about management. This is due to the woman's particular characteristics and qualities that are, sometimes, vital to the success of the business (Salganicoff, 1990) and that allow them to face challenging opportunities in the family business (Frishkoff and Brown, 1993). Thanks to their psychological characteristics they can enhance, at the same time, both the private aspects of family life and those of family business professional life (Curimbada, 2002), contrary to what is claimed by some scholars. The peculiar psychological characteristics of women mean that women in charge of a company tend to

be loyal to the company and sensitive to the needs of others to be able to define them as competent in peacekeeping (Salganicoff, 1990) or in the resolution of problems and conflicts that may arise between family members (Cole, 1997).

When processing corporate's information a clarification is needed for the understanding of the concept of narrative. Scholars involved in this field separate reporting and disclosure, where the concept of disclosure tends to be used to refer to the previously undisclosed information (Dumay, 2016, p. 178). Another important classification has to consider the level of the factuality of the information; some authors (Campbell e Rahman, 2010) divide factual information, based on concrete events, from perceptions, that are (at most) purely narrative.

The lifespan of family businesses is a relevant issue for SMEs scholars (Moy and Luk, 2003; Masurel and Van Montfort, 2006), and the major focus is on factors affecting the success of such firms (Feindt et al., 2002; Saad et al., 2006). Usually, long-lasting firms are equipped with a dense heritage (Kyriakidou and Gore, 2005; Kreiser et al., 2010; Brettel et al., 2015) that is generally communicated to stakeholders through a narration (Rae, 2005; Whyte and Classen, 2012) of facts and people that affected the success of the firm. Such a process, most of the time, involves the adoption of various storytelling instruments (Sadik, 2008; Shook et al., 2017) such as websites, interviews, videos and so on.

Such narrations are implemented through various techniques and carry on much information about heritage, values and people who made the longevity and the success of the firm. However, no previous contributions focused on women's role in long-lasting firms; in this vein, we focus on narrative (Beach, 2010) information (Healy and Palepu, 2001) on women's role in long-lasting (Ward, 2016) family businesses, (1) verify the presence of a description of women's role, (2) individuate the temporal location of women's role narratives (period and/or business phase) and (3) understand which values (e.g. ethical, human, etc.) are currently linked the women's role.

3 Methodology

To achieve the above-mentioned aims, we undertook, towards a qualitative approach, a narrative analysis of data presented in the form of stories (Pentland, 1999; Riessman, 1993; Dawson & Hjorth, 2012; Merriam, 2009).

Two main problems affect research based on long-lasting businesses: (1) the definition – in terms of longevity – of the long-lasting attribute and (2) the identification of a proper panel of firms to analyse. To overcome these issues, we considered Italian firms members of the Henokiens (https://www.henokiens.com/index.php). The Henokiens is an international association between bicentenary family companies founded in 1981 to promote the concept of family businesses as a viable alternative to multinational corporations; it currently gathers 49 members (12 Italians, 15 French, 9 Japanese, 4 German, 3 Swiss, 2 Dutch, 2 Belgian, 1 English and 1 Austrian).

Therefore, the Henokiens represents a reference point that enables us to incorporate - from the associationism - a definition of long-lasting firms (bicentenary) and, at the same time, automatically provides us with the panel of firms to perform the analysis.

The analysis consisted of the following steps:

1. verify the presence of women in the ownership/management bodies, having a parental link with the company;
2. verify the presence of narrative information describing the commitment of such women within management/operations of companies;
3. manual collection of available sources (company websites, newspapers, magazines, videos, interviews, social networks);
4. manual sift of collected sources;
5. individuate the temporal location of women's role narratives (period and/or business phase);
6. identify values (e.g. ethical, human, etc.) linked to the women's role.

Hence, the study consisted in documental research (Corbetta, 2013) using open-access information, like websites, papers, newspapers, magazines, etc.. The analysis is done with regards to different firms, defining this study as (qualitative) multiple case study (Yin, 2014).

4 Findings

The analysis conducted on the 12 Italian members of the Henokiens association revealed the presence of relevant results for 4 of the companies, where women's role is recognisable.

Table 6 - Relevant sources

Company	Industry	Women Current presence	Nickname	Women past presence
Amarelli	Sweets	Pina Amarelli	Lady liquirizia	None
Ditta Bortolo Nardini	Spirits	Cristina Nardini	None	None
Guerrieri Rizzardi	Wine	None	None	Maria Cristina Loredan Rizzardi
Vitale Barberis Canonico	Textiles	Lucia Bianchi Maiocchi	None	None

While in Amarelli, Ditta Bortolo Nardini and Vitale Barberis Canonico companies there is a current presence of women in within governance bodies, in Guerrieri Rizzardi we've been able to recognize the past role of Maria Cristina Loredan Rizzardi.

Within Amarelli the relevant personality is Pina Amarelli who has been engaged in the business after the decease of her brother-in-law Giorgio, becoming, at that time, the first business leader woman leader in Calabria. Such decision brought her to leave her academic career as a jurist to devote to her husband's family business.

Overcoming the cultural biases liked to women's traditional role in family care, she has been the promoter of Amarelli turnaround, with famous initiatives like the introduction of Amarelli's famous metal box. Over the Milan EXPO of 2015, a statuette of Pina Amarelli is exhibited among the superheroes of sustainability to commend her effort to such value.

Several values emerge from the analysis of content related to Pina Amarelli's role. First of all, she outlined the difficulty for women to gain a foothold in the business world. Over an interview, she highlighted women's role in the processing of liquorice, where they were prominent in the manufacturing of the final product, with men intervention only in the processing of raw material. Furthermore, she outlines the difficulties of generational passages, where families try to force the introduction of family members, while it would often be better to rely on a manager.

Table 7 - Findings Amarelli

SOURCES	CONTENT	VALUES
https://www.museodellaliquirizia.it	Storyboard of the museum Amarelli	Sustainability
https://www.ilmessaggero.it/mind_the_gap/pina_amarelli_liquirizia-4660328.html	Interview	Gender Revolution
https://napoli.repubblica.it/cronaca/2018/07/15/news/pina_mengano_amarelli_dal_diritto_romano_alla_liquirizia_la_main_avventura_di_imprenditrice_-201787050/	Interview	Entrepreneurship
https://www.specchioeconomico.com/200704/amarelli.html	Interview	Foresight, Innovation
http://www.go-italy.net/item/donne-in-carriera-pina-amarelli---ll-tetto-di-cristallo-non-esiste-è-solo-uninvenzione-al-femminile-/74/4087	Interview	Women pride
https://www.la7.it/facciaafaccia/video/dieci-minuti-per-una-grande-storia-pina-amarelli-08-01-2018-230857	Storyboard of the museum Amarelli and interview	Women's role, Manual skills, Generational transition in family business

Within Bortolo Nardini the relevant personality is Cristina Nardini. She represents, after more than 200 years of history, the first female figure at the top of the company. After studies and work experiences that brought her away from his family, the needs of the company, combined with the desire to be back home, entailed her to join the company.

She represents a revolution for the history of the company: since the 1940s the company was handed down to male heirs only, while women were liquidated in cash. The first exception dates back to 1943 when a cousin of Cristina Nardini's grandfather, having no male heirs, transferred his shares to his daughter, who never had an active role in the management of the business. In this vein, what emerges for the interview is the importance of the gender revolution.

Table 8 - Findings Ditta Bortolo Nardini

SOURCES	CONTENT	VALUES
https://www.ilgazzettino.it/vicenza_bassano/bassano/bortolo_nardini_cristina_nardini_prima_donna_bassano-1339416.html	Interview	Gender Revolution

Within Guerrieri Rizzardi the relevant personality is Maria Cristina Loredan Rizzardi, no longer at the guide of the company. She started at the side of her husband Antonio and in 1983 is charged with the management of the business, further developing the production of the wines.

In 1968 she was the promoter of the foundation of the Bardolino consortium, being one of the pioneers of such kind of initiatives. Such a decision had a very important strategic impact because it was the way to make the products of the Bardolino area known all over the world.

In this sense, by the analysis of available sources emerges a strong orientation towards corporate foresight, outlining, at the same time, the value of the gender revolution.

Table 9 - Findings Guerrieri Rizzardi

SOURCES	CONTENT	VALUES
https://guerrieririzzardi.it/storia/	Storyboard dell'azienda	Gender Revolution
https://wakawakawinereviews.com/2015/05/04/portraits-of-bardolino-4-contessa-maria-cristina-loredan-rizzardi-guerrieri-rizzardi/	Interview	Foresight

Within Vitale Barberis Canonico the relevant personality is Lucia Bianchi Maiocchi. She represents the new generation of female entrepreneurs, with a great engagement in sustainability policies. In July 2019 the company released the first sustainability report, voluntarily made by the company.

Table 10 - Findings Vitale Barberis Canonico

SOURCES	CONTENT	VALUES
https://vitalebarberiscanonico.it/azienda/storia/	Storyboard dell'azienda	Women's role
https://www.biellacresce.it/blog/bianchi-maiocchi-vbc-nel-futuro-serviranno-intelligenza-emotiva-e-creativita	Interevento in evento pubblico	Sustainability
https://www.ilsole24ore.com/art/da-zegna-canclini-milano-unica-apre-segno-acquisizioni-e-sostenibilita-ACW8ISX?refresh_ce=1	Articolo su giornale specialistico	Sustainability, Environment, Innovation
https://www.linkedin.com/company/family-business-association-bocconi/?originalSubdomain=it	Public event	Foresight, Family

5 Discussion and conclusions

We undertook the present study with the aim of (1) verify the presence of a description of women's role, (2) individuate the temporal location of women's role narratives (period and/or business phase), (3) understand which values (e.g. ethical, human, etc.) are currently linked the women's role.

Following a qualitative approach, we performed a narrative analysis of data presented in the form of stories (Pentland, 1999; Riessman, 1993; Dawson & Hjorth, 2012; Merriam, 2009), analysing Italian firms member of the Henokiens (https://www.henokiens.com/index.php).

The analysis confirms that long-lasting firms widespread, especially towards company websites, but also by interviews, several narrative information. Findings show that in 4 of the 12 firms investigated, women play a relevant role in the management of long-lasting firms, also by successfully managing the generational transaction.

Temporal location of women's role refers both to the past and to the present and is linked to several motivations: need to manage and economic activities and start turnaround processes, but also the will to return to the family context. In this vein, such results are consistent respect to previous literature on women's motivation (Cesaroni and Paoloni, 2016a, 2016b).

Concerning values emerging from the manual sift of narrative contents, women's role appears linked both to classical and up to date concepts. Particularly, innovation, foresight and family ties seem prevailing; also sustainability issues are perceived as important themes both four young and older female entrepreneurs.

The current version of the research has some limitation; indeed, we only considers firms that are associated with the Henokiens Association but other long-lasting family businesses (at least bicentenary firms) may likely exist over the countries represented in the association. Further developments may include an analysis of the other countries' perspective as well as a comparison between them.

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Functional Expertise and Firm Innovation: an Empirical Study on Female Board Members

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Abstract

In the wave of upper echelons theory, scholars have devoted an increasing interest towards the implications of top managerial characteristics on company outcomes, especially in terms of professional expertise and experience. However, less attention has been paid to the contribution that the female managers' background can offer to the board decision-making. With this in mind, the aim of the paper is to explore whether and how the functional expertise of female directors affects the company innovation. By relying on the classification of functional expertise provided by Hambrick and Mason (1984), the article empirically examines a sample of Italian firms belonging to technological industries through ordinary least squares regression analyses. In particular, it tests the effects of the expertise of female directors in throughput, output and peripheral functions on innovation in terms of R&D. The empirical evidence documents that the functional expertise of women directors influences firm innovation in given circumstances. More specifically, female directors with throughput functional background increase company innovation, while peripheral functional expertise of female directors limits R&D. Different results are reported for the output functional expertise, as female directors with such background seem to not affect company innovation. The paper enriches the existing debate on the managerial expertise of female directors as it disentangles the effect of the three specifications of managerial functional expertise for innovation. At the same time, the paper has significance for practitioners as it suggests companies to promote the appointment of female board members directors according to their functional expertise.

Keywords – Female directors, Functional expertise, Board, Innovation.

Paper type – Academic Research Paper

1 Introduction

In the last decades, scholars and practitioners have emphasized the importance of female directors for innovation (Nielsen and Huse, 2010) by suggesting that they can support board decision-making (Galia and Zenou, 2012) and contribute to the generation of innovative solutions (Torchia et al., 2011; Saggese et al., 2020).

However, previous research has proposed that the ability of women to affect corporate boards activities may depend on their qualifications (Peterson and Philpot, 2007). In this regard, it is important to note that female managers differ from male peers because they present a professional background in human resources as well marketing and sales business divisions, while they lack of working experiences in the financial and administrative fields (Saggese and Sarto, 2019; Ruigrok et al., 2007). Thereby, understanding how the female directors' expertise can affect company innovation is relevant to advance the debate on the topic.

According to the upper echelons proponents (Hambrick and Mason, 1984), the company activities reflect the background/expertise of their managers as it is able to drive the firm strategic orientation, thus affecting company outcomes such as firm innovation (Khanna et al., 2014; Sarto et al., 2020; Bermiss and Murmann, 2015). In this regard, there seems to be unanimity among scholars on the relevance of directors' functional expertise for top management and board decision-making (Datta and Guthrie, 1994; Beal and Yasai-Ardekani, 2000; Tyler and Steensma, 1998; Roach and Sauermann, 2010). The anecdotal evidence also witnesses the importance of appointing managers with a specific functional expertise. Indeed, literature suggests that, in the past, some functional backgrounds have been preferred to others due to business contingencies (Beal and Yasai-Ardekani, 2000). In particular, between early 1920s and 1950s, companies tended to appoint CEOs characterized by backgrounds in the field of operations and manufacturing (Newcomer, 1955), while between 1960s and 1970s, they often chose financial experts (Fligstein, 1987). Differently, from 1980s until early 1990s, the evolved business environment prompted the appointment of executives with functional expertise in operations (Ocasio and Kim, 1999), while to date there seems to be a trend towards the selection of directors with a heterogeneous background (Sarto et al., 2020).

Building on these premises, the aim of this paper is to explore the effects of different specifications of women directors' functional expertise on firm innovation. More specifically, by relying on the classification of functional expertise provided by Hambrick and Mason (1984), the article investigates the functional expertise of female directors in terms of working experience in throughput, output and peripheral business divisions (Hambrick and Mason, 1984).

We tested our predictions on a sample of Italian telecommunications, information technology and electrical/electronic furnishings firms through ordinary least squares (OLS) regression analyses. We focused on such settings as, in these contexts, innovation is especially relevant (Ruiz-Jiménez et al., 2016). Moreover, we examined Italian

companies because the Golfo-Mosca Act has fuelled the debate around women on board (Saggese et al., 2020).

Findings document that the functional expertise of women directors matters for firm innovation in given circumstances. More specifically, the empirical evidence provided by our study shows that female directors with throughput functional background increase company innovation, while, in the presence of peripheral functional expertise, they limit R&D. Different conclusions apply to the output functional background, as female board members with such expertise seem to not influence innovation.

The article is structured as follows. First, we present the theoretical background and the literature review. Then, we illustrate the statistical method and present the findings of our study. Lastly, we conclude by discussing contributions, implications and limitations of our research.

2 Theoretical Background and Literature Review

In the wave of upper echelons theory (Hambrick and Mason, 1984), academics have devoted an increasing interest towards the influence of top managers' characteristics on company innovation. In this regard, the functional expertise is one of the top managerial feature that has attracted much attention by scholars (Buyl et al., 2011; Wang et al., 2015; Herrmann and Datta, 2005; Ocasio and Kim, 1999; Beal and Yasai-Ardekani, 2000).

The functional background refers to the company departments in which managers are employed during their professional path (Hambrick and Mason, 1984). In this respect, literature suggests that the managers' functional experience influences their job as it directly shapes how information is processed and problems are perceived (Beyer et al., 1997; Bermiss and Murmann, 2015), thus affecting strategic choices (Hitt and Ireland, 1985) and company performance (Gupta and Govindarajan, 1984; Bell et al., 2011). Indeed, managers with a professional experience in a specific business function develop an orientation proper of such division as they are exposed to related relevant information (Chattopadhyay et al., 1999; Tyler and Steensma, 1998; Roach and Sauermann, 2010). Indeed, the skills and knowledge gained through the experience in a functional area help managers to properly evaluate the decisions to make through the lens of the prevailing business division thinking (Finkelstein and Hambrick, 1996). In this regard, having previous working experience in specific functional areas might differently affect firm outcomes, especially in terms of innovation (Dalziel et al., 2011; Kor and Misangyi, 2008; March and Simon, 1958; Rajagopalan and Datta, 1996).

In this regard, a useful classification to explore the implications of functional expertise for company outcomes is provided by Hambrick and Mason (1984), who suggest that the functional background can be divided into three categories on bases of the features of the departments in which managers have mainly developed their professional experiences. These three categories include "throughput function", "output function", and "peripheral function" (Abebe, 2010; Zhang and Yuan, 2011). While the throughput one includes production, technical and R&D functions, the output function encompasses marketing and

sales. Differently, the peripheral function refers to supporting functions, such as law, finance and accounting (Hambrick and Mason, 1984). Studies have mainly focused on the heterogeneity of managers and directors' functional background, but less attention has been paid to disentangle the effect of the above-mentioned specifications on firm innovation.

As far as the throughput functional background is concerned, scholars enlighten that managers with this kind of professional experience are familiar with production and core technologies and are equipped with engineering skills (Wang et al., 2015), thus giving priority to quality improvement as well as technology and innovation development (Zhang and Yuan, 2011; Elsaid et al., 2016). As a result, executives with throughput functional expertise tend to be more committed to innovation strategies (e.g. equipment updates, production automation and technology upgrades) (Sun and Jia, 2009), and are often associated with production invention and improvement (Wiersema and Bantel, 1992; Balta et al., 2010). At the same time, the managerial professional experience in firm technologies effectively drives and addresses the innovation initiatives issues (Sarto et al., 2020; Sundaramurthy et al., 2014; da Mota Pedrosa et al., 2013). Indeed, executives with professional expertise in firm divisions devoted to innovation processes are better able to effectively identify priorities and reach innovation goals (Sarto et al., 2020). Moreover, they are willing to forgo the efficiency and cost-containment targets in order to support innovation investments (Finkelstein and Hambrick, 1996; Barker III and Mueller, 2002).

In line with this conclusion, a number of empirical studies provide insights into the positive implications of director throughput functional background for firm innovation. Some studies find that executives with a work experience in R&D and engineering tasks tend to implement innovation strategies increasing R&D spending and the value of patents (Tyler and Steensma, 1998; Valenti and Horner, 2020; Sarto et al., 2020). Other studies document that firms characterized by CEOs with throughput background present higher level of R&D expenditures (Datta and Guthrie, 1994). Finally, still other research highlights that firms directed by top executives presenting experiences in throughput functions tend to foster innovation development (Jensen and Zajac, 2004).

Similar arguments apply to the output functional background, because literature suggests that managers with specializations in marketing and sales tend to support innovation ideas and initiatives (Musteen et al., 2006). In this regard, top managers with output functional backgrounds are more sensitive to market and more likely to get the inspiration for new elements. Besides, top executives with output functional expertise usually have more external social capital which is positively related to corporate innovation performance (Zhang and Yuan, 2011). At the same time, CEOs with substantial marketing experiences lead the company to obtain higher levels of performance because they tend to confer to their products and services an image of originality (Beal and Yasai-Ardekani, 2000). Moreover, top managers with output functional expertise follow more innovative strategies which entail greater change, thus resulting in high R&D spending (Barker III and Mueller, 2002; Thomas et al., 1991).

Opposite conclusions can be drawn when shifting the attention to the peripheral functional expertise. Indeed, research claims that managers with professional background in financial and legal affairs lack of proper knowledge in firm technologies and production processes and are more committed to limit legal and financial risks (Wang et al., 2015; Thomas et al., 1991). In this regard, since they tend to neglect technology and production issues, they usually do not have much influence on innovation initiatives (Wang et al., 2015) but they pay more attention to financial issues (e.g. debt and financial performance) (Minton et al., 2014; Mizruchi and Stearns, 1994; Naranjo-Gil et al., 2009; Garcia-Sanchez et al., 2017). At the same time, scholars emphasize that directors with peripheral expertise can be less favourable to too risky and costly innovation opportunities as they put more emphasis on improving efficiency and cost containment (Hambrick and Mason, 1984). The empirical evidence supports these arguments showing that directors expert in peripheral areas limit innovation and growth opportunities (Jeanjean and Stolowy, 2009; Allemand et al., 2017; Dalziel et al., 2011).

When it comes to the functional expertise of female directors, it is interesting to assess what happens when women board members have an expertise that is close to their own skills (i.e. output functional expertise) and/or the one that is far from them (i.e. peripheral and throughput functional backgrounds) (Hillman et al., 2002; Singh et al., 2008; Zelechowski and Bilimoria, 2004).

Thereby, building on these premises, we examine whether and how all the three specifications of functional expertise of female directors can influence company innovation.

3 Statistical Method and Results

We explored the influence of the female directors' functional background on company innovation by focusing on a sample of 149 telecommunications, information technology and electrical/electronic furnishings Italian firms, examined for a 4 years observation window (i.e. 2012-2015). We investigate such contexts because innovation is especially relevant to these settings (Ruiz-Jiménez et al., 2016) and, in Italy, the debate around women on board has been fuelled by the Golfo-Mosca Act (Saggese et al., 2020).

As described in Table 1, we gathered governance and financial data from the AIDA database, hand-collected information on the functional expertise of female directors from their own CVs, the company websites and LinkedIn.

Table 1. Source of data

Type of data	Source
Governance data	AIDA database
Financial data	AIDA database
Data on functional expertise of female directors	Hand-collection from CVs, company websites and LinkedIn

Our research approach was based on OLS regression analyses. In this regard, we focused on company innovation as proxied by the ratio between total annual R&D expenditure and total sales. In addition, following prior literature (Hambrick and Mason, 1984; Abebe, 2010; Zhang and Yuan, 2011), we classified the functional expertise of female directors in three categories according to their working experience in: (i) throughput functions, (ii) output functions and, (iii) peripheral functions. We caught the throughput functional expertise of female directors by the proportion of female board members expert in R&D and engineering functions (Female R&D/Engineering). At the same time, we proxied the output functional expertise of female directors (Female Marketing/Sales) by the percentage of women board members with a professional background in marketing and sales functions. Similarly, we measured the peripheral function of female directors by the proportion of women executives with a functional expertise in accounting and finance (Female Accounting/Finance). We completed our regression models by including the percentage of women appointed to the board (Female Percentage), the board size (Board Size), the company size (Company Size) and the leverage (Leverage) as controlling variables (Saggese et al., 2020; Campbell and Mínguez-Vera, 2008).

The descriptive analyses document that the majority of female directors in our sample is characterized by expertise in accounting and finance (i.e. 7.6%). Differently, a lower proportion is expert in marketing and sales (i.e. 3%), while only 0.34% presents a professional career path in R&D and engineering functions.

Shifting the attention to the regression analyses, Table 2 reports the relationship between the expertise of female directors and company innovation. More specifically, Model 1 shows that the coefficient for the percentage of female directors with a professional background in R&D and engineering functions is positive and statistically significant ($\beta = 0.680$, $p < 0.05$), thus suggesting that female directors expert in R&D and engineering functions improve the company innovation. However, as illustrated in Model 2, although the coefficient for proportion of female directors with functional expertise in marketing and sales is positive, it is not statistically significant. Different findings are reported for the presence of female directors with professional background in accounting and finance divisions. Indeed, Model 3 documents that the percentage of female directors with such functional expertise is negatively and significantly linked to our proxy for company innovation ($\beta = - 0.032$, $p < 0.05$).

Table 2. OLS regression analyses on the relationship between female functional expertise and company innovation

Variables	Model 1	Model 2	Model 3
Female R&D/Engineering	0.680**		
	(0.269)		
Female Marketing/Sales		0.018	
		(0.035)	
Female Accounting/Finance			-0.032**
			(0.012)
Female Percentage	-0.001	0.008	0.033*
	(0.012)	(0.016)	(0.019)
Board Size	0.009	0.004**	0.003**
	(0.001)	(0.002)	(0.002)
Company Size	-0.005***	-0.006***	-0.005***
	(0.002)	(0.002)	(0.002)
Leverage	0.003***	0.002**	0.002***
	(0.001)	(0.001)	(0.001)
F	2.36**	1.97**	2.10**
R^2	0.126	0.046	0.054

Levels of significance: * < 0.1; ** < 0.05; *** < 0.01
Standard errors in parentheses. All regressions control for year and firm effects.

4 Conclusions

The paper aims to explore the influence of the functional expertise of female directors in terms of working experience in throughput, output and peripheral functions on firm innovation by relying on a sample of Italian firms belonging to technological settings.

Findings show that the functional expertise of women directors matters for firm innovation measured by R&D/sales. In particular, in line with previous studies (Valenti and Horner, 2020; Sarto et al., 2020; Jensen and Zajac, 2004), the regression analyses document that women board members with throughput functional background enhance company innovation. Indeed, as suggested by the literature, managers with such professional experience are especially concerned with technology development and are more committed to take innovation opportunities consistently with the prevailing thinking of their business division (Finkelstein and Hambrick, 1996; Wang et al., 2015; Elsaid et al., 2016; Sun and Jia, 2009). At the same time, they are better equipped to identify innovation priorities and goals (Sarto et al., 2020), thus supporting innovation investments (Barker III and Mueller, 2002).

Opposite results are reported for the peripheral functional expertise, as our article shows that female directors with such professional background hamper the level of R&D. This result confirms previous evidence suggesting that directors expert in finance and accounting functions give priority to financial issues (Minton et al., 2014; Mizruchi and Stearns, 1994; Naranjo-Gil et al., 2009; Garcia-Sanchez et al., 2017) to the detriment of technology and production matters (Wang et al., 2015). In this way, they put more effort into efficiency improvement and cost containment, thus limiting risky and costly innovation initiatives (Hambrick and Mason, 1984; Jeanjean and Stolowy, 2009; Allemand et al., 2017; Dalziel et al., 2011).

Differently, the empirical evidence provided by our study documents that women board members expert in output functions do not matter for firm innovation. This result is in contrast with prior research suggesting that directors expert in marketing and sales support innovative initiatives in order to provide their products and services with an image of uniqueness (Beal and Yasai-Ardekani, 2000; Musteen et al., 2006; Zhang and Yuan, 2011; Barker III and Mueller, 2002).

On the basis of these premises, our research extends prior literature on managerial background as it suggests whether and how the functional expertise of female directors can affect the company innovation. Moreover, it advances the debate on female directors background by disentangling the effects of the three specifications of functional expertise (i.e. throughput, output and peripheral functions) for innovation. At the same time, our findings recommend practitioners not only to foster the gender diversity on the board but also to include specific functional expertise. Indeed, by emphasizing the positive (negative) implications of throughput (peripheral) functional expertise of female directors for company innovation, our research advices firms to promote the appointment of female directors according to their functional expertise.

Despite these contributions, our study is not free from limitations as it focuses on homogenous industries. Therefore, future research should explore how the effect of the functional expertise of female directors changes in multiple and heterogeneous sectors. At the same time, our research investigates only the influence of one kind of female top managerial position (i.e. directors). Thereby, additional efforts could be addressed to examine how the functional background of other managerial figures (e.g. CEO, TMT members) can contribute to firm innovation.

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The Relation between Cash Flows and Economic Performance in the Digital Age: an Empirical Analysis

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Abstract

The study of company dynamics is increasingly influenced by the role that the analysis of cash flows assumes, as these play a central role both for the company's economic performance and in predictive terms. However, the literature on the predictive capabilities of cash flows is scarce both in terms of number and depth of research, the samples that have so far been analyzed have limited dimensions. Taking advantage of the power and opportunities offered by digitization, which allows immediate access to data and information in ever greater quantities, our work has the aim of studying the relationships between cash flows (of different management areas) and the economic performance of the company using a complete sample of Italian listed digital firms in the 2008-2019 period with more solid statistical tools compared to previous studies. The choice of the database, to collect all the necessary balance sheet data, fell on Amadeus of the Bureau van Dijk platform, which already shows reclassified and easily comparable balance sheets. To assess whether our cash flow proxies could be strong predictors of future cash flow and, consequently, of business performance, we will use correlation analysis and multiple regression.

Keywords: Earnings, Cash Flows, Forecasting Future Cash Flow

1 Introduction

The financial statement plays an increasingly important role in both the Italian and international business dynamics. It is the only document that directly provides data on the company's liquidity and solvency, on the change in assets, liabilities and net worth and it is able to highlight the provenance of resources relating to different management areas, as well as the total management of the company. While the balance sheet provides information on stock values at a given instant, such as a photograph taken periodically (quarterly, semi-annually, annually) and the income statement shows flow quantities based on economic dynamics, the financial statement is able to highlight the provenance of resources relating to different management areas, as well as the total management of the company. The sentence "cash flow don't lie" is motivated above all in comparison with the magnitudes of the income statement, where many items can divert or disguise the real results. On the other hand, it should be emphasized that even cash flows are not totally free from possible manipulations by the editor of the financial statements of a company, that can determine misleading influences on all analyzable quantities.

The principal objective of financial statements is to enable users to assess the firm's ability to generate sustainable future cash flows for decision-making purposes (IASB, 2001). The International Financial Reporting Standards (IFRS) suggest two options, namely the accrual basis and the cash basis of accounting. The importance of cash flows for the life of the company cannot be underestimated, as it is similar to the role played by blood to keep living creatures alive and, therefore, its role is crucial in the decision-making process of users (Nasrollah and Hassan, 2013).

Several studies have examined the correlation between the results and future cash flows (Finger, 1994; Dechow et al., 1998; Barth et al., 2001).

Some of them have shown that both accounting earnings and cash flows can forecast future performance. Others have supported the assertion of FASB, emphasizing the superiority of earnings in relation to cash flow (Jordan and Waldron, 2010; Ebaid, 2011; Takhtae and Karimi, 2013, Moeinaddin et al., 2013, Jemâa et al., 2015).

By contrast, for others, it is the cash flow that has the most interesting predictive power (Farshadfar et al., 2008; Habib, 2010; Al-Debie, 2011; Senan, 2019).

Based on traditional literature on the predictive ability of cash flows, this research will focus on the study of the predictive ability of cash flows with respect to company performance measured by a specific indicator, ROA.

The research question of this research will be the following: can the company's cash flows predict the company's future economic performance?

2 Literature Review

Forecasting cash flows is a key element in the life of companies, used by owners to plan future cash movements to remove any threat from insolvency and illiquidity crises (Barth et al., 2001). Javedan and Largani (2014) claim that it's through predicting cash

flow that the most important information is provided to the users inside and outside organizations. Taking as a starting point the FASB assertion about the ability of earnings to act as a predictor towards future cash flows (1978), scholars have focused on the study of prediction of future cash flow by using cash flow and earnings as a predictor variables and prediction of future cash flow by using cash flow, earnings and accruals as a combined predictor variables (Mulenga and Bhatia, 2017).

For this reason, several research findings collected from the existing literature on the comparative abilities of accrual-based earnings versus operating cash flows in the prediction of future operating cash flows are mixed, contradictory or inconclusive.

Table I shows a summary of the results of the studies that assessed the predictive ability of operating cash flows, while Table II highlights the studies that measured the predictive ability of cash flows through earnings and accruals

Table I – Studies on the predictive ability of operating cash flows

Study	Method	Relevant findings
Finger C. A. (1994), The Ability of Earnings to Predict Future Earnings and Cash Flow, *Journal of Accounting Research*, 32, 2, pp. 210-223.	Forecasting cash flows through operating cash flows	Cash flow is a better short-term predictor of cash flow than are earnings, both in and out of sample, and the two are approximately equivalent long-term.
Al-Attar A., Hussain S. (2004), Corporate data and future cash flow, *Journal of Business Finance and Accounting*, 31, 78, pp. 861-903.	Forecasting cash flows through operating cash flows	Cash flow from operations is better than earnings in predicting future cash flows.
Farshadfar S. Ng C., Brimble M. (2008), The relative ability of earnings and cash flow data in forecasting future cash flows, *Pacific Accounting Review*, 20, 3, pp. 251-268.	Forecasting cash flows through operating cash flows	Cash flow from operations shows a superior ability to predict future cash flows when compared to other predictor variables used in their study
Al-Debie. (2011), Are operating cash flows a superior predictor of future operating cash flows than earnings? Evidence from Jordan, *European Journal of Economics, Finance and Administrative Sciences*, 40.	Forecasting cash flows through operating cash flows	Superiority of cash flow from operations in predicting future cash flows of earnings for future operating cash flows for one- to three-year-ahead forecast horizons
Javedan F.A., Largani S.M. (2014), The effect of cash-flow component (core and non-core) on predicting future cash flow, *Bulletin of Applied and Research Science*, 4, 2.	Forecasting cash flows through operating cash flows	It's through predicting cash flow that the most important information are provided to the users inside and outside organizations.
Senan P. (2019), Ability of Earnings and Cash Flows in forecasting future Cash Flows: a study in the context of Saudi Arabia, *Academy of Accounting and Financial Studies Journal*, 23, 1, pp. 2-14.	Forecasting cash flows through operating cash flows	Earnings and cash flows have equal predictive ability in forecasting the future cash flows, while the disaggregation of earnings into different accrual components decreases the predictive ability.

Table II – Studies on the predictive ability of earnings and accruals

Study	Method	Relevant findings
Barth M. E., Cram D. P., Nelson K. K. (2001), Accruals and the prediction of future cash flows. *The Accounting Review*, 76, 1, pp. 27-58.	Disaggregating earnings into aggregated cash flows and components of accruals	Earnings superiority for predicting future cash flows stems from disaggregating earnings into aggregated cash flows and components of accruals.
Kim M., Kross W. (2005), The ability of earnings to predict FOCF has been increasing – not decreasing, *Journal of Accounting Research*, 43, 5, pp. 753 -780.	Forecasting cash flows through earnings and accruals	Earnings are more powerful than cash flow from operations in predicting future cash flows, as the coefficients of earnings increased over the time frame
Ebaid I.E. (2011), Accruals and the prediction of future cash flows: empirical evidence from emerging market, *Management Research Review*, 34, 7, pp.1-32.	Disaggregating earnings into aggregated cash flows and components of accruals	Aggregate earnings have superior predictive ability of future cash flows than current cash flows.
Jemâa O.B., Toukabri M., Jilani F. (2015), Accruals and the prediction of future operating cash-flows: Evidence from Tunisian companies, *International Journal of Accounting and Economics Studies*, 3, 1.	Disaggregating earnings into aggregated cash flows and components of accruals	Earnings are a better predictor of future cash flow than cash flow from operations.
Frank E. O. (2018), Assessment of the Comparative Ability of Accounting Bases in Predicting Future Cash Flows: Evidence from Nigeria, *Trends Economics And Management*, 32, 2, pp. 35-48.	Forecasting cash flows through earnings and accruals	Accrual-based accounting information is superior to cash-based accounting information for future cash flows prediction
Nguyen H.A., Nguyen T.H. (2020), The prediction of future operating cash flows using accrual-based and cash-based accounting information: Empirical evidence from Vietnam, *Management Science Letters*, 10, 3, pp. 683-694.	Forecasting cash flows through earnings and accruals	Aggregate earnings have superior predictive ability of future cash flows than current cash flows.

2 Research Methodology and expected results

The intent of the authors is to investigate the ability of cash flows to predict future cash flows, providing, in this way, a valid support to the tools offered by digitization to allow people inside and outside the organizations to obtain useful information on investment decisions and to measure prospective business performance. The study will limit the analysis to the Italian market, focusing on Italian listed digital companies in the 2008-2019 period.

We expect that cash flows components can influence the firm performance (ROA). In the null form the research hypothesis will be the following:

H1. Return-on-assets (ROA) of year N is influenced by cash flow (CF) N-1

Our key variable will be an accounting-based proxy for cash flow. The choice of this proxy variable is supported by prior cash flow forecast ability research.

The database we will use to collect all the balance sheet and income statement data will be Amadeus database of the Bureau van Dijk platform, which already shows reclassified and easily comparable financial statements. The greatest advantage of using this reclassification with respect to the use of financial statements in a civil law format, such as those available on the Aida database of the same platform, is that the reclassification allows a quicker reconstruction of the cash flow statement using the indirect method, starting from the flow variables of the income statement and changes in the balance sheet stock sizes. The selection of the sample has objective and replicable criteria: the selected company must be active and listed on a regulated market, as well as based in Italy. We expect, however, that the rigidity of the parameters required for the selection of companies within the sample will contrast with respect to the availability of balance sheet data. For this reason, any company that does not have fundamental data for subsequent analysis for several consecutive years will be removed from the sample.

We intend to use an accounting measure as proxy for firm performance which has been widely used in previous research related to cash flow forecasts, i.e. ROA:

ROA (Return on Assets) = Net income/total assets

The independent variables relating to the identifiable management areas will be the followings:

- Cash flow for investments in fixed assets (CFI)
- Cash flow related to corporate dynamics (CFS)
- Cash flow from financing (CFF)
- Cash flow for extraordinary components (CFXC)
- Global net cash flow (CF)

The Cash flow for investments in fixed assets (CFI), is obtained as the sum of the change in the capital assets of fixed assets, including tangible, intangible and financial assets and the Financial Revenue income statement item, as this last component is generated by the financial assets held as fixed assets and is therefore relevant to investment management.

The Cash flow related to corporate dynamics (CFS) is obtained by subtracting the variation in the Shareholder Funds item from the profit for the year. It indicates the net result from the point of view of liquidity, obtained following any increases in paid-up share capital or the distribution of profits to shareholders.

The Cash flow from financing (CFF) indicates if the company has opened or redeemed loans during the year, and the value is obtained based on the change in the balance sheet items relating to short-term debts and long-term debts.

The Cash flow for extraordinary components (CFXC) indicates the impact on the extraordinary management fund captured using the Extraordinary Profit/Loss income statement item.

The Global net cash flow (CF) is obtained as a sum of the components described above and coincides with the change in the balance sheet item called cash and cash equivalents.

The regression analysis will consist in a regression equation (model), to explores the relationship between the cash flows available in the financial statement and the future economic performance of the company:

$$\text{Model: ROA1417}i = \beta 0 + \beta 1\ \text{CF1013}i + \beta 2\ \mathcal{C}FI1013i + \beta 3\ \mathcal{C}FS1013i + \beta 4\ \text{CFXC1013}i + \beta 5\ \text{CFF1013}i + \varepsilon i \quad (i = 1 \ldots 176)$$

Having proposed a research hypothesis in null form, the results that we expect to obtain could be in line with one of the two positions present in the literature, i.e. accrual-based earnings versus operating cash flows in the prediction of future operating cash flows.

3 Conclusions

The aim of the research will be to provide evidence of a significant link between the cash flows available in the cash flow statement and the future economic performance of the company.

In doing this, the results we obtain may be in line with the assumptions of those who claim that cash flows are a better predictor of future cash flows (Finger, 1994; Al Attar and Hussein, 2004; Farshadfar et al., 2008; Habib, 2010; Al Debie, 2011) or, on the other hand, with the arguments of those who claim that earnings are the best predictors for measuring future cash flows (Dechow et al., 1998; Barth et al., 2001; Kim and Kross, 2005; Ebaid, 2011; Jemâa et al., 2015; Frank, 2018; Nguyen and Nguyen, 2020).

Furthermore, the research will produce evidence of a significant link between the cash flows available in the cash flow statement and the future economic performance of the company, and it could be useful, if interpreted and contextualized, for external and internal users of the company. The research will therefore be potentially useful to analysts who try to predict the future performance of the studied company, analyzing the flows of the various management areas and the typical characteristics of the company, as well as the internal subjects, where the results may constitute a possible comparison benchmark with the model studied on the Italian companies of the sample. A limit of the present research work could be represented both by the reduced size of the sample used and by a database of financial reports not elaborated directly by the companies, which therefore could be not free from errors or imperfections.

Any future developments of our research could concern further analyzes to be carried out by observing the differences between companies in different sectors, for example between manufacturing and service companies, or between *capital* and *labor* intensive

companies. In this way, even more peculiar links could be identified between cash flows and economic performance.

The research field is insidious and the analyzed variables can be influenced by external elements that are not taken into consideration in this paper; therefore, the analysis will be conducted with the awareness that this work is free from any presumption of completeness and that the results that will be shown are not definitive and impeccable.

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Global Governance and Policy Facing the "Health 4.0" Challenge

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Abstract

The term eHealth includes multiple components, like the Mobile Health (mHealth), the Health Information Systems (HIS), the Telemedicine and the Distance Learning (eLearning). With the aim to explore some of the main eHealth governance issues at stake and the challenges faced at national and global levels, for the purposes of this paper, authors propose an integrative review on crosscutting eHealth governance issues and call for the development and adoption of appropriate policies and an international well-coordinated governance.
Although eHealth projects and initiatives are growing, worldwide scenario is still one of piecemeal implementation often lacking a system approach at national level and coordinated governance internationally.
The trend toward Health 4.0, extending eHealth to the Internet of Things in health, will require a deeper analysis on what is really at stake in terms of human rights, universal access to health services and further commodification of health needs, in that sense due to the global nature of the Internet, national policies will necessarily need to be part of a global governance framework based on solid international cooperation.

Keywords – eHealth, health determinants, health care, health policy

Paper type – Academic Research Paper

1 Introduction

Interconnectedness is a defining feature of globalization, and the development and worldwide diffusion of information and communication technologies (ICT) are at its roots.

The exponential use of the internet and electronic devices over recent decades has been associated with documented cases of excessive use and negative health consequences, reaching in some countries the magnitude of a significant public health concern. Consequences on health of excessive use of internet has mostly been studied and discussed under the lens of behavioural addictions and a variety of physical, psychosocial and socio-behavioural pathologies, which in many cases still need further study due to the recent emergence of the phenomenon.

However, the Internet and in general the digital society do not only represent a radical innovation of technology and tools, they also have a disruptive impact on the relationships established within the health care system. Compared to the theoretical strands of the past, it can be said that the digital society, and digital health in it, is made of a combination of "disruptive innovation" and continuous improvement. As such it comes with multiple challenges.

The World Health Organisation (WHO) uses eHealth as a generic term including distinct but related applications of digital health, such as: mobile Health (mHealth); Health Information Systems (HIS); telemedicine and distance Learning (eLearning) (Lewis et al., 2016).

More in general eHealth has been defined as the use of information communication technologies (ICT) in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research (WHO, 2005).

Digital technologies contributed among others to reduce the information asymmetry between health professionals and patients. In the past, the doctor was the almost absolute holder of the knowledge and skills related to health and played the dual role of interpreter of the need and provider of suitable services and services. In the network society the patient has autonomous access to a lot of information about health, although not necessarily the interpretative tools, and the possibility to share this information through the social media for additional opinions. This on the one side allows the patient to interact with the professional on a more balanced level, but on the other side it also exposes him to a number of risks.

Telemedicine has partially modified "access" to consultation, diagnosis and to a limited extent therapy and rehabilitation. The Internet has become the most important vehicle of a cross-border supply of health services to individual consumers.

New technologies may allow highly personalised therapies and monitoring of patients' conditions in real time (e.g. according to the instant measurement of blood glucose level in diabetics). mHealth linked devices and applications in the Internet-of-things (IoT) through their capacity to individualize access and use of health information and services,

promises to revolutionize health systems, eventually becoming a key component of universal health coverage (UHC), toward what some authors already envisaged as Health 4.0 (Comptesse, 2017).

The collection of data into large shared databases and easy access to health data by patients and professionals contributes to health system integration across different healthcare facilities and levels of complexity. Big data systems may contribute to speed-up research and the development of new therapies.

Nevertheless, in addition, to access to valuable services, the internet also channels new types of exploitation and fraud, including the sale and use of health data of individuals and the illegal promotion and sale of medicines and other products, posing severe risks to both individual and collective health and undermining legitimate trade and correct functioning of health systems (WHO, 2016).

The possibility of fraud and illegitimate data collection may also seriously affect research ad its credibility. For example, in May 2020 the WHO decided to suspend the COVID-19 trials with hydroxychloroquine over concerns about drug side effects published on the Lancet. However, later on, evidence emerged about authors' fraudulent data collection and the study was retracted, leading WHO to resume trials (Mehra et al., 2020).

This leads to rising concerns on policies and an international governance that should be addressed to ensure the cost-effective and secure use of health-related information communication technologies (ICT).

While much research and studies have analysed the impact of new digital technologies on single aspects of health care systems, we rather take a systemic approach aiming at exploring some of the main eHealth governance issues at stake and the challenges faced at national and global levels. This paper is guided by the following research questions: - Does eHealth contribute to increase equity in health systems? Does it contribute to worldwide cooperation and increase access to universal care? Is national and global governance effectively addressing eHealth issues?

We examine the existing international policies and governance challenges dealing with the risks that inevitably come with innovation and a progressively digital borderless society, including aspects such as protection of sensitive data and privacy, cyber security (interference and data theft), conditioning of behaviour through fake news with the related issues of certification of sites that give clear and correct information to patients.

We conclude calling for the development and adoption of appropriate policies at national level and an international well-coordinated governance.

2 Methods

To identify the governance challenges posed by the eHealth revolution at global level, we propose and short integrative review involving a mapping exercise of the literature. The search included peer reviewed research and discursive literature on main eHealth

barriers and governance issues at stake and the challenges faced at national and global levels published between 2000 and 2020.

Evidence came from systematic reviews (6 studies), non-randomized controlled perspective studies (4 studies), qualitative research, including assessment reports (9 studies). Authors used as source of evidence electronic databases, scientific journals and international organizations reports (WHO, EC).

3 Results

3.1 Determinants in achieving a successful eHealth intervention

Directing and coordinating eHealth development, achieving consensus on policy, protecting individuals and groups and assuring oversight and accountability in the various aspects relating to use of ICTs are relevant part of an eHealth governance function at the national and global level.

The governance of eHealth initiatives requires traceability of many requirements and design decisions.

Costs represent the main driver to effectively achieve successful eHealth interventions across the health system. Indeed, some of the common barriers (workload, role definition, undermining of face-to-face communication, workflow disruption, alignment with clinical processes and staff turnover) require huge efforts both in terms of direct and indirect costs (e.g. opportunity costs) (Granja et al., 2018).

Ross et al. (2016) identify as factors important for the eHealth policy and implementation: individual eHealth technology (e.g. innovation characteristics), the outer setting (e.g. external policies and incentives), the inner setting (e.g. compatibility between the e-health intervention and the organisation) and the individual health professionals (e.g. attitudes and beliefs) as well as the process of implementation. (Ross et al., 2016).

Among high-income countries, Norway has a long history of using telemedicine, especially for geographical reasons. Despite this, telemedicine use in Norway from 2009 to 2015 remained very low, not exceeding 0.5% of total outpatient activity at regional level and 0.1% at national level. Three major themes affecting implementation and utilization of telemedicine in Norway emerged: (i) governance and strategy; (ii) organizational and professional dimensions; (iii) economic and financial dimensions. For each theme, a number of factors and challenges faced at different health care levels were identified. (Alami et al., 2017).

3.2 End user acceptance

We investigated the end user level of acceptance toward eHealth.

For instance, a recent study revealed how in Bangladesh the successful adoption of eHealth solutions is influenced by social reference, advertisement, attitude toward the system and perceived system effectiveness (Hossain et al., 2019).

Harst et al. (2017) identified theoretical predictors that influence the acceptance of telemedicine. Characteristics of the technology, such as its usefulness, as well as attributes of the individual, such as his or her need for social support, inform end-user acceptance. (Harst et al., 2017).

Kligenberg et al. (2020) found a significant relationship between compatibility-usefulness and usefulness-attitudes among the factors that influence health care provider's attitudes toward m-health technology for emergency care of burn patients in Tanzania.

Afghanistan piloted a multi-stakeholder people-centred eHealth systems governance approach at provincial district health level over a six-month period, reporting a 20% increase in access to care (Kligenberg et al., 2020).

Botswana, like many developing countries, has also recognized the need for eHealth implementation. The mHealth in Botswana seems more costly compared to other countries such as South Africa and east African countries. This is because of several issues, including the need to import devices, the lack of attention to developing market needs, the ongoing trend of mHealth being smartphone dependent, and the inability of the populace to afford such devices (Mauco et al., 2018).

3.3 Assessment, Standardization and Interoperability

Almost all European countries have a sort of national body directly responsible for eHealth standards development or for overseeing standards development and implementation. The vast majority of the Member States adopt HL7 V2 and V3 (Health Level 7, version 2 and 3) as international standard, followed by CDA R2 (clinical document architecture, release 2, an HL7 V3-based standard) and ISO 13606 for electronic health record communication.

Unfortunately, these standards are most of the times not specific enough to assure interoperability, neither across the same region. Although in principle they allow for interoperability at various levels, further agreement on more detailed specifications, testing, and certification of solutions are required to ensure a cross-border implementation (Stroetmann et al., 2011).

Furthermore, the lack of a harmonized assessment method for eHealth technology between Europe and US make it difficult to perform a comprehensive summary of available evidence to help plan and undertake eHealth implementation (Mackey et al., 2014).

In Africa, the WHO in partnership with the African Union and major Donors/UN agencies, supported the implementing e-Health in African countries (e.g. Telemedicine Task Force, the Pan African e-Network). However, the major challenges were the programmes sustainability and the harmonization of their assessment (WHO, 2010). The

absence of a strategic systemic approach to the development of eHealth is another clear challenge.

Kenya reported myriads of eHealth projects, mainly in the mHealth strategic area and focusing mostly on primary care and HIV/AIDs. However, the lack of evaluation and the exclusion of marginalised areas and least urbanized counties – known for the highest health care needs – cause a difficult scale up of the interventions, beside the evident lack of a systemic approach (Njoroge et al., 2017).

Portugal was an early adopter of telemedicine to overcome both its geographical barriers and the shortage of healthcare professionals. The Pediatric Cardiology Service (PCS) at Coimbra University Hospital Centre (CHUC) implemented a real-time communication and the sharing of clinical information, including with overseas partners improving access to specialized care both in Portugal and Africa, representing a successful example of the international collaboration as well as of interoperability across multinational health systems (Maia et al., 2019). In this case also, the bilateral collaboration lacked a systemic view.

In Ethiopia the vast majority of the population lives in remote areas, with limited access to modern health services. The lack of health care budget, systematic shortage of health care workers and limited incentives to retain those in remote areas further jeopardize the national health care delivery system. Recently, the application of ICT to health care delivery and the use of telemedicine have raised hopes. Unfortunately, recent findings showed that due to its premature phase of development in Ethiopia and other sub-Saharan African countries, it remains difficult to talk objectively about measurable impact of telemedicine, even though it has demonstrated practical applicability beyond reasonable doubts (Shiferaw et al., 2012).

3.4 Health literacy and Digital divide

An element of concern for the eHealth implementation is about eHealth education. For instance, half of the nursing students in Sri Lanka have inadequate eHealth literacy skills, preventing them to identify trusted health resources and using this information in health decision making process (Ref).

In Israel, Neter et al (2012) measured the health literacy across the population, documenting differences between respondents high and low in eHealth literacy in terms of background attributes, information consumption, and outcomes of the information search. The association of eHealth literacy with background attributes indicates that the Internet reinforces existing social differences. (Neter et al., 2012)

3.5 Governance and regulatory framework

For the first time in 1998, the WHO Executive Board (EB) tackled the potential impact on health of the advertising and promotion of medical products via the internet (WHO 1998).

In 2005, the World Health Assembly (WHA) passed its first resolution on eHealth (WHO 2005a). An eHealth unit was created to promote and strengthen the use of ICT in health development, from applications in the field to global governance.

That same year, WHO launched the Global Observatory for eHealth (GOe), to support countries in developing and managing national eHealth strategies.

Since then "the potential impact" of the advances in information and communication technologies on health-care delivery, public health, research and health-related activities for the benefit of both low- and high-income countries expanded considerably, together with new challenges. Through the GOe WHO has been updating since 2010 an online directory of eHealth-related national policies and strategies from Member States. To date, 58% of countries have established an eHealth national strategy (WHO, 2018).

At European level, only six countries (13%) have a national policy or strategy

regulating the use of big data in the health sector and four countries (9%) have a national policy or strategy regulating the use of big data by private companies. Furthermore, 73% (33 Member States) do not have an entity that is responsible for the regulatory oversight of the quality, safety and reliability of mHealth applications.

Many Latin American and Caribbean countries are committed to reform their telecommunications systems. Rodrigues et al. (2013) analysed all the 33 Latin-American countries, reporting 19 ICT interventions; among these, 7 eHealth policies have been studied. The study found that there has been considerable progress in the establishment of ICT policies in the LAC region, but less so for eHealth policy specifically (Rodrigues et al., 2013).

At the national level, comprehensive legislation will need to address a long list of issues that many low-income countries will find difficult to introduce and sustain autonomously. The list of regulatory issues relevant for eHealth identified as key includes: access to and ownership of data, security and access to clinical information systems, privacy and confidentiality, informed consent for data use, access rights, integrity of data, patient safety, secure transmission of patient data, electronic and physical security, reliability of electronic portable medical devices used with eHealth, accuracy and reliability of online information for patients, sustainability of accuracy and integrity of electronic patient medical records, validity and reliability of clinical decision support systems, quality of care using eHealth processes, availability of efficient and effective communication systems, and reliability and dependability of telemedicine and telemonitoring. It has been argued that regulatory priorities for eHealth development should focus on privacy, confidentiality, security and standards (WHO, 2016).

Clearly, eHealth governance covering multiple areas mentioned above is a challenging issue of our times and needs requires input from global policy-makers.

At the global level, eHealth standardization has been also on the International Telecommunications Union (ITU) agenda since 2003.

Later the ITU felt the need to build on the collaboration with the WHO to create a global, open environment for the development and promotion of eHealth standards. In 2012, the 12th World Telecommunications Standardization Assembly (WTSA-12) adopted a resolution regarding ITC applications and standards for improved access to eHealth. Among issues needing global attention in order to ensure the successful adoption of eHealth applications, responses that were considered were: the conformity with standards to increase interoperability among systems, the safeguarding of privacy and security and the reduction of the cost of devices through economies of scale.

Health related internet domains have also been among the issues debated at global level.

In 2013 the WHA recognized the need for health data standardization as part of eHealth systems and services, and the importance of proper governance and operation of health-related generic top-level internet domain names (gTLDs), including ".health" (WHO 2013).

Regulating the .health domain was considered key in ensuring the internet can play its proper role in supporting global public health. The privatization of .health domain elicits concerns about the effects on health information access and quality and calls for global safeguards and policies to protect consumers. Indeed, due to the global nature of the internet, national legislators will have difficulty in ensuring that the management and operation of .health and other health related gTLDs will be consistent with public health goals (Missoni et al. 2019)

Many other technical aspects are also examined in collaboration between International Institutions, mainly the ITU, and private stakeholders such as the Personal Connected Health Alliance (PCHA), which is an international not-for-profit industry organization whose members are prominent ITC, health technology and pharmaceutical companies. ITU recognises the PCHA promoted Continua Design Guidelines, as the international standard for safe, secure, and reliable exchange of data to and from personal health devices (Missoni et al. 2019).

Indeed, legal, ethical, cultural, and economic issues are continuously debated between ITU and WHO. Furthermore, many of the regulations at the international level have been developed mainly due to trade in health services in the context of transnational data flows; one example is the United Nations Conference on Trade and Development (UNCTAD)'s Data protection regulations and international data flows (UNCTAD, 2016).

Complex issues concerning Big Data in health are specifically analysed by the UNESCO International Bioethics Committee (IBC) concerned with the protection of individual rights and fostering public good. Regarding governance UNESCO stated that in relation to Big Data, governance systems should aim at protecting the fundamental rights of the persons from whom the data originates, protecting sharing of data from exploitation, manipulation and improper control (UNESCO, 2017).

It is worth to mention that the eHealth information governance played a key role in the COVID-19 pandemic emergency. However, the difficulties associated to pseudo-anonymization of data for internet-based epidemiology as well as the risk that large amounts of data will be gathered by private companies are top concerns in Europe (European Commission, 2020).

4 Conclusions

Although eHealth projects and initiatives are growing, worldwide scenario is still one of piecemeal implementation often lacking a system approach at national level and coordinated governance internationally.

Most of the eHealth tools are not embedded within the health care system. eHealth tools that use multimodal content and provide the possibility for direct communication with providers have a higher adherence among vulnerable groups. However, eHealth tools are usually focused on specific problems, such as diabetes or obesity. Hence, they do not provide comprehensive services for patients. This limits the use of eHealth tools as a functional component of existing health care services.

eHealth programmes should be part of a national strategy as an integral plan for health system strengthening, taking into account countries' specific socio-economic contexts, including sustainability in terms of human and financial resources and normative environment.

The diffusion of eHealth goes hand in hand with the digital divide theme, thus calls for policy categories and issues that enhance the use of eHealth among populations who most need improved health services. These should include policies and guidelines to regulate the penetration of telecommunication companies, such as mobile companies, Internet service providers, integrated services digital network providers, and satellite vendors. Together with access to information and communication, eHealth must be recognised as a public good that cannot be left unregulated to the market. It is a governmental and intergovernmental responsibility to ensure that benefits reach also the poorest countries at affordable costs, providing universal and unlimited access to the Internet, and allowing for appropriate use of eHealth as part of the global effort toward universal health care, and the attainment of the relevant Sustainable Development Goals (SDGs) of the global Agenda 2030 (UN, 2015).

In this sense, the development of adequate global governance mechanism should go hand in hand with assisting national health systems in the development of eHealth and encouraging a global commitment for funding eHealth programs.

The policy goal-setting theme includes policy categories and issues that can guide the process of defining policies for eHealth that cannot be disconnected from policies to encourage appropriate growth of the telecommunications sector in a well-regulated framework.

This would include policy issues such as encouraging development and use of open-source technologies, increasing access to technology, increase connectivity in remote

areas, reducing cost, building local capacity, encouraging appropriate and sustainable innovation and developing governance and management structures.

Institutional policy issues, such as ensuring universal standards of care, and allotting and distributing the workload for health care providers and technical and managerial staff, are also included under this theme (Khoja et al., 2012)

The power of digital technologies structurally changes behaviour and above all the relationship between knowledge and perception. In other words, it poses the problem of the relationship between science, knowledge and behaviour. Digital technologies represent a great step forward in improving knowledge and possible concrete applications. Especially in the health care system the problems are represented on the one hand by the speed and flexibility of adaptation of supply structures and on the other by communication. Even using digital technologies science has to get out of its ivory tower to communicate and involve patients and thus regain credibility in society.

The trend toward Health 4.0, extending eHealth to the Internet of Things in health, will require a deeper analysis on what is really at stake also in terms of human rights, universal access to health services and further commodification of health needs, in that sense due to the global nature of the Internet, national policies will necessarily need to be part of a global governance framework.

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Prevention of Accidents at Work through Digital Technologies: Expectation from the Waste Management Field

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Abstract

The fight against both air and water pollution has become an obligation for OECD Countries. Particularly, waste collection and disposal are becoming a social problem to be tackled by worldwide Public Administrations through new models able to go beyond accounting for financial inputs and towards outputs (outcomes, impacts and service quality) by a dynamic co-productive scheme. Accordingly, recycling policies based on "door-to-door" collection have become widespread. Nevertheless, changes in waste management (WM) are consequently modifying waste collectors' working activities, transforming also the risks of accidents at work. Musculoskeletal systems of WM employees are deeply exposed to high bio-mechanic and ergonomic risks caused by repeated movements; thus, WM workers tend to develop a higher risk of both injuries and occupational diseases.

In this context, Digital Technologies (DT) seem to be an extremely useful element to optimize public service provision preventing working accidents, and related costs. Thanks to digital wearable health technologies, it is possible to monitor workers' gestures and correct, in case, their wrong postures taken on during their tasks. This would bring to prevent injuries and its related losses of productivity.

Given that no literature has arisen yet about DT impacts on occupational accidents, this study aims at investigating how DT could contribute in improving the WM field, particularly for what regards the prevention of accidents at work together with a reducing of service setbacks. Specifically, this manuscript intends: i) to investigate if DTs allow a better governance in Public Agencies performance by reducing social security costs and by guaranteeing a better continuity of services to citizens; ii) to examine which structural change would be requested in order to make operative this predictive risk model in the real working context.
To achieve these goals, this study developed a qualitative inquiry based on face to face interviews with two high-qualified experts about DTs and wearables e-tools.
Findings demonstrate a positive impact of DT in detecting critical operating issues in WM services. Particularly, information obtained by digital infrastructures allow management to make more efficient the work of the organization, reducing potential loss due to waste of time and/or physical resources; moreover, wearable technologies allow to prevent injuries by modifying the workforce management (work shifts, rests, tasks).
Finally, this contribution fosters the debate about the potential role of digitalization in Public Administrations and Policies. Particularly, this research shows how innovations based on Internet of Things could potentially improve the whole value-chain of public services' provision.

Keywords – Digital and wearable Technology, Accidents at Work, Public Waste Management, Social Security and Prevention, Occupational Safety.

Paper type - Academic Research Paper

1 Introduction

Defined as "the contamination of the physical and biological components of the earth/atmosphere system to such an extent that normal environmental processes are adversely affected" (Muralikrishna and Manickam, 2017), environmental pollution represents one of the major problems for worldwide modern economies.

In the last decade, the fight against both air and water pollution has become an obligation for OCSE Countries, so much so as to represent one of the most important issues among the development goals, recently released by the United Nations (UN-SDG 9, 12, 13).

In the Italian context, in particular, waste collection and disposal are becoming a social problem to be tackled by waste management and recycling policies addressed by the Public Administration. Hence, in the lens of health prevention (Reed et al., 2013), both local and regional governments have emphasized the introduction of environmental policies which address the challenge of pollution reduction through a rethinking of public service delivery processes (Osborne, 2006).

Moreover, it must be considered the relevance of the public role in this field, which has seen, in the last years, the shift from government to governance (Stoker 1998), leading to a recourse to contracting out in waste collection practices, with a distribution of services, not merely technical, but leading to the raise of questions about the power exercised through regulation, contracting and monitoring (Clarke, & Newman, 1997). This shift was associated with the necessity, by the public, to formalize performance measurements able

to go beyond accounting for financial inputs and outputs, thus including the outcomes, impacts and service quality (Slater & Aiken, 2015). Indeed in considering the waste collection in a local community, the relevance remains to the public, the payment is made by taxes from citizens, the collection and disposal are in charge of a private organisation (being it for profit or even not profit) in a complex dynamic of co-production scheme (Osborne et al., 2014; Pestoff, 2014), where it is not important to have not only a service at a right place, but it is also important, by the public, to regulate activities in order to avoid any possible risk of pollution and/or law respect of hygiene rules.

For this purpose, the improvement of a proper waste management policy seems to be an effective solution. In particular, recycling policies based on "door-to-door" collection have become widespread. This is also confirmed by the document issued by the European Commission in 2018 which identifies the recycling procedures as basis for circular economies.

However, the changes in waste management accordingly changed also working activities of waste collectors thus transforming also the risks of accidents at work. Indeed, a preliminary aspect regards the necessity to design and implement, innovative work behaviours by waste collectors, in order to reduce the risk of accidents. An innovative work behaviour is "the intentional generation, promotion, and realization of new ideas within a work role, work group or organization, in order to benefit the role performance, the group or the organization" (Janssen, 2003: 348). In this sense it is important to consider, when thinking about an innovative change behaviour by employees, also the ability, by managers to design and implement actions within a transformational leadership style, able to make employees capable to transcend their self-interests, through the development of a proper vision, adequately communicated to the employees, in order to have them as implementers of the change (Jasper & Signe, 2019).In the European Union in 2017 accidents at work were about 3.32 million (Cioca and Ivascu, 2017), representing a loss of productivity (European Union, 2013) of about 146 million of working hours/year (OSHA E, 2001). Workplace disruption costs account for €10 billion and loss of quality of life is estimated to €60 billion (Rikhardsson and Impgaard, 2004).

Moreover, waste management workers tend to develop a higher risk of both injuries and occupational diseases in comparison with other fields (+2% - Eurostatat, 2015).

In this scenario, musculoskeletal systems of employees involved in modern "door-to-door" waste collection and recycling activities, are deeply exposed to high bio-mechanic and ergonomic risks caused by repeated movements (INAIL, 2014 and 2016).

In this context, digital technologies seem to be an extremely useful element to both optimize public service provision and, especially, prevent working accident. Particularly, the Internet of Things (IoT) applications and devices, by allowing the connection of anyone, anytime, anywhere, to any service, devices and network can contribute to completely re-define how devices and people (clinicians and patients) interact with each other (Rhgiuou, 2018).

Accordingly, IoT applied to healthcare environment (Terry, 2016) relates to the following aspects which involve public service improvements:

1) Clinical. The possibility of remote monitoring vital signs of individuals, making them supervised without long interruption and checking also their adherence to follow-ups and prescription.

2) Organizational. The impacts of IoT on the internal process in service delivery regard the way in which biomedical information and hardware technologies, connected each other, transmit data which are able to change the behaviour of individuals (providers and users) in their role within service providing.

3) Economic. The individuals' management by IoT could radically change financial charge on service providing. By precise information availability both the service time burden and resource wasting can be decreased; thus, costs decline. Moreover, staff monitoring could prevent their working accident; as a consequence, future costs will decrease as well.

As a contrast, limits at IoT employment relates to human resource issues (i.e. staff skills), legal and ethical factors (i.e. liability, confidentiality, data protection, and patient privacy), and culture norms and practices (i.e. doctors' expectations regarding face-to-face patient interaction), along with organisational business strategy (Qi et al., 2017).

Potential setbacks regard prevalently the following aspects:

a) Technical. This regards the complexity of technology usage, installation and its intuitiveness-usability.

b) Effectiveness. This relates with the lack of strong evidences of IoT employment efficacy. This limit is mostly due to the fact these technologies are at the beginning of their life cycle, and not so many trials have been successfully concluded yet. This brings to an impossibility to declare their complete reliability in the real context. Besides, the continuous misclassifying between medical devices (CE stamp, FDA declaration of conformity, etc) and wellness devices (i.e. smartwatches, smartphone apps, etc), contributes to feed doubt about IoT affordability within users.

c) Cyber-Security. This regards mainly the protection of health and sensible information. These limits refer with the architecture of data mining, the way in which data are collected, registered, stored. The way in which date are sent, received and processed; the way to encrypt and unencrypt them, in order to make them available also for the owner and the responsible of their management. Also, in the lens of the General Data Protection Regulation (GDPR).

With specific regard to the waste management, in order to decrease both those risks incidence and related costs, according with the clinical risks predictive models based on biomedical signs monitoring (Orchard, 2018; Zhao, 2017), a possible solution could be found in the correction of wrong postures taken on by employees during their tasks (Guercio et al, 2013). This strategy should be taken starting by a precise knowledge of each individual's body movements during his/her working performance which is made

possible by digital health technologies designed for continuous human activity recognition (Mukhopadhyay, 2014).

The aim of this biomedical monitoring of waste collectors is to identify those employees who need to improve gestures during working activities with the goal to prevent injuries and related risks of loss of productivity.

However, while it has been demonstrated that the continuous advancement of health technologies (HT) - often derived from sport and wellness fields - makes possible the continuous human activity recognition (Mukhopadhyay, 2014), no literature has arisen yet about their impact on the prevention of accidents at work.

In particular, or waste management employees, the bio-mechanic and ergonomic risks of injury can be detected through Electromyography (EMG) and Electro-Kinesiology (EKG) investigations, which can be obtained in their real working context by simply "wearing" medical sensors enclosed into bracelets or a suit.

Therefore, with the goal to minimize risks of working injuries for waste collectors, wearable technologies are able to record data and communicate them to a service desk which: i) analyse obtained information, ii) compute health-related risks, iii) give feedback to employees aimed at working risks prevention.

This risk-detecting model seems to work in a way similar to the Hub & Spoke model in healthcare (Elrod and Fortenberry, 2017) and with general flow charts of a common Telemedicine service providing (Ranalli and Palozzi, 2019). Accordingly, this process should positively impact on detecting and reducing risks of accidents, injuries and diseases caused by repeated and wrong gestures during the working activities of waste collectors; this should also contribute in training and teaching employees about a correct improvement of their physical working tasks.

However, experiences about the effective execution of this model are scarce and mostly theoretical.

Given the above, this study aims at investigating how Digital Transformation could contribute in improving the waste management field, particularly for what regards the prevention of accidents at work together with an increase in working productivity, by reducing service setbacks.

Particularly, this work wants to analyse how digital wearable technologies can be accepted as an investment on social-security within the waste management field.

Therefore, this manuscript would like to investigate if DT and Internet of Things (IoT) allow a better governance in Public Agencies performance: on one hand, by reducing social security costs; on the other hand, by guaranteeing a better continuity of services to citizens.

As a secondary endpoint this work wants to examine which structural change would be requested in order to make operative this predictive risk model in the real working context. In particular, this work would like to examine for working practices:

- potential changes of workforce management;
- investments in digital technologies and infrastructures needed for this change;

- flow-chart of information "from" and "to" employees.

To achieve its purpose, this paper follows the following outline: after this brief introduction, including the main background about the theme, the second section explains methodology followed to answer the research issue. Particularly, we used an interview-based qualitative pilot case study (Patton, 2002; Yin, 2014) aimed at intercept opinions of experts about the employment of digital and wearable technologies in WM field. The fourth presents analytical findings of the interviews; while the last section discusses results obtained and provides some consideration about the potential impact of digital tool in health prevention of workers in arduous work field.

2 Methodology

In order to better understand the impact of digital transformation in the waste management, we decided to analyse a specific application of digital technologies, the so called: *wearables*, that is specific tools able to detect risks of potential accident for employees while they are working. Coherently with the qualitative "explorative case sampling" [Patton, 2002], we inquired the potential impact of these innovations within its real-life context by intercepting information-rich key informants, who are well-situated and competent people involved in the critical issues (Yin, 2014) of digitalization projects.

With the purpose to intercept some insights from high-qualified experts, the research has been designed on "face to face" interviews (Said et. al, 2017) to two experts (E1; E2), who can be considered two of the most important specialists in the field of electronic engineering applied to healthcare and people protection field.

The interviewees hold the following job-position within their organization:

1. Head of the National Center of Innovative Technologies for Public Health – National Institute of Health (ISS), Italy (E1);
2. Professor of Electronics at the Department of Electronic Engineering, University of Rome Tor Vergata, Italy, and Coordinator of several research on Electronic Engineering applied to bio-medical field (E2).

The enquiry intends to intercept opinions of those "key" experts belonging to the fields of health & security policy, biomedical engineering and waste management about the effective employment of ICT and digital tools (Qi et al., 2017) in the protection of workers' health of.

We developed the theoretical rationales for the interview protocol by drawing on digital transformation literature and particularly on the pillars of digital portfolio for digital innovation framework (Schreckling and Steiger, 2017).

The basic Schreckling and Steiger (2017) framework considers the following key dimensions related to digital transformation:

- Customer centricity (i.e. the expectations, preferences, engagement, issues and problems related to customers-patients in terms of digitalization adoption);

- Leadership and strategy (i.e. the reasons why organizations should focus on digital initiatives);
- Culture (i.e the people mindset for digital adoption);
- People (i.e. skills and obstacles for digital business);
- Structure and governance (i.e. roles and authority mechanisms);
- Processes (i.e. the objects of digitization);
- Technology foundation (i.e. the importance of new technology infrastructure and applications);
- Business model (i.e. the importance of innovate business by new offerings and products)

Given the on-going, iterative process of data discovery and comparison, we decide to exclude two pillars of the digital framework, namely Technology Foundation and Customer Centricity, as they were found not meaningful for the context of the pilot project we wanted to analyze.

Accordingly, Technology Foundation is a less informative topic for our research as the technology (in particular IoT applications) is already present in the analyzed context, differently from what suggested by the framework, which questions the need for having new technology infrastructures, systems and application for digitalizing business. Moreover, we do not consider the Customer Centricity topic as we focus on the effect of the innovation on service providers rather than users, which, in the waste management field, have to adapt themselves to the rules of the community they belong to.

Moreover, in order to have an exhaustive overview also for the technological issues that represent one of the main drivers of our research, we further enrich our theoretical basis for the interview protocol by drawing on the insights of Technology Acceptance Model (TAM) theory (Davis, 1989; Davis et al., 1992) and its modification (Dutot et al., 2015), especially for having a guide about the understanding of how operationalize questions related to technology acceptation and use in the specific context of waste management as direct derivation of the healthcare sector (the field from wearable technologies arise).

According to TAM, several factors can influence users' intention to use a new technology which prospectively could turn into an actual behavior. Such factors are contextual since they relate to both characteristics of individuals (e.g. motivations, attitudes, resistance, demographic attributes, and user type), technologies (e.g. types of innovation) and organizational environment (e.g. types of setting, processes, and conditions)

Accordingly, we framed our interviews as open, semi-structured questions, related to the pillars by adapting such framework to our case and thus having the following questions (Table 1):

Table 1: Framework for qualitative assessment of digitalization in the Waste Management Field

	PILLARS	QUESTION (s)
Impact of Digital Transformation	1. Leadership & Strategy	What is the role of digitalization in a waste management/recycling organization?
	2. Business Model / Policy	-Referring to a waste management field, who would be responsible for investments in digital transformation? -Investments would be supported by public agencies, or by private service providers, or both? What would be the investment goals?
	3.Process	-How do waste management services change through the use of information obtained by digital tools?
	4. Structure & Governance	-How employees are involved within do digitalization process? -How do employees accept this change? Positively, negatively, Why?
	5. People & Skills	-Which kind of employees could mainly benefit from that kind of digital technologies? - There would be a need for new professionals who allow these digital tools to permeate / be used within the organization?
	6. Culture	Which staff personal variables (e.g. age, gender, level of education, work experience, etc.) can accelerate / slow down this digitalization process?
Structural Change	a. How much the information obtained by digital wearable technologies could affect the workforce management? b. Which would be the specific investments in digital technologies and infrastructures? Could you describe them? c. Which would be flow-chart of information "from" and "to" employees? Could you sketch them?	

Source: Authors'. Elaboration inspired by the Schreckling and Steiger (2017) framework

3 Results

From the verbatim transcription of interviewees' opinions, we collected around 100 raw concepts, about 20 pages, which contributing in reporting insights about the potential adoption of digital technologies from companies operating in the waste management field.

Thus, the section follows the questionnaire structure with the goal of intercepting how digital transformation impacts on business operating and which leverages of change are interested.

3.1 Impact of Digital Transformation on Organization

3.1.1. Leadership & Strategy

"What is the role of digitalization in a waste management/recycling organization?"

This question highlights the potential impacts of digital technologies in waste management. "Many!" has answered the E1 interviewee; "Many! Because DT allows company to trigger a continuous communication between staff and leaders; this "feedback to feedback" relationship allows both leaders and staff in changing the strategy in order to provide better services". For instance, E1 continues, "monitoring of working activities and efforts provided by staff could allow company to:

i) changing work-shifts;

ii) managing service with less or more personnel and/or machineries;

iii) making this debate between staff and leaders a Research & Development moment of activities".

Particularly, for the correct exploitation of gestures during working activities, digital technologies allow experts to monitor activities and subsequently correct the wrong gestures with the result of a potential reduction of working accidents.

"In a service process with a high level of standardization, the punctual observation of information by digital technologies give company the possibility to protect health of workers" (E2) and to improve the service provided, by decreasing the level of absenteeism and related service breakdowns.

In particular, according with E2, wearable technologies allow experts to objectively observe and register gestures provided by workers during service activities for several times. The correctness of gestures is defined by a rule (e.g. Italian Law n. 626) which establishes when the working position and operating process is safe.

As shown in the following illustrative Figure 1, wearable technologies can replicate, by an avatar, the movements of a subject. This allows to judge if the singular gesture exposes employees to specific bio-mechanic risks. If the gesture is wrong the counter is red coloured, if it is correct the counter is blue. Surely the parameters are judged depending on the kind and the intensity (number of gestures, speed, power) of the observed working activities.

Source: Captks s.r.l., Italy, http://www.captiks.com

Figure 1: Avatar for gesture correctness analysis

From the analysis of repeated gestures, it is possible to correct each employee's movements (by a feedback received by an expert – e.g. a Security Manager), with a subsequent reduction of the risk of a working accident.

3.1.2. Business Model / Policy

"Referring to a waste management field, who would be responsible for investments in digital transformation?" and "Investments would be supported by public agencies, or by private service providers, or both? What would be the investment goals?"

About this point, both interviewees agreed that in the WM field the investments in digitalization should be taken from both public agencies and service providers.

E1 highlighted that these two subjects should contribute in the investments coherently with their own role in a long-standing business plan. In particular providers *"should purchase equipment needed for the internal process"* (E1), while, public agencies "*should be charged by those infra-structural investments related with the digital transformation functioning within the Country (e.g. the 5G technology)"*. Moreover, with particular regard to the basic need of wearable technologies for monitoring working activities' E2 clarifies that "*this kind of investment is very inexpensive. With* (about) *10.000 € it is possible to purchase a complete 10-sensors Kit, software included* (the same discussed in the previous point)*, for the total-body monitoring of working gestures*". This kit, specifies E2 "*can be used by several employees in different moments with the goal to:*

1) monitor gestures;

2) understand those possible mistakes that could bring to working accidents;

3) teach employees how to improve gestures and reduce working risks".

3.1.3. Process

"How do waste management services change through the use of information obtained by digital tools?"

The IoT-based strategies in waste management allow service providers to save resources; in particular, as highlighted by E1 "*if you can monitor things (or people) you can understand the efficiency of the service; for example: if you were able to know if a garbage bin is effectively full, you can't waste time in checking each one; or: if you could add a "R-fid" sensor on specific kinds of rubbish (for example those plastic made), you could know if someone is putting the wrong rubbish in the garbage bin. Or, again, if you can monitor by a GPS all the vehicles involved in waste collection, you could potentially understand if they are correctly operating or they take too long stops during the work-shift. If you are able to know what it is expected to find in a garbage bin, you can better organize the collection, being more efficient and safer (for example employees could wear special protection if they would know they are picking-up an infected waste)*". According to E1, the DT can completely change public service, by changing operating activities together with staff involvement.

With specific regards to wearables employment for working accidents reduction, E2 specifies that if it is possible to know the specific complexity of a service (e.g. the high of a garbage bin or a vehicles), it is possible, as well to train and then adjust gestures of the employed staff in order to save them from injuries.

3.1.4. Structure & Governance

- How employees are involved within do digitalization process?

- How do employees accept this change? Positively, negatively, Why?

Generally, "in order to get involved employees in a business change, you should motivate them by adequate training and information" (E1). "*Every kind of working monitoring should be known and well accepted by the worker, in order to allow him/her in understanding all related personal benefits and limitations*"; E1 continues: "*for example, if a WM company monitors the operation time both of worker and the vehicle that s/he is using during the service, it can probably discourage breakdowns and waste of working time; as a result, if the provided service were effectively more performing, the employee should receive a prize*". In E1's opinion the matter is not the kind of employee involved in the digital transformation, but how this change is perceived by the subject within an incentivizing mechanism.

This is valid also for wearable technologies aimed at preventing working accidents; these technologies have to be understood by the employees (and Unions as well) as a "strategic leverage for job security and not as a monitoring for personal productivity" (E1).

There is no answer about the positive or negative effect of digitalization by employees; it depends on how much this change is shared within the organization, together with its pros and cons.

Accordingly, E2 underlined that "nobody can accept to be monitored for a long time while working"; if the monitoring is for a short time and specifically aimed at health protection can be perceived, by the workers, as a "value-added" ; otherwise it would be suffered as a constriction.

3.1.5. People and Skills

"Which kind of employees could mainly benefit from that kind of digital technologies?"

and "There would be a need for new professionals who allow these digital tools to permeate / be used within the organization?"

E2 underlines that all employees could gather a benefit from an observation (by wearable digital technologies) of their working activities in the working place: "*not only the operational employees* (those that in WM are involved in waste collection), *but also the clerical ones, that often spent 8 hours per day sitting on a chair*". The administrative employees, could indeed suffer due to occupational diseases on musculoskeletal systems well as those workers with operative jobs. Clearly, who is more involved in physical

activities will tend to overcharge the musculoskeletal system, with the consequence of higher risks of injuries and muscular fatigue (E1).

With regards to professional figures, needed to foster digital technologies within WM organization, both interviewees agree upon that Security Managers should be mainly involved in the process of acceptance of wearable technologies as a tool for improving their tasks of health protection.

3.1.6. Culture

Which staff personal variables (e.g. age, gender, level of education, work experience, etc.) can accelerate / slow down this digitalization process?

No specific personal features of employees seem to be related to their inclination in using digital technologies; usually youngers and higher educated seems to have a proclivity for innovation (E2). But this is not related to the specific WM field.

On the opposite, E1 notified that most of employees are male; he added that this is due to a "legacy" of the specific field; thus, no connection between gender and propensity to digitalize has been highlighted.

3.2 Structural Change

a. How much the information obtained by digital wearable technologies could affect the workforce management?

From interviewees' opinions, this information changes a lot the possibility to manage the workforce management in waste collection. Particularly, E1 highlights that if it is possible to know about the physical effort and physical stress of an employee while s/he is working, it is possible to "*change work-shifts, in order to reduce his/her effort and prevent occupational accidents*"; accordingly, E1 continues saying "*during a door to door garbage collection shift, an operator could repeat 3/400 times the same gesture with an arm, or s/he gets in and get off 200 time from the truck. These repetitive movements implicate specific risks that wearable technologies can mitigate by, analyzing:*

- accuracy of gestures;

- speed of gestures;

- number of gestures;

If you measure these variables related to physical efforts, probably you can modify the work-shifts (e.g. reducing number of hours by increasing their frequency), *with the result of reducing risk of accidents at the musculoskeletal systems*".

"*Moreover*", E1 specified it with an example: "*if during a night shift, the operator collects 100 garbage bags but replicates the gesture of bag grasp for 200 times, it means that something wrong happened during the service*". Thus, the digital technology become a performance tool able to monitor also the service management as a whole.

Moreover, E2clarified that the monitoring of working gestures makes sense only for a short period of time, two, three working days. The employee carries out his/her tasks

while is monitored; his/her gestures and activities are firstly recorded and then automatically analyzed by a software. The result is a personalized teaching about the improvement requested to make the gestures safer.

b. Which would be the specific investments in digital technologies and infrastructures? Could you describe them?

Both interviewees agree that, in order to digitalize waste management activities, with the specific goal of decreasing risk of accidents, are requested the following resources:

a) capital investment in hardware equipment (wearables, transmission system);
b) capital investment in software infrastructure and cloud computing;
c) operating expenses for data analysis and feedback providing to employees.

No references about costs were discussed by interviewees.

c. "Which would be flow-chart of information "from" and "to" employees? Could you sketch them?"

Both interviewees confirmed that data flows "from" and "to" employees are exactly the same of a telemedicine service of biomedical monitoring.

Data start from the employee, while s/he is wearing the technologies; information are deposited to a cloud where are processed and analysed by a software; once data are analysed and understood by a professional, the feedback is transmitted to the employees. This feedback should include corrections to wrong working gestures, repeated movements and their speed.

The same feedback is also sent to the Human Resource Management and to the Security Manager in order to evaluate if it is requested a change of work-shifts, in order to reduce risk of accidents and increase occupational security.

4 Discussion and Conclusion

The study findings demonstrated a positive impact of digital technologies in detecting critical operating issues in waste management services. Specifically, interviewees highlighted that digital technologies could potentially represent a tool for an alignment of operational behaviors to business strategic goal (Ferreira & Otley, 2009). In particular, information obtained by digital infrastructures allow management to make more efficient the work organization, reducing potential loss due to waste of time and/or physical resources.

Moreover, wearables allow to intervene on the service production chain, thus having direct consequences on occupational accidents; in particular: the monitoring of the musculoskeletal system of waste collectors, during their working activities, allows to prevent their injuries by modifying the employee management (work shifts, rests, activities, physical training, etc.) and by providing employees with instructions about the

correct gestures that have to be hold during their working activities. This second point, we underline, is coherent with rule prescriptions about occupational safety.

This approach allows business in a "*quite continuous R&D aimed at maximize operational efficiency, and minimize risks in the daily activities, where planning and control represent a continuous cycle*" (E1). Digitalization, in fact, makes on-line (and strongly interconnected) these three pillars of strategic management (Kaplan & Norton, 1992):

1 Gather information
2 Provide internal communication
3 Monitoring service provided

If managers and employees can share information one to each other, through digital infrastructures and sensor, it becomes possible to easily adjust business strategy at the operative contingencies and, moreover, every change becomes better explained within the institution and better accepted from individuals. This surely improves the decision-making about operating activities (Lippa et al, 2017).

This structural change requests resources comparable to every digitalization project which implicate a direct data collection on physical subject in their working (or domestic) environment; such it happens for any telemedicine-based remote monitoring system. Thus, according to the literature about this theme (Davalos, 2009; Kairy, 2007; Ramkumar, 2018) the requested resources can be summarized as follows (Table 2):

Table 2: Costs of Digital Transformation in the Waste Management Field

Investment costs	*Operational and service costs*

Hardware:
• Personal device:
  ○ Wearable or Ambient sensor
  ○ PDA/ Smartphone
• Office Devices
	Personnel:
	• Technical/IT
	• Administrative
	• Security Manager
	• Specialist

Software: • License	Staff education: • Continuous training • Upgrade training
IT infrastructure: • Server • Internet / Utility lines • Privacy Security	Service hardware: • Depreciation of personal devices or • Rental medical of devices

Data Center Equipment	Organization hardware:
	• Depreciation:
	  ○ Office devices
	  ○ IT infrastructures
	  ○ Data Center Equipment

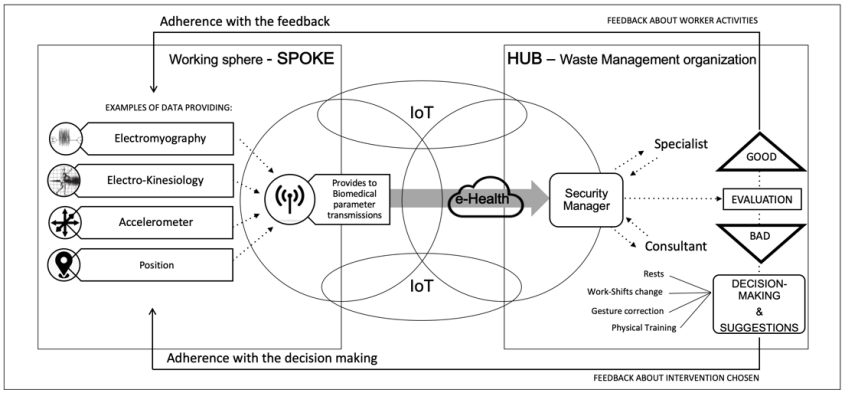
Set-up costs: • Operative Flow-chart • Privacy Rules	Software: • Amortization: • License.
Personnel: • New Hiring • Training	Staff support: • Enrollment • Training • Consulting

	Direct material: • Medical consumables • Office consumables
	Utilities

Source: Adapted from Palozzi et al., (2020)

Nevertheless, with particular regards to the technology necessities, a company has to pay attention to wastefulness of resources; very often, many operational information can be detected by an alternative use of technologies already owned by the organization. An easy example, on the specific context, was provided by E1: "*for instance, if the company wants to monitor if its waste collector is standing or fallen, the accelerometer with which, the employee's smartphone, is already equipped, represents a perfect* (and free) *solution* (as long as the smartphone is positioned on the back of the individual)".

In addition, this study confirms that information flow of a digital infrastructure aimed at monitoring employees' activities is based on "one to one" relationship between the worker (SPOKE) and his/her institution (HUB) (coherently with the Elrod and Fortenberry (2017) model. In particular this flow can thus be represented as a general model for the delivery of a telemedicine service, as shown in the following Figure 2.



Source: Authors' illustration, adapted from Ranalli and Palozzi, 2019.

Figure 2: Operating Model for Waste Management collectors monitoring system.

Nevertheless, as underlined by the interviewees, the most critical issue is represented by the "quality" of the feedback provided to employees within the business environment. Differently from the "clinical" field of telemedicine, where feedback to patients is provided by a specialist physician (who holds both the specific knowledge and the responsibility for patients' outcome), in the context of a waste management organization, the feedback mechanism would be potentially managed by an administrative employee with specific tasks on security management. This is very risky in order to effectively align workers' behaviors. About this matter, both E1 and E2 highlighted that this feedback moment is pivotal, because it "includes" (or "excludes") the operative worker within the

decision process which aims at the service improvement. The feedback, in other words, is the moment where there is a transfer of knowledge within the organization (Edmondson et al. 2001), that would be able to both increase business performance and decrease occupational accidents. This process follows a top-down flow, but on the base of bottom-up information gathered by digital (wearable) technologies.

Limitations of the study are those implicit in a qualitative method: first, in terms of its replication, it would result less reliable than quantitative ones, for the interpretive role of researchers, and limited extension of data. Nevertheless, the prestige of our interviewees reduces such a limit. Secondly, given that this research is moving its first steps, the study can be considered as a pilot, given its original level. This explains why our interviews involved only two experts.

Moreover, another limitation is implicit to the specific topic addressed by this study; it regards the limited specific literature background on digital technologies employment in occupational accident prevention: this literature is prevalently belonging to the engineering and healthcare fields, with few strong interconnections with managerial ones.

This limitation, however, poses this study as a contribution for fostering the debate by both scholars and practitioners about the potential role of digitalization in Public Administration and Policies. Particularly, this regards insights about those potential benefits, for Communities, related to the digitalization of public service in modern economies. Although digital technologies are still prevalently considered as a support for administrative activities and process controls, this research shows how innovations based on internet of things (Brous et al. 2019; Terry, 2016) could potentially improve the whole value-chain of services' provision (Bermann and Marshall, 2014), including organization of work-shift, operative tasks, and workforce management.

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Costs of Drug Treatment in Digital Platforms: Systematic Review of Literature of Bottom-Up Approaches

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Abstract

The paper proposes a plan for introducing digital transformation into the estimates of the spending on drug-related healthcare, by identify the models currently available in scientific literature to make bottom-up estimates of the costs of providing treatment to substance abuse. The authors performed a scientific review of the literature, complemented with the snow-ball method, and applied a qualitative method of content analysis. Authors do not rule out the possibility that additional cost calculation tools may exist, because many methods are published in grey literature by public or private entities in charge of monitoring drug treatment. These studies are not always possible to capture in scientific reviews of the literature. Finally, the paper contributes to set the theoretical framework required to apply methods to estimate the costs of providing substance health care, in a digital context.

Keywords – Methods, Costs of treatment, Substance abuse treatment, Digital ecosystem, Illicit Drugs, Smart Public Administration.

Paper type: Academic Research Paper

1 Introduction

In 2018, over 92 million people used illicit drugs. Moreover, alcohol remained the third risk factor for disease and mortality in Europe (OECD, 2018). According to McLellan et al. (2000), the abuse of illicit drugs is a chronic condition which often lasts the whole life of a patient. This requires practitioners, health economists and policy makers long-term treatment and innovative strategies to handle costs.

Two main approaches are commonly used to estimate the costs of providing healthcare. The top-down and the bottom up approaches. The top-down applies pre-defined criterion to disentangle specific costs within wider budgets. Here, the relative value units (RVU) or for instance the number of days that patients stay in hospital are commonly used metrics (Chapko et al., 2009). Data are frequently provided by national or international entities (Rubin, 2017).

The bottom-up approach aims to estimate the total cost after estimating the cost of providing one unit of treatment, and multiplying it by the number of treatments administrated (Olsson, 2011).

As shown in Chen (2010), the bottom-up approach is desirable to evaluate health programmes. In fact, once a methodology has been identified, the same method can be generalized, enabling to estimate total costs and to make cost-effectiveness analysis, because this method allows a rigorous evaluation of the relationship between the costs of each intervention and its outcomes.

Over the years, several studies have been carried out to calculate the costs of treating the abuse of illicit drugs (Cartwright, 2008; EMCDDA, 2017). However, methods applied are still too diverse and results are not comparable (EMCDDA 2017). It is therefore important to promote consensus-based improvements in the estimation methods and to work towards defining best practices.

One solution for bridging this knowledge gap and to developing suitable methods, could be to reinforce the use digital technology in this field. As indicated by Agarwal et al. (2010), the application of health information technologies (HIT) increases the quality of the health provided and reduce its costs. These authors stress that adopting specific HIT to the different scales of operation, increases the knowledge of costs and allows better analysis.

In the same vain, the European Parliamentary (2017) refers that digital transformation can give a better contribution to tackle substance use disorders. It mentions that there are some improvements that should be operationalized. It stresses i) increased interoperability between e-Health solutions, ii) more transparency in the use of data collected; iii) harmonization of the national and regional access to ICT services; iv) promotion of standard guidelines; v) promotion of reimbursement schemes for digital health services; vi) lowering the costs in setting-up e-Health systems and e-Applications; vii) reducing regional differences in acceding ICT services. The study of Buccioli et al. (2014) stresses the need to introduce digital transformation in this sector, because of its beneficial impact both on the decision-making processes and on the control of costs.

The use of digital technology is frequently applied in two main areas. The first uses e-Health applications to treat patients. It includes web-based environment for self-care, Information and Communication Technologies (ICT) for therapy, Artificial Intelligence and virtual therapeutic software and the therapeutic use of social media (Barak et al., 2009; European Parliamentary Research Service, 2017; Litvin et al., 2013). Digital technology is also used is to manage the operational components of Health provision, with e-Health applications. Buccioli et al. (2014) and Fritz et al. (2015) stress the benefits of e-management to reduce the costs of providing health services, especially in an era of scarce resources, responding to cost-effectiveness concerns.

Despite the political, social and economic relevance of this topic and the advantages of linking costs to digital transformation; a systematic digital processing of costs does not seem to have been systematically applied to drug-related healthcare yet (neither for treating illicit drugs nor alcohol abuse).

Therefore, an additional the aim of this study is to analyze the compliance of the models used to estimate the costs of drug-related healthcare with digital ecosystems.

This study is organized as follows. Section 2 investigates the elements required in a digital ecosystem when applied to drug-related healthcare, considering the results of the European Agenda for the treatment of substance abuse. Section 3 describes the methods used to search literature and to analyze the cost models of treating substance abuse in a digital ecosystem framework. Section 4 describes and Section 5 discusses the models available in literature. Finally, section 6 concludes by presenting the elements necessary to create and develop a desired digital ecosystem in this field.

2 Digital transformation and ecosystems

Digital transformation in healthcare is a broad concept. We consider digital transformation the transition from a setting with analog or non-digital procedures to a setting where procedures are mostly operationalized in a digital ecosystem.

As Ricciardi et al. (2019) stressed, digital transformation in health care is difficult to define because it is complex and it ca be applied in multifaceted ways. These authors suggest that "*digital transformation indicates that health services and systems are in a transition in which more health services and processes will be digitalized*". Agarwal et al. (2010) point to the potential use of mobile health; Klinker et al. (2019) discuss the system of Augmented Reality for Hands-Free Service Innovation and; Menachemi et al. (2007) suggest the systems of Electronic Health Record (EHR).

So, on the one hand, one can consider the appliance of digital transformation as a support to diagnosis or to the measurement of prevention processes (Agarwal et al., 2010; Biancone et al., 2019); or, on the other hand, one can apply digital transformation to services provided to patients and to back-office operations in health services (Meskò et al., 2017).

As Jacobides et al. (2019) referred, digital transformation in healthcare needs to be framed within a good orchestrated digital ecosystem. Therefore, we will also explain what we consider a digital ecosystem.

Jacobides et al. (2018) say that "*An ecosystem is a set of actors with varying degrees of multilateral, non-generic complementarities that are not fully hierarchically controlled*". Iyawa's et al., (2016) defined a digital ecosystem as a "*[…] network of digital health communities consisting of interconnected, interrelated and interdependent digital health species, including healthcare stakeholders, healthcare institutions and digital healthcare devices situated in a digital health environment […]*".

Therefore, we consider that a digital ecosystem is composed by community, content, practice, technology, biological species, economics species, digital species, digital environment, security, and trust (Table 1). These components are useful to frame digital transformation and should be defined when designing a digital ecosystem (in healthcare).

Table 1. Components of digital ecosystems

Components / Sources	**Description**
Community	Community is the entire set of actors/species available within the digital ecosystem environment. There are three different types of species: biological, economic and digital.
Content	Content contains the information or services used by species.
Practice	For the different species to be comfortable and operate freely, practice is required.
Technology	Technology refers to hardware and software responsible for the information interchange.
Biological species	Persons who participate in the digital ecosystem.
Economic species	Companies and institutions which participate in the digital ecosystem.
Digital species	Digital devices, software and hardware used by people, companies and institutions participating in the digital ecosystem.
Digital environment	The platform on which digital species interact.
Security	The protection of resources and species in the digital ecosystem.
Trust	The believe that all species want to achieve the same goal and the same level of security.

Source: Iyawa's et al. (2016)

This study will assess if the bottom-up methods used to estimate the costs of drug treatment operate in a framework of digital ecosystems, according to the pre-defined conceptual framework required. This assessment is made verifying their compliance with the criteria identified in Table 1.

3 Methodology

3.1 Review of literature

A review of literature was performed to identify the tools and methods used to estimate the costs of treating the dependence of illicit substances to be used by European policymakers, researchers or health care managers. The authors searched for studies

which applied a bottom-up approach. One outcome of the literature review is that the number of models is small. Below, authors describe the process applied in the literature review.

In order to review the existing methods available, this study used a multiple-case study approach. It gives an overview of other currently on-going initiatives and an understanding of their implementation.

The analysis was carried out by investigating the methods applied to estimate the costs of treatment programmes targeting substance abuse. In order to reduce contextual variation, authors selected a set of countries with high health care expenditure (OECD, 2019). Therefore, the selection of the cost-accounting methods was made among the top 12 countries with highest expenditure, out of the 37 countries monitored by the Organization for Economic Co-operation and Development (OECD). Data was extracted from the OECD database, with data published for expenditure on Health Capital (HK) as a percentage of the Gross Domestic Product (GDP)[1].

Authors used the follow online search engines: EconLit, and PubMed. In particular, the EconLit engine is recognized as the primary research tool for Economic analysis (Smith, 2009). PubMed was also used because it offers functionalities such as searches 'limited by specific search keys' or 'citations from identified sources' (Shultz, 2007).

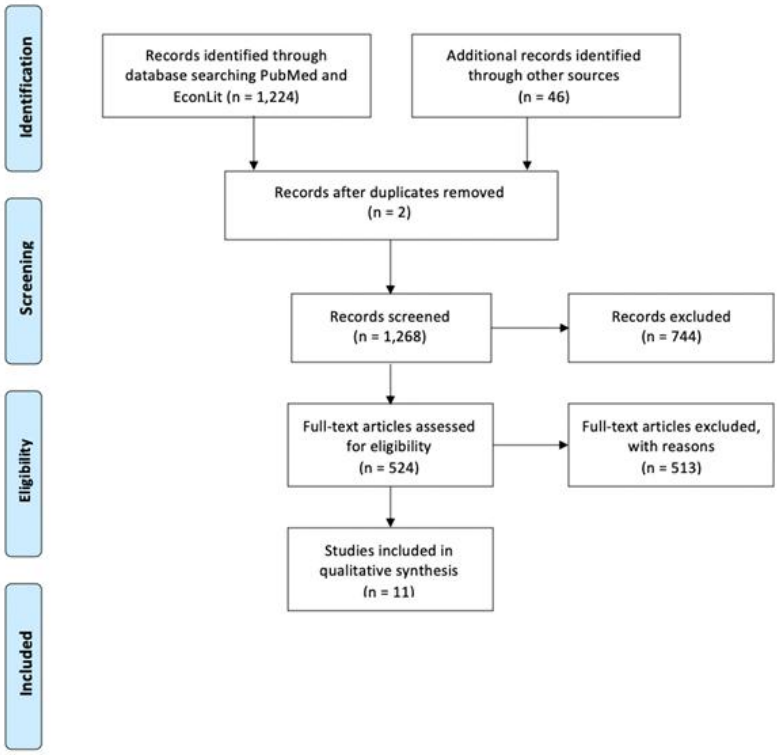
In this literature review the keywords used were: "treatment", "costs", "addiction"; "economic", "evaluation", "drug", "abuse", "methods"; "EHR", "calculation", "analysis", "digitalization", 'illicit drugs', 'cocaine', 'heroin', 'cannabis', 'methamphetamines', 'harm reduction' and opioid substitution treatment (OST)'. The review of the literature was complemented with a snowball procedure (Lecy & Beatty, 2012), because the number of studies resulting from the first search was small. In fact, the description of the methods applied to estimates of the costs of treatment with a bottom-up approach has been most published in grey literature. Therefore, models are better traceable through references.

Further, this review complied with the following criteria: (1) studies and documents published in English; (2) availability of full text and; (3) studies used a bottom-up cost calculation approach in the area of illicit substance dependence. Additionally, all the authors independently perform the analysis in the search engines reading the titles and the abstracts of each source. After this step, they share the knowledge flow and when opinion differed, a final decision on inclusion of exclusion of the source was made after an in-depth discussion of the topic.

Consequently, authors have reviewed all studies that proposed a complete method to estimate these costs. Authors considered scientific peer-reviewed papers, institutional reports, case studies and health-programmes evaluations.

The outcomes of the literature review were classified according to the PRISMA method (Liberati et al., 2009). Figure 1 presents the flow of the search, the method, the number of results obtained and the final number of papers considered.

[1] *Data extracted from the OECD Database: https://data.oecd.org/healthres/health-spending.htm, April 2020.*



Source: authors' elaboration on Liberati et al. (2009)

Figure 1. The PRISMA flow

3.2 Content analysis

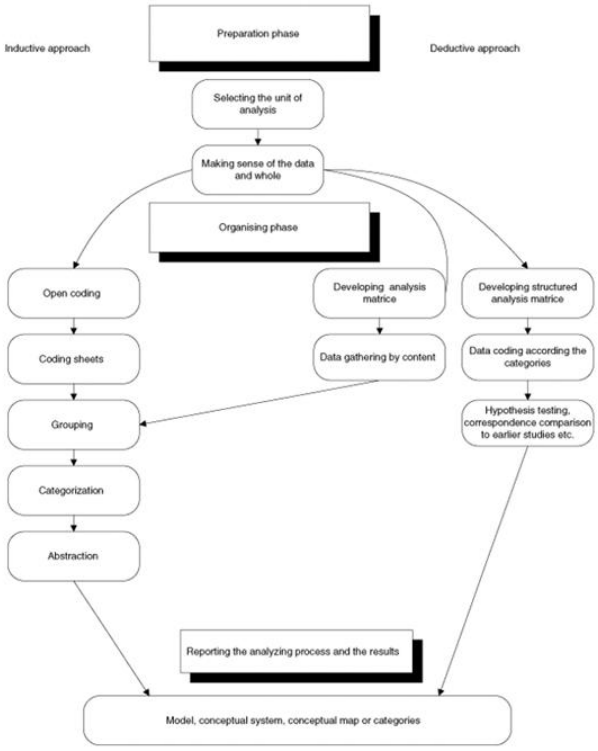
Subsequently, the authors carried out a content analysis. The aim was to identify in each study the cognitive schemas, accounting methods, categories used, readiness and easiness to apply to a wide spectrum of European countries and compliance with a digital context. This objectives were used to review the literature and to compare methods and accounting categories applied, as well as the different periods of time and institutional frameworks (Flick et al., 2004). This study implemented a deductive content analysis in three phases: first, preparation; second, organization and; third, concluding remarks (Elo & Kyngäs, 2008).

As shown in Fig. 2, the first step consisted in defining the unit of analysis applied to the cost methods. The second step, the organization, consisted in developing a structured matrix to test two hypotheses with the pre-defined criteria. Criteria were applied to analyze and compare the costs methods (Kyngäs & Vanhanen, 1999). With the support of this matrix, authors reviewed the studies founded. Table 1 displays results. The third step comprised the analysis of the information, i.e., testing compliance with the digital ecosystem framework.

The following two hypotheses were tested:

H_1. The literature provides sound methods to account and estimate the costs of treating substance abuse, with a bottom-up approach;

H_2. The bottom-up methods used to account and estimate the costs of treating substance abuse are possible to implement within the framework of a digital transformation and comply with a digital ecosystem.



Source: (Elo & Kyngäs, 2008)

Figure 2. The qualitative process of content analysis

4 Results

4.1 Cost analysis

The survey of the literature reveals that eleven methods were used applying a bottom-up approach to estimate the costs of treating substance abuse. These methods are listed below (Figure 2). Their main features are briefly summarized. The feasibility/cost of

collecting the data and the adequacy to a European framework are assessed. Their fit to a digital ecosystem is evaluated also.

DATCAP (The Drug Abuse Treatment Cost Analysis Programme) is an instrument to collect data on the costs of treating drug abuse, using a specific accounting method. This method provides summarized operational guidelines and has been applied empirically several times. It aims to provide a tool to estimate the costs of providing substance abuse treatment in an outpatient and inpatient environment. In particular, DATCAP targets specialized drug treatment units, low-threshold agencies, general and mental health agencies, hospital-based residential treatment units, residential drug treatment units and therapeutic communities. One of its advantages is the completeness of the data designed for being collected. It accounts for expenditure on compensations of employees (*e.g.* wages and social contributions); services and materials (health care services, health care goods such as pharmaceuticals, non-health care goods and non-health services) and; fixed capital. Additionally, it includes the contribution of voluntary resources, provided as labor or as building expenses. An additional advantage is that DATCAP considers not only traditional accountancy data but also opportunity costs. Data collection is based on face-to-face interviews. Each interview requires more than 8 hours (Roebuck et al., 2003). The website of the United States National Institute on Drug Abuse (NIDA) used to have a link to this method (https://www.drugabuse.gov/research/research-data-measures-resources and http://www.datcap.com/index.htm).

BRIEF DATACAP (The BRIEF Drug Abuse Treatment Cost Analysis Programme) is a simplification of the DATCAP. It is suggested to use when there is limited time and money/personnel to collect data. It provides an estimate of accounting costs net of depreciation and other related economic costs. Compared to DATCAP, it needs less data. It does not account, for instance, spending on buildings, facilities and equipment (French et al., 2004). Data collection continues being based on face-to-face interviews and each interview requires approximately 4 hours. As compared to DATACAP, its BRIEF version reduces the data collection time by 50%. Additionally, authors refer that the degree of accuracy is only reduced by less than 2%.

CLIENT DATACAP (The Client Drug Abuse Treatment Cost Analysis Programme) estimates the cost of receiving treatment in the perspective of patients. There are two types of Client DATACAP programmes (Salomé et al., 2003). The Client DATACAP-I includes open-ended and multiple-choice questions, measuring costs of inpatient treatment facilities (*i.e.* inpatient detoxification, short and long-term residential care, hospital inpatient and therapeutic communities). The Client DATACAP-O includes 25 questions measuring costs of outpatient treatment frameworks (outpatient detoxification, outpatient drug-free, methadone maintenance, day treatment and intensive outpatient modalities).

SASCAP (The Substance Abuse Services Cost Analysis Program) is a theoretical and empirical method to estimate the costs of treating substance abuse. It estimates the costs of the various phases/types of healthcare service. It diseggregates estimates by the

spending on the initial assessment of patients, treatment planning, initial medical services; individual treatment, couples' treatment, family counseling, group counseling, ongoing medical services other than methadone, case management, quality assurance and methadone. Data collection is based on interviews to clinic directors, requiring less than 4 hours (Zarkin et al., 2004).

ADSS (The Alcohol Drug Services Study) is a method with a theoretical and an empirical base, which allows estimating the costs of providing drug and alcohol treatment in specific settings (hospitals and residential treatments units). The model requires data on revenue, costs of personnel and counseling activities. The number of clients is also necessary. Data collection takes a three-step approach: first, a telephone assessment; second, a face-to-face interview and; then a follow-up (SAMHDA, 1999).

TCAT (Treatment Cost Analysis Tool) is a method to estimate the costs of providing specialized drug treatment in outpatient frameworks. It is a theoretical and empirical method which accounts for accounting costs (direct and indirect) and economic costs. To avoid interviews and save time, it permits direct data entries (Flynn et al., 2009).

US (Uniform System) is an empirical method which estimates the costs of outpatient and inpatient units. It is applied for an initial assessment of individual situations, individual counseling, group counseling and mental health treatments. Data comes from daily data of treatment programmes, outpatient programmes and methadone maintenance programmes (CCC, 1992).

DATACAP&US combines previous approaches considering treatment service costs which include patient case-load information and time analysis to determine the use of resources. Estimates are made by service category, collecting supplemental program expenditure and patient caseload information. Estimates provide the unit cost of services and result from an interview with health staff (Anderson et al., 1998).

CPPOA (Cost-Procedure-Process-Outcome Analysis) is a theoretical method which allows estimating the accounting costs with a wide range of variables (direct services provided, material, supplies, transportation, communication and financial data). It estimates the costs of outpatient and inpatient services. Finally, using the value of resources used in the healthcare process, the method estimates the social cost of drug dependence (Yates, 1999).

TSR (Treatment Services Review) is a theoretical and empirical method which considers the costs of 96 units of treatment of drug dependence and related services and; estimates the social costs of the addiction phenomenon (French et al., 2000).

SROI (Social Return on Investment) is a method to estimate public expenditure and social costs of alcohol and of drug use, developed in England. It also estimates the social return of treatment applied to both substances. SROI is an empirical method which considers mainly the costs of providing prevention, treatment and recovery interventions. The main difference from the other methods is that it is focused on identifying specific economic and social costs more relevant to English stakeholders. Additionally, it is

concerned the the costs of inequality and it promotes wellbeing in the provision of these treatments (Banke-Thomas et al., 2015; Public England Health, 2015).

4.2 Digital ecosystem

This study aims to assess if these methods can be automated and applied in a digital ecosystem. The characteristics of a digital ecosystem applied to cost estimates are listed in Table 2.

In a digital ecosystem, practitioners and healthcare managers are required to work closely together in order to estimate the costs of drug treatment. As stated by León et al. (2016), a digital ecosystems model should consider a structured approach. It means that the analysis has to take into account the contextual characteristics of treatment provision. In another words, analysis has to consider factors such as technological context, legal framework or the existence of economic asymmetries prevailing in electronic services.

Additionally, if the chronicity of patients requires multidisciplinary approaches (McLellan et al., 2000), as in drug treatment; in a digital ecosystem, cost estimates require the participation of complete health teams. The medical community (doctors, nurses, psychologists and health managers) should participate in the process, in close cooperation with economists and IT system managers.

Table 2. Components of digital ecosystems: a conceptual framework for estimating costs

Components / Sources	**Description**
Community	Health communities: doctors, nurses, psychologists, and health managers.
Content	Costs calculated with a bottom-up approach.
Practice	Application of the model to pilot projects, and gradually increasing the availability into larger frameworks.
Technology	Cost-Kit able to input and account data for raw costs and providing an automated calculation of cost of treatment.
Biological species	Health Department for cost-benefit and cost-effectiveness analysis.
Economic species	Health authorities, IT companies, universities and research centres for subsequent data analysis.
Digital species	Management software for the management of health/costs data provided by public or private institutions.
Digital environment	Electronic Health Record (EHR) as a storage of data related to drugs, services and treatments provided and medical programming using common data lake.
Security	Take maximum data protection measures based on internal or cloud storage. Provide data centres in those realities with many patients or share security standards within a geographical region.
Trust	Create a business model based on the scientific accountancy of data that can provide estimates to policy makers, operational management, citizens and researchers in the drugs field, medical and management area.

Source: adapted from Iyawa et al. (2016) framework

5 Discussion

The literature review listed the most commonly bottom-up methods found in literature and applied in the last decade to account for the costs of treating dependencies. Now, we will assess their compliance with a digital ecosystem framework, according to pre-defined criteria (Table 2).

The analysis of the compliance of each cost model to the 'community' criteria, í.e., to the criteria that the whole community handling the treatment provision should be involved in the process reveals that none approaches involves a representative proportion of the health community when estimating costs. For instance, excluding the SASCAP and CCPOA which don't require the involvement of a significant proportion of qualified personnel, all the other methods are based on the assessment of 'qualified personnel'. For instance, the DATACAP and its variants (Brief DATACAP and Client DATACAP), as well as the TSR, require qualified personnel to collect data. They are based on collecting an extensive set of data; with different cost components; and using automated spreadsheets as a data collection tool. Indeed, these models require that training is provided to data collectors and in collaboration with health care staff (which are accounted in the process of data collection). Therefore, despite these methods result in a comprehensive set of data collected on costs and allow a complete cost analysis, they can be difficult to implement in real life, because of the time they require on training and on implementing surveying costs. This fact makes it difficult to health professionals to collect and manage costs.

Even considering practices, we state that all methods are applied to selected contexts and start by designing pilot projects. This fact favors the adoption of a digital ecosystem, since it complies with the criterium 'applied technology'. In fact, both the DATACAP and the TCAT are empirical accounting tools supported by a theoretical framework. Therefore, they comply with this criterium of digital ecosystems. The Brief and the Client DATACAP too. Additionally, these models comply with the 'digital species' and 'digital environment' criteria also. In fact, these four methods appear to be applicable to digital ecosystems since they are conceived in standards 'Excel' worksheets. The application of data collection tools and of linked accounting methods in digital user-friendly contexts, which are supported by mobile applications, allows to simplify the routine data collection and the estimates of costs. Further, this tends to reduce errors and the time required to perform the different tasks. Finally, the methods such as the SASCAP, ADSS and SROI are feasible and consistent with digital platforms.

As indicated by Ford et al. (2010), the evolution towards electronic data processing with Electronic Health Record (EHR) offers a system consistent with the spirit of public health service, because an enhanced information systems is able to provide accurate data mining and allows the monitoring of costs. However, the different models were linked to any EHRs.

Considering the "security" criteria, the content analysis did not reveal any specific element neither in the scientific contributions nor in the application documents. This can

be explained by the fact that models only allow data exchange between those who have access to it.

Concerning the compliance with "trust" criteria, i.e. the belief that all species want to achieve the same goal and the same level of security, our analysis shows a wide empirical use of methodologies such as the DATACAP or SASCAP and; that models like the DATACAP&US and CCPOA are less used. This could eventually be improved if users would trust more on these models, considering the network and the community in which they are applied. For instance, the creation of a simple and transparent business model based on the scientific accountancy of data, which could provide accurate estimates, would be useful to policymakers, operational management, citizens and researchers in the drugs field: Moreover, the medical and management community would be supported (Biancone et al., 2019).

Finally, considering the geographical analysis of the sources, except the SROI, the other methods were primarily applied in the United States. Nevertheless, as shown by (Chronaki & Vardas, 2013), there models like the DATACAP which could be adapted and applied also to some European healthcare realities. In Europe, health systems are characterized by a higher proportion of public healthcare interventions and have specific reimbursement mechanisms.

6 Conclusion

The results of this study allow us some conclusions and to draw some future implications.

To summarize, in this study started by surveying the literature. Authors searched studies which used a bottom-up approach to estimate the costs of treating drug dependence. Eleven methods were found. Then, authors analyzed which methods were used as tools to estimate costs and, then, their compliance with a digital ecosystem.

As Iyawa et al. (2016) stresses, digital cost ecosystem requires the cooperation of the community of professionals . Agarwal et al. (2010) adds that the estimates of health care costs must use consensual criteria, accepted by accountants, health care professionals, economists and policymakers. Among the methods analyzed, the DATACAP, SASCAP and SROI have these required characteristics. Nevertheless, when comparing these studies, we conclude that it is still necessary to reduce the heterogeneity of accounting methods applied and agree upon a commonly accepted methods to collect data and estimate costs.

The World Health Organization, jointly with the Organization for Economic Co-operation and Development and EUROSTAT, have developed the System for Health Accounts (SHA). The SHA provides a comprehensive conceptual framework to account for health financing systems. Its purpose is to help accountants and policy makers to obtain a clear and transparent picture of their health financing systems, which is comparable by international standards (OECD et al., 2017). Therefore, the introduction of the SHA concepts and classification system are a desirable feature to introduce.

Most systems of drug treatment provision are funded through several complex arrangements. While many European countries purport to have universal healthcare coverage, the reality is that most patients pay some form of co-payment and/or are privately insured. Notwithstanding, that differs frequently with funding healthcare systems. Differences have been considered in the SHA classification system, but data published accordingly are still scarce. Data concerning expenditure on the treatment of substance abuse is generally not available.

Therefore, all in all, even if the SHA could provide valuable guidance on the mapping/accounting structure and should be used in estimates of drug-related spending. Respecting the SHA structure would assist the mapping process and would help to ensure completeness of estimates and comparability of results. But, the SHA still does not provide a specific framework for classifying drug treatment. Therefore, estimators may feel the need to develop additional and more detailed classification systems (if possible in the respect of the SHA).

Only when international consensus exist it will be possible to use an agreed method and its results. Then, cost estimates will be safe to use in cost/efficiency analysis and in the support of policy and practice.

Additionally, this study aimed to assess the cost models in the light of their applicability to automated calculation procedures, in digital frameworks. According to the information collected, only six of them assume an automated calculation method (CCC, 1992; M. T. French et al., 2000; Michael T. French et al., 2004; Public England Health, 2015; Roebuck et al., 2003; Salomé et al., 2003).

As a suggestion for further research, and to conclude, as a result of the analysis of cost models and of the analysis of digital ecosystem frameworks, we conclude about the utility of developing an European framework, where accounting rules and procedures would respect the SHA and would be applicable to the field of substance abuse treatment. The suggestion would be to push for developing a toolkit, where objectives would be such as managing data collection and aggregation data, as well as permit automatic calculations certain types of treatment costs. This concept should be designed considering the integration between different areas of care and with the possibility to add internal or external projects, as widespread in the field of dependency care. This would be particularly useful to develop cost-effectiveness analysis (McLellan et al., 2000).

Last but not least, an implication of the current analysis is the need to develop methods which benefit from more intervention of digital technology, and in respect of digital ecosystems, better considering elements such as the community, content, practice, technology, biological, economic and digital species, digital environment and security practice. Safety remains one crucial factor which has been neglected consistently in the current methods developed. The support of pilot projects would be a desirable way to proceed.

Furthermore, this paper was written considering the perspective of health managers, policymakers who need to plan and implement budgets. This way, we aim to contribute to

the development of better models and more reliable estimates of costs, allowing a fair discussion on the cost-effectiveness of various types of treatment for substance abuse.

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Digital Transformation for Health Care could be Supporting by Innovative Accounting?

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Abstract

Digital Transformation is one of the most important drivers for the progressive changing of a broad range of health care sector. Digitalization allows organizations to radically improve their performance by providing consistent opportunities to disrupt their value creation process and, therefore, by creating new customer relationships through digital infrastructures. ERP and SAP are currently analyzed in healthcare as tools for change and success in the digitization of control and management systems. At the same time, the IPSAS principles supporting NPFM tools direct the organization towards a single integrated system aimed at guaranteeing the decision-making processes that hospital structures need in the face of a significant incapacity of Italian healthcare companies to have a overview in real time. Two theoretical approaches guide the reading of the case and allow to highlight the impact of the digitalization of the control and administration system. The analysis of the Bambin Gesù of Rome (Italy), a polyclinic of pediatric excellence, guides the analysis, and allows some innovative observations. The study uses an empirical research method that integrates case study analysis, structured interviews, analysis of hospital documents and interventionist approach. The case study was analyzed between 2017 and 2020 to identify changes and principles that have changed the company's management and organizational approach,

confirming the basic theoretical model. The heads of the organization and management control of the Hospital were questioned through a survey on the identified theoretical elements. The analysis was triangulated through interviews and analysis of internal management reports in order to confirm what emerged. The Interventionist approach was realized thanks to the involvement of two of the authors in the progressive change of the organization and the internal control system, guaranteeing direct observation and a refutation of the opinions gathered by the internal experts. The introduction of NPFM tools, such as the SAP management control system and IPSAS accounting principles, has led to a standardization of accounting processes relating to clinical and research activities. The adoption of new control instruments and adhering to the accounting approaches referred to by the NPFM is currently applied and has led to an increase in efficiency, effectiveness, and quality of services with greater transparency expressed in the financial statements. The possibility of obtaining reports in real-time, the standardization of processes, homogeneity of data management associated with the characteristics of data quality guarantee support for decision-making processes and respond to the aim of the research.

Keywords – Digital Transformation, ERP, SAP, IPSAS.

Paper type – Academic Research Paper

1 Introduction

Digital Transformation is one of the most important drivers for the progressive changing of a broad range of health care sector (Cech & Tellioglu, 2019; Hanseth & Bygstad, 2015). Digitalization allows organizations to radically improve their performance by providing consistent opportunities to disrupt their value creation process (Biancone et al., 2019) and, therefore, by creating new customer relationships through digital infrastructures (Faggini et al., 2019). ERP and SAP are currently analyzed in healthcare as tools for change and success in the digitization of control and management systems (Streitz, 2018; Kraljić & Kraljić, 2018; Kuhn, 2019). Before developing an ERP process and adequate IT management tools, the health structures must have reached an adequate level of internal maturity that involves all the key processes and takes into account the characteristics of a series of processes capable of reflecting the effectiveness and repeatability in key processes of the organization (Williams et al., 2019). These elements lead to the definition of procedures, practices, and communications aimed at the internal improvement that consider different aspects and radically change internal policies and organizational elements (Williams et al., 2019) with an impact on the accounting system with a change in the internal drivers and external outputs (Bae & Ashcroft, 2004). In the healthcare sector, there are several examples in which the ERP approach and the SAP software management tool have improved the quality, efficiency, and effectiveness of the production and management processes in healthcare (Marcu & Popescu, 2012; Kraljić, A., Kraljić, T. & Delismajlović, 2013; Poba-Nzaou et al., 2014; Syafiraliany et al., 2019). At the same time, the introduction of the IPSAS accounting principles pushes the organization to define processes aimed at increasing accountability, transparency and a real vision of the structure capable of supporting the internal decision-making process.

However, there is no evidence in ERP approach and SAP using regards healthcare structures following the application of accounting harmonization in Italy and new IPSAS accounting approaches. The absence in the literature of the observation of the phenomenon highlights a lack of attention in the Italian context, which pushes healthcare towards the latest innovations without analyzing reality and contributing to a real change with a deeper understanding of the context and theme (Ricciardi, 2019; Ricciardi, 2015). The study aims to investigate the impact that an ERP approach using SAP software has on the health organization and the efficiency of the structure that applies IPSAS principles. The study integrates two approaches that observe the same phenomenon. The study uses an empirical research method that integrates case study analysis, structured interviews, analysis of hospital documents and interventionist approach (Argento et al., 2019). The method confirms and expand what is defined by the literature on ERP and SAP solution in healthcare. Williams et al. (2019) guides case analysis based on the theories highlighted by the ERP literature. The accounting approach and the outputs of SAP software allow to analyze the degree of innovation within the organization, confirming and expanding the existing literature on digital transformation. The case study is significant in that it represents a hospital of excellence of Bambin Gesù Children's Hospital of the Vatican – Rome (Agenas, 2018), therefore the data obtained will not be conditioned by organizational and managerial inefficiencies (Moullin, 2007; Hussey et al., 2009). The international accounting standards of the public sector, Ipsas, and the information tools of the private sector, Sap, can help the structure to be more effective in reporting and to direct investments in innovation with a rational administration based on the most aware budget. The adoption of IPSAS accounting principles and a digital transformation approach through the ERP approach is capable of leading to a significant increase in supporting quality output in healthcare (Biancone et al., 2017).

2 Literature review

2.1 IPSAS and NPFM tools

The adoption of international accounting standards represents a moment of change in the functioning of each organization. Accounting changes have animated literature for many years (Carruthers, 1995; Dambrin et al., 2007; Libby and Waterhouse, 1996; Nahapiet, 1988). They have been followed by many approaches to understanding evolution, causes, trajectories, and paths of these changes in different types of organizations. The application of international standards is closely related to New Public Financial Management NPFM (New Public Financial Management), which deals with identifying the most correct technical and accounting instruments to be applied (Guthrie et al., 1999). NPFM, according to Gurthrie et al. (1999), involves several approaches, the main ones being accrual accounts, performance indicators, delegated budget, devolved budgets, full costs, output groups, outcome statements, accrual output-based budgeting

and fiscal responsibility statements. NPFM is related to new managerial control approaches applicable to all public interest companies, including hospitals; Jackson and Lapsley (2003: 362) identified three areas of analysis: budgeting, accounting costs, and performance measurement. Each of these three categories is further divisible into potentially practical techniques: for example, budgeting includes zero-based budgeting, resource management, and activity-based management; cost accounting includes the target costing, activity-based costing, and strategic cost management; while performance measurement includes functional analysis, key performance indicators, and the balanced scorecard. The presence or absence of such tools leads Jackson and Lapsley (2003) to consider organizations advanced in terms of managerial control. NPFM brings the organization to five significant changes, the first related to a reporting system change, accrual-based financial statements across departments, and reliance on professionally accounting set accounting standards. The other changes involve the development of commercially minded, market-oriented management systems and structures to deal with the pricing and provision of public services, with emphasis on cash management, contracting-out arrangements and internal and external charging/pricing mechanism, development of a performance measurement approach, including techniques such as financial and non-financial performance indicators, devolvement/decentralization or delegation of budgets and changes to internal and external audits (Guthrie et al., 1999; Olson et al., 2001; Lapsley, 1999). The approaches are closely linked to management systems capable of supporting change, management, control, and economic and financial output (Destri, 2013). It is precisely on the output of the accounting system that the IPSAS is based, guaranteeing a different approach aimed at guaranteeing real transparency on different balance sheet items, which become more significant in healthcare structures and require more considerable attention than others.

2.1 SAP and information system

The acronym E.R.P. (Enterprise Resource Planning) identifies the integrated management systems, sets of integrated software applications, which manage all the relevant information of the company in a single centralized database and which allow managing in a coordinated way a multiplicity of activities of the company (Gargeya & Brady, 2005). The acronym E.R.P. it was coined in the early 1990s to indicate new integrated management systems for manufacturing companies, and then spread to the management of all production activities, including healthcare. SAP is an E.R.P. system (Jacobs & Whybark, 2000). According to the literature, it can make quantitative and qualitative improvements to the management, control, and programming systems. Nahet al. (2001) identifies 11 characteristics that E.R.P. they must possess, and which become part of the theoretical frameworks applied to all systems of this type, including SAP. The E.R.P. system must be able to change the company's programming and culture and depends on the composition of the corporate team. Due to a cultural change, the corporate

vision also undergoes an evident change with an impact on communication systems. These changes support top management in the definition of choices and re-engineering processes with performance evaluation systems and standardized levels. The processes are able to guarantee adequate business information with a personalization of the software to the necessary reports and controls. The 11 characteristics lead to tangible and intangible improvements represented in table 1 based on Nah et al. (2001), Themistocleous et al. (2001) and Stratman and Roth (2002).

Table 1 tangible and intangible benefit of E.R.P.

Tangible benefit	Intangible benefit
Inventory reduction	Information visibility
Personnel reduction	New/improved processes
Productivity improvements	Customer responsiveness
Financial cycle improvement	Cost reductions
Revenue/profit increase	Integrations
Transportation/logistics cost reduction	Standardization
Maintenance reductions	Flexibility
On-time delivery improvements	Globalization
	Supply/demand change
	Business performance
	Dismantling inefficient legacy systems

The results obtained from the study by Poba-Nzaou et al. (2014) indicate first of all that the performance motivations underlying the adoption of ERP systems in healthcare organizations are of a technological, managerial (operational and strategic), clinical (operational and strategic) and financial nature. However, these organizations differ in the ERP management or clinical advantages that are privileged considering the core business of these organizations. The analysis also highlights the impact of efficiency and effectiveness linked to the use of ERP systems. Furthermore, the management of clinical elements associated with economic elements and developed information systems has already allowed an increase in the quality and appropriateness of the treatments linked to the adoption of SAP systems in various structures through a first management development phase linked to the back office and a second base which combines elements related to the healthcare services provided. Williams et al. (2019), have defined a theoretical framework that incorporates the two aspects highlighted by putting a system of maturity based on the system's key process area, activities, variations, and maturity of the subjects involved in the use of the data. The analysis framework is based on eight steps. In the first, the context's digital maturity levels are identified. The second step defines the area of technological processes associated with functional outcome-based technologies and services (transport, collaboration, security, mobility, and data center). The third step includes defining each domain in functional activities strictly related to subdomains of the second step. In the fourth step, outcomes are identified for each capability (key practices). The fifth step involves evaluating the activity outcomes and associating each level's maturity with the technological capacity produced. The infrastructure's capacity leads to critical elements and non-critical analyzes of the results associated with the service

provided; this is mapped in the sixth step. The final step concerns the weight given to each capacity by attributing weight to critical and non-critical elements. It refers to the impact that the SAP system can give to the organization for the achievement of clinical and administrative objectives.

3 Method

The applied method investigates the same phenomenon through two different but necessary perspectives to explain the complex organizational reality (Mayer & Sparrowe, 2013). The two theories are dealing with the same phenomenon, i.e., technical tools for identifying an approach that leads to efficiency, effectiveness and quality of services within the hospital, guaranteeing a control system and real transparency in decision-makers. The phenomenon is analyzed through two perspectives, one linked to the theoretical framework of the development of an outcome-based infrastructure which also considers the maturity assessment connected to the SAP application (Williams et al., 2019), the other approach linked to the accounting principles that identify management control tools through NPFM and redefinition of balance sheet items based on IPSAS principles (Jackson and Lapsley, 2003). Both approaches deepen the management control tools that direct towards a higher management capacity linked to the digitalization of the control itself. Without applying one of the two approaches, it would not have been possible to solve the management problems encountered. The theme is complex and needs several keys. The study uses an empirical research method that integrates case study analysis, structured interviews, analysis of hospital documents and interventionist approach (Argento et al., 2019). The case study of the Bambin Gesù in Rome (Italy) confirms what has been defined theoretically (Dul & Hak, 2007; Yin, 2017). The case study was analyzed between 2017 and 2020 to identify changes and principles that have changed the company's management and organizational approach, confirming the basic theoretical model. The heads of the organization and management control of Bambin Gesù Hospital were questioned through a survey on the identified theoretical elements. The analysis was triangulated through interviews and analysis of internal management reports in order to confirm what emerged. The Interventionist approach was realized thanks to the involvement of two of the authors in the progressive change of the organization and the internal control system, guaranteeing direct observation and a refutation of the opinions gathered by the internal experts who will be called internal actors.

3.1 Case Study

The Bambin Gesù is the largest Polyclinic and Pediatric Research Center in Europe with 2,600 doctors, researchers, nurses, hospital technicians and employees and over 1,600,000 health services provided every year to children and young people around the world.

The belonging body at the Vatican operates in the Italian state for the effect of Law no. 187, that has ratified and executed the specific Agreement between the Italian government and the Holy See of February 15, 1995, to regulate relations between the hospital itself and the Italian National Healthcare system. The structure has also adopted an accounting system based on IPSAS accounting principles to guarantee a higher quality of accounting output (Mhaka, 2014). The structure has also introduced an SAP system capable of managing the structure's control, management, and administrative delivery system. The current stage of development has not yet directly affected the management of clinical data. Furthermore, Bambin Gesù Hospital is significant because it is among the first in terms of efficacy of results in care technical assessment and health research (Ruggieri et al., 2019; Andellini et al., 2019; Angelico et al., 2019) therefore, it is not influenced by inefficient results at the time of the analysis.

3.2 Results

The Bambino Gesù Pediatric Hospital needed to re-engineer its information system and integrate it with a more structured solution. The objective also expressed through the interviews was to manage all the information necessary to optimize the quality and speed of the services offered directly from a single terminal: accounting, pharmaceutical warehouse management, coordination in shift work, management control of research orders. The project proposed by Technis Blu and supported by the management of the Bambino Gesù Hospital was divided into several steps. The company that developed the control and management system focused on:

• The processes of the Bambino Gesù Hospital (and not on individual areas), with a view to greater integration;

• The use from the initial stages of a pre-configured solution, which contained within it the main responses to the needs expressed by the healthcare company, drastically reducing implementation times for the final project.

Both aspects have proved particularly useful not only at the organizational level of the entire project. In fact, they have allowed operators to get in touch since

immediately with the new system, without waiting for the final implementation. This has obviously translated into a speeding up of staff training times.

The members of the administrative and management control offices in 2017 identified several elements that led the company organization to find it difficult to define programmatic and control tools. There was no standardized system in the hospital's administrative management, and there were several difficulties in defining applicable common accounting standards and difficulties in finding updated data capable of defining reports and associated policies. All the interviewees point out the problems and the need for organizational and managerial change. The change occurred in 2018 thanks to the adoption of ERP systems based on SAP software, all the actors' highlight that they have identified the program thanks to a study of the best management systems adopted in the

private sector. The instrument was fully adopted in 2019. At the same time, the components of the administrative and management control offices had identified some problems relating to the quantification of fixed assets, which require a fair value to guarantee the correctness and enhancement of equipment and instruments that are vital within the company structure, given the clinical implication of the same (Miniati et al., 2011). The managers need a tool capable of determining the achievement and definition of policies through performance by basing the elements on financial factors. Each aspect of the process leads to an enhancement that must be quantified in real-time to bring about the correct definition of elements (Biancone et al, 2019). The direction of Bambin Gesù from 2017 needed to define policies based on target costing, activity-based costing, and strategic cost management. The adoption in 2018 of new accounting standards and the ERP system required the implementation of a training course for all subjects suitable for understanding the functionality and the possibility of adopting accounting standards. Through the company actors, it is possible to identify various advantages, including the ability to coordinate processes in a centralized and automated way through an agile infrastructure. The functions guaranteed by SAP allow dynamic management of resources with a high level of collaboration services in resource management. The main positive aspects identified concern the traceability of documents and registrations, greater internal transparency with immediate accessibility to the accounting documents of the entire company, and more exceptional ability to trace company passive flows. All respondents stated that IPSASs increase the level of accountability and transparency with a relative increase in the quality of the financial reporting and internal control system However, the corporate actors identify an often-excessive rigidity in correcting accounting errors and the management of employees' wages and contributions. To date, SAP has not yet managed the clinical procedures which remain separate from the administrative management, although they are linked and conditioned. The players note a change in the efficiency and effectiveness of business processes justified by the introduction of accounting principles and the SAP system with higher planning capacity. Considering the tangible and intangible benefits, the interviewees recalled all those highlighted in table 1.

4 Discussion

The IPSAS accounting principles have pushed towards a more excellent application of management control techniques and systems to increase transparency, efficiency, and effectiveness within the organization among decision-makers (Brusca et al., 2018). In particular, the NPFM has introduced a reform of new frameworks of accountability, new management systems and processes, and new accounting practices and procedures (Jakson & Lapsley, 2003). Geroski (2000), considering the changes brought about by the OECD, has started in all countries, including Italy, an innovation of the means available to manage accounting and public-interest organizations. New techniques such as activity-based costing, resource management and key performance indicators have been introduced into public interest organizations. Bjornenak (1997) is one of the first to talk

about the transmission of tools spread in the private sector applied to organizations of public interest, the introduction of ERP systems and the SAP system is configured just like a new approach that had not been applied until then. Alter, and Hage (1993) also demonstrated that the use of new techniques based on the grouping of processes and definitions of performance leads to a reduction of risk and uncertainties. Axelsson and Easton (1992) introduce the theme of the relationships between internal and external subjects necessary to improve the quality of the service thanks to the market and make improvements in the relationships provided by the network, for this purpose a control system suitable to respond to this new need it becomes necessary. As recalled by the interviewees and by the analysis of the information found in the internal reports, the IPSAS principles increase the level of accountability and transparency with a relative increase in the quality of the information present in financial reporting; the characteristics have already been highlighted in a study conducted by Ababned and Porretta (2019) on the United Nations agencies. The study also highlights the impact of the control system in supporting the results obtained thanks to the IPSAS. The infrastructures supporting the information systems with the digitization of information becomes a critical element for the survival of the healthcare organization in the face of new management needs (Walsh & Rumsfeld, 2017). The quality of the information together with the standardization of the processes is recalled in the adaptation of the new ERP processes (Bernal-Delgado, 2017). The investigation has continued to highlight that the data quality dimensions were mapped before initiating the structural information change, these concern the complexity (coverage, density, relevancy, and sufficiency), the relevancy (current, timely, correct, and sufficient), usability (usefulness consisting of relevance accuracy and completeness, easy to use and organized, the availability (accessible, compatible, interretable, and locatable), reliability (unbiased, reputation traceability including data source, credibility, consistency) and security (supports all other dimensions) (del Pilar Angeles & GarcĂa-Ugalde, 2012; Biancone et al., 2019a). The approach applied in the clinic follows the framework identified by Williams et al. (2013) on accessibility and on the definition of the value of the processes. In particular, the entire organizational extension part of the definition of the level of maturity that measures the key process areas defines the objectives, identifies the standardizable practices in activities and the common characteristics that have an impact on the policy, on standardized processes, on procedures, on tools and training. The questionnaires, interviews, and analyzes of the business processes identified in the new ERP infrastructure confirm the elements of the theoretical framework. Comparing the characteristics of each objective grouped by activity theology leads to a continuous improvement of the key processes. The key processes of Bambin Gesù are at the same time purely clinical activities and those strictly related to scientific research, in both cases the need for activity-based analysis through appropriate budgets is essential in defining and defining the clinical outputs that are already mapped through protocols. In this case, the ERP guarantees a dual process and scientific project vision, guaranteeing the interpolation of specific data to support

empirical evidence. Although the structure is only at an initial level of maturity in which the elements are managed at an administrative and tactical level, there are maximum usable levels of information, as the information is reliability when requested, it is usable and present in an adequate format and appropriate for use, they are relevant in that they respond to the requests of the tasks and are complete and capable of allowing decisions by the actors. The interviews allowed to identify the main activities confirmed both by the social report of the Bambin Gesù and by the report of the health and scientific activity. The measurement of the associated activities and performances made it possible to identify the main processes and measure the outcomes by assigning a weight of priority based on each activity. In the internal strategies defined, management control becomes functional to support the direction of decisions and oriental key practices. Precisely the theme of accounting principles, highlighted by respondents, is referred to the obsolescence of the equipment supporting the structure and supports decisions. According to IPSAS 17 "property, plant and equipment" after recognition as an asset, an item of property, plant and equipment whose fair value can be measured reliably shall be carried at a revalued amount, being its fair value at the date of the revaluation less any subsequent accumulated depreciation and subsequent accumulated impairment losses. Revaluations shall be made with sufficient regularity to ensure that the carrying amount does not differ materially from that which would be determined using fair value at the reporting date (IPSAS 17, 44). The analysis has shown that from 2019 an evaluation of fixed assets is active with the new fair value method, which, within a context-oriented towards excellence and innovation on new analytical accounting systems, leads to real improvement. The budgeting and planning, programming, and control process, there is still the absence in the standardization of autonomous clinical IT applications. Although the administrative and accounting processes and the diagnostic clinical ones are closely related and it is possible to intertwine the results, the organization has preferred not to standardize these processes in part because already guided by clinical protocols in part because subject to experiments that lead to an innovation of the cures that would be too conditioned by imposed management poles.

5 Conclusion and remarkable

Through interviews, analysis of internal documents, and public documents, the study highlighted the confirmation of what has been highlighted in the literature on management control systems linked both to ERP systems based on SAP Software and to the effects of the NPFM and IPSAS principles. The introduction of NPFM tools, such as the SAP management control system and IPSAS accounting principles, has led to a standardization of accounting processes relating to clinical and research activities. Although the structure has not yet reached an advanced technological maturity level, the system reflects the theoretical framework referred to by Williams et al. (2019). The adoption of new control instruments and adhering to the accounting approaches referred to by the NPFM is currently applied and has led to an increase in efficiency,

effectiveness, and quality of services with greater transparency expressed in the financial statements (Jackson and Lapsley, 2003). The possibility of obtaining reports in real-time, the standardization of processes, homogeneity of data management associated with the characteristics of data quality guarantee support for decision-making processes and respond to the aim of the research. The aspects were confirmed both through interviews and through internal hospital documentation. Adopting a framework that embraces business processes and adopting NPFM tools is oriented to investigate the same results and allow a reading of the same phenomenon. The analysis introduces some elements of reflection, including the theme of technological innovation and the need to keep the asset recorded in the balance sheet under control to determine its use and obsolescence with an impact on care. The issue needs to be investigated further and guides future research in this direction. Also interesting is the dichotomy between the theoretical framework proposed, which requires the adoption of systems under control standardized through SAP, and the need for research-oriented centers that need management freedom to register and keep under control the clinical data. This aspect should suggest that the service's digitalization process must take into account the differences between the types of clinical structure. This aspect also requires future investigation.

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Disseminating Open Government Principles in Public Procurement. The Adoption of Integrity Pacts and Open Contracting Data Standard

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Abstract

Recent studies on EU public procurement showed how an increase in public accessibility of procurement data can raise the likelihood of having competitive bidding processes, increase the number of bids per contract, and facilitate market entry by new vendors.
According to OECD, the application of Open Government principles emphasizes governmental accountability and legitimacy; nevertheless, these principles foster collaboration and engagement between civil society and public administrations.
In the context of public procurement, the adoption of Integrity Pacts – a signed contract between public authorities, companies bidding for a contract and a Civil Society Organisation (CSO) acting as independent monitor – represents a viable solution so far applied in many countries for enabling governments to gather and mobilize public support for their programs and to avoid the high cost in loss of reputation attached to occurrences of corruption in highly sensitive projects. Beside Integrity Pacts, open contracting data standard – a scheme that provide shareable, reusable, machine-readable open data across the entire cycle of public procurement – has the potential to foster the achievement of open government principles, i.e. transparency, participation and accountability.
This paper explores the extent to which the dissemination of Integrity Pacts and the adoption of innovative digital solutions (OCDS) might build shared knowledge and enable a real transition to Open Government principles in public procurement.

Keywords – Public Procurement, Open Government, Integrity Pacts, Open Contracting Data Standard.

Paper type – Academic Research Paper

1 Introduction

Public procurement (PP) represents a crucial pillar of public sector efficiency and community well-being, as it accounts for a substantial portion of taxpayers' money and contributes to achieving pressing policy goals such as environmental protection, innovation, job creation and the development of small and medium enterprises (OECD, 2015). PP has a multi-faced and holistic nature and it encompasses the key strategic and managerial dimensions of state and local governments.

The burden caused by mismanagement of public funds and corruption in public procurement, raised the awareness of a growing number of actors about the need of ensuring transparency along the whole public procurement cycle.

The spread of COVID-19 pandemic among EU has so far determined a brutal shock that worsened the economic and social condition of several countries. EU is now setting the agenda to revitalize the internal markets and to boost the resilience of State members. The Commission announced the aim to invest 1.85 trillion euros for the EU's long-term budget to build a "next-generation EU". A major portion of these funds will be spent through public procurement.

In light of these elements, data availability and legibility represents an issue of major concern for the fair and effective management of public procurement among EU countries. At this regards, a recent study from academics at Yale and MIT Sloan found that the publication of procurement data on the EU's Open Data Portal had major social benefits that range from (Duguay et al.,2019):

- the number of bids received increased per call for tender published as open data (the initial analysis in the paper suggests this was by approximately 12%);
- public officials were more likely to award government contracts to new vendors after the increase in open data accessibility and;
- prices for contracts with open data publication decreased (by approximately 8% in the initial analysis).

Coherently with these data, a report from the European Bank for Reconstruction and Development (EBRD) shows that open procurement data lowers barriers to entry and the cost of doing business for SMEs. After Ukraine enacted public procurement reforms based on Open Contracting Data Standard (OCDS), the country saw significant gains, - i.e., US $1billion in savings and around 80% of businesses using the procurement portal were SMEs; among them, 75% won at least one public contract in 2016.

Digital solutions are of pivotal importance in order to address a wide range of public policy issues as they have, among others, the power to reshape interactions between public institutions and other external key stakeholders.

Standardized open data that links all different stages of procurement (from planning to implementation), enables smarter contract management, red-flagging, efficiency monitoring, auditing capabilities, and even quicker transactions. More external monitoring of procurement can reduce levels of corruption and inefficiencies.

The European Commission's Directorate-General for Regional and Urban Policy and the Civil Society Organisation "Transparency International" runner a joint program since 2015 aimed at promoting the use of Integrity Pacts (IP) to increase transparency and accountability, enhance citizens' engagement and trust in public institutions, bring cost savings and improve competition and promote awareness and better understanding of public procurement (EU Regional Policy Website).

Integrity Pacts are signed contracts between public authorities, companies bidding for a contract and a Civil Society Organisation (CSO) acting as independent monitor. Contracting authority and bidders commits to open all the process-related documents for facilitating monitor oversight on all the procurement phases.

Many countries have so far adopted Integrity Pacts (Ips) as viable solutions for enabling governments to gather and mobilize public support for their programs and to tackle the high reputational risks (Carpenter and Krause, 2011, 27) linked to corruption phenomenon in highly sensitive projects of public administrations.

Despite a growing debate on the specific relations between transparency, accountability and participation in public procurement, (Schnequa et al., 2012; Mabillard and Zumofen, 2020), and although there is a broad consensus at the EU level on the adoption of Integrity Pacts, public management literature has so far devoted narrowed attention at addressing the role of Integrity Pacts within public procurement.

This paper explores the extent to which the dissemination of Integrity Pacts and the adoption of innovative digital solutions (OCDS) might build shared knowledge and enable a real transition to Open Government principles in public procurement.

The remainder of the study is structured as follows: section 2 presents some theoretical background; section 3 describes design and method applied in the research; section 4 shows the preliminary results of the analysis; section 5 discusses the results; section 6 is devoted to concluding remarks.

2 Theoretical background

According to Matheus and Jansenn (2019), transparency is aimed at overcoming discrepancy in information, thus enabling the public to view what is happening within the government.

Many authors framed transparency within the context of the principal-agent theory (Broadbent et al., 1996), as one of the instruments available to a "principal" for controlling that its "agent" does not engage in "shirking", i.e. activities which promote its

own interests rather than the interests of the principal (Soudry, 2007; Lindstedt and Naurin, 2010).

Mancini and Lambroglia (2017) provide an in-depth review of the literature concerning transparency in the public sector and its multiple relations and connections with other key concepts of public management discourse i.e. accountability (Ezzamel et al., 2004; Kudo, 2004; Hood, 2010; Meijer, 2014; Fox, 2018), ICT and accounting systems (Rodriguèz Bolivar et al., 2015).

Beside the need for transparency, PP has to ensure effective stakeholder participation, coherently with Open Government and SDGs principles which encourage responsive, inclusive, participatory and representative decision-making process at all levels.

Open government principles influence the political arena in which "social forces external to the government claim a larger role in the society animated by progress in IT" (Pyrozhenko, 2017, 1495). The application of Open Government principles emphasizes governmental accountability and legitimacy; nevertheless, these principles foster collaboration, engagement and participation of civil society with governments (Lee et al., 2019). The extent to which local communities and other key stakeholders can monitor and influence government decision-making arenas (Meijer et al., 2012) – both in terms of policy definition and service provision – greatly depends on the level of government transparency and openness.

From a public value perspective (Benington and Moore, 2011), the aforementioned principles are 'substantive value' that deliver specific benefits to individuals, groups and organizations (Harrison et al., 2012).

Transparency and participation in public procurement can be properly achieved by using digital technologies for a wide range of purposes (i.e.: to allow visibility of the flow of public funds, to facilitate access to public tender for potential competitors, to apply monitoring and control mechanisms which support accountability throughout the public procurement cycle, etc.).

Recent studies on EU public procurement (Duguay et al.2019) demonstrate how an increase in public accessibility of procurement data can raise the likelihood of having competitive bidding processes, increase the number of bids per contract, and facilitate market entry by new vendors.

3 Design and Method

To investigate the topic of this study, researchers assumed a qualitative methodology based on semi-structured interviews which involved projects coordinators of the main CSOs (Monitoring). Project coordinators have been selected for interviews because of their knowledge of the entire Integrity Pacts process. A total of five hours of interviews were carried out, and interviews were carried during online calls. Interviews were semi-structured and in the form of a colloquial conversation to allow interviewees to be at comfort, with questions designed to gain understanding of both the methodology behind the monitoring activities and the chosen drivers. Questions asked during the interviews

are related to some key concepts such as coordination with contracting authorities, citizens' participation and outcomes of the process especially in terms of reporting issue.

Tables n.1 Description of Interviews

Organization	Interviewees' role in the project	Duration of the interview	Format
Transparency international Italia	Project coordinator	100 minutes	Online call
ActionAid Italia	Project coordinator	100 minutes	Online call
Amapola	Project coordinator	100 minutes	Online call

The Dg Regio Pilot Program "Integrity Pacts, Civil Control Mechanism for Safeguarding EU Funds" brings together government agencies, private sector and civil society in 11 EU countries to ensure that 18 major public contracts are designed and implemented to the highest possible standards of transparency, accountability and efficiency, according to the public interest.

In addition, this project aims at engaging communities, social groups and professional associations directly affected by a specific public contract. As a result of the first four years of the DG Regio project, the Italian cases seem to be those which showed the best degree of citizens engagement during the Integrity Pacts implementation. Among other evidences (number of citizens involved, public events organized, monitoring schools etc.), this is testified by the specific DG Regio decision to host in the "Civic monitoring and Citizens Participation" stand at the 2020 High Level Conference "Engaging Citizens for a Better Governance in Cohesion Funds", held in Brussels in February, only the Italian projects by Transparency International Italia, ActionAid Italia and Amapola together with a dissemination example provided by an autonomous initiative of IP implementation born in Sicily and patronized by the Municipality of Palermo and Parliament Watch Italy.

3.1 Coding approach

The research team analysed the interviews isolating the relevant information according to the research objectives. We extrapolate from the selected case studies a series of quotes that are representative of the main dimensions identified i.e. "transparency", "participation" and "accountability". The analysis concerns the following cases:

"*Museo Archeologico Nazionale della Sibaritide e Parco Archeologico di Sibari"*

Sybaris (in Calabria), 2,800-year-old Greek city, had recently become a lost city. In the mid-20th century archaeologists rediscovered the old ruins. Now the Ministry of Cultural Heritage is undertaking two projects, "Museo Archeologico Nazionale della Sibaritide e Parco Archeologico di Sibari", funded by PON Cultura e Sviluppo FESR 2014-2020, to preserve and rejuvenate Sybaris and the archeological site. Worth a combined €2 million,

the first project involves the modernisation of Sybaris' Museum; the second project will allow visitors access to a Roman-era religious temple known as the "White House". ActionAid Italy is monitoring both procurements using an Integrity Pact, to make sure that ancient history is truly persevered and that local communities can benefit economically and socially from their heritage.

"Metropolitana leggera di Cagliari"

Infrastructure is one of the most exposed sectors to corruption in public procurement in Italy. In Cagliari, Sardinia's main city, the Sardinia's Transport Agency is working to the construction of the final 2.5 km extension of the city's tram service to connect with six new stops the tramway with the transportation hub of the city. In collaboration with local civil society, Transparency International Italia (henceforth TI Italy) is implementing an Integrity Pact on the project "Metropolitana leggera di Cagliari" and organizing workshops and a civic monitoring school to engage citizens in monitoring the €20 million project.

"Madonie Resilienti: Laboratorio di Futuro"

In Sicily 21 municipalities joined a Union called "Unione Comuni Madonie", to share resources and public services. The Union is the contracting authority of a €39 million development project of the National Strategy for Inner Areas (SNAI) called "Madonie Resilienti: Laboratorio di Futuro". Amapola is implementing an Integrity Pact to monitor public procurement procedures selected from two crucial development areas: energy efficiency and education. Amapola is targeting the local youth with awareness-raising activities: students are involved in the monitoring of procurement processes and are provided with tools to become active citizens.

Tables n. 2 Key Information gathered during the interviews.

Driver	**Interviewed Organisation**		
Knowledge Building	Transparency International Italia	ActionAid	Amapola
	1)"For the contracting authority, among the motivations to sign the Integrity Pact there is the occasion to apprehend from a direct contact with the independent monitor, thus experimenting a new and more sophisticated version of the IP." 2) "Although there wasn't any reporting of irregularity, the IP benefits from technical remarks,	1) "The Ministry of Culture has all the procurements information on a platform named Community Mibact. They have granted us access and we had the possibility to acknowledge all the tender documents." 2) "We have done a single reporting of irregularity (done by the previous project	1) "To understand the reason of our procurement's delay we crossed the information given by the contracting authorities with those in possession of DG Regio, addressing the person in charge of the management of Sicilian funds." 2) "We issued about ten recommendation to highlight things that required more attention. Major issues concerned the need to improve the use of transparency and methods of publishing information on-line. Pas have to start publishing having in mind who is going to read the documents."

	comments and suggestions that arise from the dossiers done by experts." 3) "We have sent to the contracting authority about 20 reporting in the form of recommendations. They have been communicated through emails, calls, meetings and can be found on the report published on monitorappalti.it" 4) "Furthermore our monitoring activities can be tracked by the project's verification indicators' which are available into the dossiers published on monitorappalti.it" 5) "For every procurement's phase we have done a technical report and a simplified one, directed to the wider citizenry."	coordinator). 3) "We made several requests for access to information, document integration. The document requested have been integrated timely and also clarifications have been provided promptly." 4) "We made training initiatives on Ips and open data both to the wider citizenry and to the contractor."	3) "All the procurements are published on *portaleappalti.ponmetropalermo.it.* As monitor, we had a read-only access and we can see some classified information. For example, we can see the profile of the candidate for the evaluation commission before the publication." 4)"We keep track of all the reporting into a register shared only with DG Regio and TI Secretariat. The reporting are shared during meetings or via emails." 5) "At the beginning we thought that the timing to deliver reports would have been rigid. During the process we understood that we should have delivered a report every time that there was something valuable to share. We have started to build a monitoring protocol and we have an document that we will submit as the entail of our experience."
Participation	1) "The contracting authority has always rigorously answered to our recommendation, even if technicalities and bureaucracy have always delayed the suggested solutions." 2) "The recommendation that contributed more to ensure the IP's participatory value was about a better and more regular organization of the activities to inform citizens on the project. The contracting authority organized an open soiree to discuss with citizens the multiple stages of the project.	1) "From the digital platform "ALAC", *Advocacy and Legal Advice Centre* there were no reporting; after the meeting with local community there have been a lot of "vis à vis" request of clarification about the procurement." 2) "The external channels of communication have been website and mailing list. For regular participants we activated a chat. We also arranged meetings (4 school events and 2 site	1) "We have received a reporting through ALAC, not on our project, but on the Madonie area. Once the person who made the report was asked for more information, he/she disappeared. Anyway, the reporting seemed not to be accurate." 2) "We made various (5) initiatives to involve the municipalities in disseminating the IP core concept at various levels (i.e., schools).

	They also showed the model of the final project." 3) "There wasn't any reporting of irregularity. We made recommendations, as it would has been difficult for citizen to do a technical recommendation, without a full sharing of all the document and information of the monitor." 4) "We use external communication channels: monitorappalti.it, social media page of Transparency International. Press office on single events. Live meetings and events."	visits) with the aim of communication and sensitization. The meetings have been attended also by key actors like, the Project Manager, the Director of the Museum, the Contractor and the Municipal Secretary." 3) "We worked with the contracting authority in arranging the meetings and events and a representative of local government was always attending."	
Digital Accountability	1) "As monitor we devoted a section of our website to build infographics using .xml data collected from various websites that were compliant with the Italian Transparency Law 190/2012, showing data in a more comprehensive and clear visualization."	1) Many data were already open (i.e. the Italian Investment financed by the EU Cohesion funds). We tried to understand if data related to subcontracting could have been released but the State General Accounting Department was not ready and our technological partner had difficulties; so it was impossible to release those data.	1) "We wondered if was useful to gather and release data for publication or to follow some standard for disseminating open contracting data… This was not the main focus of the project but I still don't have the answer on which dataset is better or really useful for "live" IP monitoring… or how can it be used? I think there is a lot of rhetoric and very few clarity on it."

4 Discussion of results

Under the dimension of knowledge building, TI Italy referred that the contracting authority motivation to sign the IP was driven by the desire to acquire direct experience from the monitor. In fact, more than the function of reporting – only one (minor) occurrence across the three cases – collaboration with external expertise, during a

continuous peer review process, has been highlighted as a key driver and, moreover, a common trait of the three cases selected. To this end, the big majority of reporting coming from the monitors were requests of document integration and recommendations.

Another common trait among the cases considered refers to the form of reporting. Interviewees said that reporting have been made informally to the contracting authority, by emails, meetings, calls, following a procedure that confirm the will to strengthen teamwork and collaboration more than the application of a mere evaluative control. While recommendations and suggestions are informally communicated to the contracting authority, and all the reporting are kept in an internal register and shared with the managing authority of the program (DG Regio) and the apical NGO which is presiding the program as civil society stakeholder (TI secretariat), thus realizing direct exchange of knowledge and enabling vertical oversight by the central administration and the "mentor".

Relevant part of this information is opened to the wider public through the project website monitorappalti.it which host a resumé of the entire process and the relevant documents that allow to follow step by step the IP's implementation.

Furthermore TI, for every procurement phase, have diversified the communication doing a technical report and a simplified one directed to the wider citizenry.

The monitor of the second (ActionAid) and the third case (Amapola) exploited a read-only access to the governmental platform containing relevant information on the procurement management. In this regard, Amapola project coordinator states that through this access they had the possibility to know and evaluate the profiles of the evaluation commission's members before the officialization of the composition.

About third parties involvement, ActionAid have organized a preliminary training on IP mechanisms and values focussed on the contractors. Finally Amapola stated that they have learned by the process itself – as should be in a pilot – what monitoring a procurement can mean and during the process they drafted a "living document" that will be the entail of this first experience to be shared with those who are interested in understanding, reflecting and further applying IP practices.

Driver n. 2 "Participation" collect all the sentences where monitors referred a participation to the process in the form of a concrete contribution to the end of the project and especially all the attempt to establish operative relations or to raise citizen's awareness.

PAs answers have been overall considered by the monitors timely and satisfying even if, in two case of the three cases examined, was highlighted how technicalities and bureaucracy slow down operationalization of solutions.

Recommendations safeguarded IP values. For example, TI Italy recommended to the contracting authority an improvement in the way citizens should be informed about the bidder offer. The contracting authority organized an open soiree to discuss with citizens how the works have proceeded and at which stage were arrived giving the idea of the whole project showing a model.

In all the three cases the monitor involved the contracting authority and facilitated its relation with other stakeholders and with the wider citizenry through the organization of a range of events. The range of events is wide and goes from public meetings that have mere cognitive purposes, to focus groups which involve the key stakeholders (contractors, members of public administration and relevant institutions), to school lessons, seminars and site visits.

The Monitors have been using for external communication not only off-line meetings and press involvement but also web, social media and tools. Citizens had at disposal the s.c. "Advocacy and Legal Advice Centre" (ALAC), a digital system issued by Transparency International for collecting reporting of irregularity, whistleblowing or anything that deserve the monitors attention. Only in a single case (Madonie Resilienti-Amapola), ALAC received a reporting.

Furthermore, the reporting was not sufficiently detailed and after a request of explanation there wasn't any follow up. This reveal the difficulty for citizens in expressing, through digital sources, a qualified opinion. For the same admission of TI Italy, it would has been difficult for any citizen to provide a technical recommendation, without sharing all the document and information owned by the monitors. More than giving a concrete push to the monitoring work, citizens have been encouraged to acknowledge and understand what was done by contracting authorities and contractors. In doing so – ActionAid refers – citizens involved, once gained confidence and established a direct relation through meetings, asked directly several explanations and expressed legitimate doubts. Apart from ALAC, a clear mechanism for feedback collection from the citizen's involved was not structured.

Finally, major relevance has been devoted to students' engagement, which has been unanimously considered as one of the more fruitful civic monitoring participatory dimension able to foster civic education and shared values.

The third driver "Digital accountability" was chosen to understand if the IPs had any impact under the profile of releasing/analysing open procurement data, and understand if there has been a reflection on the role of data in "live" civic monitoring.

TI Italia proceeded to a collection of data scattered in various sites and proposed in its website infographics and a more comprehensive and clear visualization.

ActionAid tried to release the data regarding subcontracting but without success because this required a more systemic efforts involving state general accounting department. For Amapola, it is still unclear the role of data in facilitating live civic monitoring through IP.

Notwithstanding the empirical evidences on the contribution that standardization of contracting data provides in enhancing the overall performance of the procurement cycle, our results show that reflections on data standardization in NGOs implementing IP has barely started. This highlights an implementation gap in the adoption of OCDS in public procurement monitoring that should be solved in the next future even considering the

systemic efforts that the EU Commission and governmental agencies made in this direction.

5 Final Remarks

The aim of this paper was to explore the extent to which the dissemination of Integrity Pacts and the adoption of innovative digital solutions have built shared knowledge and enabled a real transition to Open Government principles in public procurement.

The results which arise from the interviews confirmed that IPs play an important role in the reconstruction of a link between PA and citizens, enabling raise of awareness on public investments – and thus on local development through local investments –, in the exchange of knowledge and operationalization of solution that might foster innovation in PAs and to push forward open governance agenda.

In this regard, the monitors function as intermediate bodies that facilitate and safeguard this relation, determines at least a twofold effect:

- knowledge building for PAs. Providing solution and supporting public bodies in their operationalization, the monitors act as specialized agencies that ensure the compliance of the whole public procurement process with the law and the IP values. The role and functions performed by the monitors provide useful examples and insights about new procedures and protocols that allow better performance from civil servants.
- knowledge sharing and community engagement around IPs and its underlying principles. Focusing on the needs behind the procurement, on how the designed project answer to these needs, on the principles that ensure the lawfulness of the whole tender procedure and engaging citizens in an ongoing oversight of the implementation steps, the monitor contribute to the raise of citizens awareness.

However, it might be said that, even if the interviewed consider satisfactory the degree of knowledge and collaboration between the PAs and monitors, a big part of the participatory potential of the IPs has still to be deployed. Even if the efforts made to guarantee citizens participation is appreciable for its innovativeness, the full achievement of Open Government principles (above all, transparency and participation) requests a step forward from fostering citizens' acknowledgement and understanding – which is an initial way of empowerment – to delegating citizens, under monitors supervision, specific tasks and responsibilities of the monitoring process, i.e. document analysis, reporting, etc...

In our belief, the full transition to Open Government asks for a shift in monitors role' that enables a more coral and systemic contribution of multi-stakeholder monitoring entities, thus boosting mutual exchange of knowledge and expertise.

Looking at the impact of Integrity Pacts on digital accountability, the analysis provides us few information, mainly concerned with a better organization of existing data. The provision of comprehensive and standardized open contracting data requests a broad and

systemic effort from the key actors involved in the governance of investment funds. This efforts have started as testify by recent initiatives developed in many countries and business sectors.

This shared effort determines positive effects on the dissemination of IPs, also in terms of strategic assessment and advocacy. On the other hand, IPs act as platforms where citizens greatly benefit from the full legibility of procurement data which is a key asset for ensuring effectiveness and openness of data itself.

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The Analysis of the Repeating Processes and "Bugs" in the Widespread Implementation of Digital Innovation Processes in Public Administrations

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Abstract

Framed within researches underlying the appliance of digitisation in public administrations, this paper analyses the relevance of investigating barriers and enabling factors present in the "grey area" which ranges from the positive test of digital innovation trials to their generalisation in all the different bodies of a public administration. Having a double step of analysis, the research starts from a systematic literature review looking at how, digital transformation in the public sector, is considered and analysed in academic journals in order to look at how much failures and barriers about wide-spreading and diffusion of it were already investigated and depicted. Starting from the analysis of the literature review – in which it was found a lack of analysis upon the aspects we intended to investigate – we executed a qualitative case study upon three Italian local public bodies dealing with the full implementation of digitalised tools for the interaction with end-users and citizens in general. Findings seems to suggest that the actual wide-spreading of the implementation of a "new" tool thanks to digital transformation, requires years and it is not devoid of obstacles and costs, which should lead both researchers and practitioners to "reconceptualise" the analysis of strategies and efforts for the full implementation of a "smart" digital transformation in the public sector.

Keywords – Digitalization; Public service innovation; Knowledge Transfer, Digital Technologies

Paper type – Academic Research Paper

1 Introduction

Digital Transformation has been generally seen, in the last years, as an important driver for the progressive positive changing of public administrations, being considered a tool able to radically improve their performance, by providing opportunities to advance their value creation process in different ways, creating new relationships among providers, organisations, and end-users, through digital infrastructures.

There is a general consensus about the fact that innovative technologies can positively reshape the way we conceive public administration, and its interactions with citizens and other organisations (public, private, and non-profit) because, the availability of digital innovations, has the leverage power to positively convert public service delivery processes.

Starting from the above mentioned assumptions, we reflected on the fact that, in studying any innovation in the public sector, it is necessary to consider also that it is not achieved per se in a blink, it is rather the result of a process locally embedded: in a specific context (such as a specific policy sector with specific state and governance traditions); in a specific time; within specific power relations (Bekkers et al, 2011).

In the case of digital transformation, recent technological and societal developments need new innovation models such as "open innovation" or "user innovation" in order to empirically grasp and adequately theorize the complex interrelationship between technology developers and technology users (Chesbrough 2003).

Starting from the above mentioned assumptions this paper is focused on the analysis of aspects regarding the path, which allows the overall dissemination of a digital transformation, from experimental trials to a general agreed proper effective use.

It indeed starts from the consideration that we usually analyse, in the academic field, stories of successful experimental innovation rather than failing ones. Moreover it must be considered that, in the specific case of public administrations, their organisation is huge, and composed of several layers and bodies, from national to local ones, as well as sectors, ranging from national governmental to local levels, which deliver different services, from administrative to health services, passing through education and police. This means that, a positive technological innovation developed in some bodies, takes time to transform, a benchmark developed in a unit or a component, in a generalised practice for all bodies and branches.

Founded upon the above considerations, this study focuses upon the barriers and enabling factors present in the "grey area", ranging from the positive test of digital innovation trials to their generalisation in all the different bodies of a public administration. In particular we aim at answering the following research question: Is it always true that an innovative successfully digital transformation trial leads to a general advancement of the whole bodies of the public administration in which it was preliminary tested? And if yes, is time a relevant barrier?

In order to answer our research question we decided to run our research on two steps. We firstly carried out a systematic literature review on how digital transformation has

been considered and analysed in public management academic journals, in order to look at how much failures and barriers about wide-spreading and diffusion of it were analysed.

In a second step, starting from the analysis of the results of step one – in which it was found a lack of deep analysis on the aspects on which we were running our investigation – we decided to run a qualitative case study with interviews to workers of local public bodies, dealing with the full implementation of digitalised tools for the interaction with end-users and citizens in general.

The paper is structured as follow: the next section reports about the first step, presenting, after a description of the issue, the literature review results. In section three we report about the case study, whereas, in the last one, we present concluding remarks upon the whole research, giving some indication for further more tailored analysis about the topic.

2 Research topic and literature review results

Since the beginning of the new millennium, several scholars highlighted that public sector, thanks to the development of new enabling technologies, was entering a new phase, allowing more effective and agile approaches in public services delivery and consumption (Franda, 2002). Later on, Dunleavy et al. (2006) even named this new phase as Digital Era Governance, characterised by changes inside government, engaged in answering to the advent of new phenomena and even able to be a quasi-paradigm for government on the Web (Margetts & Dunleavy, 2013). This new era was perceived as able to create a powerful dynamic situation, driving to a disintegration of traditional techniques and services, traditionally organized around systems integrators and departmental structures, for arriving at their re-aggregation around the citizen in the form of services (Fishenden & Thompson, 2013).

Considering that more than a decade passed from these first announcements and declaration about the birth of a new era, we had to be now, in a new efficient world in which public service design and delivery had to be much more efficient and effective than what they were at the end of the twentieth century. But can we surely affirm that we are living in such a new successful era in the public sector? The answer cannot be absolute. Indeed many things (procedures, tools, relations) changed, but not all of them seemed going in the same direction of a more efficient and effective public sector. What did go wrong?

In order to answer these questions, we firstly decide to look back to find some of the not initially foreseen causes which did not allow such an expected improvement in a technologically based public sector. We therefore decided to run a literature review aimed at looking for causes which were unpredicted in the ten years ago forecast analysis.

2.1 Method

We based it on a systematic review, compromising several steps (identifying relevant publications, selecting eligible studies, extracting data from them and synthesizing the results (Liberati et al., 2009). We made this choice because, differently from traditional literature reviews, it involves the use of standardized ways to identify all the likely relevant aspects (Moher et al., 2009) and considering that we were not looking for theoretical frameworks interpretations, rather than we were interested in finding causes, we found it as the most appropriate tool.

We selected our object of analysis using Scopus and searching for journal articles and books in publish in English from 2015 to beginning of 2020, having the strategy represented in figure 1

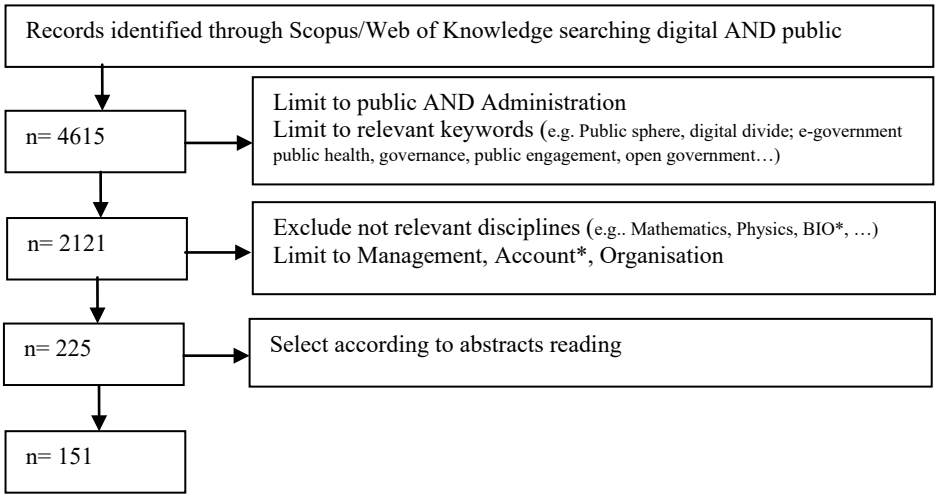

Figure 1 Flow diagram of the research

2.2 Results

According to the analysis of the 151 selected journal articles, it seems that technological innovation process in public sector is still an ongoing one and researchers are still engaged in illustrating its potentialities, through their analysis, forecasting new challenges regarding: the relevance of big data analysis, the protection of sensible data, the necessity of regulation as well as sensitise about ethic issues. In synthesis most of the research appeared to be proactive towards the future, although being aware about risks regarding intentional disinformation.

Few problems seemed to be tackled about the wide-spreading of innovation derived by the advent of the digital era: the challenging of a multi-stakeholder approach, difficult to be managed, but anyway considered a great opportunity for re-designing public services

in order to achieve greater effectiveness in the relations with users; the lack of infrastructures and the digital divide (especially in aged people). Anyway they were both considered as problems to be faced for a full integration of disadvantaged territories and of a small portions of users.

Indeed only 1 out of the 151 selected articles was dealing with the aspects of our analysis. A reflection about the article (Tate et al. 2018), which we deeply analysed after the conclusion of our study case (presented in paragraph 3) will be traced in paragraph 4 describing the alignments of our qualitative case study with what depicted by the authors.

3 The "bugs" in the widespread implementation of digital innovation processes in public administration

The above reported results appeared to give an indication referred to a digitalised era, which is facing new challenges about data protection and engaged in integrating disadvantaged territories and users, but it is anyway full embedded in delivering services in an effective and efficient way. In synthesis it seems that our question reported in paragraph 1 found a positive answer in the fact that we are living in a new successful era in the public sector. Was our premise wrong or is there something we are missing in analysing the effectiveness of digital innovation in public sector?

We considered that in the specific case of public administrations, innovation is not a unique linear process, rather than it is a sum of several different components, considering the specificities of the public sector as one composed by several layers, bodies branches, traditions, delivering very different categories of services. It is thus important to consider the influence of the specific environment in which any public innovation process takes place, bearing in mind that any innovation process is locally shaped, and thus dependent on institutionally embedded exchanges among relevant actors (Osborne and Brown, 2011). It can, thus, be argued that innovation processes should be studied from an ecological perspective (Bekkers & Homburg, 2005; Bason, 2010; Osborne & Brown, 2011). Moreover OECD (2010) reported about the fact that successful reforms in the public sector, often take several attempts before arriving at a wide-spreading able to re-design a structure.

Starting from the above reported considerations we decided to look at digital innovation in public administrations from a different perspective. Instead of looking for the validity of an innovation, we decided to concentrate our analysis upon the specific dissemination process, looking at a not fully analysed aspect, that is the implementation path which goes from a positive trial, in a unit or a branch, to the full accomplishment of innovation in all the different units of a component of the public sector.

3.1 Qualitative research design and method

Considering the above reported aspects about the complexity and multi-layering of public sector, we thought to concentrate our analysis upon a digital innovation which had

to be as "generalised" as possible as well as not too "recent". Therefore we had to look for an aspect which had no specific issues and was not specifically related to a particular service. All the above considered, together with the fact that we were running our study case in Italy, we decided to analyse the general application of two overall communication services: the digital protocol register of documents (Titulus) and the certified email (PEC). These two services started their experimental phases, in Italy, at the end of the first decade of the new century, becoming "supposedly" fully generalised, after the publication of specific memos by the regulatory national offices, in 2013. So we thought to analyse, after seven years since the actual regulation, if and how these digital services have positively affected internal public sector management and the relations of the different bodies with end-users and citizens in general.

We thus decided to run a case study, aiming at addressing 'why' and 'how' questions (Yin, 1994). In particular, considering that the topic was not deeply explored yet, we decided to execute exploratory targeted qualitative interviews (Bailey, 1987) to privileged witnesses able to be informative as experts of the area (Weiss, 1995) thus we interviewed, from October 2019 to January 2020, 6 officials working in three local public administrations based in Abruzzo, a region of the centre of Italy. Interviews were conducted in interviewers and interviewees native language (Italian). The verbatim transcriptions were translated into English and finally analysed having a content analysis (Bauer & Gaskell) of them for the redaction of this work.

3.2 Results

By the content analysis (of the different interviews we depicted four constraining factors whose descriptions are reported hereafter:

The initial perception of the digital tool as a burden

A first important aspect which emerged from our analysis was that, especially in a first phase, the implementation of the two digital services, was perceived as an additional task to be accomplished, rather than a facilitating instrument. All the interviewed people were working in their administrations much before the 'advent' of the new digitalisation (with a range going from 5 to 15 years before the enactment of the new rules in 2013), so, by their points of view, the processes, regarding the exchange of documents and information, were perfectly suitable using traditional mailing and protocols. Therefore, the change was perceived more as a burden rather than an opportunity. Indeed they declared they had been trained, but by their points of view, training was perceived as time subtracted to working hours, rather than an opportunity. But, above all, they all declared that although trained, it was not easy the shift to the new system.

The result was that two administrations delayed the actual application of the new system for more years after 2013, waiting for all personnel to be ready and instruments to be fully available. The other one adopted a kind of mix strategy, which instead of

fostering the process, had the opposite result of extending its time and especially making it much more complicated. In this sense what was reported, by an interviewee, about PEC application, is eloquent. “At the beginning the municipality declared the accomplishment of the PEC system (…) but in reality there was only one PEC address. So the process was that, the specific office received the PEC-mail, printed it, protocolled it, send the paper and related attached documents to the office to which the PEC was addressed (…) the internal protocol of the office registered the arrive of documents (…) documents finally arrived at the unit and person to which they were destined”. In synthesis, instead of facilitating the process, the application of PEC, in this case, resulted in a lengthening of both times and costs, because of the necessity to print all documents, a task which, with traditional mailing, was in charge of the sender.

Lack of proper digital infrastructures

Another important obstructing factor was found in the lack of proper digital infrastructures, not much referred to devices (which were anyway accounted by all interviewees as obsolete) rather than in the functionality and speed of the connection to internet. This aspect was not referred to the two observed innovations, but rather it was reported as a basic prior obstacle for any kind of innovation regarding the digitalisation of their administration. In this sense one of the interviewees affirmed: “when we arrived at pick hours we couldn’t work properly (…) Sometimes (…) we remained after 6.00 p.m. in order to be able to work in a proper way when we had to respond to users, sending official documents which had heavy attachments regarding scanned documents, because we needed a lot of time to upload the attachment official scanned copies”. We found anyway that, although the effort in training by the involved public administrations, interviewed people still had not a proper language and knowledge in talking about digital tools, as if they were an adding problem to be solved rather than tools to facilitate their work.

Process digital divide and consequent difficult interaction with users

As we highlighted in paragraph 2, digital divide is still seen as a barrier to be tackled, especially for older people. In our analysis we found that there was also a digital divide in the interaction between each public administration and their citizens and stakeholders in general. We defined it a process digital divide, indeed we found that there was not a specific problem regarding basic knowledge about the use of digital tools, rather than there was a lack in the communication and information about the functioning of the new digital tools, which disoriented both officials and users. All interviewed people reported about citizens asking to fix an appointment to ask how to use the new tools to digitally interact with the administration. One interviewed said: “At the beginning (…) it was really a mess, they claim for an answer but they did not save the protocol number, it was impossible to refer a request to any administrative file”; another one affirmed “many citizens were complaining, they had to request for the intervention of a consultant because

they have no knowledge of the system". But the greatest evidence of the augmented distance between administration and citizens was found in the following case reported by an interviewee "It even happened that two or three times people arrived in my office complaining for the lack of an answer to a specific request sent with a PECmail following the procedures as read on the municipality's website (…) we did not use that procedure anymore because internal organisation had changed (…) but the website had not been updated so people were still using a procedure putting a code which was not valid anymore but which had not been cancelled".

Different knowledge and systems between administrations and end-users as well as among different levels of Public Administration

A great barrier was found in the lack of shared standards. This aspect regarded, more than the PEC and Titulus, the validity of the digital signature on most sent official documents. Indeed three interviewees referred about two initial obstructing factors regarding: the impossibility to read the file because of the lack of proper reading software; and, especially, a difficult in interacting with other offices because of time differences in the wide-diffusion of the system. In this sense one affirmed "People were digitally signing with XYZ because it was cheap and very easy to be used, but the administration did a tender with HJK, so we hadn't the software to open most of the signed documents". Regarding the augmented distance between administrations' levels one interviewed stated "it was easy for them [the officials at ministerial level], they asked us to send digitally signed documents (…) only the director had the machine to digitally sign, so we had to wait for his signature (…) it was impossible to work if he was out of office". But another example really eloquent about the distance between government levels was found when we were told about interaction with EU Offices to apply for tenders to use EU funds "fortunately we receive sometimes offers by local consultants to create a partnership for a tender (…) they know all about creation and sending of an application for a project (…) without them it would have been impossible for us to participate (…) EU electronic platform is too complicated and completely different from our on line schemas".

4 Discussion and Conclusions

Aiming at finding the relevance of digital innovation upon different public sector components, the present study concentrated its analysis on the discrepancy between the issued analysis upon public services effective and efficient re-design and the actual daily wide implementation of them in all the different components of a public administration.

The work undoubtedly has limitations. First of all, the systematic review should be both enlarged in the number of analysed search engines (thus not limiting it only to Scopus) and much more refined in its selection and analysis process. A better full content analysis of the already selected articles should absolutely be done. Also the qualitative analysis has limitations, being based on a case study regarding three administrations of a

single region of a single country. Nevertheless, it clearly shows that there are aspects that need much more analysis. It is indeed impossible to look at digital innovation as a decontextualized element, it is important to consider all influencing factors. Qualitative research findings seem to suggest that the actual wide-spreading of the implementation of a "new" tool, thanks to digital transformation, requires years and it is not devoid of obstacles and costs, thus leading us to think that it might be necessary to "reconceptualise" the costs of the full implementation of a "smart" digital transformation in public bodies. Indeed all interviewees were referring their situations using the past tense, stating that all the reported issues and problems had then been solved. The point is that it requested time and efforts which were initially not considered, highlighting that, what we defined "grey area" in paragraph one, should be properly considered when working for the actual implementation of a digital innovation in a public administration. We should reflect on the fact that, as stated by Rogers (2009), an innovation is "an idea, practice, or object perceived as new by an individual or other unit of adoption"; nevertheless, the diffusion is defined as "the process by which an innovation is communicated through certain channels over time among the members of a social system". Thus, in Newman et al.' opinion (2016) the factors which are able to influence the uptake of an innovation are three: relative advantage; technical complexity; technical capability. Thus there is much to investigate from the inception of a digital innovation, to its diffusion.

In this sense our case study seems to confirm what affirmed by Tate et al. (2018) in the only article we found relevant for our study in the systematic review we run. Indeed they depicted a methodology for carrying out open innovation for digital public services, concentrating their analysis on what has been defined, by Gassmann & Enkel (2004) the fuzzy front end, that is the fuzzy zone between the time in which an opportunity (or need) is known and the time when serious effort is devoted to the development project, where there is the challenge of analysing good ideas, for deciding which one to pursue. In particular their methodology was outlined starting from the consideration that digital innovation in the public sector has to face more challenges than what it is for the private one. They depicted, in the digital innovation life-cycle for public administrations, 9 challenges to be faced to be transformed in opportunities and 8 barriers to be overcome.

Now, with respect to our research, not only the article (although the only one we found in the literature review) confirmed that our premises were not wrong, but above all, we found that, some of the barriers they depicted, were in line with the results of our case study. In particular: disconnect between citizens and officials; digitising without transforming; internal culture barriers; lack of shared standards.

In conclusion, our analysis seems to show that the premises that led us to run this exploratory research are important both at theoretical and practical level and should be adequately addressed in the near future. At theoretical level, more researchers could be progressed in order to better enucleate the issue, whose basic preliminary little theoretical foundations, was found only in one article of a bit more than one year ago. The relevance

of studying this aspect is of pivotal importance for practitioners, who ought to be aware, in the designing phase before arriving at the actual implementation, that, in the public sector, the wide-spread dissemination and diffusion of a digital innovation already tested in several trials, requires time and especially a proper strategy as well as adequate resources, otherwise the results, for an initial period which could last for years, might be even worse than the previous status quo.

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Evaluating the Status of Information and Knowledge Management in a Large Municipality

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Abstract

In modern society, municipalities and cities are accountable for various societal service missions. In addition, cities and municipalities are expected to take a responsible role in solving the wicked problems such as climate change and ageing of population, coupled with sudden challenges, like the COVID-19 virus, together with the government. This kind of development has increased the role of municipalities and cities as decision-makers in global and social challenges and their ability to use information has become a critical success factor in modern society. By systematically exploiting information use possibilities in the public sector, it is possible not only to make more informed decisions, but also to serve the citizens better and use resources more effectively.

The purpose of information and knowledge management is to collect, process, organize, store, share and utilize information in a way that enhances individual and organizational decision making and operations. The current trend of digitalization in the cities and municipalities is changing the way these activities can be carried out. At present, public organization's ability to manage its

information and knowledge resources is critical and there are still many lessons to be learnt in taking the best out of digitalization. In this study, a maturity evaluation instrument (Jääskeläinen et al., 2019) based on Choo's knowledge management model (2002) is used to evaluate the status of information and knowledge management in a large municipality organization. The aim of the study is to increase our understanding on the status of information and knowledge management practices used in the digital era governance of public sector. Theoretical part of the paper analyses and combines research literature related to digital era governance and knowledge management in order to find out connections between these research areas for the empirical analysis of this study. The empirical context of the study is a large Finnish municipality that has gone through a large scale administrative and managerial system reform a few years ago. A survey will be used to gather the empirical data for this study. Around 300 responses representing all the branches of the municipality were received. The results show that organizational information and knowledge management requires improvement especially in relation to organizing and storing knowledge, knowledge acquisition and information products and services. However, performance benefits of information and knowledge management can be obtained only through successful knowledge usage.

Keywords – Digital-era governance, Knowledge management, Information management, Maturity analysis, Public sector

Paper type – Academic Research Paper

1 Introduction

The start of 21st century has contributed to a new model of public management called Digital-era Governance (DEG). According to Dunleavy et al (2006), handling digital change effectively required a new macro-theory for public sector governance that considered the changed contextual aspects of organizational governance and placed digital technologies at the center of public administration. According to Dunleavy et al. (2006, 217) "government IT changes are no longer peripheral or routine aspects of contemporary public management and public policy changes, but increasingly important and determinant influences upon what is feasible." However, it is noted that the most significant impacts of digitization processes are not achieved without changes in organizational culture and structure inside the public sector alongside behavioral shifts by civil society.

Considering the ever-changing landscape prompted by digitalization in modern society, municipalities and cities are accountable for various societal service missions, like provision of social and healthcare services, development of industry and urban structure, including digital transformation of services. Coupled with the expanding role of digitalization, the role of cities' and municipalities' in managing and tackling climate change and other environmental issues have become increasingly important. This development along with urbanization has increased the role of cities as decision-makers in global and social challenges. Due to these changes, public sector organizations have identified the need to develop their management systems and thereby their ability to manage its knowledge resources has become critical.

The role of knowledge management in municipalities require detailed evaluation. Earlier literature presents maturity models in many different managerial fields such as information management, knowledge management, strategy and performance management (e.g. Aho, 2012; Becker et al., 2009; Hsieh et al., 2009; Jääskeläinen et al., 2019; Jääskeläinen and Roitto, 2015; Kruger and Johnson, 2010; Pee and Kankanhalli, 2009; Poeppelbush et al., 2011, Teah et al., 2006; Van Aken et al., 2005; Wettstein and Kueng, 2002). These models can be used as tools to evaluate organizations to increase the understanding of management practices and to improve the performance of organizations by presenting desirable characteristics for operations (Bititci et al, 2015; Jääskeläinen and Roitto, 2015).

In this study, a maturity evaluation instrument (Jääskeläinen et al., 2019) based on Choo's knowledge management model (2002) is used as a tool to evaluate the status of information and knowledge management in a large municipality organization. This will increase our understanding on the status practices of information and knowledge management used in the public sector. More specifically, this research attempts to investigate the following research question (RQ): ***How does a municipality organization deliver performance connecting to knowledge management within the emerging context of DEG?*** Theoretical part of the paper analyzes and combines research literature related to digital era governance and knowledge management in order to find out connections between these research areas for the analysis of this study. The empirical context of the study is a large Finnish municipality that has gone through a large scale administrative and managerial system reform a few years ago. A survey was used to gather the empirical data for this study. Around 300 responses representing all the branches of the municipality were received.

2 Literature review

2.1 Digital-era governance

Digital-era governance (DEG) is a movement towards digitalization in a society, not only about digital changes within governments. DEG signifies complex societal changes, which according to Dunleavy et al. (2006), have IT and information-handling changes at their centre. According to Margetts (1999) digital technologies were marginalized in the era of New Public Management (NPM), as governments' IT operations were outsourced to global computer services providers, resulting in digital expertise going out of government, and fragmenting data sources (Margetts, 1999). From the 1980s to the early 2000s, the NPM model was dominant in public management reforms involving disaggregation of large-scale departments, increased competition within the public sector, and the incentivization of public officials along business lines (Pollitt & Bouckaert, 2011; Dunleavy & Hood, 1994). Research has not yet provided empirical understanding on the developments and impacts of digital-era governance and its practices. Digital-era

governance practices can be categorized under three main themes: 1) reintegration, 2) needs-based holism, 3) digitization changes.

Reintegration can be seen as a reaction or even an antithesis to NPM practices. It emphasizes bringing back together the distinct functions and clusters of expertise that "under NPM were separated into single-function agencies and fragmented into complex inter-organizational networks". (Dunleavy et al. 2006, 227-228.) The main components in reintegration are the rollback of agencification and fragmentation, joined-up governance and re-governmentalization, reinstating or re-strengthening central processes, reducing production costs, re-engineering back-office functions and service delivery chains, procurement concentration and specialization, shared services on a 'mixed economy' basis as well as network simplification and 'small worlds'. (Dunleavy et al. 2006). Reintegration has expanded into more fundamentally reengineering services and removing duplicate service delivery chains. One of the most significant trends for reintegration is the development towards an 'intelligent centre'/ 'devolved delivery' (IC+DD) design in the allocation of functions across the organization. The design is adapted from big private companies entailing the generation and analysis of big data, both from a government's own administrative operations and from citizens' activities (Margetts 2014). Further, reintegration includes intelligent centre and decentralized delivery design, single tax and benefit systems (using real-time data), big data analysis, and reintegrative outsourcing (Margetts et al 2013).

Needs-based holistic reforms seek for simplification and change in the relationship between agencies and their clients by building larger and more encompassing administrative blocs, which are connected to re-engineering of processes and sorting out unnecessary steps. The main components in needs-based holism are interactive information-giving and seeking, client-or needs-based reorganization, one-stop provision, ask-once processes, data warehousing, end-to-end service re-engineering and agile government processes. Flexible directorate structures have fostered more IT and cloud-based central service arrangements. As the pressure to create for more agile government structures has increased, holism has brought up phenomenon including extensive client and needs based reorganization, co-production of services and single benefits integration in welfare states as well as development of 'social web' processes within online government. Furthermore, there is a trend to cooperate with citizens in service creation (Dunleavy et al., 2013; Margretts et al. 2013).

The third theme, *digitalization,* means the adaptation to electronic delivery and placing it to the centre of the government's operations wherever possible (Dunleavy et al., 2013). On a concrete level digitization entails electronic service delivery, automatization and simplification of processes, decreasing service channels and centralizing those into digital formats (ibid.). In fact, the trends related to DEG's digitization theme, like radical disintermediation, automated processes and channel reduction, have expanded rapidly lately (Margretts et al. 2013). Digitalization includes the following new components: '100% online' channel strategies and government cloud, free storage and comprehensive

data retention, offering public information for reuse (open data initiatives) and pervasive computing. In addition, big data approach is seen to offer significant potential as a catalyst for improving mutual government–citizen understanding, and supporting efficiency, effectiveness and responsiveness of public organizations (Margetts & Clarke 2014) Both holism and digital changes aim to move towards open-book government and building on open data initiatives (Margretts et al. 2013)

2.2 Information and knowledge management as a cycle

There are several process models that aim to support knowledge management and thus, knowledge-based value creation (Laihonen 2013). One of the best-known models is Choo's process model (1995, 1998, 2002). In Choo's information management process model, information management is described as a continuous cycle, in which six closely related but separate stages can be detected. The information management cycle begins with the *definition of information needs*. The information needs are first identified so that they can later be met as well and efficiently as possible. Information needs refer to gaps between the existing knowledge and the knowledge that is required to make decisions or to conduct certain actions. Effective knowledge management prerequires an accurate description of information needs (Choo 1995). The second phase is *information acquisition* stage, where information is obtained and collected both from external sources, such as competitors and customers, and from internal sources, such as operational databases and information systems. The data collected will be then stored in the organization's archives and possibly analysed in combination with other data sources. This means the stage of *analysing and organizing* the information, which facilitates the next stages of the process, i.e. the stage of *information distribution and knowledge sharing*. A wide distribution of information and sharing of knowledge enhances organizational learning as the aim is to enable information from multiple sources that is processed by multiple people to be synthesized in order to generate deeper insight (Choo 1998). Furthermore, in information and knowledge sharing it is essential, that reliable information in the right format reaches the right user at the right time and place (Choo 2002). For this to be realized, the knowledge sharing model has to meet the end-user's information utilization preferences and habits. This will enhance the ultimate aim of the information management cycle, the *information and knowledge utilisation,* as information is valuable only when used. At best, information and knowledge are used actively in decision-making and operational development leading to real changes in the organization's operations. By *measuring* and verifying the changes that have taken place and learning from what has happened and thereby identifying new development needs, the cycle starts from the beginning. Choo (1998) argues that this requires information processes and methods, which provide a high degree of flexibility in the representation of information and facilitates exchange and evaluation of multiple representation among individuals.

2.3 Linking the DEG framework to the knowledge management evaluation

This section links DEG framework and the evaluation of information and knowledge management based on Choo's model (Jääskeläinen et al., 2019), consisting of the following segments: vision and strategy, administrative structure and organization, information needs, information acquisition, information organization and storage, information products and services, information sharing, information usage and indicators (see Appendix 1).

Organizing and storing knowledge emphasize integration, flexibility and consistency of IT architecture and data storage and organizing. Daddieco (2004) states that one often overlooked asset for organizing and storing knowledge is that knowledge embedded within and between records and legacy record keeping systems is lacking government-wide documentation management systems and, thus efficient retrieval of relevant records is not possible. This segment can thus be linked to holistic efforts of data warehousing and digitization efforts to enhance the creation of free storage and comprehensive data retention. Organizing and storing of knowledge can also be connected to DEG's aims of reintegration since organization wide and integrated storing of knowledge can benefit organizational effectiveness and efficiency. This segment is also linked to open and big data initiatives, in the way that systematic storage and organizing of data is a basis for effective utilization of big data and open data.

Knowledge sharing includes communication with employees, delivery and sharing of information and open data. The integration theme of DEG focuses collaboration across agencies and joint-up governance. Creating agile government processes and co-production of services can be influenced by efficient knowledge sharing (see e.g. Bolivar et al. 2015; Riege & Lindsay, 2006). According to Barzki and Reid (2004), a difficulty in both the creation and maintenance of horizontal networks across organizations can be caused by an embedded culture of not sharing information and knowledge between departments in governments. DEG's integrative component to simplify networks is thus an important factor for intra- and inter-organizational knowledge sharing. Holistic aims to create client and needs-based structures can be seen to require knowledge sharing across sectors and between organizations. Knowledge sharing is also linked to initiatives of opening public information for re-use and moving towards open-book government.

Information products and services emphasize performance and quality of analytical information services. Within DEG's holism theme to create agile government processes and the digitalization theme (automated processes) essentially relate to sufficient information products and services (Dunleavy et al. 2006). Furthermore, the integrative aim to re-engineer back office functions rest heavily on functioning information systems (Dunleavy et al. 2006). Redesign of back-office functions often aims to system integration and streamlining of processes, meaning that government agencies need to scrap historic processes and systems that are lacking present day rationale. (Dunleavy 2006). Maintaining and developing sufficient information products and services is also linked to the development of e-government (e.g. Dunleavy et al. 2006; Lappi 2019) as

well as intelligent centre/devolved delivery (IC+DD) design, which builds on effective information products and services that allow data to be stored, analyzed and managed efficiently (Dunleavy et al. 2013, 8). As Zaharova et al (2004) state, advanced information analysis can help to identify customer needs and, thus help to create client and needs-based structures.

Knowledge acquisition examine the effectiveness, automatization and clarity of data collection processes and the variety, availability and usability of information. These can be linked to DEG's integrative initiatives of building governmental intelligent center/decentralized delivery (Margetts et al. 2014). Creating data warehouses and turning big data into benefits requires well-functioning data collection processes. To be able to make strategic decisions based on knowledge as in the IC-DD design, one could presume that gathered information should be in a "readily available" and "easily usable form". As stated by Dunleavy et al. (2006) interactive information exchange is fundamental to all elements of needs-based holism. Information searching could also be understood as information acquisition. Thus, creating agile government processes, client-based or needs-based reorganization, co-production of services, one-stop provision and ask-once processes could be seen to benefit from efficient knowledge acquisition.

Knowledge usage deals with knowledge being used to evaluate and measure performance and knowledge use in decision-making. Evaluating knowledge-based decision making is connected to DEG's IC+DD design and data warehousing initiatives, that aim to help public servants to make strategic decisions based on acquired information. Furthermore, the key elements to agility of structures and processes are real-time monitoring, forecasting, and prediction systems, that are cutting unnecessary time for decision-makers (Dunleavy et al. 2006). And thus, the effective utilization of information in decision-making is crucial for agility of processes.

The table 1 illustrates identified connections between DEG framework and knowledge management evaluation model (Jääskeläinen et al. 2019). For the most of the segments of evaluation model, connections were identified. However, for the segments vision and strategy, administrative perspective, information needs and indicators, one could not detect adequate similarities with the DEG framework to coherently say that contents could be evaluated within the framework. To conclude, knowledge management evaluation model seems to capture many aspects related to digital era governance.

Table 1. The research framework of this study

Reintegration	Evaluation model	Holism	Evaluation model	Digital changes	Evaluation model
Rollback of agencification and fragmentation, joined-up governance (JUG)	Organizing and storing knowledge, Knowledge sharing	Client-based or needs-based reorganization	Knowledge usage, Knowledge sharing, Information products and services	E-government	Information products and services
Re-engineering of back-office functions	Information products and services, Knowledge sharing	One-stop provision, ask-once processes	Knowledge acquisition	New forms of automated processes	Information products and services
Shared services on a 'mixed economy' basis	Knowledge sharing	Data ware housing	Organizing and storing knowledge, Information systems and products, Knowledge acquisition	Radical disintermediation	Knowledge acquisition, Knowledge usage
Network simplification	Information products and services, Knowledge sharing	Agile government processes	Knowledge sharing, Information products and services, Knowledge acquisition	Moving towards open-book government	Knowledge sharing (open data), information products and services
IC+ decentalized delivery (DD)	Information products and services, Knowledge usage	Co-production of services and single benefits integration	Knowledge sharing, Knowledge acquisition	Freeing public information for re-use	Knowledge storing and organizing, Knowledge sharing (open data)
Single benefit systems (using real time data)	Knowledge sharing	Development of 'social web' processes within online government, and field	Knowledge sharing	100% online' channel strategies (covering all contacts and transactions) and related modernizations	Information products and services
		Interactive information seeking and giving (present in all of the above)	Knowledge sharing, Knowledge acquisition	Free storage, comprehensive data retention	Knowledge storing and organizing

3 Methodology and empirical research

The data for this study was collected with an online survey, where respondents were asked to evaluate presented statements on a likert-scale from 1 to 5. The survey was sent to 1281 respondents working in a large municipality. Respondents worked as managers

(30%), department/unit leaders and supervisors (18%), and experts (52%). The respondents represented central administration (29 %) and sectoral committees including the committee of education (22 %), committee of city environment (14 %), committee of culture and leisure (13 %) as well as the committee of social services and health care (16 %). Other departments covered 6% of the respondents. Most of the respondents had been worked in the municipality for more than 10 years. The survey got 379 respondents, representing a response rate of around 30%.

IBM SPSS Statistics 26 and SmartPLS 3.0. were used in data analyses. PLS-SEM is an estimation method maximising the variance explained and does not include assumptions regarding data distributions. PLS is specifically powerful in predicting and explaining the variance of examined constructs (Reinartz et al., 2009). Bootstrapping of 5,000 rounds was used in the analysis. The constructs of the model were created by using reflective constructs in SmartPLS analysis. Reliability and validity of the constructs were analyzed by using factor loadings, composite reliability (CR), Cronbach alpha and average variance extracted (AVE). Loadings of all items in the constructs were above 0.6 and mostly over 0.7 which is satisfactory. Composite reliability varied between 0.884 and 0.917 exceeding the threshold of 0.7. AVE values were between 0.524 and 0.694 which exceeds the 0.5 level threshold. Also, the Cronbach alphas were more than 0.7, which is satisfactory. Appendix shows more detailed results as well as the items used for evaluating the constructs of the research framework. Furthermore, descriptive statistics including mean comparisons with a one sample t-test and distribution of results on the likert-scale were examined.

4 Results

To describe the overall state of how the case municipality is performing in the areas of knowledge management linked to DEG, descriptive statistics were examined by comparing the means of constructs created through PLS algorithm. Table 2 presents descriptive statistics of means and standard deviation of these constructs. To see whether there are statistically significant differences among the means a one-sample t-test was performed, comparing each of the construct mean values to the other. The one sample t-test measures the statistical significance of differences in results based on a null hypothesis. The results show that all of the means except “Information products and services” and “Knowledge acquisition” ($p = 0{,}709$) as well as “Organizing and storing knowledge” and “Knowledge acquisition” ($p = 0{,}690$) differentiated on a significant level (when using the level $p < 0{,}05$).

Table 2 Descriptive statistics of the key constructs

Report						
	Organising and storing knowledge	Knowledge sharing	Open data	Information products and services	Knowledge acquisition	Knowledge usage
Mean	2.4022	3.2075	3.4304	2.5029	2.5200	3.0445
N	287	327	327	285	339	312
Std.dev.	0.79250	0.76092	0.91528	0.77058	0.78946	0.76609

The mean of the variable "Organizing and storing of knowledge" that measures integration, flexibility and consistency of IT architecture and data storage and organizing has the lowest status with an average of 2.4. Also the result of information products and services which emphasize information service analytical performance and quality, was considerably low, with a mean of 2.5. Furthermore, the state of knowledge acquisition, that measures effectiveness, automatization and clarity of data collection processes and the variety, availability and usability of information, is considerably low with the mean of 2.5. The means of "Knowledge usage" that deals with knowledge being used to evaluate and measure performance and information use in decision-making, "Knowledge sharing" that takes into account communication of information for employees, delivery and sharing of information as well as "Open data" that measures the provision and use of open data are relatively higher. When looking at the standard deviations it appears that there are most differences in responses regarding the practices of open data.

Figure 1 presents the results of PLS-SEM analysis which shows relationships between the constructs of the analysis framework in alignment with Choo's (2002) model and further in relation to performance benefits for the organization. As noticed, not all of the studied constructs relate to organizational performance directly. Knowledge sharing ($\beta = 0.437$, $p < 0.001$) and knowledge use ($\beta = 0.272$, $p < 0.01$) have a direct link to organizational performance. Other constructs have only indirect relationships to performance. Organising and storing knowledge ($\beta = 0.516$, $p < 0.001$) and open data ($\beta = 0.223$, $p < 0.001$) are supportive to knowledge use. Knowledge acquisition has a strong positive link to organising and storing knowledge ($\beta = 0.725$, $p < 0.001$). Finally, information products and services are strongly linked to knowledge sharing ($\beta = 0.546$, $p < 0.001$).

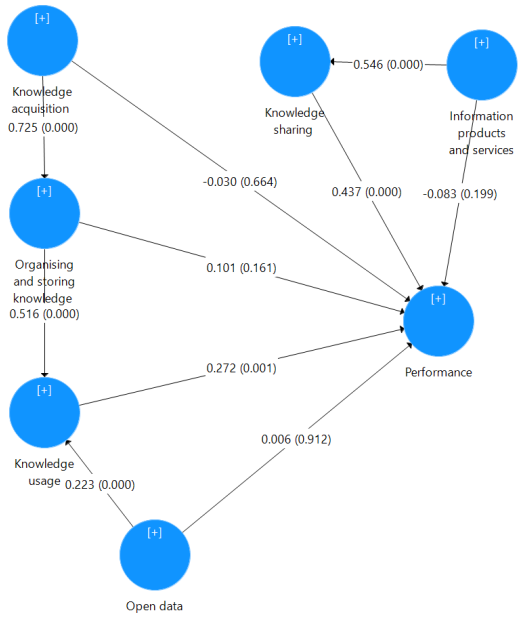

Figure 1. PLS path model

Table 3 further opens up the statistics underlying the PLS analysis. The path model explains around 44 % of the variance in organizational performance, 30% in knowledge sharing, 41% in knowledge use and 53% in organising and storing of knowledge. Multicollinearity was evaluated with variance inflation factor (VIF). The outer VIFs are between 1.0 and 3.0, which are well below the cut-off level of 10.

Table 3. Detailed results of the path model

	β	**VIF**	**t-value**	**Significance (p-value)**
Antecedents to organizational performance				
Organising and storing knowledge	0.101	2.724	1.414	0.157
Knowledge sharing	0.437	2.301	5.816	0.000
Open data	0.006	1.402	0.110	0.912
Knowledge acquisition	-0.030	3.047	0.431	0.667
Knowledge usage	0.272	2.797	3.502	0.000
Information products and services	-0.083	2.757	1.252	0.211
R^2	0.434			
R^2 adjusted	0.425			

Antecedents to knowledge sharing				
Information products and services	0.546	1.000	15.942	0.000
R^2	0.298			
R^2 adjusted	0.296			
Antecedents to knowledge usage				
Organising and storing knowledge	0.516	1.185	12.358	0.000
Open data	0.223	1.185	4.973	0.000
R^2	0.407			
R^2 adjusted	0.404			
Antecedents to organising and storing knowledge				
Knowledge acquisition	0.725	1.000	26.298	0.000
R^2	0.526			
R^2 adjusted	0.525			

5 Conclusions

This study contributes to the literature by evaluating the status of information and knowledge management through the lens of DEG framework and by empirically demonstrating how performance benefits can be obtained through the activities of information and knowledge management. The results suggest that the investigated activities are relevant for organizational performance improvement by explaining 44% of the variance in organizational performance. Most notably, performance benefits require a process where knowledge is first gathered, stored and supported by information products and services. These activities are relevant for sharing and using knowledge, but they require appropriate practices of sharing and using knowledge in order to reach performance benefits.

The studied municipality is performing quite poorly (2.4/5) within "organizing and storing knowledge". It can be interpreted that by developing these activities, the city could achieve de-fragmentated data warehousing, opening up data, creation of free storage and comprehensive data retention that reflect the contents of digital-era governance in the areas of holism and digital changes. Referring to Dunleavy et al. (2006), storing information in separate, incompatible systems has been the conventional administrative situation in many countries. This seems to be the case also in the empirical context of this study. Data warehousing or the contemporary phenomenon of data pooling is seen as a desirable path of development (e.g. Dunleavy et. al. 2006; Margetts et al. 2014). Both, Choo (2002) and Dunleavy et al. (2006) stress that data warehousing should contain information from several sources throughout the organization, that is structured in a way that is meaningful for the end-users and meets their needs. Moreover, the overall system requirement should be flexible in architecture as well as in capturing multiple forms of information, linking together data and supporting multiple users' needs.

"Information products and services" measured maturity of analytical capabilities and quality. The results show that the municipality was also performing quite poorly (2.5/5) in this area. Within the DEG framework this could be linked to the formation of automated processes. This may also hinder the agility of government processes as they require

adaptiveness and flexibility of systems as well as real-time monitoring, forecasting, and prediction systems (Dunleavy et al. 2006). Furthermore, both incompetent analytical performance of information products and systems and the low level of effective, automatization and clarity of data collection processes can affect the generation and analysis of big data. According to Margretts (2014) these aspects affect the implementation of the IC+DD model to further create knowledge-based client and needs-based structures and strategic decision-making. Furthermore, if the municipality is aiming for automatization of its service supply, developing projects and strategies should pay attention to developing sufficient analytical tools and services.

Furthermore, both knowledge acquisition and knowledge sharing, can be interpreted to influence the creation of holism within structures and processes of public organizations, as those require interactive information seeking and giving (Dunleavy et al. 2006). The low results within “knowledge acquisition” can affect the move towards DEG´s co-production of services and single benefits integration and one-stop provision. Poor knowledge acquisition may also affect negatively to the creation of client and needs-based processes, following the reasoning of Wimmer (2004), who emphasizes the access to information and knowledge resources in achieving the goal of citizen-oriented service delivery. If a municipality aims to move the organization towards DEG´s client-based delivery, processes to foster "information seeking and giving” as well as the creation of “detector mechanism” have to be in place.

The results within “knowledge usage” can be considered as fairly satisfactory (3.0/5). As the variable deals with knowledge being utilized in decision making, and measuring and evaluating performance, developing this area could particularly affect the adoption of the IC+DD model, were data is utilized for strategic decision-making. The results of “knowledge sharing” were also on a satisfactory level (3.2). The creation of agile government structures and processes to respond with flexibility to fast emerging cross boundary issues is influenced by the organization´s ability to share knowledge. To further enhance knowledge sharing capabilities within the municipality, the de-fragmentation of organization structures and creation of inter- and intraorganizational networks could enable information from multiple sources and processed by multiple people to be synthesized in order to generate deeper insight of issues at hand (Kim & Lee 2004; Choo 2002).

Notably this study also showed the importance of knowledge use and sharing in creating performance benefits. However, it is evident that practices of using or sharing knowledge are eventually not enough if the activities of producing knowledge are insufficient as in the investigated municipality.

The municipality´s is performing relatively well (3.4/5) within “open data”. Thus, the municipality´s current status within this factor can be seen to reflect the trend of open-book governance and freeing public information for re-use within DEG. It also demonstrates the pursuit for the ideals of smart city opening up data for citizens, companies and other stakeholders (Argento et al., 2019). However, this study

demonstrated that open data is not as such enough for organizational performance benefits.

Although it appeared that there are not major differences between the municipality divisions studied, a further study could be implemented, for example in a different region, in order to improve the external validity of the results regarding the status of information and knowledge management. The analysis of this study was mainly descriptive and explorative and a further study could move further towards theory testing and more detailed statistical analyses with the data.

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Appendix 1: Measures, loadings, construct reliability and validity scores

Construct	Item	Loading	CR	AVE	Cronbach's alpha
Organising and storing knowledge	Our organization has a platform or system that integrates knowledge management	0.716	0.917	0.551	0.897
	Our IT architecture is flexible for changing information needs	0.696			
	Our IT architecture does not overlap	0.706			
	Our organization has a storage for data that contains data across the organization	0.682			
	Our organization has common master data for key entities such as customers and services	0.695			
	Integration of data from different data sources is systematic and controlled	0.845			
	Data is consistent across systems	0.779			
	Data enables real-time reporting and analysis	0.720			
	Overall, I am satisfied with the storing and organizing of information	0.822			
Knowledge sharing	Our employees receive information about their goals	0.754	0.884	0.524	0.847
	Our employees receive information about their results	0.783			
	We have established practices for communicating reported information	0.737			
	Our employees regularly share experience-based information with each other	0.610			
	Our organization learns from mistakes	0.751			
	We promote two-way communication between the different levels of our organization	0.741			

	Overall, I am satisfied with our knowledge sharing practices	0.675			
Open data	We provide open data for municipal use	0.861	0.899	0.694	0.845
	We provide open data to other organizations	0.906			
	We promote the utilization of open data	0.921			
	The information systems of our organization provide up-to-date information	0.606			
Information products and services	Our information systems allow data to be viewed at various levels of accuracy (e.g., organizational levels)	0.679	0.883	0.560	0.844
	We have a responsive management desktop solution	0.755			
	Our information systems support budgeting and forecasting	0.617			
	We have sufficient data management analytics services	0.807			
	The analytics we use will create significant added value for our organization	0.751			
	Overall, I am satisfied with the reporting our data support systems	0.857			
Knowledge acquisition	Our data collection processes are efficient	0.761	0.902	0.569	0.873
	Our data collection processes are automated	0.697			
	Our data collection process is clearly described	0.800			
	We collect information from a variety of sources (eg staff, residents, surveys, national statistics)	0.635			
	The information I need in my own work is readily available	0.768			
	The information I need in my own work is in an easily usable form	0.752			
	Overall, I am satisfied with our information collection practices	0.850			
Knowledge usage	We have set clear enough goals to guide the operation of our organization	0.742	0.913	0.567	0.891
	The information available is capable of highlighting problematic areas of activity	0.777			
	The information available allows us to evaluate our performance against standards and goals	0.795			
	I have enough information to prepare for decision making	0.737			
	We generally have sufficient information to support decision-making	0.779			
	Measurement data is used to assist in strategic decision-making about our organization	0.730			
	Staff make decisions based on informed understanding	0.659			

	Overall, I am satisfied with how we use information	0.796			
Organizational performance	The performance of our organization has improved	0.846	0.915	0.682	0.883
	The effectiveness of our organization's decision-making has improved	0.850			
	The efficiency of our organization's internal processes has improved	0.825			
	Our decision-making has become more transparent	0.777			
	The quality offered to the users of our services has improved	0.827			

Improving Knowledge-Based Management in a Higher Education Organisation

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Abstract

As knowledge intensive organisations, higher education (HE) organisations also face a challenge of creating value from data and utilising knowledge in decision-making. However, in many HE organisations, knowledge management practices and culture are not very evolved. Overall, knowledge-based management is not yet widely recognised in HE-context. The aim of this research was to study knowledge-based management in HE context through a case study of a Finnish technical university. This research was conducted as a qualitative single case study and research material was collected by 19 thematic interviews consisting mostly of upper and middle management personnel. The results are analysed through a Framework of information and knowledge management. Based on a vast analysis, some suggestions were made of how the knowledge-based management could be improved in the organisation.

Keywords – knowledge-based management, higher education, case study

Paper type – Academic Research Paper

1 Introduction

The mission of higher education (HE) organisations is to provide high quality education and research, and to serve the society. Even though the goals of a HE organisation differ from many other organisations', they also create a vast amount of data and information in their operations. HE organisations are knowledge intensive environments by creating knowledge through research, by transferring knowledge with businesses and other parties and by offering higher education to students (Fullwood et al., 2013). However, currently many HE organisations do not take full advantage of the

information available. For example, Fullwood et al. (2013) say that universities knowledge strategies tend to be passive or inconsistent even though as knowledge intensive organisations that should not be the case.

There is a growing demand to better utilise data to support decision-making in HE-sector (Aljawarneh, 2016; McNaughton et al., 2017). Like other organisations, HE organisations need to distinguish what data is relevant, how to refine it, how to share it within the organisation and if needed, to other stakeholders, and how to use it in decision-making (Choo, 1998; Kaivo-oja et al., 2015), and furthermore, in creating value for themselves and/or other stakeholders. In addition to developing their own operations, HE organisations face the challenges of globally increasing competition (Pucciareli and Kaplan, 2016; Scholtz et al., 2018).

Using data and information is necessary for organisations to understand the dynamic operational environment and to be able to develop their own operations and so on to create value for the organisation. Organisations need efficient ways and practices to manage data and information from various sources to gain understanding about organisations' environment and main partners to support decisions that are met for achieving the objectives of an organisation. In this paper, we refer this knowledge-based management. It is viewed as an approach to collect, refine and use information to support decision-making and strategic development of an organisation. Organisation's culture and attitudes towards knowledge-based management are also an important factor to be considered.

Since knowledge-based decision-making has been found to be highly beneficial in HE-context (McNaughton et al., 2017), the purpose of this research is to study knowledge-based management in a HE organisation in Finland. Our study illustrates practical challenges in relation to research literature from knowledge management literature. The study points out beneficial issues for the development of knowledge-based management in the case organisation. In addition, the findings contribute to research in the HE sections where knowledge-based management is not very widely studied.

The structure of the paper is the following. At first, the theoretical premises of the study are presented, focusing on knowledge-based management and the process model of information management (Choo, 1998) in the context of higher education. In the empirical part of the study, we discuss the methodological choices and the research setting. We have interviewed the management personnel of a Finnish university and have analysed the results using Choo's process model as analytical lenses for the empirical study. Conclusions and future research end our study.

2 Theoretical setting

2.1 Knowledge-based management

The amount of data is growing at exponential rate and there is a need to distinguish what data is relevant to organisations and how to use it (Hellsten and Myllärniemi, 2019). In literature, this phenomenon has been approached by using concepts like business intelligence (Shollo and Galliers, 2016), data-based value creation (Xie et al., 2016) and knowledge-based value creation (Laihonen and Lönnqvist, 2010). Common for all is the way they refine data and information to form and use that are more meaningful.

This paper focuses on knowledge-based management, i.e. knowledge and knowledge processes. Knowledge-based approaches, like the concepts listed above, aim to understand and explain how organisations internal and external knowledge resources contribute to organisations' competitive advantage (e.g. Grant, 1996; Myllärniemi et al., 2012; Salonius and Käpylä, 2013; Myllärniemi et al., 2019). Knowledge-based management may be seen as synonymous for the concepts mentioned above. It is an approach to collect, refine and use data and information to support the decision-making and strategic development of an organisation. In our research, we stress knowledge-based development aspects as well as cultural and strategical issues which are not emphasised, for example, in the concept of business intelligence.

We refer to knowledge as the outcome of human action that takes place in decision-making situations. It is based on information, know-how and experiences. It is refined from information and data and therefore it is more valuable for decision-makers. Information, on the other hand, is data in the structured form. Data is unstructured facts that have the least impact for managers. (Thierauf, 2001). Knowledge management considers the processes and activities supporting the utilisation of knowledge resources (Wiig, 1997), and further, information and data. One common way to structure knowledge processing and related activities is the process model of information management (Choo, 2002). Choo's model, presented in figure 1, is widely used in knowledge management research. We used it as a theoretical framework when studying the case organisation's knowledge-based management.

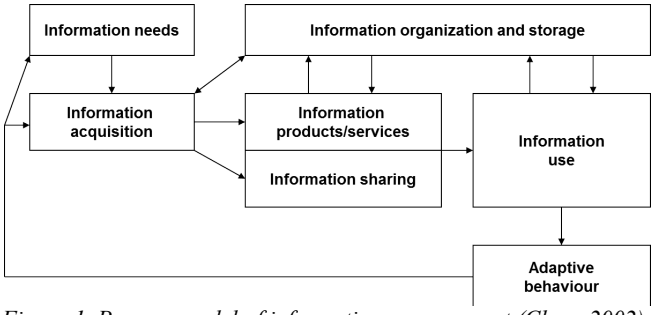

Figure 1. Process model of information management (Choo, 2002)

The model includes six stages. First, information needs are defined so that they can be later satisfied as well and efficiently as possible. Based on this, information is then acquired and gathered both from external sources, such as competitors and other partners, and from internal sources, such as operational databases and personnel. This is followed by the phase of information organisation and storage where the aim is the creation and build-up of an organisational memory. This facilitates not only latter phases such as information analysis for systematic and advanced information products/services, but also the phases of information sharing and information use. Information gets its final meaning when it is utilised for instance in decision-making, and changes in the organisational activities take place. By utilising and adjusting organisational operations, the cycle starts over.

Like said, HE organisations do not take full advantage of the information available. In order to do so, the broad understanding about knowledge utilisation is necessary. This means that knowledge-based management must be studied also from broader organisational perspective including cultural and strategical aspects. Therefore, we used the approach of Jääskeläinen et al. (2019) to cover these aspects. Jääskeläinen et al.'s (2019) framework of information and knowledge management leverage Choo's model by the aspects of governance and organisation, measures, and strategy and vision. In doing so, we could take into consideration the softer side of humans related to knowledge and the viewpoints of the employees and the organisation.

2.2 Higher education organisations and knowledge-based management

HE organisations have been acknowledged as knowledge intensive organisations for a long time (Fullwood et al., 2013; Sharimillah et al., 2013). New knowledge is created constantly through research, teaching and learning. Through these operations, also a vast amount of data is created which could be utilised to develop the organisation and support decision-making. Based on Gartner's (2017) research, the state of digitalisation in higher education organisations is lower than in other industries. It is widely recognised that the data is not utilised to support decision-making at least in the scale that it could be done (Aljawarneh, 2016; McNaughton et al., 2017; Scholtz et al., 2018).

In the HE sector, organisational structures can be either an enabling or restricting factor when it comes to knowledge-based management (Veer Ramjaewon and Rowley, 2017). HE organisations are often quite hierarchical and HE organisations tend to have challenges adapting to rapid changes, for example, due to inflexible organisational structures (Pucciareli and Kaplan, 2016). In knowledge-based management perspective, the stiffness of organisational structures can also cause a major barrier for knowledge sharing for HE organisations (Fullwood et al., 2013). Besides structural challenges, also strategic management (knowledge strategies tend to be passive or inconsistent), leadership in general and funding related issues have been mentioned as reasons behind challenges HE organisations come across.

Finnish HE organisations face these same challenges. The Ministry of Education and Culture of Finland coordinates the activities of higher education organisations and acts as their main financial source, so the organisations are performance guided (The Ministry of Education and Culture, 2020). These set a pressure for management, as well as, for example, for functional information systems, reporting capabilities and knowledge utilisation. Even though strategic management is a rather new concept in Finnish HE organisations, there is the willingness to have a larger emphasis on strategic development in systematic manner (Juppo, 2011; Ranki, 2016). When it comes to strategic knowledge management and knowledge-based management, it is not common for HE organisations to have a strategic approach to it (Veer Ramjaewon and Rowley, 2017).

Finnish HE organisations, as well as other HE organisations globally, have noticed the need for knowledge-based management. Like organisations from other industries, HE organisations are eager to develop their knowledge-based management practices but at the same time they are facing several challenges concerning knowledge-based management that were not evident or visible beforehand (cf. Ransbotham et al., 2016). In this study we point out these challenges and increase the understanding of knowledge-based management in HE organisations.

3 Research methods and empirical setting

This research was conducted as a qualitative single case study (Yin, 2002). The case organisation was the Tampere University of Technology (TUT). TUT merged with University of Tampere and Tampere University of Applied Science at the beginning of 2019 forming Tampere Universities community. In this study, we focus on time before the merge and solely on TUT organisation. The university was founded in 1965 and at the time of the study it consisted of 8300 members of personnel and students. The upper management included a rector, two vice rectors (for education and research), and five deans. These together formed an executive team of the university. In each faculty, there were two vice deans (for education and for research). Each faculty consisted of different amounts of units which were managed by a head of a unit. In total there were 19 units in the university. To support all university functions there were teaching and research related services and financial services departments.

The study was carried out during 2017 and 2018, with a focus on university's knowledge-based management. Empirical data consists of 19 theme interviews which were conducted in late 2017. Interviewees were members of upper management, middle management and personnel of support services as can be seen from table 1. Interviews covered all members of the steering group. Interviewees of vice deans, members of administrative services and heads of units were chosen so that all faculties would have similar proportions of interviewees.

Table 11. Introduction of the interviewees.

Number of interviewees	Title
1	*Rector*
2	*Vice rectors: head of education and head of research*
5	*Deans (of all faculties in TUT)*
3	*Vice deans*
3	*Members of administrative services: Teaching services, financial services, research services*
3	*Heads of a unit*

The aim of the interviews was to find out different views of organisation's knowledge-based management and to investigate general attitudes and culture towards knowledge-based management. Interviews were thematic interviews which were conducted face-to-face on university premises and lasted for 30 to 60 minutes. Interviews were formed following Choo's (2002) information management process model which includes the following phases: defining information needs, acquiring information, processing and analysing information, sharing information, information use in decision-making and feedback. In addition to Choo's model, we studied governance and organisation, measures, and strategy and vision.

Through the interviews we were able to get a vast empirical material for the analysis. The material was analysed in a qualitative manner. The findings were categorised by interview themes and interviewees' title. Firstly, the state of knowledge-based management was outlined for each interviewee group. After that, an overall view of the organisation's knowledge-based management was outlined. In this paper, we summarize the findings and propositions made during the research.

4 Findings and discussion

Valkokari and Helander (2007) point out that by examining organisations' activities through Choo's model the challenges related to knowledge management could be recognised and hence development proposals can be made. Like said before, we expanded Choo's model to enable broader examination of knowledge-based management. The analysis is summarized above.

Information needs. Information needs of different user groups are mostly undefined. In many cases, the shared information does not fulfil the information needs of upper and middle management personnel. Especially information about finances was most often mentioned being lacking. All interviewee groups recognised the same challenge despite differences in their roles in the organisation. Another major information gap was recognised as lack of predicative information. Most interviewees in a leading position mentioned that they could not get enough data or information to support predictive decision-making. It is vital for HE organisations to better utilise predicative information in order to stay competitive in the future (Pucciareli and Kaplan, 2016).

Information acquisition, organisation and storage. Even though most of the time there was enough information available, finding the needed information in due course caused problems. However, there was a clear difference between members of the executive team and other interviewees. The members of executive team felt that the amount of information provided for them was sufficient while other interviewees felt the opposite. That has to do with their role in the organisation since the information is mostly provided for the members of executive team. Even though this resolves the issue of availability it brings up another dilemma: the members of the executive team were highly dependent on the provided information.

Despite required amount of information being available, many interviewees had experienced challenges with finding or receiving information in a timely manner. Information is scattered to multiple information systems and channels. Inability to access information, lack of know-how of using the different information systems, and even unawareness of existing information systems were the main reasons. In addition to concerns raised before, the channels used for information gathering were mostly internal. Most interviewees used merely the sources available within the organisation. Only a few mentioned that they actively seek outer information sources to collect adequate knowledge to support their decision-making.

Information products/services. Above mentioned challenges affected information providers' workload; most of their time is currently spent on basic level reporting for executive team. Therefore, other interviewees felt that they do not get enough support from specialist providing and analysing information. Also, the commensurability on information perceived to be a challenge. As people gather data from the systems as they wish and maybe even form some reports of it by themselves, the results do not tend to be comparable due to different choices made in the data collection and combination.

The case organisation has a business intelligence system in use. Currently, it is only used for creating monthly reports for the executive team. The reports are sent via email and therefore information is converted to a static form. The system would allow investigating reports from multiple point of views and levels and so on enable more thorough understanding about the issues. According to Peters et al. (2016) the use of information system tools correlates positively with the competitiveness of the organisation due to wider information utilisation potential. However, currently the executive team do not find IS usage to be part of their job. Overall, there has not been a ruling of how the business intelligence system should and could be used to better support decision-making.

Information sharing. Information sharing was mostly mentioned in positive context. The interviewees thought that the amount of information shared is good via information systems. Also, they had good communication with colleagues and mostly the exchange of information was seen to work well. Unscheduled conversations were considered one of the most important sources of information. This causes a problem by since the level of uncertainty of information sharing is quite high.

Currently, information sharing is not very targeted and the strategy seems to focus on pushing all information out there for people to find. A challenge occurring from information system-based information sharing is that finding information is quite dependent on how actively one seeks it. This combined with lack of know-how in information system utilisation can cause problems in the organisation.

The interviewees also recognised prevailing willingness to use information to share information openly in the organisation. Currently, the situation is not quite there yet. The hierarchical structure of the organisation is vertically rather high, and information flows mostly from top to bottom. Personnel found it hard to share information the other way around.

Information use. According to the interviewees, decision-making is mostly knowledge-based. Information is used when it is available in timely matter. However, middle management did not always have enough information to support decision-making. Especially financial information was considered being lacking. On the other hand, upper management rely heavily on the information provided for them. The people preparing reports for management emphasised that they do not get to participate in decision-making situations even though their presence would be beneficial to open up the reports verbally so that the context and all matters effecting on the background will be noticed.

Governance and organisation. Based on the interviews, it is evident that there is willingness to use information to support decision-making. As implied earlier, this willingness does not always translate to action due to a couple of different reasons. The most important barriers are finding the needed information and the knowledge utilisation culture of the university and the attitudes towards it. The lack of transparency in decision-making undermines the culture of knowledge-based management.

The organisation already had a data warehouse in use which is an important step towards better data utilisation. However, not all interviewees knew how to access it nor had rights to access it if necessary. Those who had access thought that searching for relevant data from the warehouse was challenging. Also, some operational data was not yet connected to the warehouse. The IT infrastructure was considered too complex and non-transparent.

According to interviews, one reason for above mentioned challenges is changed organisational structures which have varied multiple times due to many organisational changes made during past years. Current structure allows all faculties to develop their own data and information utilisation practices. Interviewees felt that there are big differences depending on from which previous structure faculties and units originate.

Measures. At the university, the finances guide strongly of what is measured since TUT needs to fill certain targets set by the ministry of education to receive adequate funding. Most interviewees said that measurement is purely quantitative, and it does not support developing teaching and research. Measurements was seen as a guiding factor action instead of a tool for developing operations. Since almost all measuring was

finances based, measurement did not provide extensive enough information for all strategic and operational planning.

Strategy and vision. Currently, systematic knowledge-based management has not been a clear strategical target for TUT which seems to be common in other universities also (Veer Ramjaewon and Rowley, 2017). The interviewees said that the organisation does not have a strategy for knowledge-based management or if there was, they did not know of it. Also, all faculties, units and even personnel seemed to have different views and modes of action of knowledge-based management. However, it would be important to invest in strategical planning from this point of view. To derive value from organisational data and information in HE context it is necessary to have a clear strategy and managers full support to implement it (Pucciareli and Kaplan, 2016; Sharimillah et al., 2013). In addition to lack of strategy and systematic approach interviewees felt that upper management does not lead by example in this matter currently at least at the level the interviewees would hope they would.

The organisation is willing to develop a culture that support knowledge-based management. The organisation could, for example, improve the manner of how they communicate of decisions made. Even though a decision would be made based on a vast set of information, it is not communicated forwards clearly at the moment. Communicating of knowledge-based decision-making would have a positive effect on the knowledge and information culture of the organisation. According to Pucciareli and Kaplan (2016) academic managers should have a central role in guiding the quality and reputation of decision-making culture. It seems that the decision-making is currently more reactive than proactive though organisation vision seems to be towards a more proactive one.

Based on our study we recognised a few main challenges the organisation faces: 1) knowledge-management is not an organisation-wide practice, 2) scattered information systems cause challenges in information finding and sharing and 3) information needs have not been clarified among personnel and information needs are not met at the moment.

5 Conclusions

In this paper, we studied the knowledge-based management of a Finnish higher education organisation. We analysed the level of knowledge-based management by utilising Choo's (2002) model complemented with Jääskeläinen et al. (2019) framework. By combining these models, we were able to expand the analysis beyond using information to support decision-making by investigation and also the organisational strategy, governmental practices and measurement.

As a result, we recognised three main areas which need attention in order to improve knowledge-based management. Firstly, since the organisation has acknowledged the importance of knowledge-based management but there is no organisation wide strategy or common methods yet, it would be important to begin the knowledge driven strategic

development. There is a need for a strong support from upper management in this process to establish a culture and practices for knowledge-based management (Pucciareli and Kaplan, 2016; Sharimillah et al., 2013). The management should communicate more transparently of decisions been made and the data and knowledge on which those decisions are based on.

Secondly, to resolve challenges in information finding and sharing, information system infrastructure should be revisited to find out ways to uncomplicate it. At least it should be clearer from where different pieces of information are located. Also, it would be beneficial to improve knowledge sharing practices in the university. The stiff structure of the organisation is one cause for challenges at least with information sharing at horizontal level. Overall knowledge sharing practices should be clarified. Lack of knowledge sharing culture is recognised as a barrier to knowledge sharing in HE organisations (Veer Ramjaewon and Rowley, 2017) and therefore this leads back to establishing a culture of knowledge-based management as well.

Finally, there was a challenge of unrecognised information needs which effects negatively on knowledge-based decision-making due to lack of relevant information. The information needs should be identified in order to be able to provide necessary information at the right time for the right people. Also, information sharing could be more targeted to avoid information overflow and so on inability to find the information needed. After all, the development of knowledge practices and processes should be started by focusing on the decision-makers' and the organisations' knowledge needs (cf. Choo, 2002).

The case organisation has challenges related to its knowledge-based management. The challenges are comparable with Myllärniemi et al. (2019) research that studied data-based value creation from a globally operating manufacturing company point of view. Their data was also scattered into multiple information systems, and they had problems with knowledge sharing. Both organisations lacked of understanding of importance of data and information. The results indicate that both organisations need a systematic approach in knowledge-based management. Knowledge-based management is about management and leadership.

This analysis provided a wide understanding about the organisation's knowledge-based management practices and culture and enabled forming proposal for development. In addition, the findings contribute to research in the HE sections where knowledge-based management is not very widely studied. The research material was comprehensive, but it also had some limitations. As the interviewees were mostly members of upper and middle management, and information service personnel, the analysis does not fully cover all organisation, especially research and teaching personnel. It would be beneficial to study the views of other personnel since knowledge-based management is also about a common attitude and culture towards knowledge utilisation in the organisation. After this research was conducted, there has been an organisation merger. Therefore, studying knowledge-

based management in the new organisation and comparing the levels before and after the merger would be an interesting research topic.

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Corporate Financial Distress: an Alert Perspective. Statistical Background, Firm Valuation and Empirical Evidences from Italian Firms in a Digital Age Context

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Abstract

Banks are nowadays compelled to implement specifically adequate internal procedures and reporting files to be able to identify and manage potential non-performing corporations at a very early stage. This practice has become necessary to monitor performing loans and avoid any deterioration in credit quality. Banks have to fix the set of UTP ("Unlikely-To-Pay") and consider all the situations listed both in the EU CRR ("Capital Requirements Regulation") definition of default and in the IFRS notion of impairment. Different sets of UTP triggers may be defined on a portfolio-by-portfolio basis where the core corresponds to the financial distress prediction, which represents an extensive ongoing research topic. To investigate the influence on different states of financial distress of both micro-economic indicators and firm-specific factors, this paper applies a predictive model, well known in academics, on a unique sample of UTP. In particular, the Z-Score and its revised version were applied to companies included in a special and confidential register of UTP loan positions from a major Italian bank. This allowed the authors to effectively analyze the Z-Score and Z'-Score ability to predict UTP positions. Existing literature on Z-Score, on the contrary, considers the filling of bankruptcy procedures as a criterion for distress, which represents only the final phase of a crisis. In addition, the inclusion of corporate governance variables as control variables is another relevant contribution, since most of past research includes only economic and financial variables.

Results confirm the ability of the Z'-Score model to predict UTP, which is an event far earlier than insolvency

Keywords – Corporate bankruptcy prediction, Financial distress, Z-Score, Statistical learning

Paper type – Academic Research Paper

1 Introduction

Empirical studies have sought to identify a shared notion of crisis. The first attempts in this sense derive mainly from analyses of a discriminating type, namely, Beaver's model (1966) and Altman's model (1968).

According to many recent international studies, a company is in crisis when the market value of its assets falls below a certain threshold (the so-called default boundary - Black and Cox, 1976; Leland, 1994; Longstaff and Schwarts, 1995) while, on the other hand, certain other approaches consider the phenomenon to be a result of financial loans (e.g., the inability of a company to meet its current financial obligations) (Lummer and McConnell, 1989; Gilson et al., 1990; Wruck, 1990. Hotchkiss, 1995; Peterson et al., 1995; Tashijian et al., 1996; Beaver and Engel, 1996, Anderson and Sundaresan, 1996; Andrade and Kaplan, 1998; Boot, 2000).

Such efforts, put in place mainly to promptly identify the very first signs of crisis, allow a company and its consultants to better manage both the strategic and financial levers at their disposal to bring back the company to regularly create value (Blum, 1974, Ohlson, 1980, Zmijewski et al., 1984, Boster et al., 1992, Li and Sun, 2008; Christensen and Li, 2014).

The ability to identify the signals of the crisis as soon as possible, moreover, plays a fundamental role in managerial terms. Indeed, the effectiveness of the adoption of strategic actions in response to the negative dynamics of economic and financial results is strictly correlated to its promptness (Vašíček et al., 2017; Schivardi et al., 2017; Brodi, 2018).

Alert analysis is therefore of particular interest, and this study has been carried out in this perspective. A unique sample is used in this research. Thanks to the support of a major bank operating in Italy, the authors were able to collect confidential information regarding companies included in the sample for the 2006-2016 period, and, specifically, the dates of the inclusion of the companies in the register of UTP positions[1] held by the bank. These data, to be considered as early signs of crisis, are used as reference events for the Z-Score calculations of our analysis. The results confirm that the Z-Score model is a valid tool for alert analysis, as it is able to predict the first signs of financial instability.

[1] *A private register that includes the companies that miss debt repayments (principal or interest). Unlikely to pay (or Utp) are credit exposures for which the bank deems total repayment to be unlikely. Compared to bad loans, they are considered less risky. For this reason UTP is considered an early alert of crisis.*

The paper is organized as follows. The first part provides an overview on the existing literature for the prediction of financial distress, followed by a detailed analysis of the Z-Score model to understand its functioning and applicability. Then, the goal of the research is outlined and the following sections are dedicated to both the construction of the sample and the analysis of the results. Finally, conclusions and managerial implications are stated.

2 Review of the literature on financial distress prediction

Studies on corporate crisis can be grouped according to the following five main strands: the first is related to the causes of corporate crisis (Hedberg et al., 1976; Schendel and Patton, 1976; Hambrick and D'Aveni, 1992; Gales and Kesner, 1994; Slatter and Lovett, 1999; Sheppard and Chowdhury, 2005; Vašíček et al., 2017); the second to the indicators of cororate crisis (Beaver, 1966; Altman, 1968; Blum, 1969; Deakin, 1972; Edminster, 1972, Wilcox, 1976, Taffler and Tishaw, 1977, Dambolena and Khoury, 1980, Ezzamel et al., 1987, Winn, 1993, Bijnen and Wijn, 1994; Hung, 2004; Reisz and Perlich, 2007; Fiordelisi and Mare, 2013; Hernandez Tinoco and Wilson, 2013; Christensen and Li, 2014); the third is the one related to the debt analysis (Diamond, 1991; Ofek, 1993; Asquith et al., 1994; Chemmanur and Fulghieri, 1994; Aggarwal, 1995; Hotchkiss, 1995; Gilson, 1997; Ongena and Smith, 2000; Kahl, 2002; Brunner and Krahnen; 2004; Mooradian and Ryan, 2005; Hotchkiss et al., 2008; Dudley E., Yin Q.E., 2018); the fourth is the one focused on the evaluation of companies in crisis (Gilson et al., 2000; Damodaran, 2009); the last, is the one focused on solutions of judicial and extrajudicial crisis and comparative economic efficiency (Berkovitch and Israel, 1998; Rasmussen, 1998; Blazy et al., 2008).

With reference to the main issues analysed in this research, the strands indicated under points 1, 2 and 3 are the most relevant and, among these, the analysis of the causes represents the starting point for the preparation of an effective intervention plan. Obviously, it is not possible to draw up a definitive list of all the possible causes of crisis, which are often due to competition among several factors (Slatter and Lovett, 1999).

As for the indicators of crisis, since the 1960s, many studies, mainly from the US, have focused on the possibility of combining publicly available data with statistical classification techniques to prevent business failure. Not long before the previously mentioned studies of Beaver and Altman, which gave a strong boost to further investigation on the issue, Tamari (1964) proposed an initial pioneering attempt to statistically analyse failure.

Considerable effort has also been made to replicate and extend these models in other contexts and countries outside the US, finding strong similarities and notwithstanding the specificities of individual countries in the predictive approaches; random studies on bankruptcy are indeed much rarer (Altman and Narayan, 1996). In response to contingent factors, researchers and professionals have developed newer and more sophisticated systems to more quickly identify any signal of crisis with further details (Altman, 1998),

to evaluate the strategic variables and, therefore, to support the decision-making process (Amigoni, 1998; Eccles, 1991). In addition to the traditional predictive indicators and models of a financial nature, new multi-dimensional indicators were considered, implemented by extra-accounting measures and financial and physical techniques.

There are at least four methodological approaches to the development of risk assessment systems (*scoring*): (i) the linear probability model, (ii) the *logit* model (Ohlson, 1980; Zavgren, 1985; Forestieri, 1986; Aziz et al., 1988; Keasey and McGuiness, 1990; Platt and Platt, 1990; Theodossiou, 1991; Salchenberger et al., 1992; Ward, 1994; Back et al., 1996; Laitinen and Laitinen, 1998; McGurr and DeVaney, 1998; Dimitras et al., 1999; Kahya and Theodossiou, 1999; Beyonon and Peel;, 2001; Neophytou et al., 2001; Foreman, 2002; Brockman and Turtle, 2003; Lin and Piesse, 2001; Westgaard and Wijst, 2001), (iii) the *probit* model and (iv) the discriminant analysis model (Altman, 1968, 1993, 2002; Deakin, 1972; Edmister, 1972; Blum, 1974; Alberici, 1975; Libby, 1975; Taffler, 1976-1977; Altman et al., 1977; Deakin, 1977; Moyer, 1977; Taffler and Tisshaw, 1977; Altman, 1983; Booth, 1983; El Hennawy and Morris, 1983; Casey and Bartzack, 1984; Gombola et al., 1987; Mantoan and Mantoan 1987; Aziz et al., 1988; Piesse and Wood, 1992; Coats and Fant, 1993; Altman et al.,1994; Altman et al., 1995; Back et al., 1996; Altman and Narayanan, 1997; Jo et al., 1997; Pompe and Feelders, 1997; McGurr and DeVaney, 1998; Dimitras et al., 1999; Kahya and Theososssiou, 1999; Yang et al., 1999; Altman et al., 2013).

Credit scoring models work quite well in various domestic contexts and at different times and yet have been subject to at least three types of criticism: (i) they are based largely on accounting data, without consideration of other crucial elements (data on market values); (ii) models based on linear discriminants cannot describe the reality of the facts, which are intrinsically non-linear; and (iii) the predictive models shown above are often weakly correlated with the underlying theoretical models (Altman and Saunders, 1998).

Bellovary et al. (2007) have identified approximately 150 predictive models developed since 1965 and, although such analysis reveals that many of the predictive models can show efficacy in the early warnings of insolvencies, the authors also highlighted how researchers are continuously developing new predictive models that try to describe, in an absolute way, the possible insolvency of companies. This has led the authors to conclude that future research should focus on evaluating the effectiveness of using existing models rather than looking for new ones.

It has been demonstrated that existing models tend to have diminished effectiveness in the presence of different samples (e.g., size, sector, type, legal status, area of operational interest, etc.). Part of the generalizability of the model is its applicability in periods of different observations with respect to the "*test case*" originally used (Grice and Dugan, 2001; Grice and Ingram, 2001; Wu et al., 2010). In this sense, in more recent times, numerous empirical studies have been carried out to test the efficacy of the main models by suitably adapting or following the original formulation, with samples selected in

specific domestic contexts, also outside North America or Europe (Taffler, 1984; Peel et al., 1986; Altman et al., 1995; Bottani et al., 2004; Charitou et al., 2004; Alareeni and Branson, 2013; Altman et al., 2013; Cestari, 2013; Celli, 2015; Giacosa, 2016; Kováčová and Kliestikova, 2017). Within these cases it is possible to identify some relevant works focused on the Italian context (Bottani et al., 2004; Altman et al., 2013; Celli, 2015; Giacosa et al., 2015; Giacosa et al., 2016; Madonna and Cestari, 2016).

The model developed by Altman in 1968 (also called *Z-Score*) certainly represents one of the most commonly adopted and easy-to-use tools for assessing default risk, and while the original version of the model was built on a sample of manufacturing companies, it can also be applied to other industries (Al-Sulaiti and Almwajeh, 2007).

As explained by Altman and Le Fleur (1985), this model can be transformed into an active strategic tool aimed at preventing major financial crises. The aim of the *Z-Score* models is to measure the distance – through a score system and with a reasonable error rate – between companies from two groups (healthy and problematic).

The model, which has a descriptive-comparative nature (Altman, 1970), is based on five quantitative variables and aims to identify the tendency that links the trend of the accounting indicators in the years before insolvency for healthy companies and for those in crisis.

Altman's model is based on a formula that assigns a score that can describe the financial soundness of a company and predict its probability of default within a certain time horizon.

In analytical terms, the following linear function represent the *Z-Score* model:

$$\boldsymbol{Z-Score} = \frac{Working\ Capital}{Total\ Assets} x\ 1.2 + \frac{Retained\ Earnings}{Total\ Assets} x\ 1.4 + \frac{EBIT}{Total\ Assets} x\ 3.3 + \frac{Market\ Value\ of\ Equity}{Book\ Value\ of\ Total\ Liabilities} + 0.6\ x \frac{Sales}{Total\ Assets} x\ 0.99 \quad (1)$$

The original *Z-Score* was built on a sample of 33 US manufacturing companies listed on regulated markets. Some authors have criticized the predictive ability of the *Z-score* (and its variants) with reference to non-US companies because the model is closely linked to the characteristics of the US market (Grice and Ingram, 2001; Grice and Dungam, 2001; Ooghe and Balcaen, 2006; Kapadia, 2011). Instead, several studies on the application of the model to samples of US companies (e.g., Timmermans, 2014) have shown a significant predictive ability of the *Z-score* model, up to 95% in the year previous to the insolvency of the companies analysed (year -1), to 83% two years before insolvency (year -2) and 48%, 29% and 36%, respectively, three, four and five years before insolvency (year -3 year; year - 4; year -5).

Assessments carried out over the years outside the US market have shown that the same model is efficient (Charitou et al., 2004; Alareeni and Branson, 2013).

In 1993, Altman introduced the *Z'-Score* (Altman, 1993), which consists of an adaptation of the original model for companies that are not listed in the financial markets.

In analytical terms, the following linear function represent the *Z'-Score* model:

$$\boldsymbol{Z' - Score} = \frac{Current\ Assets - Current\ Liabilities}{Total\ Assets} x0.71 + \frac{Retained\ Earnings}{Total\ Assets} x\ 0.847 + \frac{EBIT}{Total\ Assets} x\ 3.107 + \frac{Book\ Value\ of\ Equity}{Book\ Value\ of\ Total\ Liabilities} x\ 0.420\ x \frac{Sales}{Total\ Assets} x\ 0.998 \quad (2)$$

In 1995 Altman et al. developed the *Z''-Score* model under the name of "*double and prime score"* for non-manufacturing companies and, possibly, those operating in emerging markets (with the insertion of a correction).

In analytical terms, the following linear function represent the *Z''-Score* model:

$$\boldsymbol{Z'' - Score} = 3.25 + \frac{Current\ Assets - Current\ Liabilities}{Total\ Assets} x\ 6.56 + \frac{Retained\ Earnings}{Total\ Assets} x\ 3.26 + \frac{EBIT}{Total\ Assets} x\ 6.72 + \frac{Book\ Value\ of\ Equity}{Book\ Value\ of\ Total\ Liabilities} x\ 1.05 \quad (3)$$

An analysis carried out on extensive databases in international contexts (32 countries including 29 European countries and 3 non-European countries - China, Colombia and the US) has produced very positive results for the *Z-Score* model. Nonetheless, to give greater efficiency and effectiveness to the model in both European and non-European countries, it is appropriate to structure the original analysis through the inclusion of "*country-specific*" estimates that would improve the effectiveness of the results (Altman et al., 2017).

Recent studies have shown the effectiveness of the *Z'-Score* for analyses carried out on samples of Italian companies (Madonna and Cestari, 2016; Paoloni and Celli, 2018).

A recent study on manufacturing enterprises under the Italian bankruptcy procedure (Altman et al., 2013) in the period 2000-2010 showed that the majority of the companies analysed is classified in the area of insolvency according to *Z''-Score*: in particular, in the last four years of the period considered, scores were always lower than 1.23.

Another recent study (Paoloni and Celli, 2018) on a panel of 200 companies (half of which have been subjected to bankruptcy procedures, while the other half consists of "healthy" companies) revealed the *Z'-Score* model's good diagnostic reliability in measuring the health of Italian manufacturing SMEs. In particular, the *Z'-Score* model allowed for detection of companies under default risk.

Our research adopts the Z-Score model as an indicator of the probability of default, in line with the existing literature which suggests going deeper in details in terms of its effectiveness in different contexts. At the same time, however, it aims to address a different research question compared to existing studies. The main gap in the existing

literature is related to the fact that, due to availability of data, the main research question has always been something like "*Is the Z-Score model able to predict the state of crisis defined by the filling of the bankruptcy procedure?"* This was due to the fact that the information related to the state of insolvency is typically recognizable only when it becomes public (i.e., the procedure has been filled). This has a high impact from a managerial perspective: the state of crisis is recognized too far, at a time when corrective actions become more difficult to apply. Our research aims to answer a different question. Specifically, is the Z-Score model able to predict the state of crisis defined by the inability of a company to comply with the deadlines and methods of debt payment in a phase prior to the possible filling of a bankruptcy procedure? In other words: is the Z-Score able to predict UTP classifications? The managerial implication is relevant: the ability to map early warnings allows for earlier intervention, with more effective corrective actions and with fewer limitations. The research gap that this paper aims to fill is therefore related to the timing granted by the analysis of the probability of default through Z-Scoring, which the existing literature demonstrates to be effective but not timely. Here we seek to demonstrate its efficacy as well its ability to be timely.

3 Objective of the study

Since the late 1970s, the number of databases containing historical data relating to companies in crisis has grown considerably, and the use of these elements increasingly allows for the development of new and more appropriate approaches (Altman and Saunders, 1998). It is precisely in the wake of this informative advantage that our study has been able to draw on a considerable amount of information coming from strategically relevant domestic credit institutions.

Due to the characteristics of the unique selected sample, made up of 220 Italian companies, a discriminating element of particular innovation has been used to partly fill the existing research gaps and to add one additional element regarding the applicability of the Z-Score model.

The aim of our study is twofold.

First, we want to verify the accuracy of Altman's model (with particular focus on the *Z'-Score* model).

Second, we want to test its ability to predict early signals of crisis and not just insolvency.

Internal and external stakeholders need to be able to anticipate the warning signs of a crisis before it reaches the point of no return that can lead to very dangerous consequences (Warner, 1977; Charalambous et al., 2000; Charitou et al., 2004).

In line with the importance attributed to stakeholders' interests, the analyses carried out in the present work follow the stakeholder theory approach (Freeman, 1984; Donaldson and Preston, 1995), which considers the company from the point of view of the holders of interest in general.

4 Sample definition and construction

The research begins with the identification of a unique sample, which is one of the main elements of innovation. Historically, the reference literature on corporate crises has faced a limitation in the availability of data relating to *business restructuring* processes. Beyond the complete lack of available data concerning the out-of-court recovery processes (recovery plan), which are naturally private, data on so-called judicial processes (e.g., debt restructuring agreements) and qualitative information on the management of processes are particularly difficult to achieve. Thanks to the support of a leading bank operating in Italy, the authors managed to obtain not only economic and financial data concerning companies in crisis but also the date of their inclusion in the special register of UTP positions, which for us is the event representing the crisis (while for the existing literature the event is represented by the filling of the public bankruptcy procedure).

The very nature of the data obliges the authors to make some further considerations. If from a legal point of view the state of crisis is assumed to begin when the company enters one of the procedures provided by bankruptcy law, from a bank's perspective, this *status* can be determined at a very early moment corresponding to the date on which a debtor experiences problems in the restitution of the interest or principal portion of its debt to the bank. At that time, the bank completes a special register of "unlikely to pay" positions and then takes all possible measures to protect its economic interests.

The concept of "corporate crisis" adopted in this work, therefore, takes its cue from an unfamiliar, perhaps unique definition. This setting can considerably broaden the analytical perspective. The traditional definition adopted in literature refers to a moment of publicity of the state of crisis to conduct analysis, taking as a reference only the moment at which the company gains access to one of the procedures provided by bankruptcy law; in contrast, the definition of crisis adopted in this study allows for identification of crisis even in previous moments and even independently from the access to one of the procedures provided by the law. This perspective allows for the analysis of all cases in which credit management has a private and confidential process, where access to one of the procedures provided by bankruptcy law is only one of the possible outcomes.

The sample was built by adopting the bank's information system. Specifically, we considered a) any case in which a company was unable to repay interest or part of the principal payment and for this reason b) was included in the "special register" of the bank and c) had positively concluded a restructuring process at least two years before this study began. There are two outcomes of the restructuring process. The first is complete rehabilitation of a company in its capacity to repay debts ("*in bonis*" status), and the second is the confirmed inability to repay debts because the state of crisis is too deep ("*workout*" status).

The extraction from the bank's information system allowed the authors to identify 72 companies that successfully completed the process.

Then, for each company, the following information was collected:

a) **Economic and financial data**: the database obtained through the extraction from the information system of the bank was further integrated by extracting relevant financial data on Bureau van Dijk's AIDA and Amadeus databases. Data extraction concerned the three years before and the three years after the "crisis moment" (inclusion in the special register), as reported by the restructuring managers from the bank, through interviews and surveys conducted by the authors.
b) **Governance data:** the database was further integrated with additional data on corporate governance from the CERVED database.

Following the identification of the sample, two additional samples were built for the purpose of our analysis. Therefore, the final sample is composed of three sub-samples:

- **1 (Firms in financial distress that succeeded in restructuring)**: companies that, starting from the year 2014, have shown positive results in terms of capacity to repay their obligations to the bank. No listed company has been included.
- **2 Firms in financially sound position)**: companies that did not show economic and financial problems during the period 2007-2016. A total of 72 companies were identified. No listed company has been included.
- **(Firms which have failed)**: companies that ceased their operations as a consequence of bankruptcy, voluntary liquidation, judicial liquidation or dissolution in the 2014-2016 period. A total of 76 companies were identified. No listed company has been included.

Starting from the identification of the economic and financial data of the companies in sub-sample 1, the maximum, minimum and average values of the turnover were identified and considered as an approximation of the size of the company. The sectors of these companies were also identified. Then, the entire population of Italian companies included in the dimensional limits of sub-sample 1 was identified (minimum and maximum turnover limits of the sub-sample 1). Then, only companies included in the same 2007 ATECO (Nace rev. 2) sectors of sub-sample 1 were considered. This population includes 34,124 units. Starting from the identified population, “deceased” and “healthy” companies were identified. In total, 76 "deceased" companies were identified. For the “healthy” companies, *pairwise* sampling was carried out starting from sub-sample 1. In particular, for each restructured company, another company was identified as having similar characteristics in terms of size (turnover) and reference industry (ATECO 2007). To have a balanced sampling, 72 companies were identified randomly according to these criteria through SPSS. The final sample, including the three sub-samples, is therefore made up of 220 companies.

5 Methodology and definition of variables

After elaborating the descriptive statistics to verify the existence of any *outlier* data, we proceeded to the elaboration of the correlation analysis for the variables included in our analysis. Linear regression is then used to test our hypothesis. The Y variable included in

the models is a dummy assuming values between 0 and 1, depending on whether the company is healthy (0) or recovered or ceased (1). This choice derives from the authors' desire to extend the number of observations in order to arrive at a more significant result through greater granularity in the considered data. Aware of the limits deriving from the attribution of a dummy variable to three different conditions, we also proceeded to verify the model for a sub-sample of companies belonging to two conditions. To run this second test, only companies included in sub-samples 1 and 2 were considered.

With regard to the variables included in our models, Z-Score is the Altman's score already defined; it is used as independent variable to try to explain the Y that is represented by the dummy variable. For the definitions of the other variables included in the model please refer to the Appendix.

6 Results

Correlation analysis provided the authors with significant results. Since the number of variables initially collected and considered is considerable, in Table 1 only those variables that show significant[1] relationships with the dummy variable are reported, with the (positive or negative) signs of their relation as highlighted in the very last column.

Table 1 – Correlations: summary of results

Variable	Variable	Positive or negative relationship
Company status	No. of board members (2007-2011)	-
Company status	No. of CEO (2015-2018)	-
Company status	No. of Sole Directors (2007-2011)	+
Company status	No. of Sole Directors (2015-2018)	+
Company status	No. of Liquidators (2015-2018)	+
Company status	President of BoD (2015-2018)	-
Company status	Sole Directors average term of office	+
Company status	Board of Directors average term of office	+
Company status	Z-score (2007-2011)	-
Company status	Z-score (2012-2014)	-
Company status	Z-score (2015-2016)	-
Company status	Z-score (2007-2011) Revised	-
Company status	Z-score (2012-2014) Revised	-
Company status	Z-score (2015-2016) Revised	-

[1] *Correlation is significant at 0.01 level (two-tails).*

It must be emphasized that the consistency of *Z-Score* configurations varies over the years. It is interesting to note that despite the inclusion of the 2007-2011 financial crisis period in our analysis, the z-score of this period is not actually significantly related to the status of the companies. This allows us to conclude that the financial results of that period do not distort the analyses of subsequent periods (or even that the crisis that the companies went through was not predictable through the z-score observable between 2007 and 2011).

For all the periods under analysis, there seems to be a significant negative relationship between the value of the score and the status of the company. This is consistent with the conceptual approach of the score, which involves the association of scores that are as high as the probability of company insolvency is low. The state of the company is here approximated with a dummy variable (0 = healthy company, 1 = recovered or ceased enterprise), and its relation to the score seems to confirm this hypothesis.

Following the correlation analysis, all the variables with significant correlations have been included in two regression models:

- The first model includes the analysis of the *Z-Score* in its original formulation;
- The second model includes the analysis of the *Z'-Score* in its *revised* version.

The regression analysis aims to create a better understanding of the causal link between the variables.

6.1 Model 1

Among the explanatory variables, *Model 1* accounts for the *Z-score* in its original formulation and the *governance* variables that were significant in the correlation analysis. The main data concerning the model are summarized below in Table 2 R-square value of the model is 0.315.

Table 2 - Regression results: Model 1

Model	R	R-square	R-square adjusted	Standard error
1	,561a	,315	,289	,39664

Model		Non-standard ratios		STANDARD RATIOS		
		Beta	Standard error	Beta	T	Sign.
1	(Steady)	,832	,080		10,466	,000
	Sole Directors (2007-2011)	,092	,052	,108	1,768	,079
	Liquidators (2015-2018)	,112	,061	,110	1,829	,069
	President of BoD (2015-2018)	-,107	,043	-,150	-2,472	,014
	Zscore0711	,060	,032	,157	1,855	,065

	Zscore1214	-,158	,033	-,450	-4,855	,000
	Zscore1516	-,032	,018	-,127	-1,786	,075
	BoD average term of office	,015	,005	,174	2,900	,004

a. Dependent variable: status

The results of the regression analysis, expressed by the level of significance, and the sign of the standardized Beta coefficient confirm the relationship between the *Z-Score* and the status of the company. Indeed, there is a significant negative relationship between the average value of the *Z-Score* in the years 2012-2014 and the *status* of the company. The lower the score, the higher the probability that a UTP emerges.

Therefore, the model confirms the ability of the *Z-Score* tool to predict the status of a company, at least on time horizons that extend to two years earlier than the occurrence of UTP. The results, however, lose significance if extended to wider horizons (Average value of score between 2007 and 2011).

The analysis reveals significant relationships with the corporate governance variables, included here as non-financial control variables. Therefore the model provides suggestions for further research where non-financial variables could be used.

6.2 Model 2

Model 2 arises from the need to include the *Z-Score* in its revised version in the analysis. With respect to model 1, therefore, the only variables which were substituted are those related to the *Z'-Score*. Non-financial control variables remain unchanged (Table 3).

Table 3 – Model 2: Regression results

Model	**R**	**R-square**	**R-square adjusted**	**Standard error**
2	,491a	,241	,213	,41728

Model		**Non-standardized ratios**		**Standardized ratios**		
		B	**Standard error**	**Beta**	**t**	**Sign.**
2	(Steady)	,921	,088		10,488	.000
	Sole Directors (2007-2011)	,115	,054	,136	2,114	.036
	Liquidators (2015-2018)	,101	,064	,099	1,575	.117
	President of BoD (2015-2018)	-,158	,044	-,223	-3,570	.000
	Z-Score 2 0711)	-,061	,029	,114	1,111	.037
	Z-Score 2 1214)	,016	,006	-,356	-3,395	.005
	Z-Score 2 1516)	,020	,018	-,109	-1,541	.268
	BoD average term of office	-,012	,008	,179	2,831	.125

a. Dependent variable: status

The results of *Model 2* largely overlap with those of Model 1 in terms of sign and significance of relationships. Relationships with *corporate governance* variables are maintained. The relationships between the status of the company and the *Z'-Score*, this time in the *revised* version, are maintained as well.

To further test the obtained results, we proceeded to verify the statistics following a double path: Firstly, a verification of the model on a sample represented only by healthy or restructured companies is implemented. This assessment was necessary as the dummy variable used until now (which is dichotomous) actually contains three different possible statuses related to the company (healthy, restructured or ceased). The implemented verification grants a better matching of the conditions under which the company lies (healthy or restructured) with the values associated to the dummy variable (0 and 1). The verification was carried out both for the *Z'-Score* and for the *Z"- Score*. The results, as reported in Table 4 and 5, are confirmed both in terms of significance and signs of the relationship.

Table 4 - Regression results: Z'-score for healthy and restructured companies.

Model		Non-standardized ratios		Standardized ratios		Sign.
		B	Standard error	Beta	t	
1	(Steady)	,646	,109		5,949	,000
	Sole Directors (2007-2011)	,080	,102	,061	,784	,435
	Liquidators (2015-2018)	,084	,467	,014	,180	,857
	President of BoD (2015-2018)	,038	,061	,046	,619	,537
	Z-Score 1 0711	,018	,047	,046	,388	,698
	Z-Score 1 1214	-,157	,047	-,433	-3,321	,001
	Z-Score 1 1516	-,014	,022	-,058	-,623	,534
	BoD average term of office	,017	,007	,210	2,518	,013

a. Dependent variable: status

Table 5 - Regression results: Z"- score for healthy and restructured companies.

Model		Non-standardized ratios		Standardized ratios		Sign.
		B	Standard error	Beta	t	
1	(Steady)	,667	,112		5,983	,000
	Sole Directors (2007-2011)	,069	,107	,053	,648	,518
	Liquidators (2015-2018)	,132	,467	,022	,282	,779
	President of BoD (2015-2018)	,039	,062	,048	,638	,525
	Z-Score 2 0711	,030	,024	,176	1,275	,205
	Z-Score 2 1214	-,083	,023	-,515	-3,569	,000
	Z-Score 2 1516	-,007	,009	-,069	-,749	,455
	BoD average term of office	,017	,007	,208	2,469	,015

a. Dependent variable: status

Then, a second verification considered a control sample extrapolated from the original one in order to verify the permanence of the levels of significance, even for a random sample of observations taken from the original sample. In particular, the control sample considered 51% of the observations of the original sample, selected randomly by the

SPSS software. In this case too, the verification was made both on *Z'-Score* and on *Z"-Score*. The results are reported in Table 6 and 7.

Table 6 - Regression results: Z'- score for the control sample.

Model		Non-standardized ratios		Standardized ratios	t	Sign.
		B	Standard error	Beta		
1	(Steady)	,578	,121		4,794	,000
	Sole Directors (2007-2011)	,082	,108	,067	,754	,452
	Liquidators (2015-2018)	,032	,472	,006	,068	,946
	President of BoD (2015-2018)	,042	,066	,054	,628	,532
	Z-Score 1 0711	,045	,054	,117	,836	,405
	Z-Score 1 1214	-,181	,056	-,475	-3,230	,002
	Z-Score 1 1516	-,014	,023	-,061	-,608	,545
	BoD average term of office	,020	,007	,252	2,668	,009

a. Dependent variable: status

Table 7 - Regression results: Z"- score for the control sample.

Model		Non-standardized ratios		Standardized ratios	t	Sign.
		B	Standard error	Beta		
1	(Steady)	,636	,124		5,112	,000
	Sole Directors (2007-2011)	,047	,113	,039	,416	,678
	Liquidators (2015-2018)	,150	,467	,028	,322	,748
	President of BoD (2015-2018)	,055	,066	,072	,836	,405
	Z-Score 2 0711	,040	,025	,234	1,590	,115
	Z-Score 2 1214	-,099	,026	-,571	-3,750	,000
	Z-Score 2 1516	-,006	,009	-,059	-,601	,549
	BoD average term of office	,017	,007	,220	2,296	,024

a. Dependent variable: status

Also in this case, the results are confirmed both in terms of signs and significance of the considered variables.

7 Conclusions

Despite the low diffusion and use of adequate predictive indicators in managerial and banking practice, this work confirms the predictive ability of one of the existing models, specifically Altman's *Z'-Score*.

Having reached statistically significant results on a unique sample of companies, this paper confirms that the *Z'-Score* can not only predict bankruptcy, but also the inability to make earlier debt repayments, approximated by the occurrence of Unlikely to Pay (UTP), which is the discriminating and innovative criterion used in our study.

Further relevant results that could be useful for the development of future research, emerged from the analysis.

With particular reference to the *corporate governance* variables, included in our study as control variables, we found a number of interesting relationships. The topic has strong relevance given the limited literature on the matter (Baysinger et al., 1985; Denis et al., 1995; Himmelberg et al., 1999; Huson et al., 2004; Fahlenbrach et al., 2007). This is a research gap to be filled by further research that is focused on corporate governance within corporate restructuring processes.

8 Research limitations and future researches

The work suffers from several problems. First, an issue relating to the national context emerges due to the fact that all the companies included in the sample are based in Italy. Further research could analyse different context, with companies and banks of other countries. The size of the sample used is another limitation that can be solved by future research. However, in the absence of publicly available data on UTP, the use of confidential information, both important and limited, becomes necessary. This problem, we believe, is likely to be common to any research that wants to investigate the characteristics of companies that are classified among UTPs within the banking information system. Based on the dataset sample used we will examine in future researches more advanced techniques such as neural networks, support vector machines (SVMs) and "new age" statistical learning models, including generalised boosting and random forests.

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Variables definition

- Z-score (2007-2011) refers to the average score in the period before the crisis (2007-2011);
- Z-score (2012-2014) refers to the average score in the period during the crisis (2012-2014);
- Z-score (2015-2016) refers to the average score in the period after the crisis (2015-2016);
- Z-score Revised (2007-2011) refers to the average revised version of the score in the period before the crisis (2007-2011);
- Z-score Revised (2012-2014) refers to the average revised version of the score in the period during the crisis (2012-2014);
- Z-score Revised (2015-2016) refers to the average revised version of the score in the period after the crisis (2015-2016).

Control variables[1] are defined below:

- Number of board members (2007-2011): number of people who took the role of member of the Board of Directors in the period prior to the crisis (from 2007 to 2011);
- Number of CEO (2015-2018): number of people who took the role of CEO Chief Executive Officer in the period following the crisis (from 2015 to 2018);
- Number of Sole Directors (2007-2011): number of people who took the role of Sole Director in the period prior to the crisis (from 2007 to 2011);
- Number of Sole Directors (2015-2018): number of people who took the role of Sole Director in the period following the crisis (from 2015 to 2018);
- Number of Liquidators (2015-2018): number of people who took the role of judicial Liquidator in the period following the crisis (from 2015 to 2018);
- President of BoD (2015-2018): number of people who took the role of President of the Board of Directors in the period following the crisis (from 2015 to 2018);
- Sole Directors average term of office: average duration of the role of Sole Director;
- Board of Directors average term of office: average duration of the role of Board Member.

[1] *Please note that we report only the definitions of the control variables that show a significant correlation with the dummy variable and that are therefore subsequently used in the regression.*

Diversity Potentials or Diversity Challenges? Attitudes towards Refugees under the influence of Intercultural Contact and Acculturation Strategies

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Abstract

Because of the development of migration during the last past years, this paper's objective is to identify and/or confirm factors, which predict the development of prejudices. With Germany as a preferred destination of many refugees, the research focuses on German students and their attitudes towards people with migration background. This study examines if the construct of social identity is a possible predictor for prejudices. Thereby, it also examines if there is a moderator effect of contact quality and contact quantity.
The results indicate the importance of contact quality und contact quantity in reduction of prejudices, but the effects were only significant for some of the tested models. Because of the relatively weak manifestation in the study at hand, alternative instruments should be used for investigation.
Based on the obtained results this paper finally tries to give some guidance for the facilitation of diversity and reduction of prejudices at higher education institutions.

Keywords – migration, social identity, acculturation strategies, ethnic identity, prejudices

Paper type – Academic Research Paper

1 Introduction

Since recent years, one topic dominated news headlines: migration. A vast amount of people is escaping from war and conflict and is driven from their home country. In Europe, the numbers of asylum seekers also rose extremely. Especially Germany accepted a high number of involuntary migrants. The number of asylum applications peaked with

745.545 in 2016, but strongly declined since then (BAMF [Bundesagentur für Migration und Flüchtlinge, English: Federal Office for Migration and Refugees] 2018).

Integration of the newly arrived citizens constitutes itself is the greatest challenge. A variety of populations with different cultural background now lives in Germany and is part of the German society. At the same time, research confirms that with increasing social and cultural diversity, prejudices between the groups increase as well (Benz & Widmann 2007). Prejudices in turn, are obstacles for a successful integration. Mostly, those prejudices are unjustified.

It becomes clear that for a successful integration, prejudices need to be removed or at least reduced in European societies. In order to do so, factors that influence the development of prejudices need to be identified. Measures to reduce prejudices can only be taken, if the circumstances are clear, in which such negative beliefs can flourish. Therefore, this undertaking has the endeavor, to identify and/or confirm factors, which ought to play a role in the development of prejudices. While the confirmation of relationships between factors does not bring societal change itself, the paper will advocate for appropriate measures, which can be derived from the findings.

Within the scope of this project, the research group investigated the attitudes of students in Germany towards migration and therefore conceptualized a survey for German students and students with migration background. The researchers scrutinize the construct of *social identity* as well as the influence of *contact* with the group of people with migration background. The highlighted issue and possible connections are extensively investigated in this academic work and recommendations for action concerning integration are derived.

2 Rationale

Dovidio, Hewstone, Glick and Esses (2010) recognized that prejudices should be viewed as a result of processes that happen in every individual. Overall, prejudices are considered hostile attitudes towards members of a group, which are caused solely by their group membership (Aronson, Wilson & Akert 2008). In general, people mention prejudices together with stereotypes, whereby both terms need to be separated. People develop stereotypes in the framework of cognitive processes, which serve simplification and which are necessary, to categorize the multitude of environmental stimuli (Aronson et al. 2008). Hereby, it is a matter of generalizing assumptions about traits of a group and its members, which can be either positive or negative. Prejudices on the other hand are mostly described as negative and rather affective manifestations of attitudes (Duckitt 1992).

Pettigrew and Meertens (1995) developed a theory, which differentiates between covert and overt prejudices. Whereas covert prejudices are direct and can be articulated, covert prejudices are defined as indirect negative attitudes towards the outgroup. Underlining cultural differences and one's own traditional values expresses this.

There is a vast amount of theories regarding the origin of prejudices. However, as a more emotional aspect of prejudice the study takes xenophobia into consideration. While xenophobia is an extended version of prejudice. It is coined mostly by fear against members of the outgroup, regarding a variety of possible issues of threat, and aggression against the outgroup (Bolaffi 2003). Consequently, it is in the scope of this study as a third component next to covert and overt prejudice.

The following paragraph will explain other constructs, which are investigated in connection to the development of prejudices other constructs and therefore are relevant for this work. How people perceive others depends on how people see themselves and how they categorize themselves. In this context, identity plays a major role.

Identity is a multi-layered and partly highly debated concept, which relates to the feeling of who we are and to which groups we belong (Hall 2003). Identity comprises, the personal identity, which separates us from other individuals and the social identity. Social identity influences the self-concept through membership in social groups (Simon & Troetschel 2007).

According to Wenger (1998), people define themselves through familiar and comprehensible things and separate ourselves from unfamiliar and ambiguous things. In this context, the cultural distance is important. With greater cultural differences of sojourners and host country nationals, the line between ingroup and outgroup rises and consequently the *gap* between both groups grows (Schaefer & Simon 2017).

Tajfel (1981) defines the construct social identity in his theory as part of the self-concept, which is derived from the knowledge and belonging to a group. It goes hand in hand with the value and the emotional meaning, the sense of belonging the individual has. Building on this, Schwartz, Montgomery and Briones (2006) describe ethnic identity as subjective meaning of one's own ethnic sense of belonging and feelings one has towards this group. The individual has a say in his/her feeling of belonging, whereas the ethnicity is pre-determined at birth by the origin of the parents (Phinney 1992).

By reviewing the definition of prejudices as intergroup phenomenon, the relationship between people as cause for prejudices becomes apparent. In the scope of social comparison and appreciation processes, which serve the purpose of enhanced self-confidence, self-categorization into groups is an essential motivational factor for prejudices (Turner & Hewstone 2012). Transferring this to group differences between German host country nationals and migrants in Germany, ingroup/outgroup thinking is most likely to occur. This research results show that the construct of social identity is of high relevance. Therefore this study considers social identity as a possible predictor for prejudices.

The construct acculturation describes the change of cultural patterns of groups of individuals, which is caused by the persistent and direct contact with unfamiliar cultures (Berry 1990). Such changes can happen either one-sided or bilateral between both groups. According to Berry (1990), such changes depend on expectations, which respective group members have about the relationship towards the other group (van Dick, Wagner, Adams,

& Petzel 1997). This can be the conviction that cultural differences like the ethnic identity in a community should be kept on the one hand or abandoned on the other hand.

With his work *The Nature of Prejudice* (1954), Allport was one of the first researchers, who saw the contact between different ethnic groups as a chance, to reduce prejudices (Salzborn 2016). He stated four situational premises, which need to be given, so that contact can lead to a reduction of prejudices. Next to the equal status of both distinct groups, according to Allport (1954) the different groups need to focus the same goals or values, without competition between themselves. Finally, the support of authorities is also required. This theory became known under the name of *contact hypothesis*. Today, it is a well-established theory in social psychology (Salzborn 2016). Yet, it was found that not all of Allport's four premises have to be present. Indeed, this premises facilitate the reduction of prejudices.

Brown and Hewstone (2005) added that group salience is essential for the change in perceiving the outgroup. Based on these research results, this study implements the contact hypothesis and transfers it to the contact between migrants and German students.

3 Research Question, Hypotheses & Measurement Instruments

3.1. Research Questions and Hypotheses

Building on the current literature this study aims to identify factors, which influence prejudices towards migrants. In more detail, the research question is: *Which factors predict of prejudices?*

Hereby, *the development* the study wants to investigate the dynamic relationship between variables. Target group are students, since a substantial part of this societal group will be the decision makers of tomorrow. However, the researchers to not exclude participants of other age category.

It is necessary to consider the respective influences of social identity and ethnic identity when investigating the development of prejudices. Thereby, the researcher split prejudices into overt and covert prejudices as well as xenophobia. Moreover, the aim is to receive a comprising picture of the construct *prejudice*.

For the same reason, the researcher measure the constructs of social identity and ethnic identity as two different concepts. Additionally, the study scrutinizes, how far the relationship between the named independent variables and the development of prejudices depends on the extent of contact to migrants. Following this, the current work investigates the meaning of social identity in relationship to the development of prejudices.

Based on this, the researcher build the first hypothesis:

> *H1: There is a relationship between social identity and prejudices towards migrants: the identification with the ingroup predicts overt and covert prejudices towards migrants and the manifestation of xenophobia.*

Research on the contact hypothesis provides evidence that frequent contact and qualitatively high contact (positive experiences) with people of different cultures and ethnicities can reduce prejudices and therefore improve intercultural communication (Allport 1954; Pettigrew 1998; Gómez, Tropp & Fernández 2011; Miles & Crisp 2014). Hence, the researchers expect that contact, moreover contact quantity and contact quality, have a moderating effect on the influence of the independent variables on prejudices. It follows the second hypotheses:

> *H2: Contact to migrants moderates the relationship between the investigated independent variables and the prejudices against migrants. Thereby, contact quality and contact quantity are independent moderators.*

3.2. Measurement Tools

The researcher measured the ethnic identity with the MEIM (Multigroup Ethnic Identity Measure). Phinney (1992) conceptualized this scale to inquire the ethnic identity of participants with different cultural heritage. Consisting out of 20 items, 14 items measure the ethnic identity with subscales for *Affirmation and Belonging* (confirmation and belonging), *Ethnic Identity Achievement* (extent of the ethnic identity) and *Ethnic Behaviours*. This study used all subscales of the MEIM in combination with open questions for ethnic group membership and questions about the ethnicity of the participant In the latter, there were four possible answers: (1) *I see myself as German*; (2) *I see myself as migrant;* (3) *I see myself as ethnic German immigrant to Germany;* (4) *open answer*. Those answers were adjusted for the target group of Germans and for migrants living in Germany. The researcher excluded the two items for ethnicity of the parents of the MEIM in this study.

To assess the identification of the participants with their ingroup, the researchers used the *Social Identity Scale* by Orth, Broszkiewicz & Schütte (1996). The scale consists out of 16 items, which include questions for the subscales of *Polish identity, German identity* and *binational identity*. The questionnaire uses a seven-point Likert scale. The authors emphasize that it is possible to transfer the scales to other ethnic groups as well (Orth et al. 1996).

For assessing impact of contact to refugees, the researcher chose the *General Intergroup Contact Quantity and Contact Quality Scale* by Islam & Hewstone (1993). This scale includes five items for each, *contact quantity* and *contact quality*. The contact quantity measures the frequency of contact in different settings.; the contact quality measures if the encounter was experienced as positive or negative.

In order to measure prejudices towards the group of refugees, the researchers use the *Blatant and Subtle Prejudice Scale* (Pettigrew & Meertens 1995). The scale entails 20 items of which one half measures overt prejudices and the other half measures covert prejudices. Further, the researchers divided overt prejudices into *threat and rejection* and

low familiarity. Covert prejudices differ in terms of the factors *defense of traditional values*, *exaggeration of cultural differences* as well as *denial of positive emotions.*

To assess xenophobia, this study included the short version of the eponymous scale *Xenophobia* was chosen (Wetzels, Gabriel & Pfeiffer 1998). This scale entails nine items, based on a four-point Likert scale. The researchers calculate the internal consistency in form of Cronbach's Alpha for the three different target groups resettler, migrants and native Germans. The values were $\alpha = .62$, $\alpha = .55$ and $\alpha = .83$.

3.2 Sample

In total, 699 people completed the survey. Therefore, the researchers used an online survey. Indeed, they recruit participants via social online networks such as Facebook, Xing and LinkedIn. With 69.8 %, about two thirds of the sample are female, 30.2 % are male. In total, 84.9 % are studying. The average age was 25.68 years (SD = 4.61), whereby the range between the youngest (16 years) and the oldest (50 years) is quite big. 89.9 % were born in Germany and 10.1 % in a foreign country. The distribution of subjective sense of belonging is almost identical, whereby the majority state to be German with 80.9 %. 19.1 % state that they have a migration background.

4 Results

4.1 Hypothesis 1

This hypothesis presumes a relationship between social identity and prejudices. This hypothesis is directed and assumes that prejudices increase with higher manifestation of social identity. The degree of identification with the ingroup strongly predicts the overt prejudices for the group without migration background ($\beta = .70$, $p < .01$). There is no significant relationship for the group of people with migration background.

For people without migration background, identification with the ingroup is a strong predictor for covert prejudices ($\beta = .54$, $p < .01$) as well. The relationship for people with migration background ($\beta = .28$, $p < .05$) is weaker, but exists. These results support the claim that stronger identification with the ingroup increases covert prejudices, regardless of group membership. Nevertheless, H1 can be only fully confirmed for the group of people without migration background.

4.2 Hypothesis 2

Furthermore, this study examines how strongly the impact of group contact to migrants concerning contact quantity and contact quality influences the relationship. Therefore, the researchers use a moderation analysis with respective independent variables as predictors and respective types of contact as moderators. To test for moderated mediation amongst

the independent variables, they use the Macro *PROCESS Version 3.1* by Andrew F. Hayes and Cai (2007). AS mentioned before, this study assumes that the mentioned independent variables influence prejudices. However, they also might have effects on each other, therefore distorting the direct effects on prejudices. Based on this, the researchers produced 36 possible combinations of dependency among the factors.

The analysis shows, that only seven of those 36 tested models are significant.

Five out of six models concerning the combination of the independent variable acculturation strategy, the moderators contact quality and contact quantity as well as the three dependent variables with manifestations of prejudices, overt and covert prejudices and xenophobia were significant with p <.01. An overview of the combinations is provided in table 1.

The results demonstrate that there is an interaction effect between the predictors of acculturation strategy and the contact quantity in relationship to overt prejudices. This model explains 55 % of the total variance (p < .01). The interaction effect with p <.01 is highly significant as well. The same applies to covert prejudices as criterion. The explained variance of this model is at 41% and with p <.01. Therefore, the model is highly significant. The interaction effect with p = .02 is also significant. Finally, the researchers test the combination of contact with manifestation of xenophobia. Again, the model is significant with p <.01 and can explain 45 % of the variance. Surprisingly, contact quantity had no direct effect on xenophobia and is insignificant (p = .10). On the other hand, the interaction effect between contact quantity and acculturation strategy on xenophobia is significant with p < .3. This shows, that contact quantity together with acculturation strategy can predict xenophobia.

Exemplary, figure 1 displays the moderation effect of contact quantity and covert prejudices. For the moderation variable contact quality, the results show significant interaction effects for acculturation strategies. In relationship to overt prejudices the model explains 65 % of the variance and is significant with p <.01. The interaction effect between acculturation strategy and contact quality on overt and covert prejudices is also significant with p <.01. The interaction of contact quality and acculturation strategy on xenophobia, is not significant (p =.11) this was found to be not significant, wherefore no interaction effect is assumed. Regarding the criterion xenophobia, p <.01 and an explained variance of 57 % could be found. The interaction term is also p <.01 and subsequently highly significant. Exemplary, the influence of contact quality on the relationship between acculturation strategy and overt prejudices can be found in figure 2. It seems that the effect of acculturation strategy on different subtypes of prejudice is moderated by contact quality and quantity.

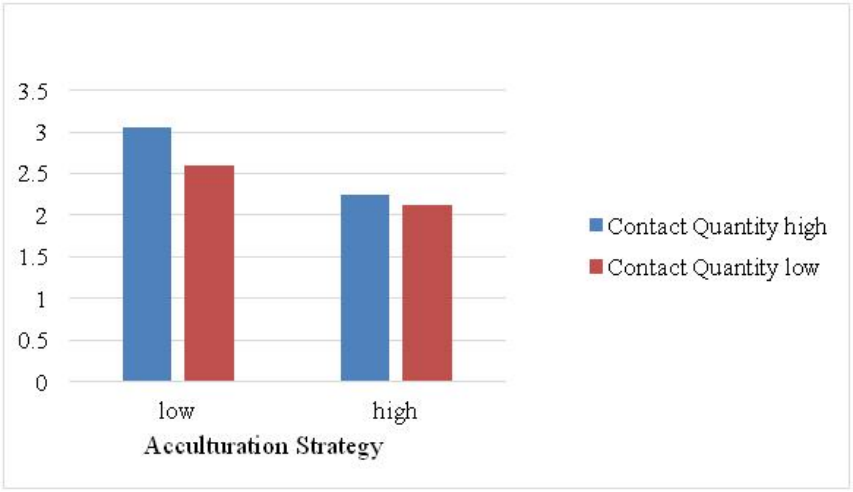

Fig. 1 Influence of contact quantity on the relationship between acculturation strategy and covert prejudices (own depiction)

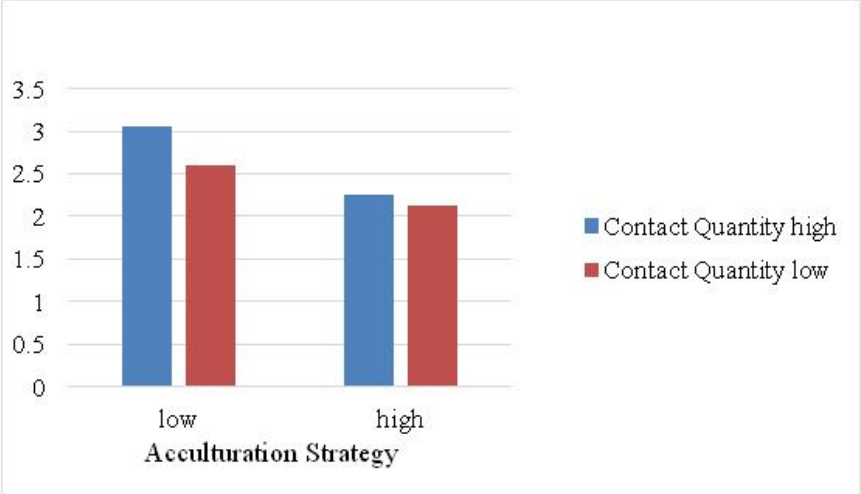

Fig. 2 Influence of contact quality on the relationship between acculturation strategy and overt prejudices (own depiction)

Table 1 Moderation analysis, predictor acculturation strategy

		coefficient			model		
K		**β**	**SE**	**p**	**R^2**	**F**	**p**
Overt	Acculturation	-.46	.04	<.01	.55	61.76	<.01
	Contact Quantity	-.09	.03	<.01			
	Interaction	.11	.03	<.01			
	Acculturation	-.32	.05	<.01	.65	95.19	<.01
	Contact Quantity	-.17	.02	<.01			
	Interaction	.09	.02	<.01			
Covert	Acculturation	-.33	.04	<.01	.41	29.15	<.01
	Contact Quantity	-.13	.03	<.01			
	Interaction	.07	.03	.02			
Xeno	Acculturation	-.35	.05	<.01	.45	25.62	<.01
	Contact Quantity	-.04	.03	.10			
	Interaction	.07	.03	.03			
	Acculturation	-.25	.04	<.01	.57	60.04	<.01
	Contact Quantity	-.13	.02	<.01			
	Interaction	.08	.02	<.01			

Notion: centralized mean predictors, standard error HC3-corrected

Identification with the ingroup (social identity) of people without migration background (Germans) is another predictor, where the results show a significant effect. For the variables social identity and prejudices the researchers confirm two models with the moderator variable contact quality. Concerning overt prejudices, the explained variance is 62 %. With p <.01 the model is significant. The interaction effect is significant as well (p <.01). In addition, concerning the impact of the manifestation of xenophobia the results show a significant interaction effect with p <.01. Figure 3 displays the influence of contact quality on the relationship between identification of the ingroup for people without migration background (Germans) and overt prejudices as an example. Table 2 provides an overview of the values. Apparently, the effect of social identity on the development of overt prejudice for the German subgroup partially depends on the quality of the contact this group experienced with migrants.

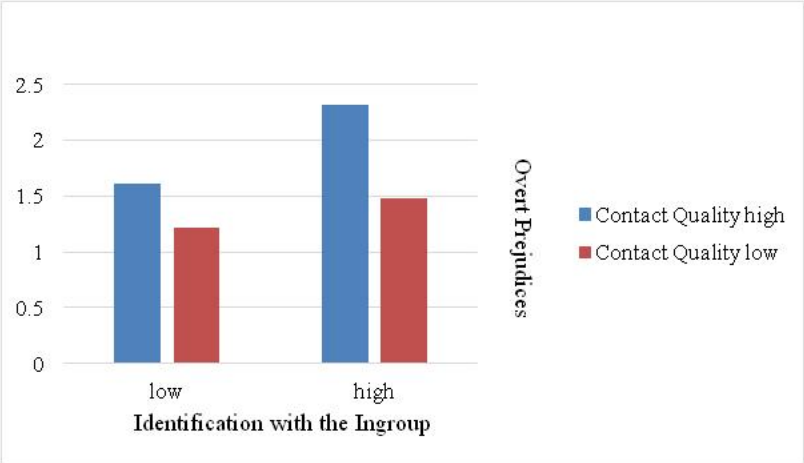

Fig. 3 Influence of contact quality on the relationship between identification with the ingroup (DE) and overt prejudices (own depiction)

The researchers find quite similar results for possible interaction effects between social identity and contact quality and two subcomponents of the prejudice construct. For both, overt prejudices and xenophobia, table 2 presents the statistical output. It is to note, that the explained variance of both models is virtually identical.

Table 2 Moderation analysis – predictor identification with the ingroup of people without migration background

		coefficient			model		
K		**β**	**SE**	**p**	**R^2**	**F**	**p**
Overt	Social Identity (DE)	.17	.02	<.01	.62	77,16	<.01
	Contact Quality	-.24	.03	<.01			
	Interaction	.06	.02	.01			
Xeno	Social Identity (DE)	.14	.02	<.01	.60	61.79	<.01
	Contact Quality	-.19	.03	<.01			
	Interaction	-.05	.01	<.01			

Notion: Centralized mean predictors, standard error HC3-corrected

Unfortunately, the other models are not significant. Therefore they need to be rejected. It was investigated how different independent variables affect the dependent variables while considering moderation variables. The results confirm that contact quantity and quality play a crucial role for several models and that the effects are significant. However, this is only true for distinct combinations with acculturation strategies and identification with the ingroup of people without migration background. Hence, H2 can only be partly confirmed.

5 Interpretation

First, it is to say that although this study obtains significant relationships between prejudices and other factors, the strength of those prejudices seems questionable. Evaluation of the scale shows that the identification of German participants with the German ethnicity is not strong. Despite the current trends, to build borders, many young people seem to have a different self-concept. The often chosen identification with the ethnic group *Human* indicates that they also see other people as human and do not separate them based on culture. Herefore, there is a need of further research, especially in comparison to different age groups and geographical regions.

Concerning the group of people with migrational background, this study obtains no or very weak relationships regarding the manifestation of prejudices. Overt prejudices and xenophobia are not related to the social identity of people with migrational background. In contrast, there is a significant effect on covert prejudices. The study assumed that people with migration background had fewer prejudices towards the other group (Germans), since immigrants more often bear the negative consequences of prejudice and xenophobia (Van Laer & Janssens 2011). The results do not confirm this assumption. Instead, it seems that people with migration background do not openly state their aversion towards other cultures (overt prejudices), but still have them to a small degree. It is to note that the sample of people with migration background is small (38 participants). Further investigations with bigger sample sizes are necessary to draw valuable conclusions.

The researchers expected main effects of the variable social identity on the different types of prejudices. The analysis confirms this. Higher identification with the ingroup predicts higher levels of all prejudice types. According to that it seems valuable to establish interventions that reduce ingroup thinking and facilitate cultural intelligence and more open acculturation strategies to reduce prejudices.

Moreover, this study observes moderation effects about identification with the ingroup (social identity). However the analysis only confirms this for the group of people without migration background (German students) and the moderator variable contact quality. The results demonstrates that positive contact with refugees reduced prejudices – even if identification with the ingroup remains very high and prejudices are rather strong. For the social identity the results show that the contact quality could reduce prejudices. However, there is no moderation effect of contact concerning covert prejudices. This effect is still not present, if the model is tested with regard to people with migrational background.

Next to the testing of the derived hypotheses, the analysis of the data reveals that there is considerably low contact between German students and migrants. This is an insight, which gives need for further research in regard to the questions why there is only low levels of contact to this group. Including refugees and migrants in society related activities like sport clubs and entertainment events could enhance both – the contact quantity and the contact quality. In addition, further studies need to obtain comparable

data to other target groups such as working persons, elderly and parents, to confirm the general relevance of the tested factors.

Overall, the extent of this study has to be critically evaluated. Through the multitude of constructs, this study includes many factors, which cannot be investigated sufficiently enough. This represents the timely limitation of this undertaking. The researchers measured the constructs with several subscales respectively, which enable to get a differentiated view on the relationships. However, this makes the survey quite extensive. Furthermore, scales like the MPQ or the MEIM contain different sub-dimensions, which cannot be highlighted because of the limitation of the work. For this matter, future research could scrutinize less constructs more differentially or investigate them in a scope of a more extensive work that addresses all variables in more detail.

In addition, regarding the content of the questionnaire, some participants gave critical feedback. Participants often stated that the term *ethnicity* was not further defined. Many people did not have a concept of this term, which refers to the answer possibility: *To which ethnic group do you allocate yourself?*

Finally, further research need to review the reciprocities in both directions and influences of the independent variables in more detail. Thereby, it is possible to assume an influence of social identity on acculturation strategy and prejudices, but also in combination with contact (Badea et al. 2018). The significant interaction terms indicate that the effect is also retroactive. For instance, prejudices can also lead to less contact and therefore affect the acculturation strategies. In conclusion, the influence contact, in form of contact quantity and quality, needs to be investigated in detail.

Furthermore, the distribution of the contact quantity could have affected the results. As already mentioned, this dimension was lowly developed for most participants and caused by the rare manifestation of high contact frequencies. Subsequent, it was difficult to make valid assumptions about the relationships.

5.1 Advice for Implication

The high number of refugees, which came to Germany in the past seven years, poses challenges for natives as well as for refugees. Up to this date, integration has proven to be a successful model to bring benefits to the economy (Batsaikhan et al. 2018). The success of integration depends on different factors. Behaviours and attitudes of people towards other cultures and different social identities all are important for the dynamic interplay between the individual and the unfamiliar environment. These dynamic processes are visible at e.g. internationally orientated universities, where contact between students with different cultural backgrounds is part of the concept.

From the results obtained in this work, it is possible to generate several guidance's regarding the facilitation of diversity and the reduction of prejudices at the higher education institutions. Social identity, or the degree of identification with the ingroup act as important variable concerning the manifestation of prejudices. The development of a

shared identity in the sense of identifying with a bigger group that includes people with different heritages has a positive relationship with reduced prejudices. Projects with refugees or projects and partnerships with international universities, which bring people and students from different nations together and let them work for a shared goal, can promote this.

Finally, meetings of this kind can be accompanied by pre- and post-courses with the topic of cultural intelligence and social identity. Knowledge about psychological processes during group formation and meetings with unfamiliar people as well as viewing respective processes on a meta level can enable students to critically reflect about their behaviour and their thoughts in such situations. Additionally, such courses can communicate a positive view on values, traditions and norms of other cultures, which makes the bridge to the acculturation. Shared projects as such do not only have the advantage that they can include many variables, but also facilitate direct contact.

During the analysis of the survey it became eminent that the extent of contact between students and refugees is very low, which gives food for thought. Even if contact can only restrictively compensate negative influences of other variables, contact programs have demonstrated to be one of the most successful approaches for the reduction of prejudices (Brown & Hewstone, 2005; Pettigrew & Tropp 2006). Shared projects with refugees would therefore promote contact and at the same time offer the possibility to exchange information about the universities and their access.

Foresightedly, measures like this indirectly facilitate the integration of migrants at the workplace and at educational institutions. It becomes obvious that for a successful integration and facilitation of all variables, which are in relationship to the reduction of prejudices, overarching projects/programs are necessary. As proven this study, it is necessary to consider influences of individual and interpersonal factors in order to foster cooperation in a multicultural society.

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Exploring the Factors Influencing Climate-Friendly Behaviour

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Abstract

Climate change mitigation is the central challenge of the 21st century. An increasing proportion of economic and psychological applied research addresses the question of how to encourage people to adopt more climate-friendly behaviour (Pettman und Zabel 2005; Schmitt 2018; Stoknes 2015; Thaler und Sunstein 2008).
Although many people think it is important to protect the environment and have a stable pro-environmental behavioural intention, this is reflected only to a limited extent in specific environmental behaviour (Bundesministerium für Umwelt und Naturschutz und nukleare Sicherheit (BMU) 2019).
The present explorative study addresses the question of which measures could foster everyday climate-friendly behaviour. The study focuses on an evaluation of the measure "Klimaschutzbürger 2.0" ("Climate Protection Citizens 2.0") undertaken by a local authority in Germany.
The explorative study, in which qualitative and quantitative interviews were conducted to generate hypotheses, took place as a participating observation of the last workshop meeting with subsequent written questioning of the participants. Special attention was paid to the question of whether online services such as climate change mitigation apps have a positive impact on behavioural intentions.
The primary data collected enable hypotheses to be generated, facilitating the further exploration of the predictors of environmentally responsible behaviour in subsequent projects.

Keywords –Sustainability and climate protection, Social psychology, Climate protection-App, Public Management, Nudging

Paper type: Academic Research Paper

1 Introduction

Almost two thirds of the German population consider environmental and climate protection to be an elementary prerequisite for coping with future tasks (Bundesministerium für Umwelt und Naturschutz und nukleare Sicherheit (BMU) 2019). In studies by the European Comission it was found out that the protection of the environment is important for around 95% of the EU-citizens (Kopatz, 2018). Although environmental protection is widely accepted as a value, this often does not change everyday behaviour (Hellbrück and Kals 2012, p. 95).

A growing part of ecological and psychological applied research is devoted to the question of how people can be encouraged to adopt more environmentally friendly behaviour (Stoknes 2015; Schmitt 2018; Thaler and Sunstein 2008; Pettman and Zabel 2005; Waskow and Pannenbecker 2013).

2 Theoretical Background

2.1 Environmental awareness

Environmental or climate awareness is a multidimensional construct.

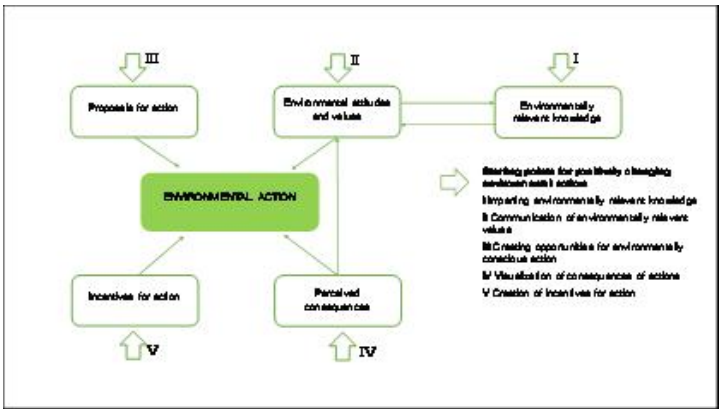

Figure 1: Influence scheme for environmentally conscious action after Fietkau and Kessel (1981)[1]

In the model by Fietkau and Kessel (1981), environmentally conscious action is explained by the interaction of five factors: environmentally relevant knowledge, environmental attitudes and values, offers for action, perceived consequences of one's own behaviour and incentives for action. Knowledge only has an indirect influence on

[1] *With slight changes quoted from Hellbrück and Kals 2012, p. 105*

environmentally relevant actions and is brought to bear via attitudes and values (Waskow and Pannenbecker 2013).

Five basic approaches to changing environmental behaviour are assigned to each of the five influencing factors mentioned: Imparting environmentally relevant knowledge, communicating environmentally relevant values, creating opportunities for environmentally conscious actions, making the consequences of actions visible and creating incentives for action. The five influencing factors are interrelated in many ways (City of Münster, Office for Green Spaces, Environment and Sustainability 2017, S. 47; Hellbrück and Kals 2012).

From the psychological point of view, a great barrier for environmentally friendly behaviour is the conviction of many people that they cannot achieve anything through individual changes in behaviour.

This expectation reflects the conviction of a lack of self-efficacy. The concept of perceived self-efficacy, also called (optimistic) competence expectation, was introduced by Bandura (Bandura 1977, 1997) as an essential aspect of his social-cognitive theory. The General Self-Efficacy Expectation (SWE, German: Allgemeine Selbstwirksamkeitserwartung) refers to the personal assessment of one's own competencies to cope with the difficulties of daily life and to be able to cope with critical situations by one's own efforts (Jerusalem 1990; Schwarzer 1992).

Since a considerable proportion of CO2 emissions is generated in the satisfaction of everyday needs in private households, the individual decisions of citizens are of great importance. This is where the strategy of influencing decisions affecting climate protection in everyday life comes in. These are at the centre of the case study examined. Special attention was paid to positively influencing the self-efficacy expectations of the project participants.

2.2 Theory of Decision

The process that is perceived as a decision requires that a person in a situation has at least two choices (Pfister et al. 2017, p. 4). A decision - like other cognitive functions - always requires knowledge and motivation and is often dependent and accompanied by emotions (Pfister et al. 2017, p. 8).

The cognitive effort required by a decision ranges from largely automated and effortless decisions to those that require detailed information search and processing. Regarding the cognitive effort, one can distinguish between routine, stereotypical, reflected and constructive decisions (Pfister et al. 2017, p. 40). The underlying guiding idea of the case study examined is to "routinise" climate-friendly behaviour in everyday life.

The view prevailing in the early days of decision research, namely that emotions are merely disturbing side issues of the actual decision-making process, has been thoroughly revised by more recent research (Pfister et al. 2017, p. 11). Of great importance for

decision research is the System 1/ System 2 theory of Tversky and Kahnemann (Kahneman and Tversky 2013; Kahneman 2012).

System 1 stands for the cognitive and emotional processes that take place largely automatically, involuntarily and unconsciously. An important characteristic of them is that they function effortlessly. System 2 stands for processes that are controlled, conscious and intentional (Kahneman 2012).

2.3 Decision Heuristics

Decisions are mostly not made rationally, but intuitively with the help of System 1. Thereby, people use certain heuristics and are subject to cognitive distortions or errors of judgement (bias). These include amongst others (Kahnemann, 2012):

- Availability heuristics (the rash connection to already existing experiences and beliefs)
- Recognition heuristics (a known information has a higher credibility per se)
- Framing-effect (the different presentation of the same information causes different emotions and judgements)
- Halo-effect (one characteristic outshines all others in the overall assessment
- Loss-aversion (the tendency to weight losses higher than profits)
- Status-quo bias (the general tendency to stick to the current situation)
- Confirmation bias (the tendency to interpret new information to be consistent with existing beliefs)

A further error of judgement important for environmental behaviour is that the value of a decision is weighted differently against the background of the time dimension. The long-term benefit of climate-friendly behaviour, which is recognised by most people, loses its motivational power in view of the currently perceived increased effort that consumers perceive when using climate-friendly offers. This insight is the starting point for measures that seek to keep the costs of climate-friendly behaviour as low as possible and to make the benefits of such behaviour tangible as soon as possible (Kahneman 2012; Kopatz 2018; OECD 2017; German Advisory Council on Global Change (WBGU)).

2.4 Nudging as a method of Decision-Influencing

The so-called Nudging systematically uses these decision errors for the desired influence on behaviour. "*Nudges (gentle pushes), i.e. impulses for desired changes in behaviour, are at the centre of a current international discussion on strategies of so-called "libertarian paternalism". Among the prominent examples of such nudges are default options which, from a paternalistic perspective, prescribe "good" solutions as standards, but always include the option of choosing an alternative (opt out).*" (Thaler and Sunstein, 2008, quoted by the German Advisory Council on Global Change (WBGU), p. 83).

The electricity bill, which shows that one's own consumption is higher than the average consumption of comparable households, can be described as nudging, because this tends to lead to increased efforts to save electricity (Kopatz 2018).

Although not uncontroversial (Bornemann 2019), nudging is increasingly finding its way into political-administrative processes. The British government, for example, established a "Behavioural Insights Team" in the administration in 2010 to apply nudge theory to improve the effectiveness of government services, including in the areas of health and climate change (Rare and The Behavioural Insight Team 2019).

The following chart provides an overview of nudging strategies that should be applied in environmental protection following a publication by the Behavioural Insight Team (Rare and The Behavioural Insight Team 2019).

Figure 2: Nudging (Rare and The Behavioural Insight Team 2019, p. 21)

2.5 Social Norms and Group-Processes

Research of the limited rationality of human behaviour emphasizes the importance of social norms and group-processes for the establishment of behavioural changes. Just knowing how other people decide influences one's own decision. People act predominantly in the way that is socially desirable, comparing their behaviour with that of others (Kahneman 2012; Stoknes 2015).

> *„Peer behaviour is one of the strongest predictors of green behaviours and attitudes on issues like littering, energy, and water use. Since the imitation effect is strong, asking consumers to go green will fail unless they are convinced that many others will do the same" (Stoknes 2015).*

Social change therefore requires people who set new social standards with their behaviour, which others then imitate. These people are also referred to as "agents of social change" in analogy to "change agents" in the organizational context (Ahaus 2017).

They act as role models and trendsetters. It is known from diffusion and transition research that "change agents" have a convincing idea of change, network with each other and thus find important fellow campaigners.

(Rogers 1983; Grin et al. 2011; Kristof 2010; Engel et al. 2018; Ahaus 2017). In this way they manage to gain the critical mass for change (German Advisory Council on Global Change (WBGU), p. 257).

> *„Since climate change is often described using highly abstract, scientific data, people yearn for personal interaction and face-to-face conversations to help them process and embody the information. […] Face -to-face contact and word of mouth are still king" (Stoknes 2015).*

The conceptual approach of the case study examined was to involve people who have a certain predisposition for social change processes in the project, to encourage them in their role as "change agents" and to support their multiplier role in their respective social networks.

3 Case Study, Method and Sample

In the following, the evaluation of the measure "Klimaschutzbürger 2.0" ("Climate Protection Citizens 2.0") in the district of Steinfurt[1] is presented. The project is part of the so-called "Master Plan 100% Climate Protection"[2], in which the goal was formulated to make the district energy self-sufficient by the year 2050.

The case study from Steinfurt has its conceptual forerunner in the BMBF-funded research project "KlimaAlltag" ("Climate Everyday Life"), which started in spring 2011. In this project, so-called "climate households" from different milieus voluntarily committed themselves to reducing their CO2 emissions in the areas of housing and energy use in the home as well as in the areas of nutrition and mobility. Over a period of half a year, they received specific advice on this issue and were scientifically supported in the implementation of the recommendations (Wilhelm and Schulz 2017; Ernst et al. 2016).

Contrarily to the examined case study of the "Klimaschutzbürger 2.0", the participants of the project "KlimaAlltag" were visited three times at home during the six-month field trial and advised on site (Waskow and Pannenbecker 2013, p. 7).

In the project "Climate Protection Citizens 2.0", 18 households from 12 municipalities were accompanied for one year (from January to December 2019) in testing a climate-

[1] *The district is located in the northwest of Germany. It is rather rural, has 434,000 inhabitants and 24 county municipalities.*

[2] *https://www.kreis-steinfurt.de/kv_steinfurt/Kreisverwaltung/%C3%84mter/Amt%20f%C3%BCr%20Klimaschutz%20und%20Nachhaltigkeit/energieland2050%20e.V./Service/Informationsmaterial/Masterplanbericht_Langfassung%20.pdf , [Accessed 8. April 2019]*

friendly lifestyle. The concept rested on three pillars: firstly, behaviour-oriented climate advice from experts, secondly, active testing of climate protection measures in the areas of nutrition, mobility, energy and consumption by the participants, and thirdly, the exchange of information among the participants at regular meetings.

A positive effect was expected from building a sense of belonging to a community of climate-friendly households. In this way, the meetings were intended to contribute to "community building" in addition to the acquisition of knowledge and exchange of experience. This was to have a positive influence on their self-efficacy expectations and to strengthen the participants in their role as "agents of social change".

3.1 Method of Data Collection

The explorative study, in which qualitative and quantitative interviews were conducted to generate hypotheses, took place as participating observation of the last workshop meeting on 29.11.2019 with subsequent written questioning of the participants (n=16).

For reasons of data protection, only gender (44% female, 56% male) and age (37.5% 31-50 years, 62.5% 51-70 years) could be queried. The standardized questionnaire on general self-efficacy expectations (Hinz et al. 2006) could not be used either. In a period of two weeks after the workshop a follow-up survey in the form of telephone interviews was conducted with four participants.

3.2 Research Questions

Amongst others, the following questions were examined

- Did the participation in the project have a positive effect on climate-friendly decisions of the test persons? Which offers had the greatest influence?
- Based on the self-efficacy hypothesis, do the test persons have the impression that their behaviour can positively influence climate change?
- Do the participants see themselves as "agents of social change" in that they were able to encourage people outside the project to adopt more climate-friendly behaviour?
- If so, how many people in their social environment did they tell about the project?
- Does the exchange within a group of like-minded people have a positive influence on climate-friendly behaviour?
- Do experience-based events have a positive influence on environmentally conscious behaviour?
- Can an app that shows the effects of individual behaviour on CO2 consumption make a positive contribution to changing behaviour? If so, which functions are considered particularly important?

4 Findings and Discussion

4.1 Control and Behavioural Intentions

To examine the basic control conviction in terms of self-efficacy, the following two questions were asked: *"Are you convinced that your individual behaviour makes a difference and can positively influence climate change?"* This question was answered with 86% agreement (43% "fully agree", 43% "agree", n=16).

The question: *"Participation in the project 'Climate protection citizens' has had a positive effect on my climate-friendly behaviour?"* was answered with 87% agreement (62% "agree completely", 25% "agree", n=16). As expected, most of the test persons are convinced that their behaviour can have an influence.

4.2 Model learning and group processes

Next to the technical inputs at one of the workshops on the topic of nutrition, the testing of concrete measures in everyday life and the exchange with other climate protection citizens had the strongest influence on a change in behaviour of the test persons.

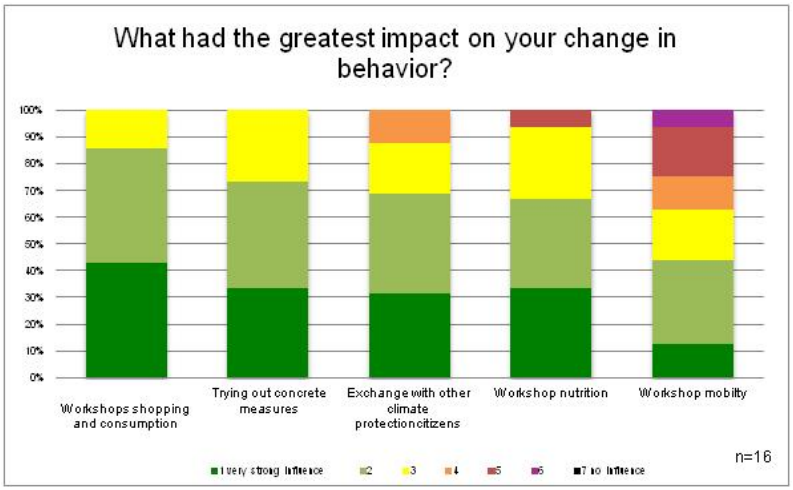

Figure 3: Subjectively perceived percentages of impact on the change in behavior

56% of the climate protection citizens have also exchanged information with each other outside the project meetings. Almost all of them would like to continue this after the end of the project, whereby personal meetings are preferred. The mentioning of WhatsApp as an exchange medium is interesting. This indicates that electronic media are certainly important for establishing contacts. This insight is important because it would be

much easier and cheaper for the circle to stay in contact with climate protection citizens via electronic media in order to ensure the important task of further supporting and stabilizing the network.

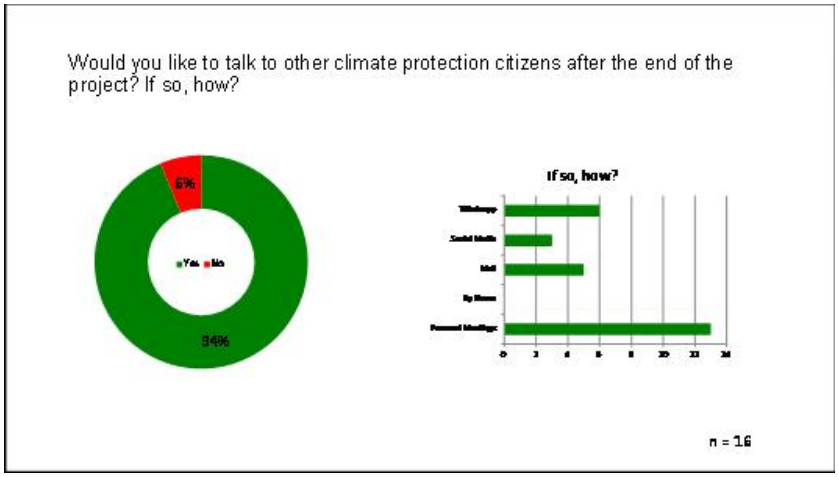

Figure 4: Willingsness to talk to other climate protection citizens after the end of the project

In the following telephone interviews with 4 climate protectors this aspect was deepened. In response to the question "Could you imagine following selected specialist presentations of the project via the Internet in future (so-called webinars) and then exchanging views with other climate protection citizens via chat?", 2 out of 4 respondents answered "yes".

4.3 Multiplier effect of the project

One important assumption was that climate protection citizens have an important multiplier role as "agents of social change". The implicit hope was that the project participants would share their knowledge in their social networks and incite others to adopt similar behaviour.

The statement: *"Do you have the feeling that you were able to motivate people outside the project to adopt more climate-friendly behaviour?* (n=15) 73% of the respondents agreed.

Another question related to how many people the participants told about the project. The results showed a wide spread: According to the participants, a total of about 500 people were reached. Altogether 4 participants reported more than 50 other people about the project, one even more than 80.

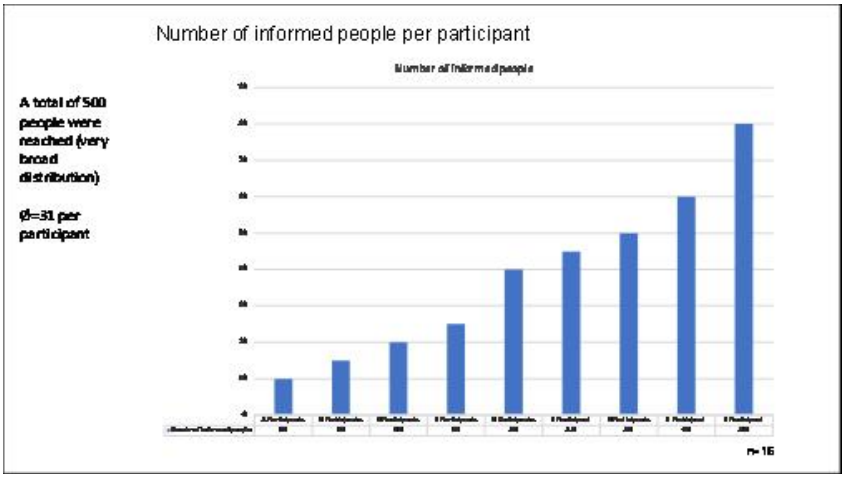

Figure 5: Number of informed people per participant

These main multipliers would have to be addressed and supported separately in future, as they seem to be very willing to disseminate information relevant to climate protection. Another hypothesis is that they serve as role models in social groups and that their influence on other people is particularly high.

In the telephone interviews that followed, this aspect was taken up once again with the following question: *"Could you imagine taking part in a project in which you learn how to organise small workshops in your circle of friends and acquaintances and pass on your learned knowledge about climate protection to others?"* Only 2 of the 4 interviewees could imagine this with restrictions.

4.4 Climate protection app as an incentive to change behaviour

According to the nudging approach, one assumption of the project was that an app that shows the effect of one's own behaviour on CO2 consumption could make a positive contribution to behavioural change. For example, could social group effects be simulated using certain forms of online challenges? Could elements of gamification cause a positive behavioral effect?

These assumptions were operationalized with the following criteria:

- Does the app have a traceable CO2 consumption calculator?
- Is there a simple point or reward system for ecologically sensible action?
- Are there small competitions that encourage participants to act in an ecologically sensible way?
- Can ecological behaviour, tips or little stories be shared with others?
- Can the participants communicate with each other in a simple way?
- Is the app easy to use (usability)?
- What personal data is collected and stored (data protection)?

Based on these criteria, a comparison of 4 already existing climate protection apps was made, which, however, did not produce a satisfactory result.

Until the survey was made, no respondent used an app that documents individual CO2 consumption. The question about the respective functions of an ideal-typical climate protection app resulted in an age-dependent evaluation. Respondents in the age group of 31-50 year-olds rated the relevance of such an app significantly more positively than respondents in the age group of 51-70 year-olds.

A CO2 calculator and the opportunity to post tips and little stories were rated as particularly important. The possibility of holding small competitions and exchanging ideas with others via chat was rated least important.

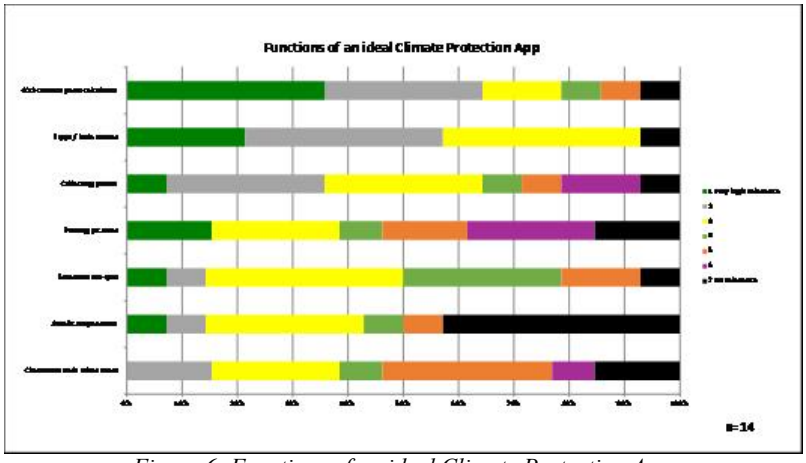

Figure 6: Functions of an ideal Climate Protection App

5 Conclusion

The basic assumptions regarding self-efficacy, group processes and model learning could be supported by the results of the survey. However, it must be noted that the group of the participants of the project was formed through self-selection therefore a higher affinity for climate-friendly behavior could be assumed.

To be able to generalise the statements more strongly, random groupings such as in the project KlimaAlltag (Stieß 2013) would have been desirable. A standardised query on the general self-efficacy expectation (Hinz et al. 2006) would also have strongly increased the significance of the results.

The testing of new forms of climate-friendly behavior (model-learning through experience-based experiences) had a very strong to strong influence (top-2-boxes) on almost 80% of the participants on their change of behaviour. Social group processes such as the exchange with other climate protection citizens also had a high influence (almost

70% top-2-boxes). 56% also exchanged views outside the project meetings, and almost all of them would like to do so after the end of the project.

The intended multiplier effects of the project can only be estimated to a limited extent. A good 70% of the participants felt that they were able to motivate people outside the project to adopt more climate-friendly behaviour. However, these effects - operationalised by the number of people to whom the climate protection citizens had told about the project - were very broadly spread. According to their own statements, there were four participants who told more than 50 people about their experiences. Further research is needed to find out whether these people have special characteristics and how the municipality could support them even better.

If special social processes can be supported by new media such as apps, must be examined separately. The support through a special app was rated very differently by the participants. Younger people rated it as much more positive. Offers of gamification such as small competitions were rated as not important by the majority. The social exchange also seemed to have no benefit for the respondents. One finding of the survey is that the benefit of an app could have been better determined by qualitative studies such as a design thinking workshop. Further research is needed here.

All in all, "social snowball effects" (e.g. train-the-trainer concepts), in which the participants are enabled to pass on the knowledge they have acquired in the projects to their social networks in a self-directed way and thus act as "agents of social change", should be more strongly encouraged.

A further development of the Steinfurt model is the real-world laboratory "Climate-friendly decisions" of the City of Münster[1]. Here, offers and providers who have already done pioneering work regarding climate protection were actively brought together with potential users (City of Münster, Office for Green Spaces, Environment and Sustainability 2017). The focus was on linking up with the user expectations of the citizens. The project focused on non-monetary incentives for environmentally friendly behaviour.

A differentiated target group orientation can significantly increase the scope of climate policy measures. Such differentiation should consider both socio-demographic characteristics and lifestyle orientations to link up with the "realities" of private households and lifestyles. In an (unpublished) pre-study within the Münster Model, clusters of milieus were formed that differ from one another in terms of climate protection.

Stieß et al. (2013) summarise their findings from the "Everyday Climate" research project in the so-called "4-E model". The model distinguishes four dimensions (Stieß 2013, p. 13):

[1] *The city of Münster has about 300,000 inhabitants and is also located in the northwest of Germany. Here, too, twelve households tried out new products, behaviour and services in 2019 to find out how to make their everyday life more climate-friendly (City of Münster, Office for Green Spaces, Environment and Sustainability 2017).*

- **„Enable“** refers to tools that empower people to adopt environmentally-friendly behavior, for example by providing information or trying out measures.
- **„Encourage“** includes all instruments that create monetary or non-monetary incentives for environmentally friendly behaviour.
- **„Engage“** describes instruments and measures that promote individual and collective commitment to environmental protection and thus help to mobilise individuals.
- **„Exemplify“** aims to "incite" other people to environmentally friendly behaviour by making role models visible.

The measures from the case study "Climate Protection Citizens 2.0" can be assigned in particular to the dimensions "Enable" and "Exemplify".

In conclusion, however, it should be noted that as important as the behaviour of individuals is in climate protection, it is necessary to flank this at the political level with laws, taxes and educational programmes (Kopatz 2018).

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High-Tech Solution for contrasting Financial Crimes. Are Bank Employees ready?

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Abstract

The present paper is aimed at proposing a training evaluation model specific for anti-money laundering in bank. This evaluation model was structured to take into account challenges that today banks and other intermediaries subject to anti-money laundering regulations have to face, and the possible exposition of intermediaries to those risks related to knowledge management. The originality of the proposed model lies in the fact that, to the authors' knowledge, today, a model specific for AML training evaluation in banks still not exist. Among the limitations, there is the fact that, for the moment, it is a purely theoretical model and that needs to be tested.

Keywords – Training Evaluation Model, AML/CTF, Suspicious Transaction Reporting, Customer Due Diligence, knowledge risks.

Paper type – Academic Research Paper

1 Introduction

'Ndrangheta, Camorra, Cosa Nostra, Nasa Stvar, Mara Salvatrucha, Yakuza, Solntsevskaya Brava, Le Mileu, Obtshak, so many ways to name organized crime, an economic sector in all respects, which has never known and still knows crisis. Figures on organized crime's turnover show its unequivocal solidity and dangerousness for the entire world economic system. Moving large volumes of capital, money laundering and terrorism financing occupy a very important position among organized crime's activities. In the last few years, the United Nations Office on Drugs and Crime hypothesized that the amount of money spent by criminals and tax evaders on the planet annually fluctuated

between 800 and 2 million dollars. In other words, from 2 to 5% of global GDP. These figures have almost never been updated. And this is not even the biggest problem, if we consider that with the spread of increasingly sophisticated technologies, crimes such as money laundering have found ways to become increasingly difficult to identify and therefore prevent. Damages caused by these financial offences are there for all to see. Engaging in the fight against them has now become a moral obligation.

Economic crimes affect financial sector in the extent of about 45% of all financial organizations and, in terms of "penetration" of crimes as money laundering, the sub-segment of banking gets the primacy concomitantly with investment management and capital markets segments (PwC, 2015, 2018; Global Initiative against Transnational Organized Crime, 2017). Banks, in fact, carrying out financial intermediation activities, play a crucial role in the payment system and, therefore, are more exposed to situations potentially related to illicit financial transactions. It's not a coincidence that in Italy, for example, Financial Intelligence Unit (FIU), in the first half of 2019, received 51,201 reports of suspicious transactions (SOS), 3.8% more than the corresponding period of the previous year (FIU Official Web Site). However, the large amount of such reports is not the only indication of an effective action to prevent financial crimes. The system of prevention and contrast of money laundering and terrorist financing works properly, above all, thanks to the continuous improvement of the quality, timeliness and completeness of the reports of suspicious transactions. In this context, the role of reporting subjects is crucial. Financial Intelligence Unit has recently found some critical issues related to the lack of diagnostic capacity of reporting subjects, especially in the insufficient focus of suspicion, as well as the incomplete and incorrect compilation of reporting model (FIU Official Web Site). At the same time, in the new provisions on customer due diligence to combat money laundering and terrorist financing, the Bank of Italy provided new tools for Know Your Customer (KYC) procedures based on advanced technological solutions, such as the biometric recognition of customer suspicious elements (Banca d'Italia, 2019). But making these tools available to reporting agents, defined by the competent authorities as doubtful and unprepared, could further aggravate the weakness of their skills profile, as they are required to employ new, more advanced and complex technologies to recognize suspicious situations. A contradictory situation therefore appears to arise: the found weaknesses in the capabilities of the reporting agents are answered by providing complex tools based on advanced technologies.

In this sense, anti-money laundering training could play a fundamental role in correcting the shortcomings in the abilities of the reporting agents. Even more helpful could be the evaluation of anti-money laundering training programs. In almost all cases, banks are obliged by legislation to do anti-money laundering training. The same does not apply to training evaluation. And in fact, this practice is still not very widespread, as shown by a lack of proper scientific production on this topic (La Torre, M., 2015).

The present paper has the main purpose of covering this lack by highlighting the importance of anti-money laundering/combating terrorism financing (AML/CTF) training

evaluation, proposing an original training evaluation model which aims to respond simultaneously to the challenges posed by the Competent Authorities and technological progress, also considering the further threat of so-called knowledge risks, i.e. the risks associated with knowledge management.

For this purpose, the remainder of this paper is organised as follows. In Section 2 below, the regulatory framework is proposed and the role of suspicious transaction reporting and customer due diligence process in preventing and combating ML/TF is highlighted. Section 3 is dedicated to the potential of the AML/CTF training evaluation in supporting the quality of suspicious transactions reporting and customer due diligence process; a digression on the most well-known training evaluation models and on the main knowledge risks is also provided. The paper continues with Section 4, in which the training evaluation model is illustrated in its structure and main characteristics. Conclusions and ideas for future research are contained in Section 5.

2 Suspicious transaction reporting and customer due diligence process in preventing and combating ML/TF. Opportunities and challenges from technological progress

The international anti-money laundering regulatory framework is the result of a complex articulation of sources consisting of international standards, European standards and international conventions. The main objective of the European regulation on the prevention and combating money laundering and terrorist financing has been, from the beginning, to create a harmonized regulatory environment between the Member States, especially implementing, over time, the evolution of the international principles. The five Directives and the various provisions issued since the 1990s are testimony to this commitment.

In particular, with the fourth Directive (EU/2015/849) but, above all, with the fifth Directive (EU/2018/843), currently in force, the prevention system of the Member States is definitively aligned with the Recommendations of the Financial Action Task Force (FATF) of 2012, enhancing the risk-based approach, a fundamental criterion for the gradation of preventive measures and controls. “FATF Recommendations represent an international standard, which countries should implement through measures adapted to their particular circumstances; the measures set out by the FATF Recommendations basically refer to: i) identify the risks, and develop policies and domestic coordination; ii) pursue money laundering, terrorist financing and the financing of proliferation; iii) apply preventive measures for the financial sector and other designated sectors; iv) establish powers and responsibilities for the competent authorities (e.g., investigative, law enforcement and supervisory authorities) and other institutional measures; v) enhance the transparency and availability of beneficial ownership information of legal persons and arrangements; vi) facilitate international cooperation” (FATF, 2019, p. 6).

Fourth Directive also confirmed the central role of the Financial Intelligence Units (FIU). In accordance with international rules and criteria, a Financial Intelligence Unit (FIU) is expected to be present in each Member State, with full operational autonomy, with functions to combat money laundering and terrorist financing. The main task of FIU in the system of prevention of money laundering and terrorist financing is the acquisition of financial information regarding money laundering and terrorist financing hypotheses mainly through reports of suspicious transactions sent by financial intermediaries, professionals and other operators. Of this information, FIU performs financial analysis, using all the sources and powers available to it, and assesses the relevance for the purposes of transmission to investigative bodies and collaboration with the judicial authority, for the possible development of the action of repression: " FIUs, therefore, act as intermediaries between private entities, subject to AML/CFT obligations and law enforcement agencies. The added value of the FIU is the analysis it carries out on all the information received, as well as the wide range of other financial information that it has at its disposal and that it can use to better evaluate the information on the suspects provided" (The role of the Financial Intelligence Unit, available at https://uif.bancaditalia.it/sistema-antiriciclaggio/uif-italia/index.html). From these last statements, the importance of a correct and efficient reporting activity by the interested parties is underlined, especially in consideration of the impressive volume of reports that FIU receives every year. In 2019, Financial Intelligence Unit for Italy received 54,621 reports of suspicious transactions, an increase compared to those received in the corresponding period of the previous year (+12.2 percent). During the year 105,789 reports were acquired, with an increase of 7.9 percent compared to 2018. The growth in the second half of the year was determined by the anti-money laundering reports, which reached 53,773 units (+13.2 percent), in absolute the highest number of reports of the species received in a 6-month period. The reports relating to the financing of terrorism, on the other hand, recorded a further reduction (375 compared to 409 in the second half of the previous year, which already showed a decrease compared to the same period of 2017) (UIF, 2020a, p. 1). As regards the consistency check of the data transmitted with the reports, in January 2020, some evolutionary interventions were released aimed at allowing a more accurate representation of the operations described in the reports of suspicious transactions and improving the quality of the data transmitted. In addition, new data consistency checks will be added to new checks to ensure greater compliance of the data sent with the regulatory provisions. Unlike pre-existing controls, which always involve discarding the report in case of violation, the new verification scheme allows, in the presence of minor inconsistencies, the acceptance of the data sent. In such cases, the reporting parties will receive a special message with the list of identified findings which must be carefully checked; in the event that errors or gaps are actually found in the data transmitted, a replacement report must be sent promptly (UIF, 2020b, p. 1).

The effects of technological progress and the digitalization process have therefore impacted also the reporting of suspicious transactions, as well as customer due diligence:

" […] innovation is not confined to new financial products and services. It also includes the development of new solutions to address specific compliance challenges, such as customer due diligence (CDD), which is central to the AML/CFT regime. Meeting CDD obligations can be challenging for firms, as this process is often associated with significant costs and customer inconvenience" (EBA, 2018, p. 2).

The provisions of the Bank of Italy regarding customer due diligence, issued on 30 July 2019, also support the application of technological innovation. In particular, these provisions: i) regulate the video-identification procedures with security features suitable to mitigate the risks associated with the physical absence of the customer; ii) confirm the possibility of conducting adequate customer verification, even remotely, on the basis of a flexible procedure, according to which financial intermediaries can autonomously identify the most appropriate controls to mitigate these risks, such as feedback based on forms of biometric recognition; iii) allow intermediaries to automate some phases of the AML/CFT processes, providing algorithms for risk profiling and automatic procedures to monitor customer operations and identify anomalous operations (Banca D'Italia, 2019). On 10 November 2019, Legislative Decree 125/2019 also again amended the anti-money laundering legislation: the interventions concern, among other things, the expansion of the categories of obliged parties, certain changes in the subject of adequate verification and some corrections to the sanctioning system.

In such a context, improving the quality, timeliness and completeness of reports of suspicious transactions represents a primary objective of the system for preventing and combating money laundering and terrorist financing; the abilities of the reporting agents both to correctly identify the situation of real danger, and to use new technologies for the detection of suspicious behavior, must be up to the task assigned by the control and supervisory Authorities.: "[…] the European Supervisory Authorities (ESAs), expects that competent authorities ensure that all relevant staff employed by firms, and also staff at the external provider, are provided with regular training which specifically focuses on the practical application of the innovative solution and its technical abilities as well as on the detection and escalation of potentially suspicious transactions arising from the use of the innovative solution. Such training should be provided in addition to ongoing general AML/CFT training" (EBA, 2018, p. 10).

The real situation, however, does not seem exactly in line with the expectations of the Authorities. A survey conducted by the Bank of Italy in the first half of 2019 showed a certain resistance of financial intermediaries to use tools based on new technologies (especially those connected to AI) in the context of AML/CFT processes, with particular reference to profiling customer risk and the identification of suspicious transactions. Based on the evidence that emerged from the survey, in the 2017-2018 two-year period the intermediaries' anti-money laundering function was involved in 33 FinTech initiatives. In the following Table 1, the results of the Bank of Italy survey, with reference to the main innovative solutions adopted in the AML/CFT area, are reported.

Table 1 - FinTech investigation by the Bank of Italy. Main results

FinTech Initiatives	Response from financial intermediaries
New procedures for remote identification	From the answers provided by 64 intermediaries, it emerges that: six intermediaries use certificates for the generation of digital signature, issued by bodies accredited by AGID, for the identification of customers; only 4 intermediaries employ alternative remote recognition procedures, which provide for: i) the initial transmission by the customer of his own photo or video, in which the customer shows himself in possession of the identity document of which he has transmitted copy or, in the case of the video, utters a word suggested by the system; ii) subsequent manual verification of the information transmitted; Finally, no intermediary uses identification methods based on regulated digital identities (for example the SPID) nor does it use automated biometric recognition systems to identify customers for anti-money laundering purposes.
Databases for Customer Due Diligence	Widespread and generalized use and mainly used to identify politically exposed persons, terrorists, subjects subjected to financial sanctions, subjects involved in negative press reports regarding AML/CFT.
Algorithms for risk profiling and transaction monitoring	Progressive refinement of the automatic systems and algorithms used for profiling the ML / FT risk of the customers and monitoring the transactions, through a progressive adaptation of the risk and anomaly indicators with respect to the specific operations of the customers of the individual intermediaries and through the use of Big data and AI (such as Machine Learning and neural networks)
Automation of AML processes	Increasing automation of some phases of the anti-money laundering processes, especially in the identification of high risk subjects, in customer risk profiling and in the collection of data and information through OCR systems for the extraction and conversion of text from scanned documents or images.

Source: our elaboration from Banca D'Italia, (2019), pp. 23-25.

From the results summarized in Table 1, emerged that financial intermediaries, and in particular banks, still look with some prudence to technological innovations in AML/CFT processes. The motivation could concern both the sometimes excessive complexity of the technology at the basis of the proposed instrument or solution, and problems that go beyond technological progress and which date back to the relationship between AML provisions and preparation of the recipient banks' staff.

3 Supporting the quality of suspicious transactions reporting and customer due diligence process. The role of AML/CTF training evaluation

The application of tools and techniques with high technological content in the field of prevention and combating money laundering and terrorist financing is now a consolidated reality. "The benefits of using these tools could be found in the possibility of reducing regulatory arbitrage used by criminal organizations, even if the collaboration between the various countries in this field is still at an early stage. The main criticalities that characterize these tools concern the computational capacity required and the confidentiality constraints on information, the latter particularly relevant if external resources are used in the development of the tools" (Coelho et al., 2019).

In this sense, a valid support certainly comes from the training of human resources - which is also mandatory by law for anti-money laundering - but even training evaluation, as sometimes could occur several lacks ranging, from a weak connection between training and organizational results, to a flawed attention about trainees' needs and changes in work behaviors after training (Bird, Cassel, 2013), and also to the possible exposure of the financial intermediary to the so-called knowledge risks.

Training evaluation models

"Training evaluation is a systematic process of collecting and analyzing information for and about a training programme which can be used for planning and guiding decision making as well as assessing the relevance, effectiveness, and the impact of various training components" (Hashim, 2001, p. 374). Over the years, several scholars have dealt with training evaluation, also proposing models to be applied in organizations of different types and sizes, and with reference to the training programs of the most diverse themes. Among the training evaluation models proposed over time, there are some well known and applied for decades in companies all over the world. Table 2 below presents them in a concise manner, highlighting their structure and main characteristics.

Table 2 - Training Evaluation Models

Training evaluation models	Structure	Main characteristics
Kirkpatrick's Four Level Model (1959)	Four levels: 1. Reaction 2. Learning 3. Behaviours 4. Results	It is the best known, discussed and applied training evaluation model. Level 1 deals with feelings and reactions of trainees towards training activity. Level 2 allows to check the level of learning post-training. At stage 3, work behaviours are evaluated and at fourth organisational results are assessed. Relationship between levels is hierarchical, this means implicitly consider better - for information - every level than its antecedent.
Hamblin's Five Level Model (1974)	Five levels: 1.Reactions 2. Learning 3. Job behaviours 4. Organization 5. Cost-benefit	Hamblin's model points out the difficulty of linking training to organizational performance due to the influence of direct and indirect elements and stresses, at the same time, that training evaluation should focus mainly on level of trainees' learning.
Brinkerhoff's Six Stage Model (1987)	Six levels: 1. Goal setting 2. Program design 3. Program implementation 4. Immediate outcomes 5. Intermediate outcomes 6. Impacts	This model, although similar Kirkpatrick's, adds a level specifically devoted to definition of training objectives, which must be clarified and defined before delineation of training program.

Bushnell's Input-Process-Output Model (1990)	Four levels: 1. Input 2. Process 3. Output 4. Outcomes	It consists of four stages: input, process, output and outcomes. At first level, performance of some elements such as trainers and trainees qualification, training materials and budget is evaluated. At process stage, training action is assessed and, at third level, elements considered are trainees' reactions, knowledge and skills acquired and training's effect on work behaviours. Do not confuse this last stage with output level, which concerns long term training's effects.
Richey's Model (1992)	Four levels: 1. Trainee's characteristics 2. Knowledge 3. Attitude 4. Behaviours	Model that emphasizes influence of some factors, both referred to the context is and to some specific trainee's characteristics, as abilities and attitudes respect to delivery system.
Kaufman, Keller, Watkins' Five Level Model (1994)	Five levels: 1a. Enabling 1b. Reaction 2. Acquisition 3. Application 4.Organisational outputs 5. Societal outcomes	Compared to other contemporary models, it added a level of training evaluation dedicated to societal outcomes, ie the social consequences of organisational actions. Also detailed are the first two levels, considering the role of methodologies, tools and resources and effectiveness of their use in training activity.
Holton's HRD Evaluation Research and Measurement Model (1996)	Three levels: 1. Learning 2. Individual performance 3.Organisational results	This model considers influence of motivational, environmental and ability elements on training outcomes, such as trainees' learning, their individual post-training performance and results at the organizational level.
Phillips' ROI Training Evaluation Model (1996)	Five levels: 1. Reaction and planned action 2. Learning 3. Applied learning on the job 4. Business results 5. Return on Investment	Respect to Kirkpatrick's, this model adds a fourth level dedicated to the ROI of training, a level to wonders if monetary value of training results exceed costs incurred for implementation of training program in the organization.
Kuzmin's Participatory Training Evaluation Method - PATEM- (2004)	Five levels: 1. Introduction and process description 2.Data collection 3.Data analysis 4. Feedback 5. Reflection	PATEM is a very flexible and collaborative training evaluation model. Measuring trainees' reactions to training, this model allows to obtain interesting information about evaluation findings. With this model, evaluation becomes part of training and promotes involvement of participants, which can in this way share their experience both at individual and group level.

Pineda's Integrated Training Evaluation Model (2010)	Six level: 1. Participant satisfaction 2. Learning achieved 3. Pedagogical coherence of training program 4. Transfer of training 5. Training impact on organisational goals 6. Training profitability	This model offers an integrated approach to the analysis of variables that can affect training evaluation. It introduces a new level of evaluation on pedagogical appropriateness, which has the purpose to verify the internal coherence of training process in order to achieve training goals more effectively and efficiently.

Source: La Torre, M., (2015), p. 609.

Each of these models could be useful to increase the accuracy of customer risk profiling and to improve the reporting quality, although they are not specific to AML training, and do not provide attention to knowledge risk prevention.

Knowledge risks

Knowledge risks can be defined as "a measure of the probability and severity of adverse effects of any activities engaging or related somehow to the knowledge that can affect the functioning of an organization on any level (Durst & Henschel, 2020, p. 5).

Any organization, regardless of type and size, can be exposed to several different knowledge risks. Durst and Zieba (2018) first mapped these risks, also distinguishing them according to their nature in human, technological and operational. In the following Table 3, a schematization of the main types of knowledge risks is provided.

Table 3 - Knowledge risks

Knowledge risks	Main features
Risk of knowledge loss	It is both a human and technological knowledge risk. With reference to its human origin, risk of knowledge loss could manifest itself every time in an organization human resource management strategies are implemented. Therefore, this knowledge risk could be really insidious because it could become unavoidable in response to phenomena as employee turnover - voluntary or involuntary – or to accidents as death or illness of employee (Durst & Zieba, 2017).
Risk of knowledge waste	Belonging to the category of operational knowledge risks, risk of knowledge waste could occur in situations where the knowledge in the possession of the organization - and potentially valuable - is not used; it always originates within the organization (employees), and has the character of randomness (Durst & Zieba, 2017).
Risk of knowledge spillover	Organizations could be exposed to the risk of knowledge spillover if valuable knowledge leaves the organization and ends up to competitors that use it to their advantage. The risk of knowledge spillover originates from outside the organization (co-operants, competitors) and relates to the relationships that the latter maintains with the external environment (Durst & Zieba, 2017).
Risk of knowledge hoarding	Risk of knowledge hoarding is defined as "the act of accumulating knowledge which may or may not be shared in the future; that is, it is

	knowledge that has not been requested by another individual" (Webster et al., 2008, p. 6)
Risk of knowledge hiding	Is defined as "an intentional attempt by an individual to withhold or conceal knowledge that has been requested by another person" (Connelly et al., 2012, p.65).
Risk of knowledge unlearning	It is the "process of reducing or eliminating pre-existing knowledge or habits" (Tsang and Zahra, 2008)
Risk of knowledge forgetfulness	It can be considered as the abandonment of practices or entire strategies that were dominant, but which now hinder the acquisition of new knowledge and therefore also organization competitiveness
Risk of knowledge outsourcing	It belongs to the category of operational knowledge risks, originates from the outside of the organization (co-operants), and is a risk attributable to a single potential cause (situation-specific risk) (Durst & Zieba, 2017).
Risk of knowledge digitization	It belongs to the category of technological knowledge risks. It originates within the organization and is connected to the use of digital technologies for the performance of corporate functions, including also knowledge management (Durst & Zieba, 2017).

Source: our elaboration.

In this paper, we propose an AML/CTF training evaluation model specific for banks and other intermediaries subject to the anti-money laundering discipline. A model that takes into account both the expectations of the competent Authorities, and the ability of human resources to correctly apply the knowledge learned during training, and the quality of the knowledge management internal to the organization in terms of prevention of knowledge risks that could influence AML training output. In the following section, the presentation of the aforementioned model is proposed.

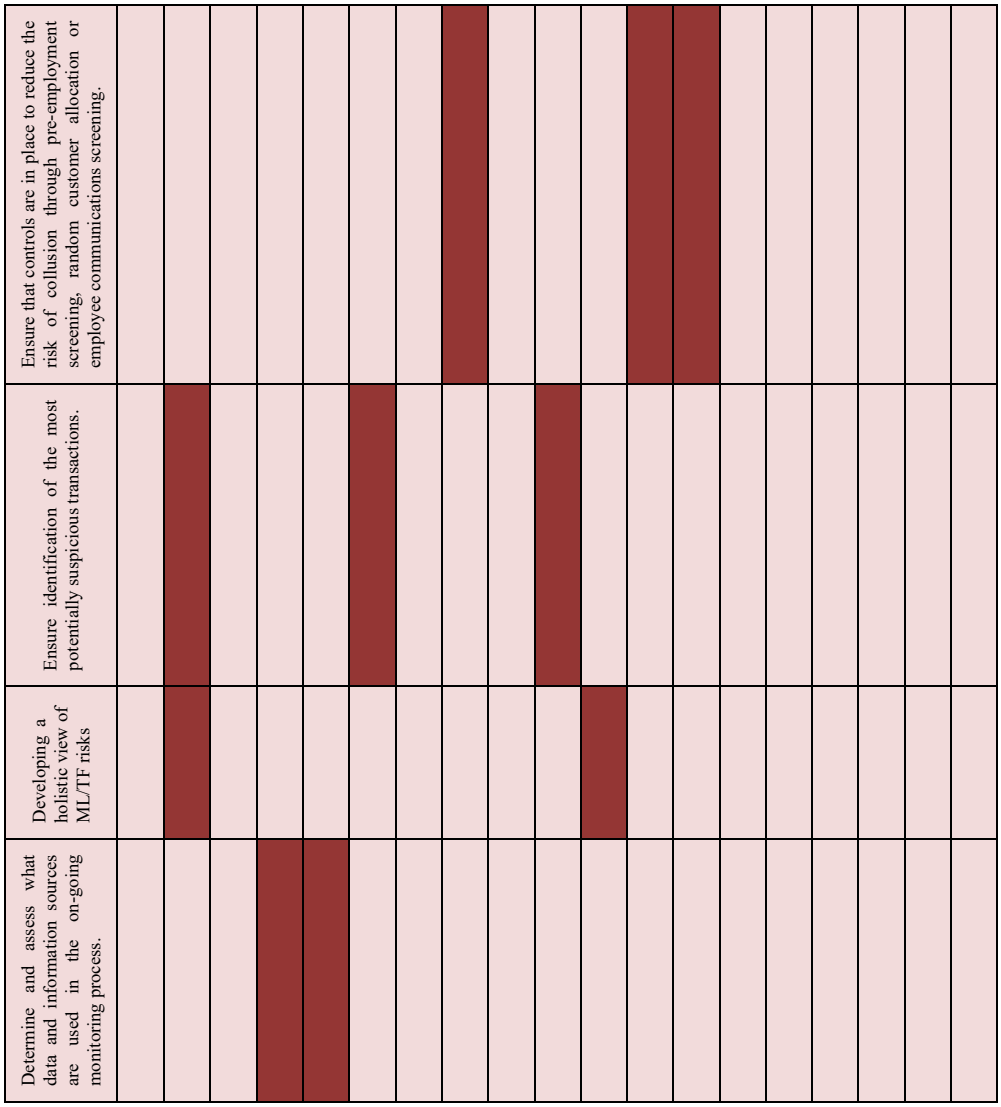
4 Towards a specific training evaluation model for AML/CTF in bank

The model proposed in this study has the dual objective of filling the gap in the training evaluation literature due to the lack of specific assessment models for AML/CTF in banks, and of supporting the recipients of anti-money laundering legislation in the prevention and contrast of financial crimes, responding to the requests and expectations of the competent Authorities. The structure of the proposed model is presented in the following Table 4.

Table 4 - AML/CTF Training Evaluation Model

Authorities Expectations	Knowledge Risks									Knowledge resources needed					Knowledge resources available				
	knowledge loss	knowledge waste	knowledge spillover	knowledge hoarding	knowledge hiding	knowledge unlearning	knowledge forgetfulness	knowledge outsourcing	knowledge digitization	Training activities	Team work	External expert coaching	Incentives	Processes simplification	Training activities	Team work	External expert coaching	Incentives	Processes simplification
Complete evaluation of the technological solution to ensure that it has undergone appropriate tests aimed at establishing whether it is in line with internal AML / CFT policies and procedures and with AML / CFT regulation.									■			■		■					
Drafting of a document that describes in detail the roles and responsibilities regarding the application of the technological solution in AML/CTF processes. If this solution is not in-house, the intermediary's autonomy. must be reiterated with references to any changes to the solution itself					■			■			■								

Ensure that all relevant staff employed by the companies, as well as the staff of the external supplier, receive regular training which focuses in particular on the practical application of the innovative solution and its technical capabilities.	Identification and evaluation of other risks associated with the innovative solution and also with the external supplier (where the solution is not developed internally).	Periodic evaluation of the innovative solution, with identification of possible errors and weaknesses.



Source: our elaboration.

The main features of the proposed training evaluation model are:

- The proposed assessment takes into account the main regulatory requirements with specific reference to the latest forecasts for technological solutions for customer profiling and the reporting of suspicious transactions for AML / CTF purposes.
- Based on these requests, the model the possibility of considering the possible exposure of intermediaries to knowledge risks.

- Based on the type of knowledge risk identified, the model gives the possibility to consider one or more knoweldge resources necessary to face the identified knowledge risks.
- With respect to the knowledge resources identified as necessary to manage knowledge risks, the model offers the possibility of identifying the knowledge resources actually available to the organization.

The output of the assessment is therefore represented by a greater awareness of the knowledge resources available to the organization: this will allow the training activity to be structured so as to satisfy any deficiencies that emerged during the assessment from the difference between the knowledge resources needed and those actually available.

5 Conclusions

The use of innovative technological solutions is now a consolidated reality also with reference to the prevention and contrast of financial crimes. This is demonstrated by the fact that the reference regulations and the control activities of the competent authorities in the field of anti-money laundering and the fight against terrorist financing are also dealing with ever-increasing attention to these issues, especially with reference to the adequate verification of customers and the reporting of suspicious transactions by financial intermediaries.

The thing that still raises some doubts is whether bankers are really ready to use such technologically advanced solutions in anti-money laundering operations. The results of a recent survey conducted by Bank of Italy showed that Italian bankers still show some diffidence and uncertainty in the application of these solutions.

Beyond the frequency of use, however, human resources must be adequately trained, especially with reference to complex issues such as anti-money laundering. Precisely with reference to the complexity of the subject and the particularity of the interests at stake, training should also be accompanied by an adequate training evaluation activity. There are several training evaluation models made available by scholars over the years, from the four-tier model of Kirkpatrick (1994) to the six-tier model proposed by Brinkerhoff (2001). Despite the number of such models, it is surprising that to date, there is still no specific training evaluation model for the banks and other financial intermediaries to whom the AML discipline is addressed. In this regard, in this paper, a specific model for the evaluation of AML training has been proposed. Although in a still theoretical formulation, the model has the objective of specifically supporting the banks engaged in the fight against financial crimes, proposing an evaluation that consider: 1) the expectations of the competent authorities regarding the compliance of the intermediaries with the provisions; 2) the possibility that intermediaries are exposed to risks related to the management of knowledge useful for an effective contrast to financial crimes; 3) the difference between knowledge resources necessary to face the knowledge risks deriving from deficiencies in the AML training activity and the knowledge resources actually

available to the intermediary. With reference to future research, the next step could be to try to test the model on an AML bank training program.

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Modelling Organizational Learning in Complex and Turbulent Environments: an Agent-Based Simulation in NK Landscapes

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Abstract

Organizations are increasingly considered Complex Adaptive Systems (CAS). This view has outlined the need to adopt a different theoretical and methodological approach in organizational research and design. The present paper copes with this challenge and aims firstly at introducing an agent-based computational laboratory, named CLOD (Computational Laboratory of Organizational Design), to explore the advantages that agent-based approaches could offer to scholars and practitioners in the organization research, particularly in the field of organizational design. Furthermore, some generative simulation experiments are reported and discussed to analyze the impact of the increasing complexity of the external environment on learning performances of organizations of different sizes.

The conceptual architecture of the computational laboratory CLOD is based on the seminal March's model of exploration and exploitation in organizational learning. Some generative experiments have been performed (18 experimental sets), in which organizations of different sizes have to learn by coping with external environments characterized by increasing complexity levels (modeled through the values of the parameter K in the NK landscape), and, eventually, by a certain level of turbulence.
In a stable setting, as expected, the learning performances of the organization decrease significantly, moving from a single peak environment (K=0) to higher levels of environmental complexity (K =5). Furthermore, the increasing size of the organization is related to better performances in stable environments for low or moderate levels of complexity. In turbulent and complex environments, instead, the size of the organization, particularly in the medium-long period, seems to be not influent and other organizational solutions have to be found to reach significant learning performances.
The Clod lab can be considered, at this stage of the research, as a tool supporting theory development or refinement in organizational design disciplines. Further applications can be tested for practical and teaching purposes.

Keywords – Complex Systems, Organizational Learning and Design, Agent-Based Modelling, NK Landscape

Paper type – Academic Research Paper

1 Introduction

The studies on organizational design represent a well-established stream in organization research (Donaldson, 2006). Until the advent ok knowledge-based economy, the primary purpose of organizational design scholars was to define effective and efficient structures to deliver great volumes of standardized products or services toward customers (Yoo at al., 2006). Furthermore, the focus on structure of traditional organizational design studies was also devoted to explicitly reduce the uncertainty of external environments, by providing "stability and predictability" (Yoo et al., 2006, p.215). The Structural Contingency Theory, developed about five decades ago (Lawrence and Lorsch, 1967), states that it is possible to define a priori what kind of organization is required to deal with different environmental conditions. The underlying hypothesis is that the organizational structure has a decisive role in determining organizational performances. Also, technology has been considered pivotal in defining organizational solutions (Thompson, 1967). It is therefore not surprising that, with the development of information and communication technologies, the contingent hypothesis has been extended to design formal systems for coordinating collective action (Raymond, 1990).

During the nineties, the organizations have started to be increasingly considered as Complex Adaptive Systems (CAS), as stated effectively by Morel and Ramanujam: "Organizations are now routinely viewed as dynamic systems of adaptation and evolution that contain multiple parts which interact with one another and the environment. Such a representation is so common that it has acquired the status of a self evident fact" (Morel and Ramanujam, 1999, p. 278). This perspective has outlined the need to adopt a different

theoretical and methodological approach in organizational research and design. It has implied the need to consider the interdependence between the different parts and the processes of the organization, and the co-evolution between the organization and the external environment (Boisot and Child, 1999).

More recently, organizational design & development's scholars highlighted the need for new approaches considering the challenges deriving from the growing environmental complexity and the limits of more traditional approaches (Jelinek et al., 2008, p. 317): "Organization design science is still very early in its development: different, even conflicting theories about organization design and development abound; laboratories for organizational experiments are largely absent; and little knowledge on management and organization is systematically codified — too much remains anecdotal and dependent on context".

The present work aims at contributing in this direction to the emerging research line that try to characterize the organizational research as a "science of design" (Jelinek et al., 2008), by adopting methodological approaches able to support a better understanding of the relationship between the organization, its performances, and the external environment. Particularly, the article intends to present a computational laboratory based on an agent-based model, to support the organizational researchers in organizational design.

As argued by (Boero and Squazzoni, 2005, sec. 1.15), these kinds of tools (like agent-based modelling and simulation) allow "translating, formalizing and testing theoretical hypotheses about empirical reality in a mechanism-based style of analysis". They offer additional possibilities to social sciences' researchers due to their capability of taking into account aspects and methods like "heterogeneity and adaptation at micro level, non linear relations, complicate interaction structures, emergent properties, and micro-macro links". In doing so, they allow to contribute to theory development and testing in the area of organizational research. From the practical point of view, these new methodological approaches offer the possibility of developing support tools for managers, consultants, and policy makers, as well as innovative tools for teaching and learning about organizations and their environments (Gómez-Cruz et al., 2017).

Agent-Based Modeling & Simulation (ABM&S) is the methodological approach that inspires the construction of CLOD.

2 The Agent-based computational laboratory

The CLOD laboratory has been developed starting from the conceptualization of mutual learning between the organization and its members as conceived in the March' s model of 1991. To reframe the original cellular automata model in an agent-based environment we first subdivided it in different blocks (classes of agents, environment, learning mechanisms and organizational structure and procedures) and then we translated each block in specific elements of a pseudo-code. Furthermore, for each building block of the lab some additional features have been created to include potential extensions and to increase the realism of the original model. Table 1 summarizes the characteristics of the

blocks in the actual version of the CLOD lab and reports, for each block, a short description, the extensions of the original model that have been modelled in the actual lab, and future developments. In the next sub-sections, we describe more in depth the characterization of the main building blocks, briefly referring to the possibilities offered by some of the extensions included in the current version.

Table 12: CLOD Lab's building blocks

	Building blocks	Description	CLOD	Future developments
Agents	Organization	Set of internal stakeholders within a business (e.g., employees, managers, the board of directors, investors) that work to achieve the organization's goal and satisfy the external demanding.	Members Subset: Elite Leader	Departments Customers/Market Segmentation
	Environment	The external stakeholders that are not within a business itself but who care about or affect its performance (e.g., consumers, regulators, investors, suppliers).	Customer/Market	
Environment features	Complexity	The number of Customer/Market's requirements	#dimension	Competitive Environment
		Interdependence degree between Customer/Market's requirement.	K	
	Turbulence	Exogenous environmental change affecting customer's request.	Degree Frequency Span	
Organizational structure	Size	The organizational dimension measured as the number of employees and managers employed.	#members	Specialization Network Groups
	Hierarchy	A system that has many grade or ranks from the lowest (members) to the highest (Leader)	3-levels	
Organizational processes	Turnover	The rate at which members leave the organization and are replaced by new ones	– Yes – No – Yes, after equilibrium	Selection criteria Assessment method
	Elite selection	Set of rules enabling members to follow the organization (hierarchical) climbing properly	Best performances	
	Evaluation method	Metrics and parameters set out to assess the organization performances and the performances of single members	Score or Fitness	
Evaluator	Individual agent	Someone that judge the performances according to the defined evaluation method	– Customer – Leader	Different Stakeholders
	Market	The Market evaluates the organization performances based on the level of fitness	Landscape	
Variation	From Leader	Members' beliefs change according to those of the leader and a settled	Conformity	Socialization Other criteria

	From Members	probability. The leader changes his beliefs according to those of Elite members and a settled probability.	Listening	
Cognitive settings	Uncertainty	The beliefs of agents are expressed considering the Ambiguity of Natural Language	Fuzzy (Verbal Judgements Dual-truth Model)	From Creativity From Experiences

2.1 The agents

Any entity of our laboratory is an agent able to make some actions according to a set of rules. The main agents are the environment and the organization. The environment is represented by one agent or by a landscape, while the organization is represented by different classes of agents (breeds in NetLogo language).

2.1.1 Environment

The external environment is fundamentally represented by the customer who expresses her/his needs through a string of #dimension binomial choices (YES/NOT), computationally implemented by 1 and -1. In our proposal, the number of dimensions characterizing the customer's needs is a parameter that can be modified through a slider in the lab interface.

Moreover, the environment could be also characterized by a certain level of turbulence. The turbulence is particularly important as it adds dynamicity to the complexity of the environment and represents the intensity of surprises coming from technology, regulations, and markets.

2.1.2 The organization

The March's model represents an organization that develops on three levels. According to that, in our agent-based interpretation, the first level consists of the members of the organization, agents characterized by individual beliefs and knowledge about the external environment. The second level is made by a subset of members, named Elite, interpreted as an intermediate hierarchical level of most influential members legitimated by their superior performance. On the third level, there is a leader who represents a hierarchically higher level (the top management or the CEO) that is responsible to cope with customers' requirements. This organization is asked to answer the external environment, represented in the baseline version of the CLOD by a customer who expresses his requests through the elements of a vector of requisites.

Both members and the leader represent their beliefs about customer's requisites through a string of #dimension elements that could be represented by crisp or fuzzy

values. In the crisp representation, beliefs of organizational actors could be each equal to 1, -1 or 0. The value 0 in one of the dimensions of the vector of an organizational actor means that she/he is not able to express any belief on the corresponding dimension of the customer's vector. The current version of our laboratory also includes a fuzzy representation of organizational beliefs, but this extension is not analysed in this paper (for details about that, see: Ponsiglione et al., 2019). It is possible to note that in accordance with March's model, our lab can simulate an organizational turnover process in which one or more members leave the organization and are replaced by members 'novices' with random beliefs, according to a probability named "turnover-intensity".

2.2 Evaluator as the customer

In the case in which the evaluator is associated with the customer, the program models his/her needs through a string of #dimension binomial choices (YES/NOT), computationally implemented by 1 and -1. In our proposal, the number of dimensions characterizing the customer's needs can be modified by the modeller or by the experimenter. Increasing the size of customer requirements' vector simulates a more demanding market. Accordingly, the increase in customer dimensions implies a corresponding increase in the number of leader and members' dimensions.

The level of turbulence in the environment is implemented as the probability of changes of customer's requisites, happening according to a probability named "turbulence-degree".

2.3 Evaluator as the market

When the evaluator is the market, the model includes the representation of the environment as a NK fitness landscape as proposed by Kauffman (1993). This means that the needs of the market are modelled in terms of a fitness landscape (Kauffman & Weinberger, 1989). This type of landscape is useful in analysing the complex aspects related to companies' organizational learning and adaptation processes. Based on Kauffman's model (1993), two essential structural variables have been considered in the CLOD lab: N, the number of attributes that characterize the environment (from a computational point of view N is the parameter #dimension), and K, the number of attributes of N with which a given attribute interacts. Each attribute can take two possible values, represented in the agent-based model using 0 and 1. The shape of the landscape is determined by the interactions between the attributes. In the case in which there is no interaction between the attributes (K = 0) the landscape tends to present a single peek configuration, implying, according to Levinthal and Warglien (1999), a situation in which any local improvement leads to a global improvement, also known as the universal "best practice" situation. In all the other situations, as K increases from 1 to N-1, the fitness landscape becomes increasingly rugged, passing from a moderately rugged situation to a

randomly multi-peaked one. This scenario has been modelled in the CLOD by randomly choosing for each attribute a number of K attributes that affect the fitness value associated to that dimension. For each combination between the values of a particular attribute and the values of the attributes upon which it depends, a random fitness value has been generated in the interval [0,1]. The fitness landscape is given by the values of all the possible combinations for all the attributes.

Similar to the case in which the evaluator is the customer, the requirements of the entire market can evolve over time, due to a certain level of turbulence, determined by changes in areas such as technology and regulations. This fact is reflected in the proposed model, using the "turbulence-degree" probability. At each iteration, the attributes in the array of market requirements will change with the probability "turbulence-degree", chosen in the interface of the model. The new fitness values for the attribute will be computed by subtracting their current value from 1. An example is given in Table 2 for the case K = 1 in which the fitness value of any attribute is affected by only one other attribute. The first two columns include the potential combinations of values between the current attribute d_i and the attribute d_j that influences its fitness value w_i. The last column includes the updated fitness values.

Table 13: Updating the fitness value of the attributed

di	dj	Wi	wi'
0	0	0.277161294629748	0.722838705370252
0	1	0.292627792432195	0.707372207567805
1	0	0.744500208454028	0.255499791545972
1	1	0.543131500278636	0.456868499721364

2.4 Learning mechanisms

Two types of mechanisms, which partially resume the learning mechanisms of March's model, contribute to spread the knowledge throughout the organization. On the one hand, there is a top-down learning based upon the principle of conformity: the knowledge of each member of the organization is compared with that of the leader; members' beliefs change according to those of the leader with a probability called "members-conformity-degree%". In the case in which the evaluator is the environment, the knowledge is replaced by the mean fitness value, calculated for each member and for the leader and taking into account the fact that they search and move in a NK fitness landscape.

At the same time, best performing members (the performance of each actor is measured as described later) are selected as belonging to the Elite. The Elite interacts with the leader through an additional learning mechanism: the disagreement between beliefs of Elite's majority and those of the leader leads to a modification of the latter with a different probability named "leader-listening-ability%". Through these two mechanisms, the leaders and the members become more homogenous and converge over time to a stable equilibrium.

2.5 Organizational processes

Central in the original March's model is the organizational process of learning performances evaluation. This evaluation is basically made by the Reality in the March's model and by the customer (or by the market) in the CLOD laboratory. The result of the evaluation process, in fact, depends on the agreement between members or leader beliefs and customer's requisites (market's needs).

All members and the leader are aware of their overall performance represented in term of Score. The Score is given by the number of beliefs that match customer's requisites minus the number of disagreements, normalized on the number of dimensions. A different concept is that of Knowledge. The Knowledge is measured at any time as the proportion of customer's requisites correctly represented in the beliefs of leader and on average in members' beliefs. Neither the members nor the leader has any information of customers' requisites. In this context, both leader and the members can reproduce false beliefs in their processes of exploration and exploitation.

Another fundamental process in March as in the CLOD lab is the Elite selection. At each time step, all members with higher scores than the leader could interact with him influencing his beliefs. In fact, each Elite's member expresses its own answer to the customer for any dimension. The output of the 'voting' process ends with an array of proposals calculated as the majority of the sub-groups 1 or –1.

When the evaluator is the market, the mean fitness (that is the measure of performances, replacing) is computed for all the members and for the leader. Similar to the case in which the evaluator is the customer, a fundamental step is represented by the selection of the Elite, which will include the members of the organization having a mean fitness greater than the one of the leader. Given the fact that each member of the Elite has its own individual points of view regarding the requirements of the market, an overall point of view of the entire Elite is determined by computing for each dimension the majority belief.

The laboratory has been implemented using NetLogo agent-based modelling platform (version 6.1.1).

3 Experimental design

In this section, we describe the two experiments that have been performed to explore some utilities offered by this computational laboratory as a tool for organizational research and design. The first experiment lets to internally validate the NK extension of CLOD laboratory by comparing the results obtained through simulations with the results showed in Bocanet and Ponsiglione (2012). Concerning the validation of the CLOD laboratory reproducing March's model, results are reported in Ponsiglione et al., 2019.

The second experiment aims at analysing the effect of environmental complexity and of different organizational sizes on performances measured in terms of fitness.

Both experiments were conducted in a stable (Experiment 1.1 and 2.1) and in a turbulent environment (Experiment 1.2 and 2.2); related parameters of the behavioural spaces are reported in Table 3 and 4. For each experimental configuration, 100 simulation's iterations were performed to make results more robust.

For the internal validation of the model, we simulated 81 configurations in a stable environment. In the turbulent environment, leader-listening ability% and members-conformity-degree% were both fixed to 50, while the K values were 1, 5, and 10 (Table 3).

Table 14: Experimental Design for NK model validation

Experiment 1.1 Effect of learning rates in **Stable Environment**	#dimensions	30
	#members	50
	Eq-stop	True
	leader-listening-ability%	10;50;90
	members-conformity-degree%	10; 20; 30; 40; 50; 60; 70; 80; 90
	Turbulence?	False
	Turnover?	NO
	K	1-5-10
Experiment 1.2 Effect of learning rates in **Turbulence Environment**	#dimensions	30
	#members	50
	Eq-stop	False
	leader-listening-ability%	50
	members-conformity-degree%	50
	Turbulence?	True
	Turbulence Degree	2
	Turnover?	NO
	K	1-5-10

In Table 4, both Experiments simulate organizations of different sizes (50, 100, 200) coping with an increasing environmental complexity. According to prior March's results, we settled the leader-listening ability% and members-conformity-degree% equal to respectively 90% and 10% as this configuration represents the combination that achieves the best organizational performances.

Table 15: Experimental Design

Experiment 2.1 Effect of environmental complexity and organizational size in **Stable Environment**	#dimensions	30
	#members	50;100;200
	Eq-stop	True
	leader-listening-ability%	90
	members-conformity-degree%	10
	Turbulence?	False
	Turnover?	False
	K	1-3-5
Experiment 2.2	#dimensions	30

Effect of environmental complexity and organizational size in **Turbulence Environment**	#members	50;100;200
	Eq-stop	False
	leader-listening-ability%	90
	members-conformity-degree%	10
	Turbulence?	True
	Turbulence Degree	2
	Turnover?	False
	K	1-3-5

4 Results and discussion

This section briefly reports and discusses the experiments performed through the CLOD laboratory. For each Experiment, we report some graphs to visualize the outputs of simulations and the One-way ANOVA tests with the relative post-hoc. The latter allow us to appreciate the existence of statically significant differences among different obtained outputs. More details will be provided in the following sections.

4.1. Results of Experiment 1.1

With this Experiment, we intend to internally verify the code of the agent-based NK extension, on which the CLOD laboratory is based. We compare our results with those reached through other different models, that have been already verified by the comparison with some stylized facts reported in the relevant and related literature (in particular, we take into account Bocanet and Ponsiglione's study, 2012).

Figure 2 shows the main results of Experiment 1.1. On the y-axis of Figure 2 the organizational performance is reported (average-leader-score); and on the x-axis there are the levels of member-conformity-degree%. The different values of leader-listening-ability% are represented by different colours (blue=10%, red=50%, green=90%). It is possible to note that the higher the K value, the lower the organizational performances. Moreover, for high levels of complexity (K > 5), organizational performances are strongly affected by randomness (Bocanet and Ponsiglione, 2012). Finally, in a stable environment, greater environmental complexity makes the learning rates less impactful in determining organizational performances. These results are also proved also by the ANOVA tests, given that as K increases, the number of statistically significant differences among organizational performances, determined by diverse learning rates, decreases very fast (ANOVA tests are available upon request).

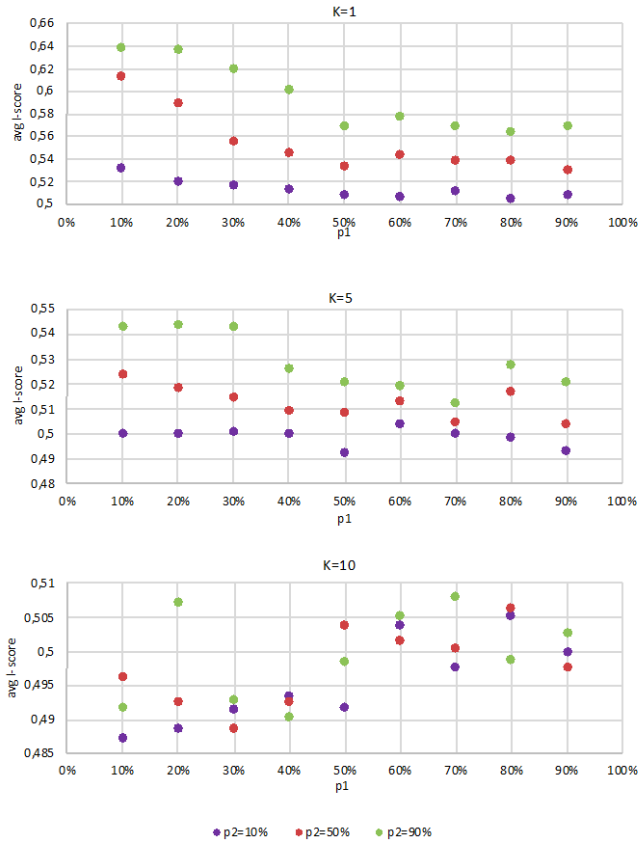

Figure 3: Results of Experiment 1.1

These results appear to be in line with those obtained by Bocanet and Ponsiglione (2012). Moreover, the trends of organization's performance as reported in Figure 1 for the Experiment 1.1 are substantially similar to those obtained and published by March (March, 1991, p. 76). In fact, we can notice that the peak of knowledge accumulated in the organization is obtained when the leader-listening-ability% is high (90) and the member-conformity-degree% is low (10). The convergence of results is not confined to some specific points, but is verified for the whole trend, thus giving further support to the internal validation.

4.2. Results of Experiment 1.2

The Experiment 1.2 aims at analysing the impact of different learning rates on organizational performances in turbulent environments. In Figure 3, we can observe that in the case of K = 1 the trend of average leader knowledge is consistent with the trend identified by March (1991, p. 80). In fact, the average leader knowledge (for each

considered period of time, the value of leader knowledge is averaged on 100 simulation runs), after an initial increase, decreases dramatically as simulation evolves, because the system is not able to preserve a certain degree of internal diversity.

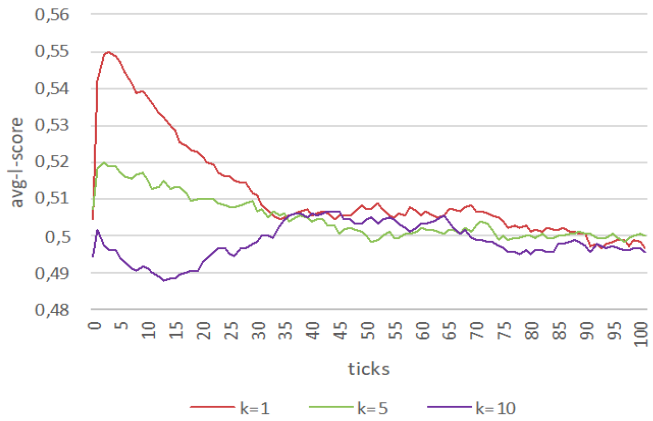

Figure 4:Results of Experiment 1.2

Over the simulation, the organizational performances progressively deteriorate, until the achievement of completely random results, represented by the average score around 0,5. This value represents a sort of attractor on which the performances converge for all the K values. These results are confirmed by the ANOVA tests shown in Table 5. Indeed, while at the beginning of the simulation, some statistically significant differences exist in terms of organizational performances related to different levels of environmental complexity, after this temporary phase, such statistical differences disappear.

Table 16: Model Validation Experiment 1.2 - Comparison among different K values 1; 5; 10

P1=50% P2=50%	**K**			**Test**	
Number of Step	**1**	**5**	**10**	**p-value**	**post-hoc**
Step_4	0,5488	0,5188	0,4961	0,0000	2-1*;3-1*;3-2*
Step_14	0,5298	0,51301	0,4887	0,0000	2-1*;3-1*;3-2*
Step_34	0,5048	0,5058	0,5028	0,8322	2-1;3-1;3-2

*.05 and **.01

In other words, with customer's requisites that change over time, the lack of internal diversity, due to the achievement in the short period of an equilibrium stage, determines a progressive deterioration of organizational performances, until the achievement of completely random results. Finally, results of Experiment 1.2 can be assumed as a further sort of internal validation of the agent-based model, able to reproduce qualitatively the same behaviour of the original cellular-automata model of March (1991), also with different levels environmental complexity.

4.3. Results of Experiment 2.1

Results of Experiment 2 are reported in Figure 4. Results are presented using box-plots. Each graph in Figure 4 compares the distributions of the leader's knowledge values for different organizational sizes with respect to a specific value of K.

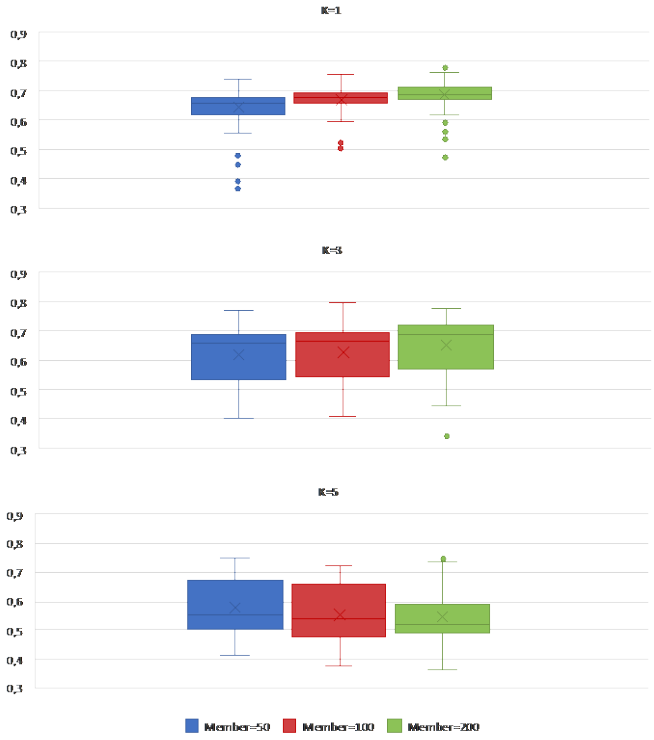

Figure 5:Results of Experiments 2.1

As shown in the upper part of Figure 4, in stable environments the organizational size plays a role in determining organizational performances, although the increasing environmental complexity has a negative influence on the level of knowledge achieved. In order to verify the impact of organizational size on performances, some ANOVA tests have been performed (Table 6).

Table 17: Results of ANOVA test Experiment 2.1

P1=90% P2=10%	**Organizational Size**			**Test**	
K	**50**	**100**	**200**	**p-value**	**post-hoc**
1	0,6454	0,6729	0,6873	0,000	2-1*;3-1*;3-2*
3	0,6212	0,6292	0,6529	0,044	2-1;3-1*;3-2**
5	0,5769	0,5536	0,5451	0,046	2-1**;3-1*;3-2

In particular, there are statistically significant differences among considered groups (small, medium and large organizations) in terms of organizational performances with reference to K equals to 1. On the contrary, as K increases, the number of significant differences is reduced; specifically, for K=3 there are statistically significant difference between small and large (p-values=0,05), as well as between medium and large (p-values=0,1). For K = 1 and 3, the Anova tests confirm that better performances are achieved by larger organizations. While for K=5, there are statistically significant differences between small and medium (p-values=0,1), as well as between small and large organizations (p-values=0,05); in these latter cases, best performances are achieved by smaller organizations. It seems that, in stable environments and for low-moderate levels of complexity, the increasing size of firms is able to sustain learning performances over the random value. In the case of K= 5, performances are very close to the average level of knowledge (0,5) and only small firms can reach performances level significantly different from the random value. Table 7 shows that different levels of environmental complexity affect the organizational performances for any organizational size. According to the literature, large organizations respond better than the smallest ones to increasing environmental complexity, excepting the case of K = 5

Table 18: Results of ANOVA test Experiment 2.1

P1=90% P2=10%	K			Test	
Organizational Size	1	3	5	p-value	post-hoc
50	0,6454	0,6212	0,5769	0,000	2-1*;3-1*;3-2*
100	0,6729	0,6292	0,5536	0,000	2-1*;3-1*;3-2*
200	0,6873	0,6529	0,5451	0,000	2-1*;3-1*;3-2*

4.4. Results of Experiment 2.2

The Experiment 2.2 aims at analysing the effect of environmental complexity and organizational size in a turbulent environment. As expected, increasing K implies an organizational performances decrease. Moreover, for higher K values, the organization with 100 employees appears to perform better than the other ones, although not all the statistical differences are significant (Tables 9-10).

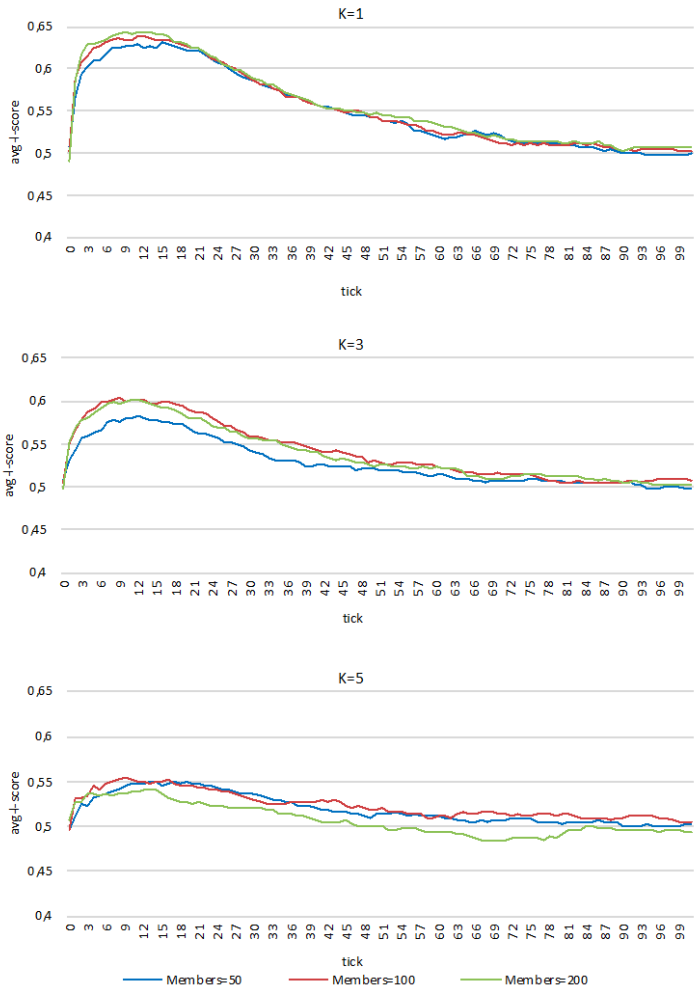

Figure 6:Results of Experiment 2.2

Table 19: Results of ANOVA test Experiment 2.2 – Differences among different organizational sizes

P1=90% P2=10%; K=1	**Organizational Size**			**Test**	
Number of Step	**50**	**100**	**200**	**p-value**	**post-hoc**
Step_4	0,6393	0,6239	0,6304	0,0060	2-1*;3-1*;3-2
Step_14	0,6260	0,6348	0,6419	0,1185	
Step_34	0,5745	0,5740	0,5759	0,9702	
P1=90% P2=10%; K=3	**Organizational Size**			**Test**	
Number of Step	**50**	**100**	**200**	**p-value**	**post-hoc**
Step_4	0,5584	0,5880	0,5802	0,0096	2-1*;3-1*;3-2
Step_14	0,5788	0,5967	0,5972	0,1745	
Step_34	0,5308	0,5537	0,5546	0,0165	2-1*;3-1*;3-2

P1=90% P2=10%; K=5	Organizational Size			Test	
Number of Step	50	100	200	p-value	post-hoc
Step_4	0,5328	0,5460	0,5354	0,2957	
Step_14	0,5495	0,5500	0,5400	0,5783	
Step_34	0,5296	0,5251	0,5148	0,234	

Table 20: Results of ANOVA test Experiment 2.2 – Differences among different levels of environmental complexity

P1=90% P2=10%; M=50	K			Test	
Number of Step	1	3	5	p-value	post-hoc
Step_4	0,6093	0,5584	0,5328	0,0000	2-1*; 3-2*; 3-1*
Step_14	0,6260	0,5788	0,5495	0,0000	2-1*; 3-2*; 3-1*
Step_34	0,5745	0,5308	0,5296	0,0000	2-1*; 3-2; 3-1*
P1=90% P2=10%; M=100	K			Test	
Number of Step	1	3	5	p-value	post-hoc
Step_4	0,6239	0,5880	0,5460	0,0000	2-1*; 3-2*; 3-1*
Step_14	0,6348	0,5967	0,5500	0,0000	2-1*; 3-2*; 3-1*
Step_34	0,5740	0,5537	0,5251	0,0000	2-1*; 3-2*; 3-1*
P1=90% P2=10%; M=200	K			Test	
Number of Step	1	3	5	p-value	post-hoc
Step_4	0,6304	0,5802	0,5354	0,0000	2-1*; 3-2*; 3-1*
Step_14	0,6419	0,5972	0,5400	0,0000	2-1*; 3-2*; 3-1*
Step_34	0,5759	0,5546	0,5148	0,0000	2-1*; 3-2*; 3-1*

Table 10 shows that, as expected, different levels of environmental complexity affect the organizational performances. While, Table 9 shows that in turbulent environments and for increasing levels of complexity, the role of size is not clearly defined and, as suggested also by March in is seminal work, the process of learning seems to be a "random walk" (March, 1991, p: 80).

This evidence suggests that the additional complexity of the external environment determined by turbulence requires other organizational solutions over the increasing of size (e.g. the personnel turnover) to generate an internal diversity in the firm to cope with the external dynamicity. The size of the organization in terms of members seems to be not significant to address learning challenges determined by increasing turbulence of external reality.

5 Conclusions

The goal of this work was to analyze the potential of an agent computational laboratory as a support tool for organizational design. The paper describes the blocks of the laboratory, which is based on an agent model, and proposes two types of experiments. A first group of experiments is aimed at verifying the model internally; the second group of experiments intends to explore the organization's behavior in environments characterized

by different levels of complexity and dynamism and analyses the role played by the organizational size in these contexts.

Organizations activate their learning capacity for answering to uncertainty and changing environments (Lei et al., 1999; McGill and Slocum, 1994; Wu and Shanley, 2009) and the role of organizational size in this response is not clearly assessed in the literature. Our results confirm that larger organizations, in general, reach better performances with respect to smaller ones in stable environments, also when the complexity of external environment increases. Instead, in the presence of moderate levels of turbulence, the organizational size seems to be not crucial in developing better learning capacity and organizational performances, and in the presence of moderate to high levels of complexity the organizational response seems to be "a random walk". This finding prompts us to investigate on more appropriate solutions to make organizations able to preserve or develop a specific level of diversity adequate to a certain degree of environmental complexity and dynamicity. Next developments of the research will be devoted to activate additional features of the lab to assess the impact of other organizational variables and solutions to organizational performances in complex and turbulent worlds.

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Knowledge Share among Firms: an Agent-Based Approach

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Abstract

The main objective of the study is to investigate how firms can improve their performance. In particular, the impact of the creation of knowledge by firms (closed innovation) or the share of knowledge among firms (open innovation) on the firms' performance is investigated. Both economic and innovation performance are considered. The economic performance is evaluated using the turnover of firms, whereas the innovation performance is evaluated using not only the number of patents but also other patents features that are relevant in predicting the forward citations that are considered as a proxy of the innovation performance and capability. The results show that firms' innovation performance increases in the share of knowledge case, whereas the economic performance has a better result in the case of no share of knowledge.

Keywords – Agent-based models, Knowledge, Innovation, Performance.

Paper type – Academic Research Paper

1 Introduction

In their efforts to progress and produce new technologies and perform superiorly in complex and uncertain innovation and competitive environments, firms increasingly must rely on external knowledge (Chesbrough, 2003). In this way, firms shift toward the so called "model of open innovation". The main element of "open innovation" is "the use of purposive inflows and outflows of knowledge to accelerate internal innovation" (Chesbrough, 2006). It implies the collaborative production and exchange of knowledge across organizational boundaries (Enkel et al., 2009) confirming that knowledge sharing is the main driver of successful collaborative innovation (Bogers, 2011).

The global tendency, i.e. the shift toward open innovation and the need to exchange knowledge, has been supported by several studies (e.g., Bader and Enkel, 2014; Terjesen and Patel, 2017; Zobel et al., 2017; Lazzarotti ed al. 2017). Thus, firms search and cooperate with external knowledge sources and actors in order to complement and upgrade their internal knowledge bases and competencies, thereby accelerating their own innovation process effectively and efficiently.

The mentioned studies demonstrate the correlation between open innovation and performance. However, despite often significant correlations have been confirmed, the link between open innovation and innovation and economic performance is pivotal. Few authors found that this relationship may take for example an inverted U-shape (Greco et al., 2016). Moreover, to understand which kind of innovation performance are really enhanced by open innovation and share of knowledge is very difficult.

This lack of agreement is probably due to methodological choices and lack of data rather than to the real proprieties of the phenomenon. Indeed, for example, often U-shaped relationships have not been hypothesized in previous studies (Greco et al., 2016; Cheng et al., 2019).

In order to fill this gap, the present study proposes an agent-based model to simulate different relationships and overcome the difficulties in acquiring large-scale data about firms' openness and performance. The main objective of the study is to investigate how firms can improve their performance. In particular, the impact of the creation of knowledge alone by firms (closed innovation) or the share of knowledge among firms (open innovation) on the firms' performance is investigated.

The study specifically investigates firms' performance when they adopt an open or a closed innovation strategy, i.e. sharing or not knowledge Among the different open innovation strategies, co-patenting is one peculiar and strong possibility very useful to investigate this openness paradox. Co-patenting implies the share of knowledge between the partners and the joint ownership of collaborative outcomes and often it has been seen as a not efficient strategy because of its complexity, challenges and managerial costs (Belderbors et al., 2010; Belderbors et al, 2014). With the agent-based model, how the development of joined patents may impact on both economic and innovation performance can be simulated. The economic performance is evaluated using the turnover of firms, whereas the innovation performance is evaluated using not only the number of

patents but also other patents features that are relevant in predicting the forward citations that are considered as a proxy of the innovation performance and capability (Ponta, 2019). In Ponta (2019), using machine learning algorithms, the following patents features have been identified: the number of backward citations, the number of International Patent Classification (IPC) classes, the number of extensions, the number of months between the publication date of the youngest and the oldest patent of the family. In particular, the number of IPC classes may represent the diversification of the company and in how many different technological domains the company can operate for a new innovation, the number of backward citations may be a proxy of the knowledge owned by the company and consequently the quality of the innovation, the number of extensions may represent the level of internationalization acquired (Petruzzelli et al., 2015) by the company and the number of months between the publication date of the youngest and the oldest patent of the family characterized the ability of the company to refine an innovation (Dechezlepretre et al., 2017).

Results show that firms that share knowledge have better innovation performance, evaluated not only with the number of patents but also with the other patents features described in Ponta et al. (2019).. Differently, in terms of economic performance the no share of knowledge shows better performance and a U-shaped relationship occurs. In conclusion, the developed agent-based model provides a very suitable tool to make classical what-if analysis. In particular, it is a sort of computational laboratory where to perform experiments and find the more convenient policy to improve the firms' performance (Pyka et al., 2009; Raberto et al., 2019; Iandoli et al., 2012).

The paper is organized as follows: Section 2 presents the model, Section 3 shows the results and Section 4 provides the discussions and conclusion of the study.

2 The model

To investigate the main objective of the study outlined above, an agent-based model and simulator (PABIM) has been developed.

The model includes heterogeneous agents that represent firms organized as a directed random graph, i.e. the interactions are unidirectional and characterized by a weight w_{ji}, assumed a positive real number.

The graphical representation of the present PABIM model in terms of firms (circles) and interactions (lines) is shown in Figure 1.

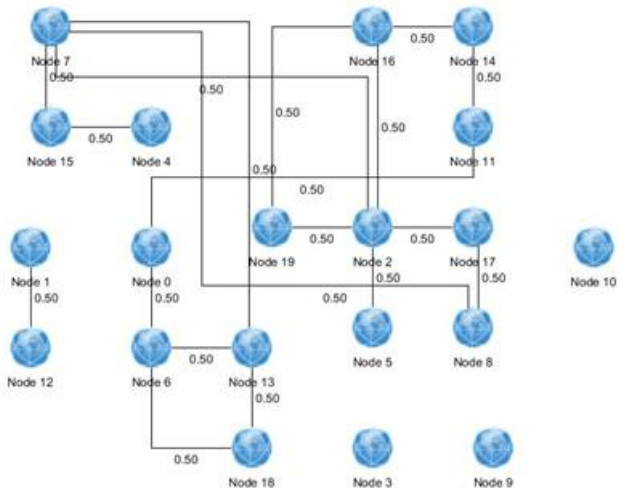

Figure 7 – Graphical representation of PABIM model in terms of firms (circles) and interactions (lines) at time step 0.

At the beginning of the simulation, all the firms have the same output node degree, defined as the number of outgoing arrows, and are endowed with the same quantity of cash and the same number of employees. During the simulation, the output node degree of each firm is directly proportional to the firm's size, i.e., it increases if the firm's size increases and decreases if the firm's size decreases, thus the number of employees, proportional to the firms' size, varies during the simulation.

In the model, a firm i is characterized by an identifier id_i, a number of employees N_i, a list of its filed patents P_i, an amount of cash C_i, the turnover Tu_i, the percentage of turnover invested in R&D α_i, an industrial sector IS_i and a probability to patent ρ_i.

The percentage of turnover invested in R&D research is different for each firm and proportional to the firms' dimension. At each iteration step, each firm invests a fraction of the turnover in R&D research, necessary to file patents. All the R&D expenses are finalized to patent.

The probability ρ_i of firm i to file for a patent is set to depend on the cumulated R&D research investment Mc_i employed by the firm i since the latest patent filed, as follows:

$$\rho_i^t = 1 - \frac{1}{1 + \eta\, Mci\,{}_i^t} \qquad (1)$$

where η is a shape parameter, homogenous across all firms, setting the patent research speed, i.e., the higher is η, the higher is the probability to file for a patent, for any level of cumulated R&D research investment Mc_i employed.

The probability to make a patent using shared knowledge between firm i and j (co-patent between firm i and j) is given by Eq. 2

$$\rho_{ij}^{t} = 1 - \frac{1}{1 + \eta\,(Mci_{i}^{t} + Mci_{j}^{t})} \quad (2)$$

If firm *j* cannot patent alone, it chooses from among all the firms' requests, to make a patent using shared knowledge with the firm with the greatest connection strength.

If a patent is not possible at time *t*, the firm can extend a patent issued at time step *t-1*. If firm *i* did not file for a patent at time step *t-1* no patent is extended.

The patent is characterized by an identifier, an IP class, one or more countries in which the patent is extended, the number of forward and backward citations. It is worth remembering that the backward citations are the patents cited when the new patent is issued, whereas the forward citations are the ones received by the patent. Moreover, a patent is characterized by a cost composed of a part that represents the cumulated (discounted) cost of filing and maintaining a patent and another part that depends on the R&D investment done until the year of filing. Moreover, a patent is also characterized by an extensions cost which represents the cumulated (discounted) cost of extending and maintaining the extensions of a patent. Management costs have also been considered.

The value of the patent, intended as the cumulated (discounted) turnover generated by the patent is defined by firms proportional to costs, through a multiplier $\mu_{p,i}$ defined at the beginning of simulation and constant during the simulation. $\mu_{p,i}$ is a positive real number to consider both the case of success and failure of a patent. In particular, $0 < \mu_{p,i} \leq 1$ represents the failure case, whereas $\mu_{p,i} > 1$ represents the success case.

The revenues for firm *i* of a patent *p* filed at time *t* is:

$$R_{p,i}{}^{t} = \begin{cases} V_{p,i}^{t} & \text{if firm } i \text{ files a patent alone at time step } t \\ V_{p,i}^{t}\ \nu \dfrac{Mc_{i}^{t-2}}{Mc_{i}^{t-2} + Mc_{j}^{t-2}} & \text{if firm } i \text{ files a patent at time step t using shared knowledge with firm } j\ (copatent) \end{cases} \quad (3)$$

where ν is a coefficient positive and less than 1, which simulates the management costs between firm *i* and *j*. Furthermore, the turnover of firms is updated. and firms determine the number of employees to hire or fire at each iteration step, according to their revenues. In particular, if the variation of turnover, ΔTu_i, is larger than zero firm *i* will hire a number of employees directly proportional to ΔTu_i, whereas if ΔTu_i is smaller than zero firm *i* will fire. Furthermore, if ΔTu_i is equal to zero no hiring or layoffs are implemented.

Finally, at each time step, the economic and innovative performances are evaluated. It is worth remarking that at each time step t, each firm checks if it can make a patent alone, and if not, the firm can try to share knowledge with the connected firms.

It is worth remarking that at each time step *t*, each firm checks if it can make a patent alone, and if not, the firm can try to share knowledge with the connected firms.

2.1. Firms Performance

At each iteration step, the economic performance Pe_i^t of firm i is evaluated as its turnover Tu_i^t. As said in the introduction, in literature many measures have been proposed to evaluate the firms' innovation performance. Among the performance measure based on secondary data, i.e. the patent database, in this paper, not only the traditional measure of number of patent is considered, but also the following patents features have been considered: the normalized number of patent, the number of backward citations, the number of IPC classes, the number of extensions, the number of months between the publication date of the youngest and the oldest patent of the family, each of them defined using machine learning algorithms, i.e., Regularized Least Squares, Deep Neural Network and Decision Trees, as described in Ponta et al. (2019).

3 Computational Experiment

3.1 Design of experiments

In order to investigate the research question described above two scenarios have been considered. In the scenario (i) each firm can only create knowledge, whereas in the scenario (ii) the knowledge's share strategy is allowed. Simulations have been performed ceteris paribus, meaning that all the parameters are identical with the exception of the strategy. In particular, twenty firms, working in eight different sectors have been simulated. It is worth noting that each firm can file one patent maximum per year. The two cases previously described are explored with six different values of η, the parameter which controls the probability to translate the R&D investment into patents, see Eq. 1; in this way twelve different scenarios are obtained. The methodology used is based on Monte Carlo computational experiments: each scenario is simulated with fifty different seeds of the pseudorandom number generator. So, a total of 600 simulations were considered in order to conduct the investigation. The computational results are presented in the form of boxplots. In particular, each boxplot shows the distribution of the time averages of relevant variables over a twenty-years time interval, concerning the fifty simulations characterized by different seeds. Boxes enclose the values from the first to the third quartile; they also include whiskers that extend up to the minimum and maximum data points that are not considered outliers; the horizontal segments inside boxes represent the median of the distribution. The analysis aims to investigate the impact of sharing knowledge on firm performance, considering both economic and innovation performance. Table 1 summarizes the simulations initialization data. The data used in the simulations were estimated from the Orbit Intelligence database provided by Questel[1], collecting patents that are published by firms with a registered office in Italy, or by an inventor with

[1] *www.questel.com*

a residence in Italy from 2000 to 2018. It is worth noting that each firm can file only one patent per year maximum.

Table 21 - Simulation Parameters

Symbol	Description	Value
T	Years	20
I	Number firms	20
ES	number economic sector	8
do	number of initial output connection	0, 2
T_u	Turnover init	20000
η	patent research speed	0.00001 to 0.001
α	% of turnover invested in R&D	[2 - 17]
μ	Multiplicator	[0.5 - 2]
ν	coeff management cost	0.9
C_e	patent extension cost	350
C_f	patent filed fixed cost	500

3.2. Results

Figure 2 shows the economic and innovation performance in scenario (i) (blue) and in scenario (ii) (red). The scenario (i) is characterized by a no share of knowledge strategy. As in the real world, firms patent only alone and do not cooperate to achieve technological improvement more quickly. Scenario (ii) is characterized by the possibility to share knowledge, that is, firms cooperate to reach the issue of a patent. In particular, Figure 2 (a) shows the economic performance approximated with the turnover. It can be noted that for all the values of η, the turnover in scenario (i) is larger than in scenario (ii), meaning that firms can convert R&D investment into patents without sharing knowledge, and making patents alone saves the management costs. For a firm, it is more remunerative to reach enough knowledge to patent rather than to use shared knowledge. Moreover, for very large η the two scenarios are similar because, even in the case of shared knowledge, firms file for patents alone. Furthermore, it is worth noting that in both scenarios the maximum value of economic performance is reached for an intermediate value of η meaning that too less or too large number of patents does not permit to reach the optimal value of economic performance. Figure 2 (b) shows the innovation performance evaluated with the number of patents. For all η the innovation performance is larger in scenario (ii), i.e. when firms share knowledge. Moreover, it is worth noting that, both in Figure 2 (a) and (b), the increase of the capacity of firms to translate R&D expenditures into patents is not proportional to the increase in economic and innovation performance. In fact, for larger η the economic and innovation performance behaviour is very similar. In order to investigate innovation performance deeply, Figure 3 shows the five patent features mentioned in Section 2. In each subfigure, both scenario (i) in blue and scenario (ii) in red are plotted for easy comparison. Figure 3(a) shows the normalized number of patents with

respect the firm size. It is possible to observe that for all η it is larger in scenario (ii), i.e., when firms share knowledge are able to file for a larger number of patents compared to the no share case. Thus, independently of the ability of firms to transform R&D research into patents, the possibility to use sharing knowledge increases the innovation performance of firms. The number of backward citations, the number of IPC classes, Figure 3 (b) and (c) show the number of IPC classes and the number of backward citations patent features, respectively. It is possible to observe that for all η in scenario (ii) the two features are larger than in scenario (i). Finally, Figure 3 (d) and (e) show the number of extensions, the number of months between the publication date of the youngest and the oldest patent of the family, patents features. It can be observed that for all η in scenario (i) and in scenario (ii) these patents features are larger than in scenario (ii). It is worth noting that in both scenarios the maximum number of these features is for η not very small nor very large. Summarizing the results of the innovation performance, in scenario (ii), i.e. when firms can share knowledge, firms reach better performance compared to scenario (i).

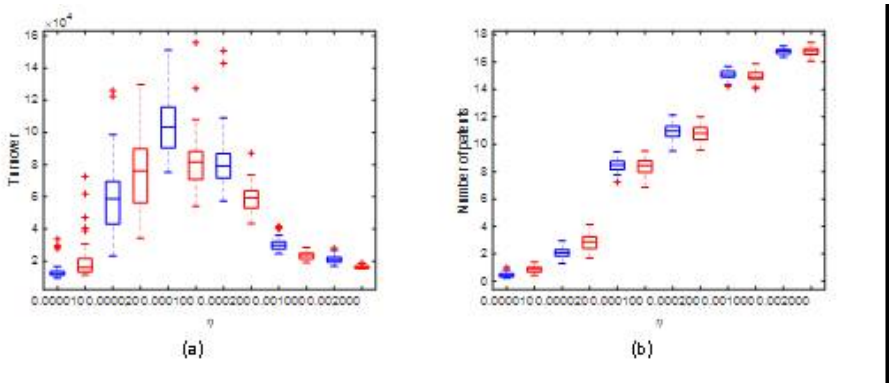

Figure 8 – Distribution of: the economic (a) and innovation (b) performance of firms for scenario(i) (no share of knowledge) in blue and scenario (ii) (share of knowledge) in red

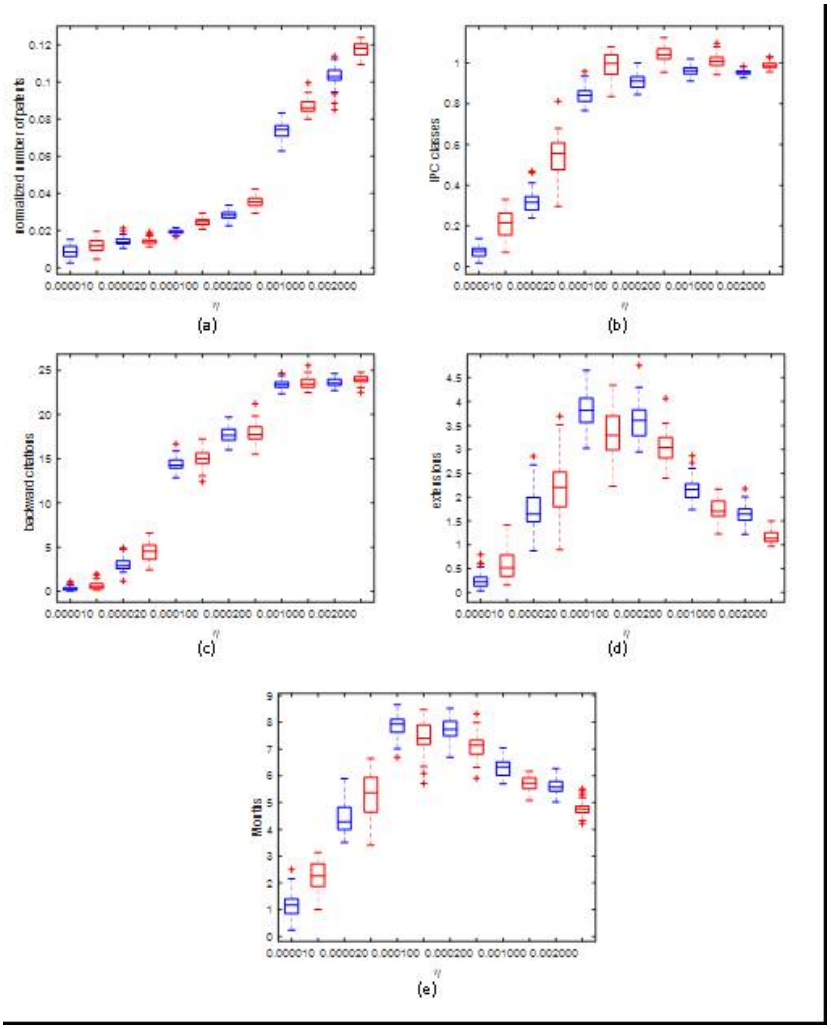

Figure 9 - Distribution of the following patents features: the normalized number of patents (a), the number of extensions (b), the number of IPC classes (c), the number of backward citations (d) and the number of months between the publication date of the youngest and the oldest patent of the family (e) for scenario(i) in blue and scenario (ii) in red.

4 Discussion and Conclusions

The computational results presented in the paper are able to capture the impact of the creation of knowledge by firms or the share of knowledge among firms on firms' performance. The paper has proposed a new methodological approach, i.e. an agent-based model, that provides a more complete understanding of the phenomenon, of the pivotal link between open innovation and innovation and economic performance (Greco et al.,

2016) and of which kind of innovation performance proxy are really enhanced by open innovation.

Furthermore, the firm performance dynamics that emerged from the simulations show important results, both at the economic and innovation levels. The possibility of a co-patenting strategy points out very interesting aspects. In particular, the economic performance is greater in the case of a no co-patenting strategy and there is also a U-shaped form. This result confirms that filing for a joint patent is more expensive, because, for example, managerial costs between the firms are also necessary. Moreover, the inverted U-shaped demonstrated that when increasing the patent research speed, there is a sort of maximum for both shared or not knowledge. High R&D velocity could lead to lower economic benefit probably because of difficulties in capturing the innovation value and high R&D expenses cannot generate higher sales. In the case of co-patenting, this is even more true, probably because co-patenting could lead also to higher complexity and managerial costs, confirming also more recent studies about the not linearity of the relationship (Greco et al., 2016). Instead, innovation performance is more effective in the case of a co-patenting strategy. In particular, in terms of number of patents developed, the open innovation strategy of sharing knowledge and developing a co-patenting shows better performance. The use of external knowledge permits to fill internal lack of competencies and develop a larger amount of innovations. Also in terms of diversification, the share of knowledge permits to increase the performance. However, at a certain point, there is a sort of plateaux where the share or not of knowledge reach similar performance. This suggests that when the research speed of a company is particularly high, probably the company cannot reach other technological domains and the share or not of knowledge will not lead to higher diversification. Differently, for lower research speeds, the use of a co-patenting strategy permits to reach more technological domains and increase the diversification. This suggests that the other partner help to open toward more sectors and technological domains (Petruzzelli et al., 2015).

In terms of backward citations and consequently of quality of the innovation, companies with lower R&D speed increase their knowledge base and their innovation quality when sharing knowledge. When companies own a higher research speed, the possibility of sharing knowledge leads to lower expansions in terms of knowledge base, probably because they internally own already a wide knowledge base and innovation competencies (Petruzzelli et al., 2015).

In terms of patent extensions and consequently internationalization of the innovation in other countries, the sharing of knowledge is positive for lower levels of R&D speed. After a certain point, the sharing of knowledge lead to lower benefits. That could be due to the fact that companies with high R&D speed already market and protect their innovation at an international level and in multiple countries (Petruzzelli et al., 2015).

Results in terms of the number of months between the publication date of the youngest and the oldest patent of the family that represent the ability of the company to refine an

innovation show that probably the sharing of knowledge for lower R&D speeds allows to better refine the innovation. Differently, companies with higher levels of R&D speed are already capable by themselves to internally refine the innovation and propose incremental changes to the original one (Dechezlepretre et al., 2017).

In conclusion, the agent-based model here developed provides a tool that is very suitable for making a classic what-if analysis. In particular, it is a sort of computational laboratory where to perform experiments and find the most cost-efficient policy to improve the performance of firms. In fact, it allows for understanding what happens in terms of performance if a firm decides to adopt an open innovation strategy and specifically adopt a joint-patents or not. This allows for taking a further step towards understanding the outcomes tied to applying a possible joint patent strategy that has not yet been widely analyzed, due to a lack of data. This simulator will be a very useful tool for managers because they will be able to simulate a chosen strategy before applying it in the real world. Nevertheless, this study is not without limitations. Although patents are widely used to measure innovation performance, they represent only a limited set of company innovation assets. Furthermore, in some sectors, patents are not widely adopted as mechanisms to protect innovations because other innovation assets that are more difficult to measure, such as R&D expenditures, intellectual assets, human resources skills, and aesthetic design, also provide information to measure innovation performance (Grazzi et al., 2020). For this reason, other sources of information and data (for example expenditure in R&D) will be used to strengthen the simulator. Moreover, in the model, firms can choose only one strategy from among the possible ones, i.e., to patent alone, to co-patent and to extend an older patent, but in the real world, firms can patent and extend an older patent at the same time. Thus, the possibility to adopt a mixed strategy will be allowed in future research. Other next steps, to overcome some limitations, are to differentiate the R&D expenditure, which in the current model is only used to patent. Finally, it is worth remembering that this is a first step to verify if and how a patent's features influence a firm's performance based on a modeling assumption that needs to be further investigated.

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Information Patrimony in Collaborative Innovation Networks

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Abstract

Collaborative innovation networks represent adequate structures within which to foster members' abilities to interact and cooperate in order to increase the level of knowledge and facilitate access to innovation. In this paper we consider two collaborative innovation network models, called orchestration and choreography and we compare them in terms of knowledge flow by means of a network centrality measure called Neighbours' Information Patrimony, recently introduced to study the influence of the pattern of connections around a network member. We present empirical results on a wide set of simulations and we discuss outcomes and results to explain some behaviour in such innovation networks.

Keywords – Collaborative innovation networks, Network orchestration, Network choreography, Neighbours' Information Patrimony.

Paper type – Academic Research Paper

1 Introduction

In recent years, innovation has evolved beyond the boundaries of single firms towards a more network-based approach (Ferraro and Iovanella, 2017; Grange et al. 2020). Firms investing in innovation outside their internal and business borders increase indeed their opportunities to innovate. Thus, firms have undergone a fundamental change in the way they undertake innovation activities. In particular, in the framework of a knowledge-based economy, firms join innovation networks that allow them to share knowledge with partners, enabling access to new technologies and resources (Hurmelinna-Laukkanen and Nätti, 2018).

Collaborative innovation networks, which emerged in recent years as a result of the evolving challenges faced by businesses, represent adequate structures within which to foster members' abilities to interact and cooperate in order to enhance the level of knowledge and facilitate access to innovation (Galati et al, 2019). They allow the creation of new value by combining ideas and practices and sharing resources, skills and technologies, thus fostering relevant synergies. Innovation networks can be seen as the consequence of combining existing and novel knowledge from various firms and their business boundaries in order to create unique products, services, and processes depending on the current needs of the market.

Although the scientific literature has explored how the relationships among network members help achieve the innovation outcome (Ferraro and Iovanella, 2015), little has been said regarding how single members act to exploit and manage the network. As a matter of fact, the processes that a network member must perform in order to control, coordinate, influence and monitor its own activities within the network remain poorly understood.

Generally, interactions are considered by means of operational processes (Kuura and Lundin, 2019) that are operationalised concepts in the form of a process construct of developmental events; thus, processes are meant as sequences of activities, that are assessed over time in order to explain causal relationships between variables. In a networked environment, a process is intended as a sequence of deliberate and purposeful cause-and-effect actions that are instrumental in the evolution of the system. Such actions comply with the network's rules and purposes and allow value to be created from the system.

As in Slotte-Kock and Coviello (2010), we notice that network processes are different according to the structure of the underlying network. For this reason, we identify two different models: the orchestration model (Dharanaj and Parkhe, 2006; Faccin et al. 2020) and the choreography model (Ferraro and Iovanella, 2015).

The structure of the network influences the spreading of knowledge among its members., Information availability stemming from the network connection patterns varies indeed starting from the observation that a single member is not only affected by its alters (i.e. its neighbours), but also by the alters of its alters. Under this perspective, different patterns of knowledge diffusion correspond to different network structures.

In the light of the above, the aim of the present paper is to look into how information mechanisms are managed within the orchestration and the choreography models. In doing this, we initially contribute by providing a formal representation through a network science approach (Barabási, 2016).

Under the proposed approach, it appears as relevant to observe how the neighbourhood of a network's member, as well as the patterns featuring alters of alters, influence knowledge exchanges. Starting from recent developments concerning the assessment of the neighbours' information patrimony relating to a network's member (Arpetti and Iovanella, 2019), we hereby analyse how different patterns of relationship influence the network and how members can benefit from such patterns.

The outcomes of the proposed reflection allow to distinguish network's members based on their neighbour's information patrimony and provide supporting empirical evidence with a view to implementing sustainable development and assisting in assimilating, utilising and reconfiguring the knowledge flow.

2 Organizational models: orchestration and choreography

2.1 The orchestration model

Traditionally, the literature considers planned networks as interactions represented in a hierarchical structure, with a prominent member or participant performing a leadership role in managing the system. The operation of such networks is well described by the *orchestration* model, which considers the fundamental role of the orchestrator or hub as the one holding particular importance and exercising influence, due to its individual qualities and prominent position within the network (Dharanaj and Parkhe, 2006).

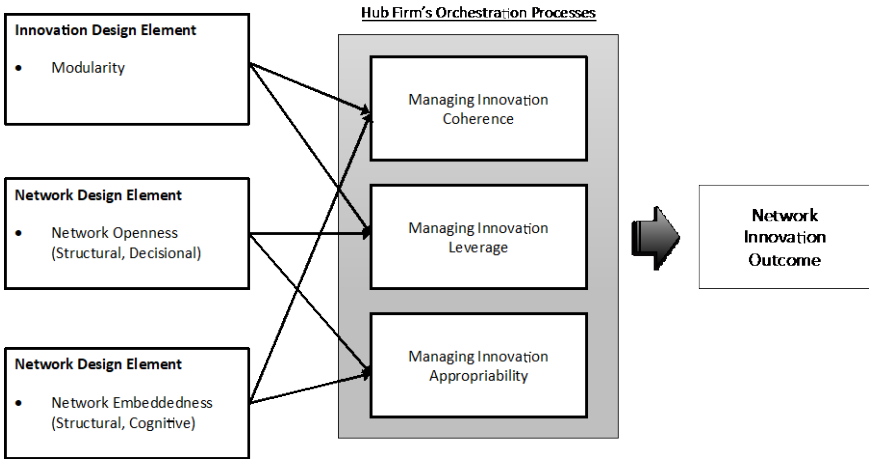

Figure 1: Orchestration processes, innovation design and network design (source: Nambisan and Sawhney, 2011).

Due to its central position, the orchestrator monitors and controls the knowledge flow and keeps a huge number of connections that, in turns, are willing and able to provide it with important opportunities and resources. The orchestrator has the qualities necessary to pull together and leverage on the dispersed resources and skills of network members, via facilitating and coordinating the interactions needed to achieve the outcome of the system. Furthermore, the orchestrator influences the network design and how processes are established (Laukkanen and Nätti, 2012).

The centrality of the hub implies its higher position within the members' hierarchy and therefore constitutes a significant source of power. Usually, network members perceive the central firm as holding a higher status and being more trustworthy than peripherals, since it can access knowledge and resources more easily. Indeed, it is generally the orchestrator who recruits network members and shapes their connections. By consolidating the legitimacy of the network's activities, it is able to attract further partners and to put increased efforts and resources into encouraging fruitful links among members (Paquin and Howard-Grenville, 2013).

In orchestrated networks, activities are implemented according to the members' role and are constrained by the corresponding patterns of network composition. Such activities are undertaken through instances of the orchestration processes undertaken by the hub. The orchestrator acts as a controller and executer in the network and functions as a leader with the possibility of invoking process execution by network members.

Figure 1 shows the orchestration model as reported in Nambisan and Sawhney (2011).

2.2 The choreography model

Recently, more complex and heterarchical organisations have emerged featuring more than one hub, where the decision-making power is spread among all partners. In such cases, the orchestration model is no longer suitable to describe the networked environment. Indeed, network members participate in a self-organising process, in which order emerges on the background of the interactions among partners. Although such networks must deal with issues similar to those featuring the orchestrated systems, such as relations, processes and value creation, they require a leadership type that is more likely to be spread throughout all partners.

The *choreography* model (Ferraro and Iovanella, 2015) takes all members of the network into consideration, without relying on one single core actor. We argue that choreography governs behaviours by shaping the level of connectivity and cohesion among network members. It represents a valid organizational system in order to support the execution of certain activities and to achieve effects resulting into innovation outcomes.

The choreographic shape of a system results in coordinated activities among all members which consequently produces heightened innovation. Interactions in choreography are concrete instances of activities carried out by members, which comply

with the network's rules and purposes (Cinelli et al, 2019). Activities can take place between members – for example, in the case of the knowledge flow when two or more agents share information – or they can be within agents.

In the choreography model (see Figure 2), network's members share certain assets, capabilities and production capacities while maintaining their individuality. The network's leadership and control are peer distributed among partners and collaboration patterns are more relevant than individual roles.

The choreography requires that potential members interested in the benefits of joining the network demonstrate certain membership characteristics, which are mainly expressed in terms of ontology, which extends the concept of embeddedness introduced by Nambisan and Sawhney (2011). The ontology allows members to conceptualise what exists within the network. The conceptualisation is completed within the domain of knowledge, formally characterised by the set of objects that can be represented and referred to as the universe of discourse. The set of objects and their relationships are reflected using a specific vocabulary that represents knowledge. In this context, ontology is described by defining the names of the entities in the universe of discourse, i.e., members, processes, resources, etc. with a semantic description of each term.

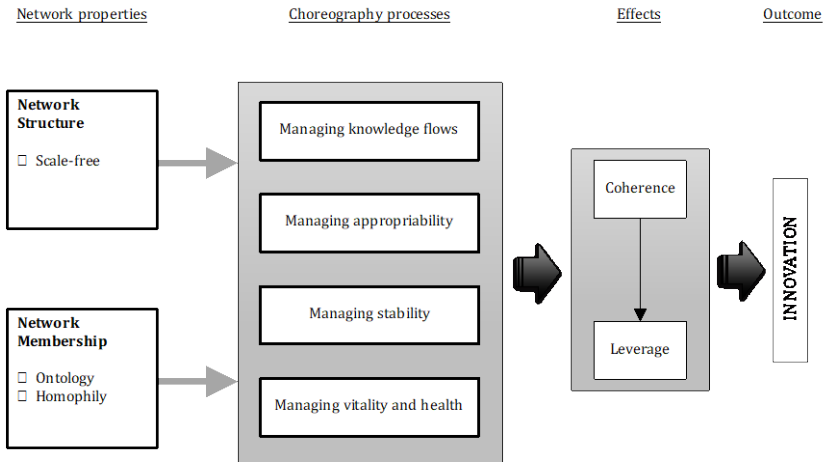

Figure 2: The choreography model (source Ferraro and Iovanella, 2015).

2.3 Comparing the management of knowledge flow between the two models

In orchestration, the hub leverages on the embeddedness to facilitate information dissemination, interpretation and persuasion. On the other hand, in choreography, members recognise a certain degree of consensus to the knowledge domain of ontology and are committed to it, as long as their actions are consistent with its set of definitions. Members act in accordance with the ontology and behave rationally in order to achieve the final outcome of the network.

Network members should join orchestration or choreography models to exchange, spread and use knowledge in order to stay competitive. Such efforts require collaboration in ever more open and distributed configurations in increasingly complex situations, characterized by a growing number of heterogeneous actors.

Table 1. Knowledge flow management in orchestration and choreography models.

Orchestration	***Choreography***
Knowledge is defined	Knowledge is not defined *a priori*
The hub integrates partners knowledge assets and capabilities	Enhances access to knowledge sources
The hub coordinates knowledge sharing among partners	Envisions exchange, share and use of information among members
Knowledge is defined to meet market requirements	Enhances how information mechanisms are located
Knowledge flow is monitored and controlled by the hub	Creates an environment of trust and commitment in which to share information among members
The hub, due to its status, can access knowledge easily	Facilitates assimilation of information among partners
Knowledge is shared, acquired and deployed within the network	Provides for sharing good practices and business experience within and outside the network
The hub assesses the value of knowledge in the network and organizes its transfer where it is required	Enhances trust among members so that they are more willing to share assets
The hub manages the knowledge leverage	Enhances learning from the network

Throughout the two observed configurations, the knowledge flow among members runs in different ways. Table 1 summarises the main differences between the orchestration and choreography models in terms of knowledge management. In particular, the orchestrator manages the knowledge leverage by offering a common set of technologies, tools and other assets that all network members can use with the aim of ensuring a coherent quality, minimising redundancies and enabling product improvement. The hub manages also knowledge coherence in order to preserve external knowledge coherence and ensures that network members adapt their activities accordingly and coordinate interactions among them with a view to guaranteeing internal coherence. The orchestrator therefore defines policies for intellectual property rights distribution and allocates rewards stemming from product commercialisation. The details of the relevant strategies and practices are resumed in Table 2.

Table 2: Network processes, strategies and practices (source, extract from Nambisan and Sawhney, 2011)

Orchestration Process	***Strategies and Practices***
Managing Innovation Leverage	• Identify opportunities for asset leverage by analysing common innovation activities among partners • Modularise leverageable assets by redefining innovation architecture • Establish centralised infrastructure to host and to facilitate asset leverage • Group leverageable assets based on their usage context and offer guidance • Establish forums to involve partners in the design and development of leverageable assets • Define multiple levels of partner involvement in asset design based on intensity of asset leverage • Implement systems that monitor partners' asset usage
Managing Innovation Coherence	• Utilise ties among partners to disseminate information on the changes in the innovation platform • Utilise common vocabulary/frameworks to shape partners' perspectives on the innovation platform • Offer tools based on common vocabulary and frameworks to facilitate transition to revised platform • Group partners based on innovation architecture to redefine member interactions and task coordination • Organised workshops, etc., to rapidly redefine partner ties based on revised innovation architecture

In the choreography model, knowledge coherence and leverage are considered as internal effects of the network since they represent the added value to the system for the members (see Table 3). The model ensures the impartial distribution of value within the system, thus reducing the threat of members' opportunism, whilst strengthening equitable allocations.

Innovation coherence deals with the consistency of the network's activities regarding the coordination and alignment of processes and outcomes. Within choreography, we can distinguish between internal and external coherence. The former concerns the alignment of innovation processes with the interactions of members within the network, whilst the latter is related to the technological environment and the market structure where the network operates. Innovation coherence permits a shared alignment with the technological environment, complying with the network's goals and fulfilling outcomes with respect to market needs.

The innovation leverage has to do with the control, reuse and sharing of technologies, processes, and other innovation assets with a view to supporting and enhancing innovation, thus creating additional value for assets' owners and for the actors controlling the assets. Such leverage allows members to include and integrate new technologies in their internal innovation processes, thus contributing to generating additional profits for network members through attracting new potential partners.

Table 3. Network choreography effects

Choreography Effects	***Activities***
Coherence	• Use common and shared tools based on network ontology • Align with the technological environment • Ensure that network members attend organised workshops and training actions • Align with the processes and outcomes • Align with the network's goals • Align the network's outcomes with the marketplace
Leverage	• Enhance the network identity • Identify opportunities for asset leveraging among network members • Involve partners in the design and development of leverageable assets • Control, reuse, and share innovation assets • Incorporate innovation into other members' innovations • Generate additional profits for members • Attract new members

The network is able to manage and strengthen the value-creation opportunities through choreography by including leverage among members and generating surplus value, whilst taking into consideration the structure of the assets that can be shared and deployed. This effect can be improved by allowing new members to join the network, thereby increasing the degree to which current innovation assets can be leveraged. Furthermore, members are expected to be more willing to leverage on other members' innovation assets if they recognise similar characteristics.

In Table 4 we resume the main characteristics of the two models under analysis. We focused mainly on the knowledge flow and the consequent leverage and coherence required in order to provide the innovation outcome.

For further details, we refer to the above mentioned literature and the references therein.

Table 4. Main characteristics between orchestration vs. choreography models (source Cinelli et al, 2019).

Orchestration	***Choreography***
Individual leadership	Diffused leadership
Hierarchical organisation	Heterarchical organisation
Centralised executer	Peer-to peer
Clearly defined outcome	Broad innovation outcome
Tacit and explicit knowledge	Explicit knowledge
Bilateral relationships	Multi-lateral relationships
Essential information	Redundant information
Managing innovation leverage	Ontology-driven leverage
Managing innovation coherence	Network membership-driven coherence
Clearly defined market opportunities	Less-defined market opportunities
Hub controls assets	Broad sharing of assets
Asymmetry of benefits for hub and members in creating and adding value	Benefits for all members in creating and adding value

3 Inter-organisational network modelling and evaluation of the network information patrimony

For our purposes, we consider the definition of Neighbours' Information Patrimony (*NIP*) introduced in Arpetti and Iovanella (2020).

The *NIP* is a measure which exploits networks properties in order to understand how a node may take advantage of the set of its connections as a whole. In this respect, the information patrimony of an individual can benefit from the network configuration, via capturing information stemming from its connections' patterns.

To this end, the proposed measure considers the quality of nodes' connections and consequently, how nodes might enjoy benefits deriving from a good neighbourhood – meaning a superior connections set – thus obtaining better information.

Let us consider a network $G = (V, E)$ representing an inter-organisational network where the V set contains the n organisations in the system, while the E set contains all m collaborations among such organisations. Members of the V set are indicated by an index i while the E set can be conceptualised through the adjacency matrix A, whose generic element a_{ij} is equal to 1 if the link between i and j exists or, otherwise, to 0. In the present paper, we consider undirected and unweighted networks, i.e., the relationships at stake are mutual and considered as being continuous over time.

Among the different network measures used in Social Network Analysis, we consider the *centralization degree* of a node i, called d_i, which measures the number of nodes that are present in its neighbourhood and the *average degree of the neighbourhood* of a node i, called $k_{nn,i}$ and defined as (Pastor-Satorras et al, 2001):

$$k_{nn,i} = \frac{1}{d_i} \sum_j d_j a_{ij}$$

It is now possible to introduce the collective effects of a neighbourhood on a node i and we therefore define the Neighbours' Information Patrimony NIP_i of node i as (please refer to Arpetti and Iovanella 2020 for the full description):

$$NIP_i = \frac{d_i}{2m}\left(1 + k_{nn,i}\right)$$

In this setting, all the information available to the organisation consists of the amounts of connections set present in a network (i.e. $2m$), thus the Information Patrimony IP of a node i is equal to its market share $d_i/2m$ (i.e. its portion of market due by its degree). The above formula introduces a further component, the effect on the information patrimony induced by the network, thus the NIP of a node i is equal to the sum of its information patrimony with the information patrimonies of all its connections, i.e. the nodes j in its

neighbourhood. Some simple algebraic manipulations bring to the above outlined formula.

By means of the present contribution, we intend to analyse the different behaviour of the NIP in the two introduced models, namely orchestration and choreography, and, to this purpose, we consider the following hypothesis:

> *HP1. The orchestrated network is modelled with a central node, called hub, connected to each of the other members; no other connections are allowed; the choreographed network is modelled as a scale-free network.*

Scale-free networks are a well-known network model introduced in Barabási and Albert (1999). Such networks are open and dynamically formed by the continuous addition of new nodes that represent members, while the links between members mimic collaborative agreements. Scale-free networks emerge in real situations characterized by inhomogeneity in degree distribution, with a few nodes having many links and the majority having only a few connections. In general, degree distribution in scale-free networks follows a power law distribution with exponential rate conventionally indicated with γ.

Scale-free networks offer a theoretical framework for the choreography model that permits a suitable abstract representation of inter-relations, where the network characterization indicates the mapping of connections among elements. Although networks may appear very different from each other with respect to their functions and attributes, the analysis of their structure denotes the ubiquity of several asymptotic features and reveals the emergence of general and common self- organizing rules (Ferraro and Iovanella, 2015; Cinelli et al., 2019).

In Figure 3 an example of orchestration network model – where the orchestrator is reported as the central node in dark green – and an example of choreography network model where nodes are coloured in a gradient of green proportionally to their degree are represented. Both networks feature 50 members and it can be easily noted how the hub holds a central position in the orchestration model, while the choreography is characterised by a degree distribution admitting a few nodes having high degree, and a majority of them having a low degree.

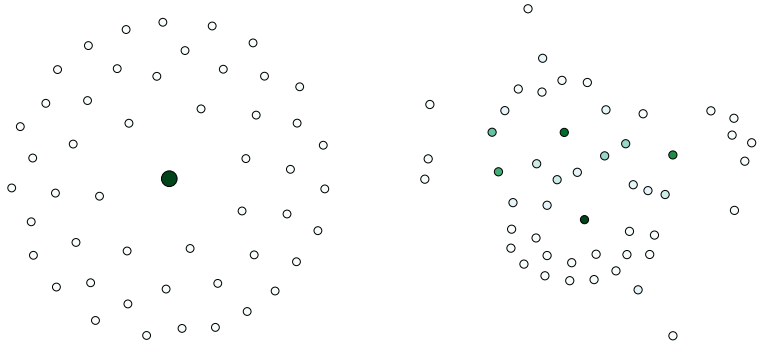

Figure 3: An orchestration network (left figure) and a choreography network (right figure).

Under the perspective of HP1, in this paper we aim at studying the two different network representations considering the *NIP* in order to draw empirically observable outcomes as well as insights for explaining real-world network behaviours.

4 Empirical analysis

The analysis was conducted by simulating the two different models by means of synthetic networks generated considering, for both cases – orchestration and choreography – the number of members as $N = \{10, 20, 30, 40, 50, 100, 150, 200, 250, 300, 350, 400, 450, 500, 550, 600, 650, 700, 750, 800, 850, 900, 950, 1000\}$.

In order to simulate the orchestration networks, we created for each value of N a star network where the central node – which has degree equal to N - 1 – acts as the orchestrator, while the other orchestrated nodes have degree equal to 1. The choreography organisation was simulated by generating scale-free networks. For each value of N we generated 100 different networks; the results, in the following, are averaged over such a set. For the sake of completeness, please note that, for a fixed N, only one star can exist, while a scale-free network can assume different configurations, each of them respecting the same power law degree distribution; in our setting, we considered the classical value of $\gamma = 2$ (Barabási, 2016).

The left diagram in Figure 3 shows the values of *NIP* for each value of admissible degree. Red spikes indicate that, in the orchestration, only two types of members are allowed: the orchestrator and the orchestrated members. For the orchestrator, the value of *NIP* is 1 since it owns all the information patrimony in the network, while the orchestrated members benefit of a large value of *NIP* since they are all connected to a single, huge, node.

When we consider the choreography case, we note a different distribution of the values, the highest related to the low value of degree. It means that small nodes benefit more from the connection patterns than hubs, since they are more prone to be connected to nodes with highest degrees.

As a result, the *NIP* is a measure capturing a well-known effect, i.e. the network impact on the information patrimony of a node: the higher the quality of the neighbourhood, the more the benefit for the relevant node.

Clearly, in the case of orchestration, the absolute values are higher but it is worth noting that, should the hub in the orchestration disrupt, all the values of *NIP* would crash to 0, while in the case of choreography, a hub disruption would have a moderate effect on the *NIP* values of the remaining nodes (Ferraro and Iovanella, 2018).

The right panel in Figure 3 shows the value of *NIP* for the nodes with higher degree. In the case of orchestration, it is always equal to 1 since the hub controls all the information patrimony in the networks. In the case of choreography, the value of *NIP* is slightly increasing with N, but it never reaches the value of 1. It means that, even if a hub reaches high degree values, it never controls all the information patrimony in the network.

We can therefore conclude that the two organisations show opposite behaviours that we can expect but that are not easy to empirically explain. The orchestrator has a full control of the information patrimony, but the network is poorly resilient; on the other side, in the choreography context, as a result of a smaller degree, hubs still maintain high values of information patrimony, and the system is more resilient.

We performed an additional analysis of the two organisation types by looking into the distribution of *NIP* between members by means of the Gini index (Gini, 1912).

The Gini index is widely used in order to measure the inequality among the values of a vector of numbers (e.g., the income of a nation, etc.). A value of 0 expresses a perfect equality (all the values are the same) while a value of 1 expresses a perfect inequality.

For instance, in the left panel of Figure 4, the Gini index for the vector of degrees in the orchestration case is trivially equal to 1, since the hub has degree $N - 1$ while all the other members show a degree 1. In the case of choreography, as it can be anticipated, we can recognise a certain level of heterogeneity in the degree.

When we analyse the *NIP*, the orchestration case shows an almost perfect equality since N - 1 members own a value of *NIP* equal to 0.5, except for the single case of the hub having *NIP* equal to 1. In the case of choreography, the Gini index shows instead a more heterogeneous behaviour, since the information patrimony is more spread among the members of the network. This aspect is again expected, but the *NIP* measure is able to confirm and capture it empirically.

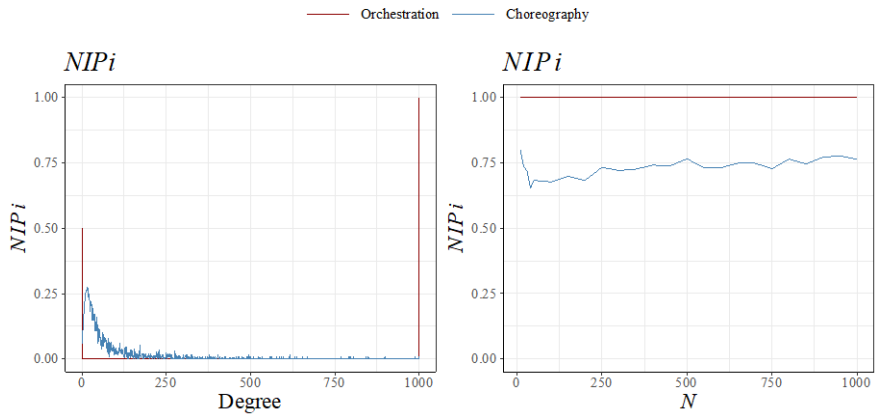

Figure 3: Values of NIP for each degree (left figure) and for hubs for each value of N (right figure); values averaged on 100 runs in the choreography case.

The relationship in terms of information patrimony between the orchestration and the choreography models unveils a trade-off between the two models that can be expressed in terms of information patrimony versus reconfiguration costs. In the case of orchestration, the system exists because of the presence of an orchestrator who, in a centralised manner, rules the other members giving rise to a fault-intolerant system where any mistake by the

orchestrator would imply the loss of all the connections and essentially the impossibility to timely reconfigure the system. The choreography model show instead an opposite layout, meaning a fault-tolerant system where the loss of the most prominent node has relatively severe consequences on the whole system and in which members affected by the loss can still benefit from their remaining connections in order to pursue their activity.

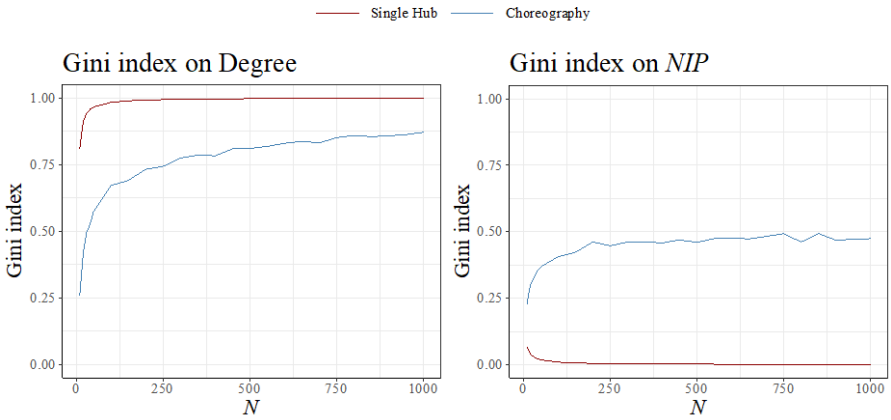

Figure 4: The Gini index for the degree values (left figure) and for the NIPs (right figure); values averaged on 100 runs in the choreography case.

5 Conclusions

This study considers two different network organisations, hierarchical and heterarchical, and describes two models able to characterize their behaviour, namely orchestration and choreography.

By means of a new measure, called *NIP,* we discussed how knowledge flows among the members in both models. The simulations carried out on synthetic networks provide empirical evidence of the differences between the two models in terms of heterogeneity and resilience.

These preliminary results pave the way for future investigations, mainly in the field of defining how knowledge flows within the two models and how leverage and coherence can be expressed within them.

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Meta-Choices in Ranking Knowledge-Based Organizations

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Abstract

This paper deals with the main meta-choices problems that arise in the multidimensional benchmarking of knowledge-based organizations. The first is the metachoice problem related to the choice of the algorithm used to compute the ranking (Iazzolino et al., 2012; Laise et al., 2015; Daraio, 2017a). The second is the metachoice problem related to the choice of the variables to be included in the model (Daraio, 2017a). Lastly, a third metachoice problem is related to the choice of the data on which the analyses are carried out (Daraio, 2017a).
The authors focus on multidimensional benchmarking analysis applied to KPIs related on one side to the IC (divided in the three dimensions of Human Capital, Structural Capital and Relational Capital) and on the other side to performances, evaluated in both financial and non-financial terms.
In particular, this paper analyzes the problem of ranking a sample of 65 Italian Universities based on performance-related criteria. The methods used to carry out the comparative analysis are (i) Data Envelopment Analysis (DEA) and (ii) Analytic Hierarchy Process (AHP).

The paper demonstrates the difficulties of the "implementation problem" in performance measurement, related to the subjectivity of results of the evaluation process when there are many evaluation criteria, as in a benchmark context.

Keywords – Ranking, Multicriteria, Efficiency analysis, DEA, Metachoice, Universities, Performance, Intellectual Capital

Paper type – Academic Research Paper

1 Introduction and contribution of the paper

The article deals with the problem of evaluating business performances in knowledge-based organizations. In particular, the problem of ranking a set of Universities based on performance-related criteria is analyzed.

In this work, we propose a theoretical contribution that brings together two lines of research in which the authors have worked in recent years. The first strand concerns the complexity of evaluating the activities of knowledge organizations, which include universities (Daraio, 2017a, b, 2019, 2020). The second refers to the measurement of the performance of companies with multicriteria methods and the so-called *metachoice* problem that always arises in a benchmark multicriteria analysis that can be synthesized as follows: "*how to choose an algorithm to choose*?" (Iazzolino et al., 2012; Laise et al., 2015). By putting these two contributions together, we propose a new model for evaluating the performance of knowledge organizations that considers the different components of knowledge capital as inputs, and includes the Value Added produced by the institutions among the outputs. By applying this model to the case study of Italian universities, we highlight how the evaluation of the business performance of knowledge organizations is affected by three different *metachoice* problems that interact with each other, influencing the obtained results.

The main result we show is that behind rankings there is not a perfect measurement, or in economic terms, a maximization of performance is not feasible (or reachable), due to the existence of three *metachoice* problems. The first is the metachoice problem recalled above and investigated by Iazzolino et al. (2012) and Laise et al. (2015) which relates the *methodology* dimension in Daraio (2017a), and underlies the choice of the algorithm used to compute the ranking. A second metachoice problem underlies the theoretical dimension of the modeling, called *theory* in Daraio (2017a), that relates to the following choice: which variables to include in the model, or better "*how to choose the theory to identify the variables to consider in the model and in the empirical analysis*? A third metachoice problem that arises relates the *data* dimension in the framework of Daraio (2017a), and consists in the choice and main limitations of the *data* on which the analyzes are carried out, in other words, *what data have to be used in the analysis, and how data problems and limitations affect the empirical analysis*?

As we will see in the empirical illustration on Italian universities, these three metachoice problems are relevant and are able to affect the rankings of the considered knowledge institutions; furthermore, they interact with each other witnessing the complexity of the evaluation related to its implementation (Daraio, 2017b).

When studying Universities and in general knowledge-based organizations an important element has to be considered. The main characteristic that drives performance is *knowledge*, and in particular the so-called Intellectual Capital (IC). The inclusion of knowledge and IC in the assessment of performance is not immediate also for the *data* problems related to its measurement.

In this paper, the authors focus on multidimensional benchmarking analysis applied to Key Performance Indicators (KPIs). KPIs are related, on one side to the IC (divided in the three dimensions of Human Capital, Structural Capital and Relational Capital) and on the other side to performances, evaluated in both financial (Revenues, Value added, Ebitda) and non-financial (number of publications, number of patents) terms.

The paper provides several practical implications in all cases in which a ranking has to be assigned to a group of organizations based on performances.

The adoption of a set of criteria is certainly an advantage to avoid uni-criterial or mono-dimensional myopic evaluation. However, this also creates some methodological problems. The paper demonstrates the difficulties of the so called "implementation problem" in performance measurement, related to the "relativity" (subjectivity) of results of the evaluation process when there are many evaluation dimensions, as in a benchmark context.

2 Complexity of the assessment: the metachoice problems of knowledge organizations

In this paper, we want to highlight the *metachoice* problems that always arise in a multidimensional benchmarking analysis.

The authors of this paper argue that any multidimensional benchmarking evaluation implies the development of a *model* that concerns the choices made from a theoretical, methodological and empirical point of view (data). See Figure 1 that shows the main dimensions of an assessment which coincide with the metachoice problems.

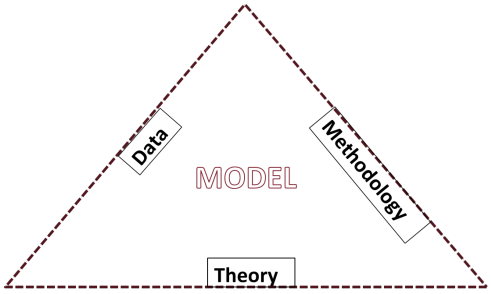

Figure 1. Main dimensions of the metachoice problems of knowledge organizations

From a *methodological* point of view, a metachoice problem arises because multicriteria (or multidimensional) ranking algorithms cannot be selected using a multicriteria algorithm; the choice of an algorithm ultimately depends on the *subjective* preference of the policymaker; and the metachoice solution to the benchmarking problem is, in accordance with Simon's satisficing solution, describing a non-maximizing performance measurement methodology.

In order to perform a benchmark analysis, a set of dimensions in addition to criteria must be chosen. The choice of the variables that proxy the main conceptual dimensions considered in a multidimensional benchmark highlights the *theoretical* metachoice problem. To decide what are the main conceptual references of the model of the benchmark we pursue we cannot use a theoretical justification, we need to explicit the *subjective* preference of the policymaker and/or the analyst that carry out the analysis.

A third metachoice problem arises when an empirical analysis has to be carried out. A third dimension to consider is *data*, and the problems of choosing the data, their availability and their quality interact with the two previously described metachoice problems, showing the complexity of the benchmarking exercises particularly when the focus is on multicriteria benchmark analysis applied to a set of knowledge organizations.

3 The case study: analysis of efficiency of the Italian universities

In this section the case study is illustrated. The empirical analysis is based on the analysis of the efficiency of a set of Italian Universities.

3.1 Sample and data collected

The attention was focused on a sample of 65 University scattered throughout Italy. Universities of different types and sizes were considered: 11 mega-universities, 15 large universities, 16 medium universities, 13 small universities, 5 polytechnics, 2 doctoral institutes, 3 high schools. Data collection takes three years, from 2016 to 2018, in order to use the most recent data available.

A series of indicators have been identified, divided into inputs and outputs, to evaluate the performance of Italian universities. The indicators will be illustrated in detail in the next section.

3.2 The selected indicators: intellectual capital and performance

This paper proposes a set of indicators especially designed for universities and related to the intellectual capital dimension.

The term intellectual capital (IC) was first introduced by John Kenneth Galbraith: the concept of the term incorporated a degree of 'intellectual action' rather than 'intellect as pure intellect' (Edvinsson & Sullivan, 1996). The intangible assets and IC constitute the largest proportion of universities' assets (Ramírez Córcoles, Peñalver, & Ponce, 2011;

Secundo, Margherita, Elia, & Passiante, 2010; Secundo, Margherita, Elia, & Passiante, 2010). When related to a university, IC is a term used to cover all the institution's non tangible or nonphysical assets, including processes, innovation, patents, the tacit knowledge of its members and their capacities, talents and skills, the recognition of society, its network of collaborators and contacts, etc. (Ramírez Corcólez, Tejada, & Gordillo, 2013).

At an international level, it is generally accepted that there are three basic components of IC: (i) Human capital, (ii) Structural capital and (iii) Relational capital (Ramezan, 2011; Steward, 1994; Johnson, 1999; Smith & Parr, 2000; Edvinsson & Malone, Intellectual Capital, 1997). The components of university's IC have been categorised in various ways, although undoubtedly it is the tripartite classification that is most widely accepted in specialised literature (Secundo, Margherita, Elia, & Passiante, 2010; Leitner, 2004; Bezhani, 2010; Paloma Sánchez, Elena, & Castrillo, 2009). Specifically, it is possible to read the three components as follows (Ramírez Córcoles, Peñalver, & Ponce, 2011):

1 *Human capital*: The sum of the explicit and tacit knowledge of the university staff (teachers, researchers, managers, administration and service staff) acquired through formal and not formal education and refresher processes included in their activities.
2 *Structural capital*: The explicit knowledge related to the internal process of dissemination, communication and management of the scientific and technical knowledge at the university.
3 *Relational capital*: The extensive collection of economic, political and institutional relations developed and upheld between the university and its non-academic partners, i.e. enterprises, non-profit organisations, local government and society in general.

According to literature, the input indicators are defined starting from the three components of the IC.

Input indicators*:*

Human Capital

- No. Academic Staff
- No. Technical and administrative staff
- Academic Staff costs
- Technical and administrative staff costs

Structural Capital

- No. Departments
- Patents and similar intellectual property rights
- Concessions, licenses, trademarks and similar rights
- Scientific equipment

Relational Capital

- Contributions from others (private)

- Contributions from others (public)
- Contributions from commissioned research and technology transfer

The main goals for universities are generally accepted to be the production, diffusion, transfer and preservation of knowledge (Young Chu, Ling Lin, Hwa Hsiung, & Yar Liu, 2006); for this reason, university performance assessments are defined by the output indicators listed below.

Output indicators*:*

- Total Revenues
- Value Added
- EBITDA
- No. Patents
- No. Spin-offs
- No. Journal papers

The indicators were selected with the criteria of the feasibility of data gathering and of consistency between universities: most of the indicators can be valued through the items of the university's income statement and balance sheet, the others through online portals.

Some important theories (Kaplan & Norton, 1996; Sveiby, 1989) suggest that non-financial measures provide a means of complementing financial measures and should also be present at the strategic level of the firm; therefore we consider both financial indicators on the amount of resources devoted to a given activity, and non-financial indicators, as number of academic staff or number of spin-offs.

4 Results

4.1 Descriptive statistics and preliminary correlation analysis

On the base of the discussion and literature described in the previous section, we identified the variables reported in Table 1 to be considered respectively as inputs and outputs to assess the performance of the Italian universities.

Table 1. Inputs and outputs selected according to the literature.

INPUT	**Label**
Cost Of Technical And Managerial Staff	X1
Personal Cost Dedicated To Research And Didactics	X2
Contributions From Other (Private) Entities	X3
Contributions From Other (Public) Entities	X4
Proceeds Research Commissioned	X5
N Management And Administrative Staff	X6
N Teaching Staff And Researchers	X7
Scientific Equipment	X8

Concessions, Licenses And Trademarks	X9
Patent Rights	X10
N Departments	X11
OUTPUT	**Label**
Total Income	Y1
Number Of Patents	Y2
Number Of Articles In Magazines	Y3
Added Value	Y4
Ebitda	Y5
Active Spin Off	Y6

The tables reported in Appendix show some descriptive statistics on the data available for 65 Italian universities over the years 2016-2018. As emerges by inspecting the values reported in the tables, there is an high heterogeneity among the Italian universities considered (high standard deviation values and high interquartile ranges) and most of the considered dimensions of inputs and outputs show skewed distributions (average and median values differ for almost all variables over the whole period). For the variables X11 and Y6 the data are available only for the 2018.

The following Tables 2 and 3 show the correlations among inputs and respectively outputs. The analysis of the correlation is particularly useful to carry out a preliminary assessment of the relationships among the variables because for the methods that will be used to compute the rankings of the Italian universities, and in particular, for the Data Envelopment Analysis, the so-called "*curse of dimensionality*" is really a plague. This means that the algorithms involved in the DEA efficiency score computation require many (even thousands!) data when the number of variables used is quite high, as is the case here (for further details, see e.g. Daraio and Simar, 2007).

In the further analysis we keep into account the correlations that are most significant (values higher than 0.9) for the final selections and inclusions of variables in the analysis. In this step of the analysis, then, we see that our final dimensions of performance selected to calculate the ranking of the performance is influenced by a methodological problem (the curse of dimensionality).

Table 2. Input correlation matrix

INPUT CORR MATRIX	**X1**	**X2**	**X3**	**X4**	**X5**	**X6**	**X7**	**X8**	**X9**	**X10**	**X11**
X1	1.000										
X2	**0.963**	1.000									
X3	**0.668**	**0.728**	1.000								
X4	0.444	0.449	0.303	1.000							
X5	0.548	0.593	0.728	0.114	1.000						

X6	**0.988**	**0.964**	0.646	0.450	0.497	1.000					
X7	**0.957**	**0.993**	0.739	0.417	0.612	**0.962**	1.000				
X8	0.491	0.522	0.432	0.208	0.294	0.487	0.510	1.000			
X9	0.205	0.242	0.354	0.002	0.079	0.213	0.236	0.130	1.000		
X10	0.235	0.221	0.221	-0.035	0.255	0.205	0.213	0.249	0.150	1.000	
X11	**0.942**	**0.943**	0.632	0.500	0.418	**0.951**	**0.934**	0.550	0.261	0.171	1.000

Table 3. Output correlation matrix

OUTPUT CORR MATRIX	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**
Y1	1.000					
Y2	**0.739**	1.000				
Y3	**0.934**	**0.693**	1.000			
Y4	**0.996**	**0.727**	**0.926**	1.000		
Y5	**0.925**	**0.694**	**0.844**	**0.936**	1.000	
Y6	0.531	0.599	0.516	0.525	0.461	1.000

The following Table 4 shows the variables that will be used to calculate the rankings of Italian universities.

Table 4. Inputs and outputs finally chosen for the empirical analysis

Input variable	**Output variable**
total personnel cost	added value (VA)
human capital	number of patents
structural capital	number of articles in magazines
relational capital	spin-off active
scientific equipment	
concessions, licenses, and trademarks	
contributions from other (private) +(public) entities	
commissioned research proceeds	

4.2 Methods applied to compute the rankings of knowledge organizations

The methods used in the analysis to carry out the comparative analysis on the rankings of the Italian universities are Data Envelopment Analysis (DEA) and Analytic Hierarchy Process (AHP). DEA is a method based on linear programming to estimate an efficiency score that measures the distance of a set of decision making units from an efficient or best practice frontier. The variant of the AHP used for the analysis, called AHP Benefit-Cost Ratio (BCR), considers the distinction of the considered dimensions in benefits (considered as outputs) and costs (considered inputs).

Here below we report the specific algorithms implemented:

1) DEA Input oriented assuming Constant Returns to Scale (Charnes, Cooper, and Rhodes, 1978), labelled as DEA INP CRS

2) Dea Input oriented assuming Variable Returns to Scale (Banker et al. 1984), labelled as DEA INP VRS

3) Dea Output oriented assuming Constant Returns to Scale (Charnes, Cooper, and Rhodes, 1978), labelled as DEA OUT CRS

4) Dea Output oriented assuming Variable Returns to Scale (Banker et al. 1984), labelled as DEA OUT VRS.

5) AHP BCR: analytic hierarchy process (AHP) with the variant called AHP Benefit-Cost Ratio (BCR), implemented according to Robert (2020).

All the scores have been normalized to have comparable values comprised between 0 and 1.

4.3 Comparative analysis on the results obtained

We have computed the rankings of the Italian universities using the methods outlined in the previous section.

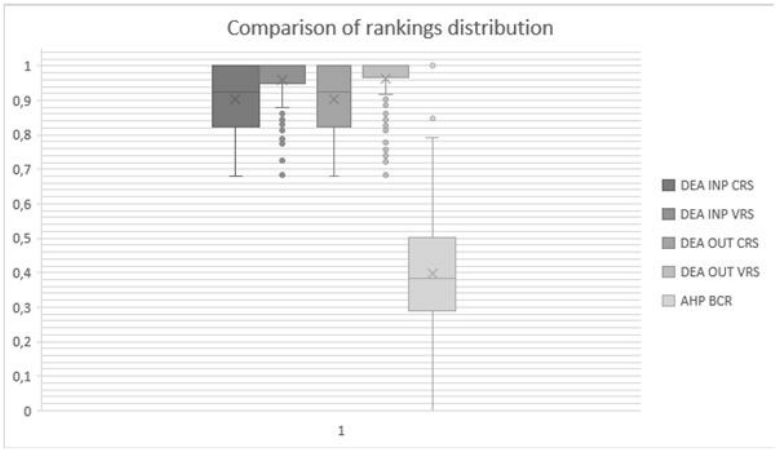

Figure 1. Boxplots of the distribution of the efficiency scores calculated on the sample of Italian universities with the 5 methods applied.

Figure 1 shows the comparison of the distributions of the rankings obtained by applying the 5 methods outlined in the previous section. We note that the DEA input and output Constant Returns to scale efficiency scores coincide, as they should by definition, while the distributions of DEA variable returns to scale are more skewed and show the presence of many outliers. This is an additional warning we have to keep into account. DEA estimators of efficiency are determinist in their nature. This means that all the deviations observed from the efficient frontier is attributed to inefficiency, so no noise is

allowed. As a consequence, the efficiency scores calculated by DEA suffer from the influence of outliers and/or errors in the data. About the AHP BCR method, we observe that the scores are much more spread than the efficiency scores calculated with the DEA approach.

But a question may arise now to reader and it is the following. Of course, by applying different methods we obtain different results and so different values for the efficiency scores of the Italian universities, but are those that are on the top of one ranking also on the top of the other rankings? In other words, is the rank correlations among the efficiency scores high or low?

The answer to this question is reported in the following Table 5.

Table 5. Spearman Rank correlation among the efficiency scores calculated with the 5 methods: DEA INP CRS, DEA INP VRS, DEA OUT CRS, DEA OUT VRS, AHP **BCR .**

	DEA INP CRS	**DEA INP VRS**	**DEA OUT CRS**	**DEA OUT VRS**	**AHP BCR**
DEA INP CRS	1				
DEA INP VRS	0.6069	1			
DEA OUT CRS	1	0.6070	1		
DEA OUT VRS	0.6003	0.9989	0.6004	1	
AHP BCR	**0.5494**	0.3217	**0.5494**	0.3202	1

A rank correlation value close to 1 means that the two efficiency scores calculated on the base of two methods, although they show different values, correspond to the same ranking of the universities analysed. A rank correlation close to -1 indicates that the efficiency scores calculated with a method are almost the invers in the order of those calculated with another method, meaning that those universities that are on the top of a method are on the bottom of the other and *vice versa*. Intermediary values of the rank correlation show varying level of correlations among the rankings obtained by the different methods.

The results reported in Table 5 show that the rank correlations calculated on the efficiency scores of all the 5 methods are positive and very high for the DEA VRS input and output model. We note that the rank correlations between AHP BCR and DEA CRS Input and output model is quite high, with a value of 0.549, and this could signal a certain similarity/agreement between the hypothesis underlying the two methods. Of course, the rank correlations are not equal to 1 and this means that universities on the top of a given method are not on the top of the other methods consistently, and this create a problem of choice of the algorithm that has to be done by the researcher.

A final metachoice problem that arises in the evaluation of the rankings of knowledge organization, relates to the choice of the *theory*. At this purpose, an interesting extension of this work could be to analyse what happens if we include in the model only the Human capital as input, while the outputs are the same as the previously described overall model. Then we could investigate also what happens if we include only structural capital or

relational capital as inputs. These further analyses are left for further developments of this paper.

5 Discussion and conclusion

The main conclusions of this paper are the following:

(i) In the evaluation of knowledge organization (as universities are), when is based on different genuine criteria and on a set of different dimensions including IC, three metachoice problems arise and interact among each other. Multicriteria ranking algorithms cannot be selected using a multi-criteria algorithm (methodological choice); so they rely on the subjective choice of the analyst/policy maker that has to choose also the conceptual background of the benchmarking (theoretical choice) addressing the empirical issues that arise (data choice).

(ii) the choice of an algorithm, of the conceptual reference and of the data ultimately depends on the subjective preference of the analyst/policy maker that should be explicitly described highlighting the "fitness for purpose" strategy (satisficing principle) followed, inevitably based on the compromise choices done to address the existing metachoice problems.

Our proposal or solution to the benchmarking problem is in accordance with Simon's satisfacing solution, describing a non-maximizing performance measurement methodology (Simon 1955; 1978; 1997). It may be worthwhile to emphasize that Simon's point of view is adopted by the Managerial Acconting multicriteria approach: "we believe however that achieving satisfactory profit is a better way of stating corporation goals" (Anthony, 1966). As is well known, such a perspective has a long tradition in managerial and accounting literature (Anthony, 1966; Cyert and March, 1963; Drucker, 1966; March and Simon, 1958; March, 1966; March, 1996).

Our suggestion to the analyst who conducts performance assessments is therefore to be transparent with stakeholders (including policy-makers and managers of universities that use rankings), describing all the crucial meta-choices that underlie their analyzes and highlighting the role that they have on the results. This behavior defined "technologies of humility" by Jasanoff (2007) could be achieved through a checklist as proposed by Daraio (2019), according to which, the analyst describe all the choices done in the analysis and the impact that these choices have on the obtained results, possibly identifying lines for further improving the analyses. This approach corresponds to the awareness of having achieved a "satisficing" result in terms of rankings of the institutions, à la Simon, which considers the hypotheses and compromises done, rather than an objective measure of the institutions that may fit all the purposes.

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Appendix: Descriptive statistics on the analyzed data

2016	AVERAGE	STANDARD DEV	MIN	FIRST QUARTILE	MEDIAN	THIRD QUARTILE	MAX
X1	30174063.40	29882682.24	839241.16	10663404.00	22119800.56	36392853.37	156479849.57
X2	71136203.07	64665153.33	2183048.99	22910984.00	59387584.41	89336474.40	303736781.15
X3	3100098.59	4273499.48	0.00	575200.00	1759184.39	3125522.11	19471787.24
X4	3372500.10	5649989.37	0.00	523700.00	1102824.36	3909413.48	33445929.37
X5	3914840.42	6831294.54	0.00	484720.00	1463262.57	3543183.38	45069339.49
X6	786	768	18	273	557	1017	4101
X7	970	896	30	337	801	1212	4340
X8	4881458.63	6005719.83	0.00	740809.31	2568278.70	7033356.48	35481238.27
X9	4256532.88	31378311.16	0.00	0.00	8780.55	116163.00	254740019.00
X10	171101.59	405743.54	0.00	0.00	19714.04	164995.00	2841960.00
X11							
Y1	175337408.67	165188587.13	0.00	54742376.14	136012776.15	223989783.03	794318158.04
Y2	217.15	223.38	1.00	82.75	173.00	249.00	1295.00

Y3	1951.94	1795.31	91.00	671.50	1416.00	2457.25	8002.00
Y4	127614276.11	120270866.06	0.00	38810935.80	95925566.00	167117511.69	579161026.90
Y5	29328196.70	30196561.81	-2987463.00	8946821.03	19167773.05	40638072.43	135099933.00
Y6							

2017	**AVERAGE**	**STANDARD D**	**MIN**	**FIRST QUARTILE**	**MEDIAN**	**THIRD QUARTILE**	**MAX**
X1	29513833.73	28717248.12	906129.88	10303267.00	21308343.00	40598820.50	154763171.26
X2	71254500.40	65797554.53	1950996.46	23190175.43	55197008.00	87076967.60	297412285.88
X3	2865331.86	3601296.42	6903.64	458606.61	1448134.53	3563301.87	14645497.00
X4	3095323.00	5508521.99	0.00	424361.11	1144143.95	3414544.16	32948685.92
X5	4006524.53	7452385.05	0.00	481620.61	1741375.62	3963103.93	51184764.48
X6	775	757	18	265	556	997	4102
X7	965	890	30	328	769	1227	4145
X8	4754713.64	5925280.68	0.00	824342.85	2923470.00	6165339.51	36838861.60
X9	4195081.68	31143878.08	0.00	36.50	11583.47	117568.50	254740019.00
X10	176160.02	420855.92	0.00	0.00	10932.00	126264.30	2841960.00
X11							
Y1	182914422.60	167833680.28	6582896.96	56725165.42	136474069.00	222798605.10	769644208.06
Y2	225.25	237.56	1.00	83.50	174.00	259.50	1413.00
Y3	1984.21	1825.11	110.00	689.00	1422.00	2544.00	7943.00
Y4	131372241.00	120002251.58	3801698.19	44209253.58	97922319.00	166295720.56	568487762.81
Y5	30603906.87	28688724.76	240935.00	9381059.64	21401379.62	40202675.16	118842044.00
Y6							

2018	**AVERAGE**	**STANDARD D**	**MIN**	**FIRST QUARTILE**	**MEDIAN**	**THIRD QUARTILE**	**MAX**
X1	30827895.87	29026410.80	1042861.51	10397213.99	21849599.03	43012172.51	157343178.07
X2	69249442.85	62572442.53	1828979.20	23823069.13	51973390.47	82974249.00	291157122.39
X3	2951763.11	4233421.12	4460.00	468683.00	1833490.97	3094036.45	23245571.07
X4	2539723.27	4055558.82	0.00	369353.21	1232214.11	3226953.02	22105574.39
X5	4531811.65	8420343.55	0.00	778928.08	1801750.61	4772003.00	59760757.90
X6	763	731	23	263	544	983	3906
X7	970	896	34	332	748	1253	4090
X8	4566030.534	6195309.059	0	655429.145	3056553	4910558	40417510.15
X9	159282.6557	366176.6405	0	41	15620.7	117002.155	2008491.66
X10	176369.9815	434529.016	0	0	10548.15	142928	2898335
X11	12	10	1	6	9	16	58
Y1	177604565.69	168672153.34	0.00	55790305.69	136836696.44	223208932.64	783678965.11
Y2	231.43	249.63	1.00	86.50	175.00	269.00	1522.00

Y3	1929.63	1770.27	107.00	686.75	1369.00	2441.25	7517.00
Y4	125853647.45	119199807.50	0.00	42243424.60	95902995.00	160219531.18	581301789.95
Y5	28763691.99	29765114.72	-11126794.83	7546090.99	20721032.00	39900979.50	132801489.49
Y6	17	15	0	4	12	26	70

The relationship between Collaborative Managers Networks on the Performance of Mexican SMEs: Implications of Collaboration Dynamics among Entrepreneurs

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Abstract

Research in the areas of management and strategy commonly considers the issue of networks as a really broad issue in the organizational phenomenon but little addressed by its complexity (Moliterno & Mahony, 2011). However, recent studies have invited to different methodological approaches to distinguish different types of variables among networks issues (Chen, Chang, & Chang, 2015; Ofem, 2015; Oyedokun Akintunde, Adele Ademola, Ogunkunle Oluwatobi, & Adegbile Aderibigbe, 2016; Peltier & Naidu, 2012; Toledano, Urbano, & Bernadich, 2010). Despite the development of these studies, especially in Anglo-Saxon contexts, in Latin American countries have been less addressed, despite being described as an important area in the research agenda for management (Ferreira, Reis, & Miranda, 2015). For some authors, the absence of an integrated theory of networks in management has led them to design theoretical proposals, such as Moliterno & Mahony (2011) who suggested the multilevel capacity in organization's networks, explained by different actors and interactions between them.

In this paper we focus in to measure and analyze the relationship between Collaborative Managers Networks (CMN) and Performance of Small and Medium-sized Enterprises (SMEs) in an emergent economy like Mexico, to provide recommendations to managers to integrate collaboration with different actors in management practices into their business strategies. The designed theoretical model was contrasted through a system of partial least squares (PLS-SEM) of structural equations modeling, using the SmartPLS® software (Ringle, Wende, & Becker, 2015) obtaining information from 170 SMEs operating in the Bajio Region (México) in the leather-footwear sector.

The results provide evidence that companies with CMN have a positive effect on its firm performance. However, the majority of networks are oriented just on building links with business actors. Financial and political actors are less involved in managerial practices of collaboration. These findings have strategic implications for the entrepreneurs, mainly in getting advantage in new strategies of collaboration among new actors.

This paper provides evidence of four main CMN insights. Firstly, derived from literature research, a CMN conceptual approach. Secondly, the research findings support understanding on the relationship between CMN and Mexican SMEs Performance and propose a multiple dimension CMN model using PLS-SEM as statistical tool. Thirdly, a Spanish adapted test of CMN that use measuring scales in a Latin-American country. Finally, this research attempts to recommend innovative networking strategies in managerial practices and entrepreneurial dynamics on SME companies.

Keywords – Networks, SMEs, Performance, Collaboration, Entrepreneurship.

Paper type – Academic Research Paper

1 Introduction

Research in the areas of management and strategy commonly considers the issue of networks as a really broad issue in the organizational phenomenon but little addressed by its complexity (Moliterno & Mahony, 2011). However, recent studies have invited to different methodological approaches to distinguish different types of variables among networks issues (Chen, Chang, & Chang, 2015; Ofem, 2015; Oyedokun Akintunde, Adele Ademola, Ogunkunle Oluwatobi, & Adegbile Aderibigbe, 2016; Peltier & Naidu, 2012; Toledano, Urbano, & Bernadich, 2010).

Despite the development of these studies, especially in Anglo-Saxon contexts, in Latin American countries have been less addressed, despite being described as an important area in the research agenda for management (Ferreira, Reis, & Miranda, 2015). For some authors, the absence of an integrated theory of networks in management has led them to design theoretical proposals, such as Moliterno & Mahony (2011) who suggested the multilevel capacity in organization's networks, explained by different actors and interactions between them.

In order to discuss about network theory, it is necessary to describe how social interactions provide the ability to connect with different actors (individuals, companies, public institutions, groups, etc.) for both scenarios: individuals and organizations. Hence, mainly management research has used this approach to describe organizational phenomena, but not how the organization is structured through these networks (Salancik, 1995), connections and dynamics. This scenario provides a theoretical and empirical gap in the exploration of new approaches to the treatment of networks; especially those formed by key players in the strategy and improve of performance of the organizations, such as the function of manager. New interests and personal interactions are manifested in complex networks, especially when needs and environmental changes are dynamic, this scenario disrupts the formation of new patterns (Ibarra, 1996; Salancik, 1995) and even dynamics between actors.

Networks involve the movement of *power*, *information* and *knowledge* that allow access to resources (Acquaah, 2007), opportunities for economic promotion and social support. For Small and Medium Enterprises (SMEs) access to different kind of resources is the key for survival and log-term consolidation processes. In that sense, studying the impact of networks on performance becomes a strategic issue that give insights about how a SME's manager should connect with different actors in order to get benefits from the commonly named 'networking'.

2 Collaboration Networks: a complex ocean of relationships and a key driver for performance

Collaboration Networks are links constructed by the orientations and capacities of individuals (Ibarra, 1996) in order to interact with key organizations or people. Even though, each organization has a series of fundamental actors that depending on the level and intensity of the interactions could create a 'central node' in the case of organizations or a 'connectivity node' in the case of individuals (Robinnet, 2016; Salancik, 1995). This interpretation becomes fundamental when studying companies' clusters, because the main task is to detect such patterns of behavior and discover principal links, intensity and why these are established.

As we mentioned, the analysis of networks in organizational theory is focusing on the assessment of how the networks are structured in actor's number. Although recent literature has focused on the effect of networks on entrepreneurship, mainly through

internal networks (Martins, 2016) but not over external ones. This last is a central gap in the management research agenda (Edmond & Wiklund, 2010; Ferreira et al., 2015) that could provide a path to a 'theory of networks'. Similarly, less common is the study of how networks and their flows, with external actors, affect performance of organizations. Determine the actors that mostly contribute to the improvement of organizational performance or how they describe the contribution of each categorical network (Political, Business or Financial), become a main trend in strategy and management studies, especially to elaborate practical recommendations to a SME's manager.

In the network approach analysis there is a risk: "Not seeing and distinguished forest from the tree" (Salancik, 1995, p. 346). For that reason, and avoiding this risk, studying networks involve getting information about blocks of interactions and detecting, at individual level, the actor that will diffuse resources to other social members or organizations. However, from this point of view (Greve & Salaff, 2003; Ibarra, 1996; Salancik, 1995) the study of interactions is the starting point of a network analysis that allows to consider two steps: Firstly, how a particular network block affects the organization or not. And secondly, how a particular actor affects the organization or not. Both approaches give us some hints about the importance of the creation or the absence of links with particular actors. Especially in industrial clusters where a collaboration behavior becomes essential to cope deficiencies or a lack of resources, mainly in SMEs startups.

According to Salancik (1995), this phenomenon of enterprises with not interaction with certain external actors is mainly caused by the following two reasons: First, the absence of advantages in the interaction, meant that the link does not generate any useful resource or relevant information. And second, the existence of institutional barriers that could inhibit or prohibit interaction. Both elements reveal a lack of closeness or a belief that there is not a possible benefit from the interaction with certain groups, actors, hidden costs, etc.

In this process, when an interaction between two actors takes place, it is likely to readjust the structure of this relationship and therefore new networks are created. For example, if an SME entrepreneur approaches to a federal agency for the granting of support, the federal agency will undoubtedly refer the case to a state agency, creating a new link to strengthen the SME. These new relationships could generate certain tension with different actors. According to the last example, a SME entrepreneur can attend to a federal office, because there is a belief in the local sector that state office has not any resource to provide support to local businesses. This could create a tension between government levels and therefore the fields of action of each one.

This complexity of dynamics of collaboration and its effects through networks create a series of conflicts and 'Network Resources Opportunity Gaps (NSOP)', especially for SMEs and in the design of managerial networking strategies. As Salancik (1995) mentioned, an effective network approach should be oriented to understand the effect of this theoretical variable (Collaboration Networks) and describe how this helps to explain

a detected research problem; in this case the lack of consolidation of SMEs, opening opportunities to search new markets or collaborative associations among SMEs, and of course, the improvement of performance in a long-term view.

Considering that the SMEs flourishing in the economy is a fundamental way to enhance social development and to improve a country's quality of life (OCDE, 2015b) particularly for an underdevelopment country as Mexico (INEGI, 2014). For that reason, understanding how certain individual links or networks blocks can increase or decrease the SME's performance level, becomes fundamental.

3 The Collaborative Manager Network: SME Manager as a networking strategist

The managerial figure in the organizations is commonly visualized (and idealized, most of the times) as the leader of the organization but this is only partially true. Even though management and leadership are related, management exercised is an art, a science and a share-trade that converge in organizational frameworks of great turbulence and immediate results (Mintzberg, 2009). Manager position, according to the definition, is the "person who is responsible for an entire organization or for an identifiable part of the organization" (Mintzberg, 2009, p. 16).

In that sense, performing as manager entails a coexistence with pressures and activities that most are defragmented. These activities involve the manager to change and decide on many occasions quickly and with a lot of stress. In this context, the manager must decide strategies counseling different actors and possible outcomes. For that reason, "be a manager is more like to be at the center of the hurricane, they have a lot of action, mobile, fluid, tangible, ongoing and non-routine activities" (Mintzberg, 2009, p. 31).

In that context, the manager becomes a strategic organizational axis and strategic center of a company (Mintzberg, 2009). Moreover, a double role is conceived (interior and exterior) and in both of them the manager must communicate around an environment and control inside the corporative team. This could create tensions and struggles inside the organization, for that reason, a manager should be connected with strategic actors outside the organizational borders, especially not only to access resources, but also to receive advices and feedback.

Working as networks for managers means to be part of a complex structure of trust relationships between companies, managers or units (Borgatti & Halgin, 2011). For the members of each network, the nature of communication and support may be unilateral or bilateral but mainly linked to the achievement of products, services, resources and actions. Networks are distinguished by shared activities and control between the actors and that end up being conducted through processes, events and sometimes particular rituals of cooperation (Milovanović, Primorac, & Kozina, 2016). Relationships of cooperation within organizations can be derived between multiple levels commonly established by hierarchical management figures towards external characters (Geletkanycz

& Hambrick, 2006; Lee, Lee, & Pennings, 2001). These connections are a pivot of limit expansion in the search of resources, opportunities or advices that could facilitate a performance improving (Li, 2005). These connections provide some added values for managers, for example the ability to share and disseminate information, not only unilaterally, but multilaterally in the context in which they operate (Xin & Pearce, 1996). For example, for SMEs in contexts as Mexico and most of Latin America, the lack of confidence in institutions formally constituted by government (OCDE, 2015b, 2015a) allow an alternative search for resources or access to market information by other means, as informal contact networks or by collaboration with customers or key suppliers (Peng & Luo, 2000).

In that context, understanding and analyzing the design, maintenance and development of managerial networks managers and external actors assume it as a systemic and cooperative activity between them. That allows to analyze the construction and management of personal relationships with others and how these connections impact on performance (Coulthard & Loos, 2007). This represents a shift in the management, because the focus is now on the manager and its dynamics of collaboration, being a 'central actor in a networking strategy'. Commonly, networks entail certain strategic goals, for example: socio-affective links to face risk-taking (Kaplan, 1984), access to capital for investment, growth, loans, among other purposes, and encouragement to persistence in business (Hoang & Antoncic, 2003). However, especially on SMEs performance, recent investigations demonstrate the impacts of these in the business context (Doloreux, 2004; George, Wood, & Khan, 2001; Kusumawardhani, Mccarthy, & Perera, 2009; Tendai, 2013).

The empirical evidence mentions that the alliances and links that organizations establish with those distinguished by an entrepreneurial style, gain access to new technologies, gain technical and operational talent, remain as industry benchmarks and in general obtain a creative capacity (Lee et al., 2001; Peng & Luo, 2000; Xin & Pearce, 1996). Then, collaboration networks are then related to be as 'escape valves' of companies that are looking for a competitive advantage over those organizations that do not establish links with entrepreneurial organizations (Alvarez & Barney, 2001). Organizations that are assumed as connected entities (both internally and externally) are fertile crops for the creation of new social networks (mostly external) and are highly attractive spaces for entrepreneurs who use their interpersonal relationships to achieve resources that would not be affordable only by using their internal networks. In other words, a managerial decision to connect a company with different actors around a business ecosystem could strengthens the organizational capacities to access to privileged industrial information, new resources and talents for innovation, risk taking and proactivity, learning and the discovery of opportunities (Martins, 2016).

Undoubtedly, this context offers an opportunity, especially for SMEs that are looking for new networking strategies that strengthen certain competitive advantages over other competitors in the market. This search for SMEs managers begins with possible links

with government offices and financial institutions. However, a lack of trust with these actors, especially in underdevelopment economies create 'connection barriers'. Nonetheless, the economies should be oriented by the construction of links between these actors, because they facilitate new approaches, resources and opportunities for local SMEs and hence their growth and survival (Su, Xie, & Wang, 2015).

Su et al. (2015) classify these connection-actors, in three main categories: First, as 'political networks' corresponding to established relationships with government officials, government agencies, state and local government agencies, professors and research centers. Secondly, a different type of networks, as 'financial networks' that emphasize relations with bankers, private financing officers, investors, potential partners, shareholders and banking agencies. And third, as 'business networks' corresponds to the relationships that the organization established with customers, suppliers and competitors.

4 A backbone in networking strategy for SMEs managers: Collaborative Manager Network (CMN) and its effects on performance

Even though some studies have been conducted to understand the influence of collaborative networks in organizations and new ventures (Cisi, Devicienti, Manello, & Vannoni, 2016; Ripollés, Blesa, & Ripollés, 2006; Su et al., 2015; Walter, Auer, & Ritter, 2006; Zhao & Aram, 1995)there is still a theoretical and empirical gap in describing and understanding the effect that collaboration networks have on the performance of organizations (Ferreira et al., 2015; Martens, Lacerda, Henrique, & Rodrigues de Freitas, 2016).

However, this is a complex issue and materializing the study of networks is multifactorial. The social fabric that managers possess is derived from scenarios of numerous contacts both at a formal and informal level and these can have (or not) a strategic purpose for the resources of the companies. In that sense, it is important to point out that the literature in strategic management indicates that the presence of these relationships and contacts has a positive effect on the company. The strongest argument in this sense is that a company that does not relate to actors in its environment will have a worse performance than those that do so (Cisi et al., 2016). Understanding the structure of the formal and informal relationships of the organization with key actors means possible important allies, especially in the search for resources in their business environment (Díaz García & Carter, 2008).

However, there are findings pointing to the virtue of collaboration networks in a significant way, as well not. In the literature research, findings have been obtained in two senses: the first one indicates that density of the network and familiar connections have a positive effect on the performance of the organization, but it may not be statistically significant (Surin & Wahab, 2013). And in the second sense, the possibility of negative effects between collaborative networks and performance (Ricciardi, 2014). These results

open a debate between the relationship between collaboration networks and performance, being a main issue in the research management agenda.

Hence, the effects of collaboration manager networks on performance's company become an area of research opportunity for strategy and management fields, especially in Latin America economies (Ferreira et al., 2015; Robinnet, 2016; Širec & Bradač, 2009; Tendai, 2013) is fundamental to make an operational research with a network approach. For that reason, firstly it is necessary to describe the actors and resources that are attracted and detached from the network (Stamm, 2004). According to this and even if the networks performance positive effect is still in debate, to set an operational concept of manager's network becomes important in order to design a possible measure scale and a future assessment with performance as planned in this research. In that sense, the concept of 'Collaborative Manager Network (CMN)' is defined for this research as a *microstructure of relationships trust-based between SME's manager and other actors in a business environment, these links are mainly established with some strategic purposes as to share knowledge, information or resources. To have an easy and operational pattern to study these networks, actors are separated in three networks categories: a) political networks, b) financial networks and c) business networks*. This operational approach for CMN includes three elements that allow adapted design items and measure them from a SME's manager perspective in a survey: 1) extension (Adapted from Peng & Luo, 2000), 2) uses (Adapted from Acquaah, 2007) and 3) intensity (Adapted from Ibarra, 1996; Kumar Panda, 2014; Panda, 2014). The next paragraphs describe these operational elements:

Extension of the CMN. Undoubtedly, the issue of measuring extension of a network is a complex issue, open questions, such as: how many contacts does the government have? Or how much do you invest in gifts for the 'x' network contacts? It broadens the spectrum of the non-response bias and hinders the collection of information; however, Peng and Luo (2000) structured items that facilitate measuring process. The items were adapted to a Mexican cultural context and a Likert scale that allows evaluating if a certain type of network is considered from the range of "very small" to "very extensive" by the respondent manager.

Uses of the CMN. Connections with strategic actors through these networks facilitate the acquisition of resources more easily and quickly than if they were not present; for managers, creating, developing and extending their networks depends on a series of factors (Ibarra, 1996), some of them are: personality, background life-history and experience gained in the industry. As well as, of course, developing the skill to establish those connections with true socio-affective perspectives with clients, suppliers, competitors, research centers, government agents, bankers, shareholders and staff that are in contact with the company's processes. For these reasons, when an organization is exposed to a series of external networks (Granovetter, 1983) it is exposed to high quality information (and other resources) for its products. Under this context, it is possible to determine that there are three main uses of collaboration networks (Acquaah, 2007): 1)

Access to *valuable information* for the industry (INFO), 2) Access to *resources* that promote a competitive advantage (RES) and 3) Acquisition or exploitation of *knowledge* (KNOW). In order to adapt these items a Likert scale of 1 to 7 is included, from "very little" to "a lot" and the uses are established in columns and in the rows the actors of each of the networks, this survey design makes easier the information gathering process with managers. This design was originated from the recommendations of the managers visited in the previous pilot study and this element saved considerably time in the collection of information and possible bias among managers' answers.

Intensity of the CMN. Intensity assessment was established through the time that the manager invests on the development and maintenance of their networks. As mentioned in previous lines, the importance of the network is established by a socio-affective link established and one of the ways to promote it is continuity and familiarity in the human contact process (Ibarra, 1996; Kumar Panda, 2014). For this reason, a categorical and ordinal scale of five items was established which measures manager time-investment from none to more than 10 hours per month.

Even though, the analysis of CMN-performance relationship is considered relevant in relation to improve business performance, in particular, because networking is considered as a strategic key of SMEs. Performance is a complex issue, especially to be measured. In the last decades it has been the focus of a number of studies, however there is not a homogeneous and universal definition (Davidsson, Achtenhagen, & Naldi, 2010; Davidsson & Honig, 2003). Mintzberg (2009) mentioned that the continuous search of a performance's improvement must be accompanied by series of management tactics that support even capacity and expansion mind-sets. In our economic scenario, even though survival becomes important, growing and improving performance for the company meaning confidence, power and independence in its environment (particularly for SMEs). So, growth and improvement of performance are two sides of the same coin.

For that reason and derived from a literature review that allows to describe a homogeneous performance definition that joining organizational performance and growth aspects, it was considered appropriate to use Quinn and Rohrbaugh's model (1983), which is based on fourteen elements to assess business performance. Quinn-Rohrbaugh's methodology (1983) has been widely used at the international level, correlating it to variables, such as, innovation (Van-Auken, Madrid-Guijarro, & García-Pérez-De-Lema, 2008), the transfer of knowledge (Rodríguez Orejuela, 2007) and the organizational culture (Hartnell, Ou, & Kinicki, 2011). This one-dimensional performance approach analyses the components of the organization and establishes the criterion of efficiency towards internal-external relationships, organization's structure, flexibility and the attention on goals and procedures. This model enables the assessment not just financial or operative performance, but also includes a notion of an organizational performance (Venkatraman & Ramanujam, 1986). One-dimension approach and fourteen items characterize this organizational performance concept, which includes conditions related

to: human relations, open system, internal processes and finally sales and personnel indicators.

In our next section, we describe a framework to explore the relationships between two elements: 1) The Collaborative Manager Network (CMN) with three networks categories (Political, Financial and Business) in a reflective model and 2) One dimensional Quinn and Rohrbaugh's performance model.

This main conceptual model represents the relationships that were empirically investigated in Mexican SMEs in footwear and leather industry in Guanajuato state.

5 Exploring the relationships between CMN and performance in Mexican SMEs

Figure 1 presents the framework proposed to investigate how CMN affect company performance. The effects between the CMN construct and organization's performance have been studied previously in different industrial and manufacturing sectors (Baum, Calabrese, & Silverman, 2000; Cisi et al., 2016; Havnes & Senneseth, 2001; Kusumawardhani et al., 2009; Li, 2005; Naudé, Zaefarian, Najafi Tavani, Neghabi, & Zaefarian, 2014; Ofem, 2015; Ricciardi, 2014; Širec & Bradač, 2009; Tendai, 2013).

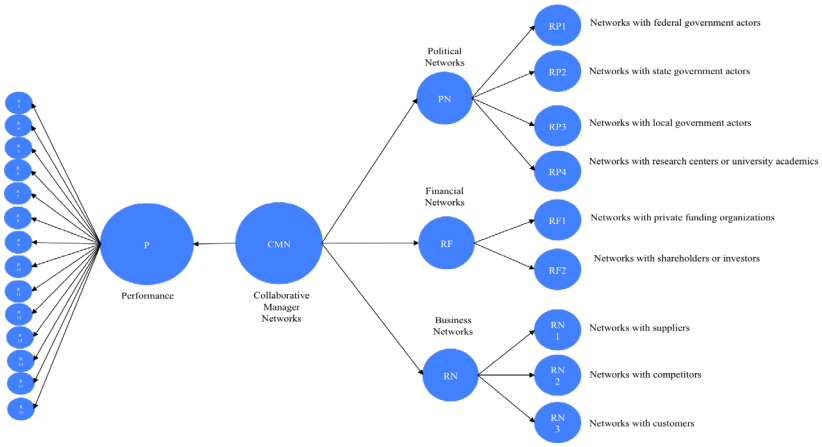


Figure 1. Research theoretical model

The results of previous research show that the relations between CMN and performance have a diversified effect, depending on the characteristics of the sectors, networks type and the way in which it is measured. In this context, this study proposes an exploratory investigation of the relationships between CMN and Performance of Mexican SMEs in the Bajio region, which is one of the most important economic sectors in the country. For this reason, the following working hypothesis is proposed:

Hypothesis 1. *Collaborative Manager Networks (CMN) has a positive effect on Performance of SMEs in the leather-footwear sector, in the Mexican Bajio Region,.*

5.1 Research Methodology

In order to verify the existence of a relationship between CMN and SMEs performance the Structural Equations Model (SEM) approach has been deployed (Hair, Hult, Ringle, & Sarstedt, 2014). This statistical model belongs to multivariate analysis tools of second generation that allow simultaneously measure the associations (Hair et al., 2014). The variables building the model are Performance as one-dimensional concept and CMN with three types of networks: a) Political, b) Financial and c) Business measured with items related with: extension, intensity and use.

The theoretical model to be tested contains a latent variable of second order: CMN; detaching from it, three categories according with Su, et al. (2015). The organization's performance is a dependent variable of first order, which is an unobservable variable and therefore measured by fourteen items adapted from Quinn-Rohrbaugh's model (1983).

Data about these variables were collected through a survey, which was applied to SMEs managers in the cities of Bajio region with the highest density of enterprises in leather footwear sector (CONACYT, 2014; INEGI, 2014). In total 170 valid instruments were obtained during fieldwork (See table 1). For the exploratory objective of this research, the sample size obtained (170 observations) and data distribution (not-normal), the use of the PLS-SEM technique was used (Sarstedt, Ringle, Smith, Reams, & Hair, 2014).

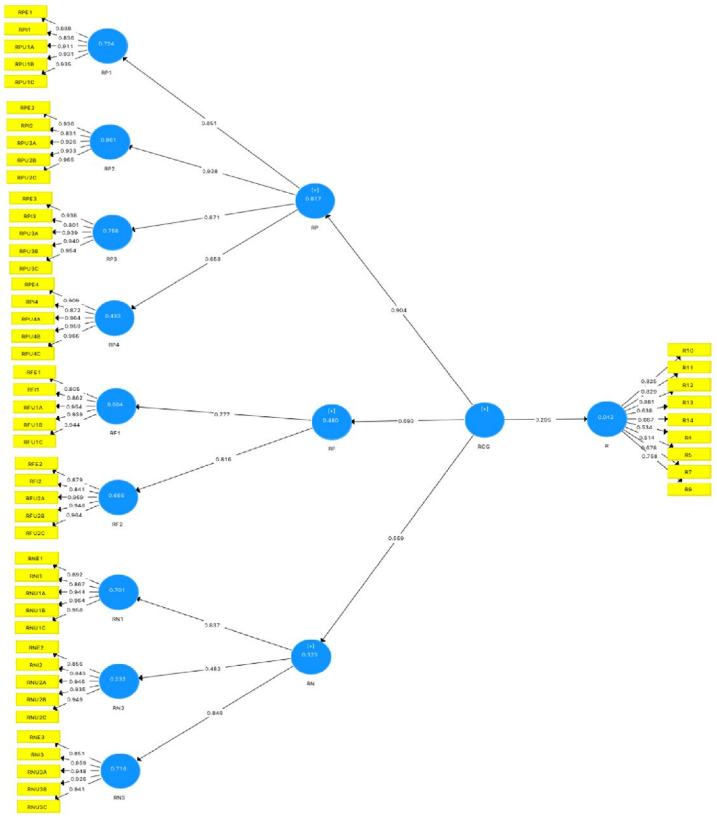
Table 1. Frequency by firm size

Firm Size	Frequency	Percentage	Valid percentage	Accumulated percentage
Medium	9	5.3	5.3	5.3
Small	161	94.7	94.7	100.0
Total	170	100.0	100.0	

Source: Obtained using IBM SPSS® software.

5.2 Findings

Derived from the literature a research model type I reflective was designed (Becker, Klein, & Wetzels, 2012) and PLS-SEM algorithm was analyzed by the SmartPLS® 3.2.7 software for the 170 observations (see Figure 2).



Source: Obtained using SmartPLS® software (Ringle et al., 2015).

Figure 2. Path model in SmartPLS®

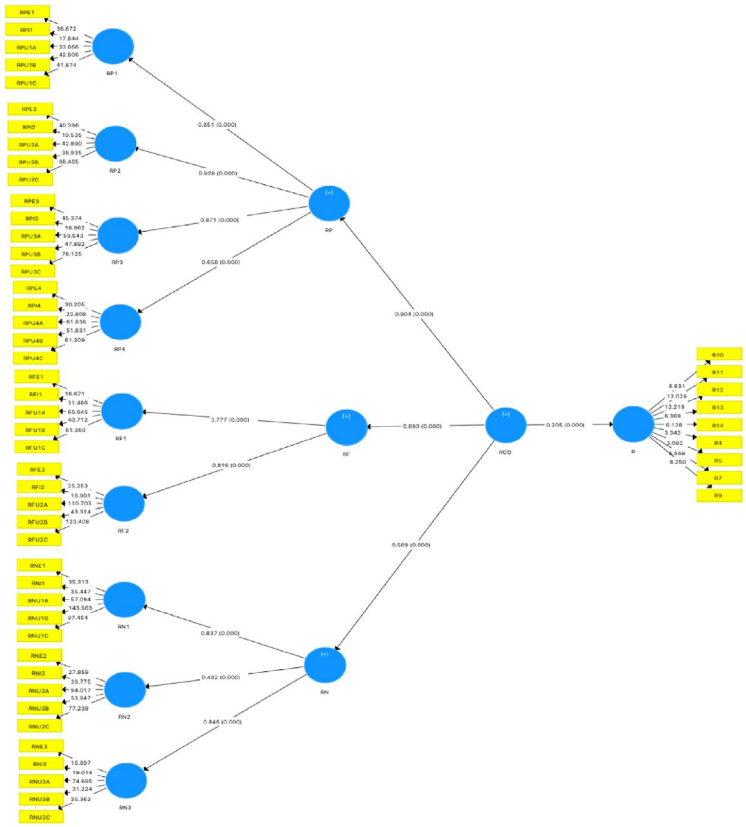
In reflective models, evaluation starts with the loading's assessment obtained by checking each indicator of each network. Loadings greater than 0.700 indicate that the construct explains at least 50% of the indicator variance, if they not get that loading, remove indicators is a recommend path in order to improve the model fit. In this case, indicators get the minimum score to pass the first step of test.

According to the results, approximately 20% of the SME performance is influenced by CMN. This scenario provides a scheme about the importance of the CMN in the performance development in the leather-footwear SME. This factor determines to enhance and guide strategic efforts to strengthen activities of linkage between diverse actors of the economic ecosystem and SME managers that allow them to improve their performance as well as increasing their survival rate.

A significant discovery in the model was a low orientation to connections on Financial and Political Networks (see Figure 3) in Mexican SMEs of leather-footwear sector. A low orientation to build networks with federal political actors was detected. As well, a low orientation to create networks with University professors and Research Centers was

detected. These are main discoveries among managerial practices because of a short-oriented strategy with this kind of actors that provides a disconnection between fundamental knowledge, resources and information around the environment. If this connection happens, the SME could get some resources or information to survive an economic crisis. This is a main practical recommendation derived from this research. Moreover, it is considered as a gap to attend an opportunity area to develop a networking strategy oriented to improve the performance in a short-term.

For the performance construct, a Hair's criterion (2014) was adopted where the researcher can examine the effects on the composite reliability and the validity of the construct before eliminating indicators that loadings are below from 0.700 (Hair et al., 2014). It is necessary to mention that after the analysis, indicators below this standard continued to respect the general parameters of the corresponding model and therefore continued to be part of the dimension (see Figure 3).



Source: Obtained using SmartPLS® software (Ringle et al., 2015)

Figure 3. Adjusted path model in SmartPLS®

The next validation step is to analyze Internal Consistency Reliability of the model, when using SEM-PLS it is determined through composite reliability. The parameters for this in exploratory studies indicate that the margins of 0.60 to 0.70 are acceptable, parameters between 0.70 and 0.95 are considered satisfactory, higher or equal values to 0.95 can produce problems with redundancy, however, in the scenario that items measure different aspects of theconsidered constructs and are highly correlated, it means that there is a good measurement model (Becker, 2015). In this case, this happens with CMN scores for this reason. Performance dimensions obtained scores greater than 0.85 but less than 0.95 (see Table 2). The next step is the evaluation of the convergent validity of reflexive constructs. Convergent validity is determined by the average variance extracted (AVE) of all items associated with each construct (Sarstedt et al., 2014). The AVE value is computed by the mean square of the loads of all indicators associated to the construct (Sarstedt et al., 2014). An acceptable AVE corresponds to 0.50 or greater; the construct explains at least 50% of the variance of its items. In this sense, the elements of the CMN and Performance constructs have an AVE higher than 0.50, thus manifesting convergent validity (see Table 2).

Table 2. Results of Reflective Model

Construct / Dimension		Index	Loading	Composite Reliability	AVE
Collaborative Management Network	Political Networks	RP1	0.851 0.928	0.956 0.965	0.812
		RP2	0.871	0.963	0.845
		RP3	0.658	0.972	0.839
		RP4			0.874
	Financial Networks	RF1	0.777	0.956	0.815
		RF2	0.816	0.966	0.850
	Business Networks	RN1	0.837	0.968	0.857
		RN2	0.482	0.959	0.823
		RN3	0.846	0.958	0.820
Performance		R4	0.661 0.665		
		R5	0.744		
		R7	0.681		
		R9	0.724		
		R10			
				0.899	0.505
		R11	0.780		
		R12	0.778		
		R13	0.658		
		R14	0.763		

Source: Obtained using SmartPLS® software (Ringle et al., 2015)

Subsequent to the reliability and convergent validity of the reflective constructs, it is necessary to determine the discriminant validity of the constructs. The discriminant validity determines how different a construct from others is in the model. The most

conservative way to do it is using the Fornell-Larcker criterion (Hair et al., 2014; Sarstedt et al., 2014) by comparing the square root of the AVE of each construct, if it is greater than the correlations with the other constructs, according to the Table 3, it can be defined that there is discriminant validity.

Table 3. Fornell-Larcker criterion to discriminant validity of the model

	R	RF1	RF2	RN1	RN2	RN3	RP1	RP2	RP3	RP4
R	0.711									
RF1	0.047	0.903								
RF2	0.150	0.279	0.922							
RN1	0.298	0.181	0.168	0.926						
RN2	0.111	0.159	0.186	0.141	0.907					
RN3	0.259	0.106	0.117	0.557	0.207	0.906				
RP1	0.189	0.203	0.287	0.211	0.273	0.114	0.901			
RP2	0.042	0.327	0.340	0.195	0.187	0.123	0.728	0.919		
RP3	0.057	0.261	0.328	0.197	0.234	0.141	0.622	0.829	0.916	
RP4	0.054	0.207	0.212	0.133	0.194	0.074	0.462	0.467	0.379	0.935

Source: Obtained using SmartPLS® software (Ringle et al., 2015).

Subsequently, an evaluation of the structural model was performed. For this, it is necessary to consider the following criteria: a) the coefficient of determination (R^2), b) the crossvalidated redundancy (Q^2) and c) the path coefficients (Sarstedt et al., 2014). The indicator R^2 is a measurement relative to the variance explained on each dependent construct, so it is assumed to be a predictive measure of the model. The interpretation ranges considered are: greater than 0.67 it has substantial value, moderate explanatory value with 0.66-0.33 and a weak value with a range of 0.32-0.19 (Chin, 1998).

The results indicate that CMN networks corresponding to RP2, RP3 (state and local government) and RN3 (connections with customers) have values that allow a substantial explanation of the construct. This constitutes a discovery with practical implications, since it provides interesting insights about the possible networking strategies and a main gap to build relationships that Mexican SMEs in the leather-footwear sector can adopt in short-term (see Table 4).

Table 4. R^2 and adjusted R^2 of the structural model

		R^2	Adjusted R^2	Q^2	
CMN	RF	0.480	0.477 0.602	0.468	
	RF1	0.604	0.663 0.319	0.458	
	RF2	0.665	0.700	0.515	
	RN	0.323	0.227	0.311	
	RN1	0.701		0.562	
	RN2	0.232		0.177	
	RN3	0.716	0.714	0.543	
	RP	0.817	0.816	0.797	
	RP1	0.724	0.722	0.549	
	RP2	0.861	0.860	0.677	
	RP3	0.758	0.757	0.590	
	RP4	0.433	0.430	0.338	
	P	0.042	0.036	0.473	

Source: Obtained using SmartPLS® software (Ringle et al., 2015)

Another way to evaluate the predictive relevance of the model is Q^2, which is described as a predictive measurement, where values greater than zero indicate an acceptable predictive value (see Table 4). The cross-validated redundancy is used to obtain the Q^2 value (Hair et al., 2014; Sarstedt et al., 2014). The results indicated model's predictive value.

Afterwards, the strength and significance of the path coefficients were evaluated by the relations established in the model and its hypotheses constructed from it. Using SmartPLS® there were four relationships obtained of the variables (see Table 5). From the results obtained, it can be highlighted that CMN has a positive and significant relationship, with performance (0.205). In addition to these discovers, and in order to comply with the objective and hypothesis of this research, it can be highlighted a significant and positive relationship the three network categories with CMN in the Mexican SMEs of leather footwear sector of the Mexican Bajio region (see table 5).

Table 5. Coefficient path and significance of the structural model

Relation	Coefficient Path	t value	
RCG -> R (Hyphotesis)	0.205	3.774	***
RCG -> RF	0.693	13.287	***
RCG -> RN	0.569	13.646	***
RCG -> RP	0.904	47.647	***

*** p <= 0.001. Bootstrapping tests were carried out with a greater number of subsamples (Hair, Sarstedt,

Pieper, & Ringle, 2012; Kock & Hadaya, 2018; Streukens & Leroi-Werelds, 2016) specific data 5,000 subsamples by experiment (Hair, Ringle, & Sarstedt, 2011).
Source: Obtained using SmartPLS® software (Ringle et al., 2015).

6 Discussion and Conclusions

Based on the results obtained and presented on Table 5, it can be inferred that CMN as a variable has a positive and significant effect on the performance of Guanajuato companies in the leather-footwear sector. The model has explanatory capacity and predictive relevance, which indicates that it has the quality characteristics to be, highlighted in decisions and discussions by academics, managers, industrial chamber leaders and authorities at its various government levels. This discovery is in accordance to (Cisneros-Reyes, Lira & Arredondo Hidalgo, 2019) who proposed that a leather footwear SMEs transformation should start with the willingness, not only of the businessmen and businessmen's guild, but, especially, of the government and of the academic institutions that count on the knowledge and resources to stimulate it.

These empirical observations obtained show that the CMN has approximately 20% influence on the performance of SMEs in the leather-footwear sector on Guanajuato State. Similarly, it can be inferred that according to the value of R^2 (≥ 0.02) it has a weak explanatory capacity (Cohen, 1988) however, despite the above, the model has predictive relevance. This scenario gives an acceptance of the main hypothesis of this research study.

This finding has valuable implications in the formulation of commercial and strategic scenarios in cooperation between competing companies, especially in the leather-footwear sector. Like Havnes and Senneseth (2001) who also find that the CMN has a positive effect on the performance of companies. For these researchers, companies that showed greater intensity in their collaboration showed a considerable growth in the extension of their market than those companies that consistently showed a low intensity of collaboration. This finding could support the assumption that collaboration through networks precedes growth in market expansion.

It is important to note that the model analyzes a causal relationship between the CMN and the level of performance described by the SME manager. In this collective construction, CMN is manifested by three types of networks and the particular analysis of each network-actor corresponds to a possible second level of analysis, which is undoubtedly interesting for both industry and decision makers, because the level of performance according to the collaboration will be based on what type of actors the manager is related to obtain the maximum benefit from their performance.

In that sense, Su et al. (2015) in a study of new ventures in China about collaboration with various external actors and how they moderated the entrepreneurial effect with their performance, detected that the collaboration networks established by the actors (managerial networking) measured through political, financial and business networks, impact in a differentiated way. Their results confirm, like those presented in this study,

that political networks manifest a negative effect on the relationship with performance (See Figure 7) and that the majority of the connections have concentrated with low indicators of use, extension and intensity (See Figure 4).

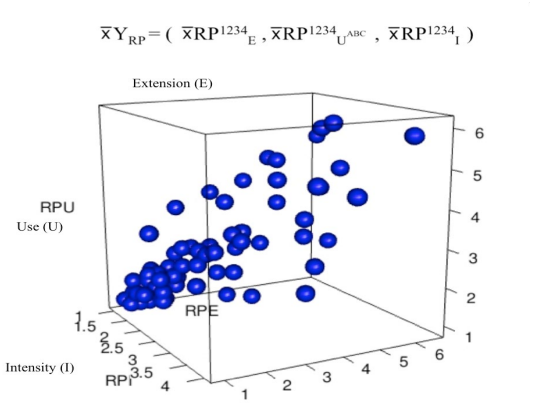


Figure 4. Model of Political Networks and its dynamics on Use, Extension and Intensity Dimensions. Using Open Source Software R.

In addition, financial networks and business networks have a positive effect. Political networks designated with the initials RP maintain a negative causal relation of -0.015 with the performance. Financial networks with the acronym RF with a relatively small positive effect of 0.052 and they have a particular dynamic in model, more SMEs' managers have connections with banks or financial actors (See Figure 5). In the case of Business networks identified with the acronym RN with a considerable positive effect with a value of 0.300 (p=0.000) and they have a dynamic of higher scores of use, extension and intensity dimensions (See Figures 6 and 7).

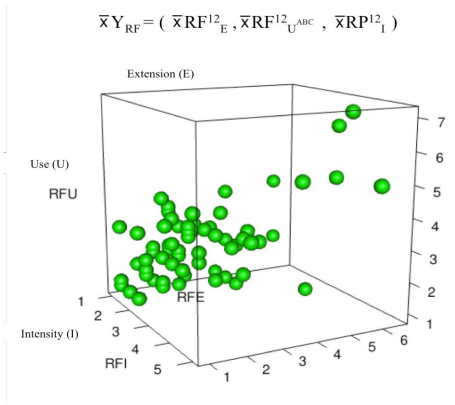


Figure 5. Model of Financial Networks and its dynamics on Use, Extension and Intensity Dimensions. Using Open Source Software R.

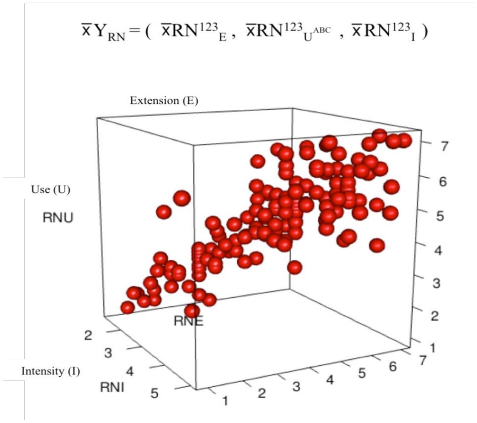


Figure 6. Model of Business Networks and its dynamics on Use, Extension and Intensity Dimensions. Using Open Source Software R.

Derived from the results it can be inferred that the CMN is a construct that its manifestation behaves differently in a causal relationship with performance. In this case, like the findings of Su et al. (2015) the political networks show a negative relationship with the performance and the financial and business networks maintaining a positive effect, this last with a 30% impact on the SME performance. It is possible to conclude that although the CMN has a positive effect, however with the negative effect of RP the total performance is an opportunity area of improvement. In the case of the RN these are positive, significant and with the highest index of the three types of analyzed networks.

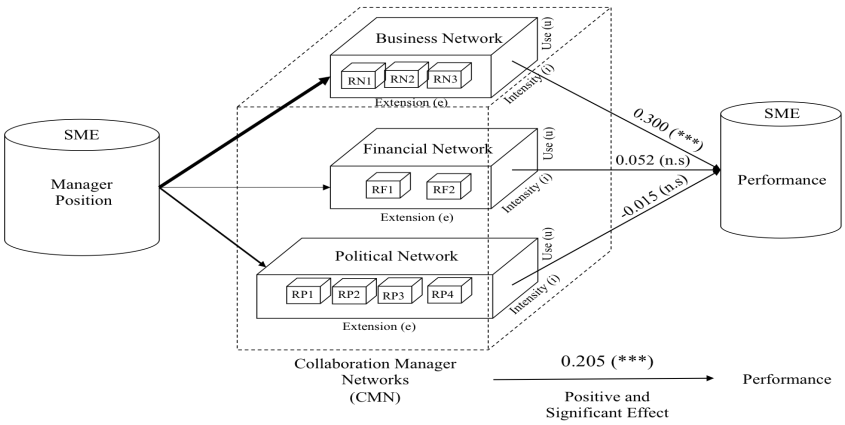


Figure 7. CMN and the differentiated effects on SME performance

The study contributes to advance the conceptual understanding of the relationships between different actors and business performance as well as provides interesting

implications for practice. From conceptual point of view, findings provide evidence of CMNs settings in an emerging and Latin-American economy in a specific SMEs sector. In the field of performance, this research illustrates a behavioral model and determines dynamics and indicators with most significance on the studied sector.

Additionally, findings provide evidence that CMN emerge as an innovative and creative contribution for the design of the link between strategy and networking of the managers. This opportunity gap is an element that has been called 'crossing into the unknown area' of unusual links (the unknown area, the gray area in Figure 8). Relations with key actors, which for 'average manager of the SMEs' are 'unknown'.

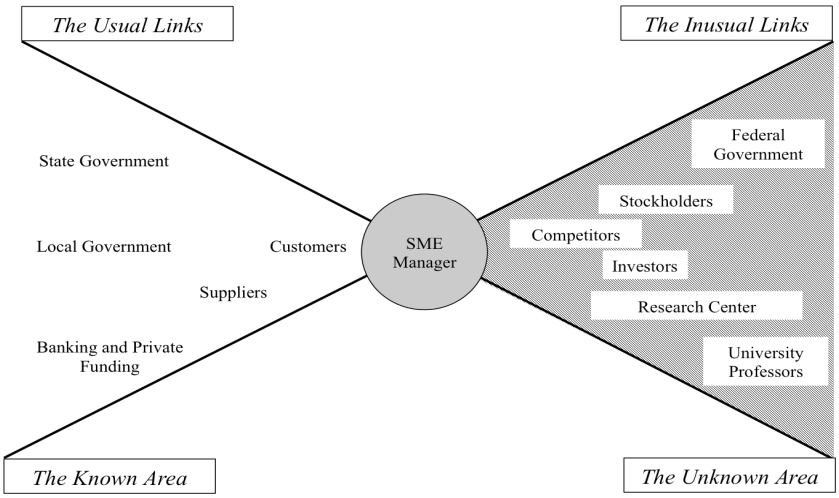


Figure 8. The 'unknown area' for SME Managers as an opportunity gap for networking and enhance performance

As can be seen in Figure 8, relationships established by the manager are mostly around business networks (specifically managers of client and suppliers' companies and just few actors in the political and financial areas). Hence, there is a range of unexplored possibilities from links with other actors. Especially, in a society oriented by knowledge and innovation, for SME manager enhance connections with professors and research centers of the universities of the region of the state of Guanajuato to develop new strategies to improve performance.

And finally, this research provides a methodological option and uses in the analysis of relationships between network analysis and performance by carrying out Structural Equations Modeling (SEM) and Partial Least Squares (PLS), using the software SmartPLS® (Ringle et al., 2015).

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Copyright-Based Companies and Digital Technologies: New Challenges for Defining Sustainable Business Models

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Abstract

This paper aims at analysing how the development of digital smart technologies and the Web affected the business model of a particular field of copyright-based companies: the collecting societies. The impact of the Internet and digitalization on the cultural enterprises will be investigated, focusing the analysis of the new business models established. It is necessary to clarify how the operators of the cultural enterprises have transformed their business model into an online business model and who the new players in this market are that have led to the change in the use of copyrighted works. Following an analysis of the literature on the subject, a vertical analysis of a specific sector of the creative enterprises will be carried out. Our research demonstrates the relevance of the analysis of the business models of cultural enterprises and how innovative business models can represent a tool to contrast the phenomenon of piracy. The findings of the research allow to assert that there is a close connection between innovation, intellectual property and business model: the high costs necessary for the creation of innovative products, also related to the protection of intellectual property, can be contained if the management of intellectual property is integrated into the within an innovative business model. Business model innovation can allow managers of this type of firms copyright-intensive to resolve the trade-off between costs and benefits of innovation, reviewing their business models for creating value.

Keywords – Copyright, Digital Technologies, Sustainable Business Model, Collecting Society

Paper type – Academic Research Paper

1 Introduction

In the context of new economy, increased interest in creativity and creative enterprises has emerged; the creativity is considered as the ability to produce new ideas, represents an essential resource in a knowledge-based economy, as well as necessary for the development of scientific, technological and cultural knowledge (Simonton, 2012).

Meanwhile, creative enterprises mainly deal with the production and sale of artistic works and, through the management of intellectual property rights, base their activity on creativity. These companies are also referred to as creative industries or copyright-based companies, emphasizing the importance of copyright protection for their sustainability (Trequattrini, Lardo, 2020).

Given its economic importance, the cultural industry may represent the challenge of the Italian competitiveness in the World, since it is composed by companies with high cognitive intensity, that is characterized by a high rate of creative innovation and specialized human capital, which helps to promote the new generations for the challenges of digital and new business models.

Some cultural industries are global players that have modified their organization in the last few years. The digital transformation and the new Information and Communication Technologies (ICTs) have given rise to a deep change in the business models adopted by companies, in order to exploit the potential of Web 2.0. ICTs allow to process, extract, copy and transfer creative content at a very low cost; this has significant effects on the publication, promotion and distribution of artistic works.

The digitalization process reduces distribution and storage costs and makes it possible to reach significantly more potential consumers. The development of information and communication technologies has historically played an important role in modifying the traditional ways in which culture is produced and distributed.

Technological innovation generates opportunities for the development of new business models or forces the transformation in order to achieve sustainable businesses. Evidence shows that some companies (for example, Amazon, Apple, AirBnB, Facebook) have been successful through the innovation of the business model, in turn made possible by new digital technologies, while others (for example, Japan, Kodak and Atari) have missed these opportunities and experienced performance declines.

Therefore, the aim of this research is to understand how the development of digital smart technologies and the Web affect the business model of a particular group of copyright-based companies: the collecting societies (CSs) (Riccio, 2012; Riis, 2012; Rochelandet, 2003).

In particular, this research presents a qualitative research (Hair et al., 2013) based on the comparison of two case studies of CSs operating in Italy: SIAE and Soundreef. To compare the business model of these societies we used the VUCA framework (Bennett, Lemoine 2014).

The need for strategic management of copyright derives from the presence of clearly identified intangible assets capable of ensuring a competitive advantage if they are integrated within the business model of the company. The impact of the Internet and digitalization on the cultural enterprises will be investigated, focusing the analysis of the new business models established able to integrate copyright into the business model of the societies to ensure a competitive advantage.

The remaining paper is organized as follows. Section 2 provides a literature review about the CSs, a specific category of copyright-based industries, and about the main studies on business model innovation. Section 3 exposes the methodology. Section 4 explains the case study analysed and Section 5 provides conclusions and main implications.

2 Literature review

2.1. The collecting societies

Economic copyright theory examines the financial incentives and/or contributions linked to copyrights by explaining the related positive and negative features (Watt, 2014). In this context, a copyright is a right recognized in law and represents the authors' original creative work (Hartley, 2005).

Copyright protection has many implications in the current landscape, one of which lies in its economic value on the market. Copyright industries contribute to the gross domestic product of every nation in the world, despite there being different national laws (Smith, 1996).

According to the World Intellectual Property Organization (WIPO) (2005), the copyright-based industries defined as wholly engaged in the creation, production, performance, exhibition, communication or distribution and sales of copyright protected subject matter. These include literature, music, theatre, film, the media, photography, software, visual arts, advertising services and collective management societies. It, annually, classifies copyright-based industries, distinguishing four categories: Core Copyright Industrys; Interdependent Copyright Industrys; Partial Copyright Industry; Non-dedicated Support Industry.

A particular group of copyright-based companies: the CSs (Riccio, 2012; Riis, 2012; Rochelandet, 2003). Particularly, CCSs born as a corporative structure aimed to defend authors' economic interests towards users of protected intellectual, cultural and artistic works. Thus, the corporative model of CSs is based on the remunerations' establishment with users and the remunerations' collection and distribution with their authors and

creators' affiliated. Additionally, they are directed to protect the interests of their members through the suppression of abusive utilizations and assuming solidarity and charitable task fostering members (Di Genova, 2000). CSs are networks composed of authors and creators directed to take collegially advantage of copyright (Besen and Kirby 1989; Hollander 1984; Watt 2014).

They have the following principal functions: license the use of the rights they manage, monitor the usage of works by licensee to enforce the conditions upon which the licence has been granted, collect and distribute the royalties payable as a result of the licensed use (Hollander, 1984). As CSs are constituted somewhat differently in different countries, it is difficult to generalise about some of their characteristics and activities (Handke, Towse, 2007).

The collective rights management (CRM) has received most attention in the economics literature. Economists typically see CS as an efficient way of overcoming the problem of high transaction costs for administering copyright in some markets (Coase, 1960; Williamson, 1979). In addition to the transaction cost theory, the economic function of copyright management companies can be explained through the information's economy (Sandler 2004; Stiglitz 2002). A not symmetric distribution exists in terms of information among contractual partners and connected risks. The existence of asymmetric information might generate adverse contractual conditions assumed by less informed individuals. In the absence of solutions from the market, broker intervention becomes essential. CSs devoted to acquiring licences are inclined to take actions based on their transaction experience.

Additionally, CSs are better able to detect violation of intellectual, cultural and artistic works allowing for the litigations activation and income increasing from the copyright (Tétrel 2008). Thus, CSs have a strong position to assume contractual risks. They can easily collect information on the market to fix a price maximizing the profit connected to cultural and artistic works. They can offer general licences as an incentive to their users. In a related manner, an issue related to optimal dimensions of CSs is posed. CSs represent the natural monopoly (Watt 2014, 167).

2.2. Business Model Innovation

Business model innovation (BMI) has attracted extensive attention from scholars and practitioners. BMI can be considered both the main instrument for enterprises to adapt to environmental changes and continuously create value (Karimi and Walter 2016), and also the key driving force for enterprises to create competitive advantages and achieve excellent performance (Martins, Rindova, and Greenbaum 2015).

Nowadays, the digital era and the Industry 4.0 paradigm, combining different technologies, open unforeseen possibilities to create radically new products, services, to share knowledge between different actors of the technology ecosystem (Lombardi, 2019)

and to generate innovative business models (Caputo, Marzi and Pellegrini, 2016; Spieth et al., 2016).

Many scholars have shown how companies can substantially enhance their value creation process by developing innovative business models (Abdelkafi et al., 2013). BMI refers to a new activity system of the firm (Foss and Saebi, 2016) and innovative structures for value creation and value capture (Chesbrough, 2010) involving a single firm and its alliance partners and customers (Bouncken and Fredrich, 2016).

The emerging smart technologies allow companies to show and create knowledge and to increase their competitiveness (Lombardi, 2019). To improve the possibilities to compete in new contexts, digital technologies (Loebbecke and Picot, 2015; Roden et al., 2017) are powerful forces pushing firms toward new business models (Cohen and Kietzmann, 2014; Fjeldstad and Snow, 2018; Holweg and Helo, 2014), making the capability to innovate increasingly relevant (Chesbrough, 2010; Foss and Saebi, 2018; Zott and Amit, 2007).

Therefore, the digital technologies have changed the way of doing business also creating new competitive contexts. In fact, there are industries in which competition have started through the introduction of new technologies able to overcome structural obstacles and monopoles developed during years. An important example is the one of the sector of collecting societies where also regulatory action has brought the development of competition through the creation of new companies based on innovative business models but also the BMI of companies previously operating in the market. In this perspective, in the next section, we are going to analyse how the development of digital smart technologies and the Web affected the business model of the (two collecting societies operating in the Italian scenario: SIAE (Società Italiana degli Autori ed Editori) and Soundreef Ltd.

3 Methodology

This study presents a qualitative research (Hair et al., 2013) based on the comparison of two case studies. According to Massaro et al. (2019), qualitative methods allow researchers to illustrate the influence of the social context. Within qualitative research methods, case studies support researchers when "a how or why question is being asked about a contemporary set of events over which the investigator has little or no control'' (Yin, 2014). Additionally, case study research allows gathering a profound understanding of a "real-world case" (Ridder et al., 2014). We claim that the case study methodology is an appropriate research method that will enable us to test the existing theory on a specific research context, gathering a deep understanding of a complex social phenomenon (Yin, 2014).

Particularly, the research method consists of a set of specific procedures, tools and techniques to gather and to elaborate data on the changes that characterized the change in their business model. Data were collected in the form of primary and secondary data. Data triangulation (Patton, 2002) assists our aims both in collecting more comprehensive

relevant information and crosschecking the consistency of the source to enhance the robustness of our findings. The first step of the study is to identify the profile and the business model of the main copyright collecting societies operating in Italy: SIAE (Società Italiana degli Autori ed Editori) and Soundreef Ltd. Thus, the primary sources are the following: Website of SIAE and Soundreef Ltd. ; the statute of SIAE and Soundreef Ltd.; the financial statements of SIAE and Soundreef Ltd. In the second step the research, to compare the business model of these societies we used the VUCA framework (Bennett, Lemoine 2014).

3.1. The VUCA framework

VUCA model (Bennett, Lemoine 2014) is taken root in emerging ideas in strategic leadership that apply in the organizations identifies the variables that affect the context in which organizations view their current and future state. They present boundaries for planning and policy management. The particular meaning and relevance of VUCA often relates to how people view the conditions under which they make decisions, plan forward, manage risks, foster change and solve problems.

VUCA is an acronym to describe or to reflect on the volatility, uncertainty, complexity and ambiguity of general conditions and situations. Volatility represents the nature and dynamics of change; Uncertainty reflects the lack of predictability; Complexity represents the confusion that surrounds organization; Ambiguity represents the potential for misreads.

4 Results and discussion

In this section, we explain the functions and the business models of SIAE and Soundreef Ltd in order to identify the main characteristics of these type of societies.

SIAE is a society established for the collective management of authors' rights; from a technical point of view, it is a Public Body with economic interests based on membership. The authors and publishers holding economic rights on their works can entrust SIAE with their protection, SIAE collects the rights due to them and then distributes them to each relevant rightholder. Every year, SIAE issues over 1.2 million licences for the use of protected works, thus making the recognition of the right easy for all those wanting to use those works and guaranteeing authors and publishers with the payment of a just remuneration for their work.

SIAE's business model is based on an extenisve collection to be administered, a widespread presence in the area (in Italy there are 10 offices, 28 branches and 435 agents), a multiplicity of services to be provided in agreement with other entities. Over the years there has been a large recovery in efficiency in the control activity through the introduction of innovative IT tools.

Soundreef Ltd is an Independent Management Entity (Directive 2014/26/EU) registered with the Intellectual Property Office of the United Kingdom. Soundreef Ltd

manages the rights of over 39,000 songwriters and music publishers worldwide, 22,000 of whom are Italian, and operates in over 90 countries either directly or via representation agreements. Soundreef Ltd is owned by Soundreef S.p.A., a company that develops the appropriate technology for monitoring, collecting and maximizing the earnings of songwriters and music publishers. The company regularly deals with millions of transactions and analyzes a vast amount of data, with the aim of improving data security and efficiency in the music industry.

The Company uses a SaaS (Software as a Service) developed to track reproductions analytically and to calculate the fees, making payment to the rightholders faster than compared to traditional methods. Soundreef's activity focuses on two areas: in-store, that is when music is played in shops, commercial activities or restaurants; live, for live performances, with online compilation of the digital borderò and direct payment of the organization of the concert without any type of intermediary.

The business model is based on a widespread use of digital tools, which allow Soundreef to have a remarkably short cycle of reporting and royalty payments. Another aspect of differentiation concerns the transparency of information, in the sense that every author or publisher who subscribes to Soundreef has an online profile where he can view exactly where his music is played, also territorially, how much he has earned and when it will be paid.

From the analysis of the characteristics of the two societies, it is possible to asserts that the main differences in Soundreef's business model compared to that of SIAE are intrinsically linked to the different legal form and organizational structure that the two economic entities strategically adopt.

Soundreef Ltd is an Independent Management Entity while SIAE is a Public Body

The digital transformation and the new Information and Communication Technologies (ICTs) have given rise to a deep change in the business models adopted by companies, in order to exploit the potential of Web 2.0. ICTs allow to process, extract, copy and transfer creative content at a very low cost; this has significant effects on the publication, promotion and distribution of artistic works. The digitalization process reduces distribution and storage costs and makes it possible to reach significantly more potential consumers. Technological innovation generates opportunities for the development of new business models or forces the transformation in order to achieve sustainable businesses.

The current challenge that involves all collective societies is linked to the need to adapt their business model to the international and national regulations that enable access for new players in the market with multi-territorial licenses and new digital technologies (Haunss, 2013).

In the Italian context, on the one hand, there are traditional collecting societies that have tried to answer to the growing relevance of the Internet and ICT, trying to transform previous business models in a digital model (SIAE). On the other, there are the new players, established in recent years, who have tried to impose a new interpretation of how

to do business in this market, promoting their own model based on fully digital organization management, to obtain greater value (Soundreef).

The main difference, as well as in the legal form, is in the geographical location. SIAE has its headquarters in Rome, but has 10 regional and interregional offices and 28 branches distributed throughout the Italian territory, which is accompanied by a large number of agents. SIAE also operates in the international context through representation contracts signed with over 150 authors' companies in 145 countries. Soundreef, on the other hand, is based in London and has managed to operate on the national territory by relying on the LEA, the newly formed non-profit company that collects the rights of Soundreef members in Italy. This was possible following a sentence of 12 September 2014 by the Court of Milan, which established the legitimacy of Soundreef's activity in Italy.

In addition, SIAE and Soundreef stand out in the way in which copyright protection is exercised.

Soundreef was born properly as an innovative digital platform; therefore, it operates entirely through technological and IT tools. The creation of Soundreef, in 2011, and the promulgation of the Barnier Directive, in 2014, are simultaneous with the implementation by SIAE of an innovation process focused on digitization, which achieves the maximum level of investments in 2015. In fact, the creation of Soundreef in the market has marked the beginning of substantial digital investments by SIAE, in order to adapt to the technological evolution and services required by copyright holders in parallel both with Soundreef and The entire market, now made up of collecting companies, which operate mainly through digital and innovative tools.

Although SIAE has evolved in a digital sense, the competitors and, above all Soundreef in Italy, would seem to be able to use more advanced digital instruments. One of these, for example, allows Soundreef to monitor, analyze and account for every single radio passage, allowing the author directly to recover the royalties on his song.

Digital tools allow Soundreef to have a remarkably short reporting and royalty payment cycle. Through the Soundreef live, for example, it is possible to report to the author and publisher after only 7 days from the date of the concert, while a traditional collecting can arrive to report even after 12 months. In addition, for payment, Soundreef pays its authors within 90 days of the concert while a traditional collection can pay up to 18 months after the concert.

Another aspect of differentiation with respect to a traditional management model concerns the transparency of information, in the sense that each author or publisher who signs up for Soundreef has an online profile where he can view exactly the place where his music is played, how much he earned and when he will be paid.

SIAE has also innovated through the digitization processes, trying to adapt to new business models. The digitalization process of SIAE is in line with the global panorama and is also linked to the need to contrast the competition from other emerging collecting companies following the liberalization of the market.

In particular, SIAE has redefined the service model, the offer and the rates, developing an innovative technological architecture through various digital touch points and new processes, with the aim of making the user experience as fast as possible and effective.

Unlike Soundreef, SIAE maintains its presence at the base of its business model through branches throughout the national territory, maintaining in the direct relationship with its authors and editors, as well as with the event organizers themselves, the strength of the own creation of value. The latter feature constitutes an important advantage in possession of SIAE built over the years.

The comparison between the business model applied by SIAE and by Soundreef can be made by applying the VUCA framework (Bennett, Lemoine 2014). SIAE, operating in a context of great uncertainty, adopts traditional strategies aimed at defending the rights it possesses, limiting external transfers, that is, through the dynamic management of the portfolio of rights geared towards closure, taking into account the limited degree programmability of business also for the regulatory context characterized by continuous evolution and the high level of cognitive self-sufficiency. Despite recent efforts to innovate its business model with the activation of digital-based services, SIAE still has as its objective the implementation and dynamic exploitation of the copyright rights held based on full exclusion, in order to exploit a monopoly position in relation to the rights held, excluding third parties from their use and using them as a defense or attack tool against competing companies.

Considering the collecting companies that recently entered the copyright management market, Soundreef bases its business model on the digital management of copyright and on agreements with non-profit companies for the collection of rights and with software houses for the software that allow monitoring and recognition of the rights of its customers on the various channels, especially digital. Being a private company and not a public economic entity such as SIAE, Soundreef's objective is to maximize the utility deriving from the exploitation of the intellectual property rights held; in a highly volatile context, Soundreef has a very clear idea of the future of the business (high rate of business programmability and a limited level of cognitive self-sufficiency), keeping the strategy of open innovation more adequate.

Soundreef, in fact, has a limited repertoire to administer and a limited knowledge of the sector, being a start up; however, it is clear that the sector will evolve towards digital technologies. It follows that, in recent years, it has gradually expanded the library of rights to be administered through important acquisitions of rights from the outside and, at the same time, has exploited, through agreements with technologically advanced suppliers, knowledge in the field of digital. The agreement concluded with SIAE has the objective, on the other hand, of consolidating its position also in the traditional services sector.

5 Conclusions and main implications

The findings of the research allow to assert that there is a close connection between innovation, intellectual property and business model: the high costs necessary for the creation of innovative products, also related to the protection of intellectual property, can be contained if the management of intellectual property is integrated into the within an innovative business model. It follows that business model innovation can allow managers of cognitive-intensive enterprises to resolve the trade-off between costs and benefits of innovation, reviewing the characteristics of their business and involving partners in new models for creating value.

Our research demonstrates the relevance of the analysis of the business models of cultural enterprises and how innovative business models can represent a tool to contrast the phenomenon of piracy.

The future of copyright management is evolving and will continue to change due to the evolution of digital and Internet technologies, which transform the way in which creative works protected by copyright are made available, used, consumed. and redistributed. All this will necessarily entail a redefinition of the concept of territory, material copying and broadcasting, which the collecting societies will have to face, transforming and innovating the business model (Hilty, Nérisson, 2013; Lyubareva et al., 2014).

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Conditioning Factors of Digitally-Enabled Growth Strategy in SMEs

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Abstract

According to several authors (Kane et al., 2015; Yeow et al., 2018), strategy is a crucial element regarding firms' digitalization and technology is not the only key factor. On the other hand, SMEs face specific challenges to seize digitalization opportunities and take advantage of them, mainly due to their lack of resources and capabilities (Cenamora et al., 2019). Therefore, the purpose of this research is to deepen the study of digitalization in SMEs, focusing on the analysis of the strategic dimension. In particular, the aim is to better understand the factors that condition digital strategy in SMEs, considering this as a kind of strategy supporting firm's digitally-enabled growth (i.e. digitally-enabled growth strategy). The conditioning factors taken into account are digital leadership and digital organizational culture.

A maturity model approach is applied. In particular, a self-assessment questionnaire based on the "DIGROW" digital maturity framework (North et al., 2019) was addressed to 7,040 SMEs from the Basque region (Spain) between July and November 2018, and was answered by the CEO or the IT manager in each firm. The number of firms that responded to the survey amounted to 540 (response rate 7.67%). After eliminating only partially completed or invalid questionnaires, the final sample consisted of 427 companies. The present study only focuses on SMEs (380 in total), leaving out micro-enterprises.

The results of the regression model tested show that the relationship between each independent variable (i.e. digital leadership; digital mindset; empowered employees) and the dependent one (i.e. digitally-enabled growth strategy) is significant in all cases at a significance level of 95% ($p<0.05$) Therefore, it can be concluded that digital leadership, digital mindset, and the fact of having empowered employees who experiment with digital initiatives have a positive and significant influence on digitally-enabled growth strategy.

This research sheds light on the factors that can support a digitally-enabled growth strategy, thus providing a better understanding of the aspects that need to be reinforced in order to sustain strategies guiding digital transformation and growth.

The findings of this research are helpful for managers who want to foster the development of strategies than can support their firms' growth based on digitalization. Moreover, policy making can be improved by prioritizing the key drivers of business digital transition.

Keywords: digital strategy; digitally-enabled growth strategy; digital leadership; digital organizational culture; SMEs.

Paper type: Academic Research Paper

1 Introduction

Sustainable competitiveness and growth of SMEs are increasingly determined by their capability to make use of digital technologies (EU, 2017), which are creating opportunities for developing new growth routes based on digitalization. A literature analysis by Tarutėa and Gatautis (2014) shows that the adoption of information and communication technology impacts on SMEs performance dimensions such as profitability, growth, market value, social and environmental performance and satisfaction. Many SMEs, however, are lagging behind in digital transition (OECD, 2017). They lack resources and capabilities or suffer from inertia, which hampers opportunities (Cenamora et al., 2019). Moreover, although many SMEs are able to launch specific digitalization initiatives they lack a digital strategy that guides their progress in their digitalization journey and support their growth based on digitalization (i.e. digitally-enabled growth) (North et al., 2019). Kane et al. (2015) posit that strategy and not technology is the key driver of the success in digital arena. Yeow et al (2018) conclude that it is paramount for top management to communicate a clear, albeit broad, strategy to all levels of the organization. Therefore, strategy arises as a key aspect to foster SMEs digital transformation.

Along these lines, this research deepens the study of digital strategy as a lever of growth, by analyzing the conditioning factors or antecedents of said strategy. In particular, the influence on digitally-enabled growth strategy of three antecedent factors is examined by means of regression analysis: digital leadership, digital mindset, and employees' empowerment.

2 Theoretical background

2.1 Digital strategy and digitally-enabled growth strategy

According to recently developed conceptual approaches digitalization goes further and transcends technology (Bharadwaj et al., 2013; Yeow et al., 2018), considering that digital transformation involves the embeddedness of IT throughout organization. IT strategy becomes integrated with business strategy, giving rise to a concept of "digital strategy". In words of Bharadwaj et al. (2013:472) "the time is right to rethink the role of

IT strategy, from that of a functional-level strategy—aligned but essentially always subordinate to business strategy—to one that reflects a fusion between IT strategy and business strategy. This fusion is herein termed digital business strategy". Other authors (Kahre et al., 2017; Yeow et al., 2018) also agree with this approach. In this line, Kahre et al. (2017:4707) posit that "digital business strategy reflects a new logic of competitive strategy where boundaries between business and IT strategy become blurred. Dynamically synchronized, business and IT are mutual drivers of strategic change, business value and ultimately competitive advantage".

On the other hand, based on the exploration of possible futures (Moore and Manring, 2009), firms will have to develop an understanding of how digital solutions will help to deliver the firm's objectives and to review their strategy regarding digitalization. Regarding SMEs, the question of how SMEs can succeed in the digital environment requires understanding what strategic orientation best equips SMEs to compete in that environment. Quinton et al. (2017) advocate a digital orientation which they define as "the deliberate strategic positioning of an SME to take advantage of the opportunities presented by digital technologies. This positioning includes the attitudes and behaviours that support the generation and use of market insight, proactive innovation, and openness to new ideas" (p. 4). Depending on the competitive landscape and opportunities present, digitally enabled value propositions may be defensive, focusing on protecting current revenue or offensive with the possibility of completely develop new business models that yield both revenue increases and cost reductions (Johnson, no year).

Pelletier and Cloutier (2019) argue that SMEs have to understand that a successful and consistent digital transformation requires investing not only in IT artefacts and infrastructure (e.g. hardware, software, networks, etc.) but also in strategic, intellectual, structural, formal and informal, social and cultural dimensions (Chan and Reich, 2007). The challenge, therefore, is to align technological, organisational and human resources (Peillona and Dubruc, 2019). This is supported by Cataldo and McQueen (2015) who highlight the importance of IT in a strategic context in SMEs. Similarly Johnson (2018) states that digital growth depends more on business models than technology. Yeow et al. (2018) found that as an organization shifts towards a digital strategy, misalignments between the emergent strategy and resources give rise to tension and require alignment actions, which iteratively reconfigure organizational resources and refine strategy in order to respond to both changes in the environment and internal tensions. Sunday and Vera (2018) argue that using the concept of dynamic capabilities to examine the process of ICT adoption helps to unveil the recursive nature of the process. This idea is also supported by other authors (Galliers, 2011; Yeow et al. 2018), who consider that digital strategy relies on organizational capabilities: "The dynamism and complexity of the business and technology environment suggest that digital strategy is emergent, iterative, and influenced by evolving organizational capabilities" (Yeow et al., 2018:44).

Based on the above arguments, this study is focused on digital strategy which is . supported by organizational capabilities and addresses ways and means to sustain

competitiveness. Therefore, we introduce the concept of digitally-enabled growth strategy, defined as a process to purposefully align technological, organisational, and human resources to create unique value making use of digital resources including data, information and technologies, in order to support firm's future growth (North et al., 2019).

To implement digitally-enabled growth strategies SME leaders have to empower employees and develop the required skills for transformation in a learning process that requires integrating technology, business and learning strategies in an entrepreneurial-oriented organization. To understand such technology driven transformation processes Fountain's (2004) technology enactment framework differentiates between objective and enacted technologies. Objective technology incorporates innovations such as analytics or the Internet, whereas enacted technology entails the use, design and perception of those technologies by individuals within the organization. The role of technology, therefore, is dependent on the organization and what individuals within the organization make out of it. This observation is particularly relevant for SMEs where technology decisions depend on few people, their level of digital competencies and attitudes.

This sheds light on the importance of leadership practices and the development of a digital mindset or culture in the firm.

2.2 Digital leadership

According to DeLone et al. (2018) governance represents one of the success factors in digital transformation. Therefore, it is crucial that leaders (e.g. owners and/or managers of SMEs) recognize the potential of digitally enabled growth (BCG, 2013).

Digital leadership emerges as a crucial aspect regarding digitalization and the implementation of a digital strategy. El Sawy et al. (2016:141) define digital leadership as "doing the right things for the strategic success of digitalization for the enterprise and its business ecosystem. Digital leadership means thinking differently about business strategy, business models, the IT function, enterprise platforms, mindsets and skill sets, and the workplace". According to Li et al. (2016) leadership is a key aspect for the improvement of SMEs success and "one of the main challenges that SME leaders face today is how to optimally integrate business and information technology systems within their organisations to fully leverage the potential of digital technologies" (Li et al., 2016:186). They also understand that "SME leaders capable of effectively aligning business and digital strategy are more likely to succeed". Therefore effective implementation of digital strategy depends to a great extent on the leaders' capabilities. In this line, digital leaders play the roles of both "strategy formulator" and "strategy implementer" assuring the alignment between strategy design and execution (Li et al., 2016).

Regarding the alignment between strategy formulation and strategy implementation, new digital leadership roles are emerging, such as Chief Digital Officer "who would be in charge of leading the digital units and aligning digital strategies from the top of the

company with the requirements of the local units" (DeLone et al., 2018:217). The importance of leaders' role in the implementation of digital strategy is also emphasized by other authors such as Sow and Aborbie (2018) who study digital transformation in health organizations of USA concluding that "a digital transformation strategy necessitated the collaboration of leaders, resources, and teams to ensure that an implementation was successful and did not significantly disrupt operations" (Sow and Aborbie, 2018:145).

Moreover, digital leaders need to have other capabilities other than the capacity to align strategy formulation and implementation. According to Böck and Lange (2018), digital leaders' main skills and capabilities are the following: adaptability; motivation; the capacity of involving employees in the change process digitalization implies; empathy; communication capacity; technological understanding; trying out new ideas and concepts (i.e. creativity). In this line, other authors also highlight creativity as a characteristic of digital leaders as well as the ability to empower employees (Sow and Aborbie, 2018).

Employee empowerment is specially emphasized by these authors who understand that "leaders must be flexible and support their employees who can make a difference during and after a digital transformation, along with recognizing what they have to offer and how they can make a difference at the organization in the long term" (Sow and Aborbie, 2018:146). Moreover, El Sawy et al. (2016) share this approach stating that "top management and all employees will need to be more adaptive and willing to experiment and innovate while occasionally failing" (El Sawy, 2016:142-143). This is supported by Chan et al.(2019) who argue that in a digitally oriented organization, employees are empowered and encouraged to experiment with digital initiatives. Therefore, digital leaders have to empower people in order to promote experimentation at all organizational levels.

Moreover, digital empowerment allows for increased rationality with stakeholders (customers, suppliers and partners), and employees (DeLone et al., 2018). Empowerment also enables building an organizational meaning inwards and also outwards (Deuze, 2006). Finally, empowered participation of employees involves awareness, motivation, cooperation, technical competence, as well as attitude towards problems, attitude towards participation, learning relationship, and valuation of knowledge (Mäkinen, 2006).

Considering the aforementioned, the following research hypotheses can be formulated:

H1: there is a positive and significant relationship between digital leadership and digitally-enabled growth strategy.

H2: there is a positive and significant relationship between employee empowerment and digitally-enabled growth strategy.

2.3 Digital organizational culture

According to DeLone (2018), digitally-driven organizations are characterized by horizontal communication, democratic culture, and a unified understanding between IT and business. In their opinion, "The hierarchical models that have historically envisaged a

top-down line of command are now being perceived as ineffective as they preclude employees at the bottom of the hierarchy to make fast and informed decisions" (DeLone, 2018:214). Therefore, digitalization needs the implementation of less hierarchical organizational structures and the development of a democratic culture. Culture emerges then as a critical issue.

Moreover, El Sawy et al. (2016) consider that a successful digitalization strategy requires a different kind of people mindset and skill set. People mindset takes part of the organizational culture, since it has to do with the set of beliefs and values people have. Along these lines, Schein (1985) defines organizational culture as "the deeper level of basic assumptions and beliefs that are shared by members of an organization, that operate unconsciously, and that define in a basic 'taken-for-granted' fashion an organization's view of itself and the environment" (Schein, 1985:6). To this regard, the question arises about the kind of mindset or the particular set of beliefs and values that are needed for supporting digitalization. Thus, about the characteristics of a digital organizational culture.

Digital organizational culture can be defined as "the set of behaviours and habits, developed and applied by managers and employees, to take full advantage of new technological advances through the use and diffusion of them and with the objective of transforming business models or organizational models to create value for customers, employees and shareholders" (Lorenzo, 2016:71).

Among the characteristics of an organizational digital culture Duerr et al. (2018) highlight the following: start-up mentality (i.e. idea generation is supported); acceptance of failures; embracing digital skills; power equality among employees and across the hierarchy; dual decision-making (i.e. decisions being made at lower levels and more distributed in the firm); IT as a business creator (i.e. no boundaries between business and IT). Some of these features are similar to those proposed by other authors such as Lorenzo (2016) who emphasizes experimentation, aimed at discovering new business opportunities and the development of new business models enacted by new technologies. The mentioned characteristics are aligned with the idea of a democratic culture and employee empowerment that digital leaders should promote.

On the other hand, there is a strong tradition in the field of Strategic Management regarding strategy implementation, rooted in the assumption that the implementation of a new strategy requires the alignment of both leadership style and organizational culture (Thompson et al., 2019). This is also supported by the 7-S framework developed by McKinsey in the late 1970's, that has become widely accepted and applied (see McKinsey, 2008). In coherence with this classic approach to strategy implementation, we assume that both digital leadership and digital organizational culture are important elements conditioning a successful digital strategy implementation.

Therefore, and according to this approach, we propose the following hypothesis:

H3: digital organizational culture (i.e. digital mindset) has a positive and significant relationship with digitally-enabled growth strategy.

3 Research Method

3.1 Digitalization capabilities assessment questionnaire

A questionnaire has been developed based on the "DIGROW" framework of digital maturity (North et al. 2019) that allows to assess the digitalization capabilities of SMEs. The theoretical foundation of the framework is Teece's (2007) model of dynamic capability development, including "sensing", "seizing", and "transforming" capacities. For the building of a practice oriented self-assessment framework a capacity of strategy definition and communication was inserted between Teece´s "sensing" and "seizing" capacities. As a result, the framework encompasses four building blocks, where each block includes four capacities. Each of these capacities can be evaluated at five levels described by an anchor statement. In a pre-test conducted on firms (North et al., 2019), it was found that these five levels would allow a sufficient degree of differentiation. The building blocks of the "DIGROW" framework, and their corresponding capacities, are the following:

- *Sensing digitally-enabled growth potentials:* searching for digitally-enabled growth opportunities, understanding and developing digital customer needs, sensing technology-driven opportunities, and use of external sources for digital innovation.
- *Developing a digitally-enabled growth strategy:* digitally-enabled growth strategy, digital leadership, digital mindset, and empowered employees.
- *Seizing digitally-enabled growth potentials:* digitally-enabled business models, digital market presence, digital customer experience, and agile implementation/deployment of digitalization initiatives.
- *Managing resources for digital transformation:* digital skills and learning, digital processes, digital technology and security, and digital investments.

3.2 Survey and sample

The companies subject to study are small and medium-sized enterprises (SMEs) from the Basque region in Northern Spain. The definition of SME proposed by the European Union has been applied in order to categorise firms.

SMEs comprise three different categories of enterprises, namely micro-enterprises, small enterprises and medium-sized enterprises (see Table 1). To classify firms, the official European definition of SMEs takes into account three different factors: level of employment, level of turnover, and size of balance sheet.

Table 1: Definition of SMEs

Company Category	Employees	Turnover	Balance sheet total
Micro	< 10	< €2 million	< €2 million
Small	< 50	< €10 million	< €10 million
Medium-sized	<250	< €50 million	< €43 million

Source: Commission Recommendation dated 6 May 2003 regarding the definition of micro, small, and medium-sized enterprises (2003/361/EC) - Official Journal of the European Union, L 124/36, 20 May 2003).

Keeping with this definition, SMEs are characterised by having between 10 and 249 employees. This study focuses only on SMEs, leaving aside micro-enterprises.

The questionnaire explained above was sent to 7,040 SMEs in cooperation with regional business associations between July and November 2018 and was addressed to the CEO or the IT manager in each firm. The number of SMEs that responded to the survey amounted to 540 (response rate 7.67%). After eliminating only partially completed or invalid questionnaires, the final sample consisted of 427 companies. As for company size , 47 firms were micro-enterprises (i.e. less than 10 employees), 220 were small firms (i.e. between 10 and 49 employees) and 160 were medium-sized firms (i.e. between 50 and 249 employees).

3.3 Data analysis

In terms of statistical data analysis carried out, regression analysis was applied with the aim of testing relationships between different sets of variables in depth. The software used was IBM SPSS (version 26.0), and the main results obtained from these analysis are provided in the following section.

4 Findings

Our regression model explores the relationships between the capacities that make up the second dimension or building block of the "DIGROW" framework (i.e. developing a digitally-enabled growth), with digitally-enabled growth strategy being considered as the dependent variable, and digital mindset, digital leadership and empowered employees as the independent variables.

The results of the regression model test show that the relationship between each independent variable and the dependent one is significant in all cases at a significance level of 95% ($p<0.05$) (digital leadership, $t=10.522$ ($p=0.000$); digital mindset, $t=4.343$ ($p=0.000$); empowered employees, $t=3.107$ ($p=0.002$)) [see Table 2]. Therefore, it can be concluded that digital leadership, digital mindset, and the fact of having empowered employees who experiment with digital initiatives have a positive and significant influence on digitally-enabled growth strategy. Thus, all research hypotheses (H1, H2, and H3) are confirmed.

On the other hand, as also shown in Table 2, the relative importance of each independent variable regarding the dependent one is not the same. Digital leadership is the most relevant capacity influencing digitally-enabled growth strategy (β=0.533), followed by digital mindset (β=0.287), and empowered employees (β=0.151).

Table 2: Regression model (coefficients and significance)

Model	Non-standardized coefficients		Standardized coefficients	t	Sig.
	B	Standard error	Beta		
(Constant)	.418	.183		2.288	.023
Your company has a digital leadership	.533	.051	.522	10.522	.000
Your company has developed a digital mindset	.287	.066	.201	4.343	.000
Your company empowers employees to experiment with digital initiatives	.151	.049	.144	3.107	.002

Dependent variable: Your company has a digitally-enabled growth strategy.

Finally, the explained variance of digitally-enabled growth strategy is 0.609 (see Table 3). This means that the three independent variables considered – i.e. digital leadership, digital mindset and empowered employees - overall explain the dependent variable at 60.9%. In other words, these three factors condition digitally-enabled growth strategy to a great extent.

Table 3: Regression model (variance explained)

R	Square R	Adjusted squared R	Standard error of the estimation
.780	.609	.606	1.126

Dependent variable: Your company has a digitally enabled growth strategy.

5 Discussion and conclusions

The findings obtained in this study confirm that digitalization is not only about technology but goes further (Bharadwaj et al., 2013; Yeow et al., 2018). Setting a digital strategy that guides the identification of digitally-enabled growth opportunities, and the use of technology as a leverage to transform the organization and develop new business models and new ways of generating value, is crucial. Also this study shows that digital leadership, digital organizational culture (i.e. digital mindset), and employee empowerment support a digitally-enabled growth strategy.

Moreover, the results are also in line with the classic approach regarding strategy implementation which considers that a coherent alignment between leadership style,

organizational culture, and strategy is key in order to assure a successful implementation of the strategy. This study demonstrates that this logic is not only applicable to the implementation of business strategy but also to the successful implementation of digital strategy.

On the other hand, and as far as practical implications of this study is concerned, this asks SMEs leaders (i.e. owners and/or managers) to provide a clearer picture about the main pillars of the digitally-enabled growth strategy, create a shared understanding, and support digitalization initiatives of the employees. Research demonstrates that proactive companies show strong leadership, develop a digital mindset, have well-developed sensors in terms of technology and market developments, learn from many sources, integrate into business ecosystems and actively promote their presence in the digital market (Conference Board of Canada, 2014; IDC-SAP, 2017; Sinkkilä, 2017; Müller et al., 2018).

Finally, this research has some limitations that open the way to further research. First, the study is cross-sectional, that allows to analyse the conditioning factors of a digitally-enabled growth strategy at a particular moment of time, but it doesn't allow to understand the evolution of the relationship between such factors and strategy over time. In this line, future longitudinal studies might be carried out. On the other hand, this study focuses on SMEs of a particular region. Future comparative studies between SMEs of different geographical settings might be undertaken in order to check if the different elements conditioning digital strategy are equally important or not everywhere.

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Digital Supply Chain Performance Metrics - A Literature Review

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Abstract

Digital technologies enable firms to streamline, accelerate, and automate the process of procurement, manufacturing, and distribution. Digital technologies allow seamless integration of upstream suppliers and downstream customers into the firm's activities. As a result, a significant shift in supply chain practices and performance is experienced. Substantial research has been undertaken to measure digitalized supply chain performance and its effects on firms. This paper presents a systematic literature review on performance measurement for the digital supply chain to apprehend current practices, recognize gaps and advocate future research itineraries. We used the *Balance Score Card* (BSC) model to categorize 243 identified metrics into four BSC perspectives. Internal and financial perspectives received the most attention while "growth and learning" perspective received the least attention. External partners, such as distributors and suppliers, were virtually ignored in the identified literature.

Keywords – Digital supply chain, Digital transformation, Digitalization, Performance measurement, Balance Score Card.

Paper type – Academic Research Paper

1 Introduction

In a rapidly changing world, businesses are competing against each other to serve customers with a faster, cheaper, and higher quality product. For many firms, quicker and

better supply-chain related activities with respect to competitors are critical to achieve competitive advantage (Ramish & Aslam, 2016). In the current turbulent environment, the competition has shifted from firm vs firm to supply chain vs supply chain (Bi et al., 2010; Büyüközkan & Göçer, 2018). Making it vital for a firm to continuously improve, upgrade, and invest in its Supply Chain. Poirier (1999) predicted that digital technologies would act as "tsunami of change" that will "wash away" traditional supply chain models and transform business activities entirely. True to its prediction in the past decade, digital technologies have penetrated and improved every aspect of the supply chain, including procurement, manufacturing, distribution, and customer/supplier relations (Lu et al., 2012). This adoption and reliance on digital technologies to perform business activities is referred to as "digital transformation" or "digitalization". These terms describe the integration of digital technology into all business areas to create new or modify existing business processes, culture, and customer experiences; fundamentally changing how firms operate and deliver value to customers (Nahrkhalaji et al., 2018; Wei et al., 2019). In other words, digital transformation is the use of digital technologies to enable business improvements (Reis et al., 2018). Therefore, the digital transformation of the supply chain is defined as the use of digital technologies to connect, integrate, and improve the business activities also involving suppliers and customers (Büyüközkan & Göçer, 2018).

Recent studies have reported several benefits of the DSC over the traditional supply chain, including, improved financial performance (Haoud & Hasnaoui, 2019; Youssef & El-Nakib, 2015), operational efficiency (Lu et al., 2012; Zhao & Jiang, 2013), customer satisfaction (Jiang & Zhao, 2014; Jonsson & Gunnarsson, 2005; Zhao & Jiang, 2013), employee skills (Llach & Alonso-Almeida, 2015; Srinivas, 2007), supplier relations (Ranganathan et al., 2011; Zhao & Jiang, 2013) along with a reduction in operational and manufacturing cost (Di Vaio & Varriale, 2020; Haoud & Hasnaoui, 2019; Korpela et al., 2017), cycle time (Haoud & Hasnaoui, 2019), and errors (Youn et al., 2014). Realizing the significant advantages offered by the Digitalized (digital) Supply Chain (DSC) on firm competitiveness, many firms have started the process of full or partial digitalization of their supply chain (Wu et al., 2016). Previous studies have provided guidelines on how to adopt these technologies successfully. Including studying antecedents for DSC (Brandon-Jones & Kauppi, 2018; Ranganathan et al., 2011), frameworks to assist in the process of digital transformation (Kittipanya-ngam & Tan, 2020; Pant et al., 2003; Srinivasan, 2010), assessing firm digitalization level (Gilbert et al., 2017; Makris et al., 2019), and application of emerging technologies (e.g. Big Data, 3D printing, Internet of Things) in the supply chain (Mohr & Khan, 2015; Shah & Ververi, 2018; Wang et al., 2016).

Though DSC has several advantages over the traditional supply chain, the adoption of digital technologies is not easy or cheap. It has both short-term and long-term effect on firm performance and competitiveness. To control/monitor the process and quantify benefits obtained from DSC, effective Supply Chain Performance Measurement systems are needed. Performance Measurement Systems can reveal the gap between planning and

execution that can help firms in identifying problems and areas of improvement (Chae, 2009). As a result, a plethora of studies are available on the topic. For example, Gopal & Thakkar (2012) reviewed 28 articles focusing on supply chain metrics to measure its performance published between 2000-2011. Recently, Guersola et al. (2018) examined 276 articles and reported on the importance and depth of the available literature. Although there are some review papers on Supply Chain Performance Measurement systems, none of them focuses on the analysis of performance measurement of the DSC. Several studies in recent years have measured the performance of DSC systems using self-developed criteria and metrics. These metrics vary in nature and have focused on different aspects of DSC. This study will summarize and synthesize these metrics using the Balance Score Card (BSC), developed by Kaplan and Norton (1992). One key advantage of using BSC lies in its flexibility and ability to be implemented in different types of supply chain systems and organizations (Yongvanich & Guthrie, 2009). BSC adopts a holistic approach in measuring performance, assuring that the system performs well as a unit, not just individual links. Therefore, the objective of this paper is to review the scientific studies measuring the performance of DSC to answer the following research questions.

1. What is the current state of research in DSC performance literature?
2. What are the most used metrics for performance measurement?
3. Which aspects of the DSC performance measurement literature requires further attention?

2 Theoretical background

Supply chain management is the process of managing suppliers, manufacturers, warehouses, and stores to produce and distribute goods in the right quantity, at the right location, on the right time, to minimize system-wide costs while satisfying the service-level requirements (Simchi-Levi et al., 2000). Traditionally, these integrations are discrete and take place in a series of soiled steps (Büyüközkan & Göçer, 2018). With the increase in global uncertainty and ever-changing customer demands, this discrete method of managing a supply chain is no more valid. It lacks the speed, transparency, flexibility, and timely actionable information needed to remain competitive in the current business environment (Büyüközkan & Göçer, 2018). Digital technologies can provide solutions to some of the most pressing challenges in supply chain management by reducing complexity, cost, and increasing volume and flexibility, leading to higher service levels (Agrawal & Narain, 2018), by directly linking suppliers and customers and vice-versa. Unlike traditional supply chain, DSC heavily relies on systems (e.g. software, hardware, communication networks) that support activities performed by globally distributed partners to buy, make, store, move, and sell a product (Bhargava et al., 2013). Büyüközkan & Göçer (2018, p. 165) defined DSC as "*an intelligent best-fit technological system that is based on the capability of massive data disposal and excellent cooperation and communication for digital hardware, software, and networks to support and*

synchronize interaction between organizations by making services more valuable, accessible and affordable with consistent, agile and effective outcomes".

To take advantage of the benefits offered by digital technologies, an increasing number of firms are investing and adopting digital technologies in their supply chains (Büyüközkan & Göçer, 2018). This adoption of digital technologies acts as a double-edged sword. On the one hand, they make supply chains faster, efficient, and reliable. On the other hand, they introduce a higher level of complexity and variables into the system that require more sophisticated metrics to measure its performance (Cho et al., 2012; Mondragon et al., 2006; Ralston et al., 2015). These metrics are used for "*assessing and controlling progress, highlighting achievements, enhancing understanding of key processes, identifying potential problems (e.g., bottlenecks), and providing insight into possible future actions, among others*" (Ahi & Searcy, 2015, p. 361). They enable top management to convey firm objectives in measurable and straightforward terms that allow firms to standardize the processes and define goals clearly (Magretta & Stone, 2002). In the absence of appropriate measures, firms are unable to implement strategy, manage operations and track performance over time (Bremser & Chung, 2005). Both financial and non-financial measures are used for assessing the performance of a supply chain. These measures should be embedded in the system at the time of planning and selected depending upon the goals and type of supply chain (Dweekat et al., 2017). Over the years, different supply chain performance measurement models were developed to standardize and robust the system. These models put forward different methods and processes to measure the performance effectively. Citing the lack of tools to grasp a holistic view of firm performance, Kaplan and Norton (Kaplan & Norton, 1992) proposed the BSC. They argued that BSC would provide a quick and comprehensive view of the business to the top management. Today, BSC is among the most widely used performance measurement model (Saleheen et al., 2018a). Ever since its introduction, BSC has been widely used for measuring firm performance, particularly the performance of the supply chain (Bigliardi & Bottani, 2010; Dweekat et al., 2017; Marimin et al., 2017) including the performance of DSC (Bremser & Chung, 2005; Dweekat et al., 2017; Liang, 2015). Unlike the majority of the models available at that time, BSC included both financial and non-financial measures (Duarte et al., 2011) that monitor the overall firm performance over time (Saleheen et al., 2018b). BSC measures firm performance in the following four perspectives (Kaplan & Norton, 1992): Customer perspective (value-adding view)**,** by focusing on delivering value to customers; Financial perspective (shareholders' view), by focusing on delivering value to shareholders; Internal perspective (process-based view)**,** by focusing on promoting efficiency and effectiveness in processes; Growth and learning perspective (future view)**,** by focusing on sustaining innovation and change capabilities, through continuous improvement and preparation for future challenges.

We advance the notion that the overall performance of the DSC can be measured using these four perspectives.

3 Methodology

To answer the research question, a systematic literature review following the guidelines by Okoli (2015), was conducted. Systematic literature reviews are transparent, evidence-based activities (Tranfield et al., 2003) that report the decisions, procedures, and conclusions made by those conducting the study (Cook et al., 1997). The articles included in the review were retrieved from several queries submitted to the database *Scopus* without specifying the time frame in January 2020. We searched for the multiple combinations of keywords presented in Table 1. The keywords were selected based on a preliminary review of the literature and using a form of brainstorming. The search resulted in 248 articles that were examined for further study. Figure 1 summarizes the methodology of this study. After removing the duplicates and inaccessible articles, remaining 200 articles were subjected to further exclusion criteria. The exclusion criteria included, (i) articles not published in English, and (ii) articles with no mention of the DSC and its performance in their title or abstract. After rigorously analyzing and reviewing the remaining 46 articles, an additional exclusion of 29 articles was made. These additional exclusion criteria focused on the objective of the article: an article was excluded if it did not discuss the metrics to measure the performance of DSC. As a result, 17 articles were identified as relevant to the study.

Table 1. Keywords used for literature search

Query					No. of Results
"digital supply chain"	AND	"performance"			16
"e-Supply chain"	AND	"performance"			58
"smart Supply chain"	AND	"performance"			15
"e-Supply chain"	AND	"benefits"			34
"digital supply chain"	AND	"benefits"			14
"smart Supply chain"	AND	"benefits"			10
"smart Supply chain"	AND	"metrics"			3
"e-Supply chain"	AND	"metrics"			4
"digital Supply chain"	AND	"metrics"			0
"e-Supply chain"	AND	"index"			8
"digital Supply chain"	AND	"index"			0
"smart Supply chain"	AND	"index"			2
"smart Supply chain"	AND	"indicators"			2
"digital Supply chain"	AND	"indicators"			2
"e-Supply chain"	AND	"indicators"			3
"digital transformation"	AND	"supply chain"	AND	"performance	13
"digital transformation"	AND	"supply chain"	AND	"benefits"	9
"digital transformation"	AND	"supply chain"	AND	"metrics"	2
"digitalization"	AND	"supply chain"	AND	"metrics"	2
"digitalization"	AND	"supply chain"	AND	"benefits"	27
"digitalization"	AND	"supply chain"	AND	"benefits"	8
"digital transformation"	AND	"supply chain"	AND	"index"	1
"digital transformation"	AND	"supply chain"	AND	"indicators"	2
"digitalization"	AND	"supply chain"	AND	"indicators"	11
"digitalization"	AND	"supply chain"	AND	"index"	2
Total					**248**

Table 2. List of articles identified

Year of publication	Journal Article	Conference proceedings	Book Chapter	Total
2007	(Sammon & Hanley, 2007)			1
2009	(Bayraktar et al., 2009; Mukhtar et al., 2009; Sambasivan et al., 2009)			3
2010	(Hafeez et al., 2010)			1
2011	(Ranganathan et al., 2011)			1
2012	(Lu et al., 2012)			1
2014	(Jiang & Zhao, 2014; Youn et al., 2014)			2
2015	(Llach & Alonso-Almeida, 2015; Valverde & Saadé, 2015; Youssef & El-Nakib, 2015)			3
2016		(Mezouar et al., 2016)		1
2017	(Dweekat et al., 2017; Gilbert et al., 2017; Marimin et al., 2017; Shibin et al., 2017)			4
2018		(Kayikci, 2018)	(Futschik, 2018)	2
2019	(Petrović & Mimović, 2019; Schmidt et al., 2019)	(Haoud & Hasnaoui, 2019; Wiedenmann & Größler, 2019)		4
Total	18	4	1	**23**

The references of all relevant articles were also investigated to expand the literature. A total of 6 articles were identified from the bibliography, making the final number of articles used in this study to be 23. Table 2 presents the list of articles along with type and year of publication. The metrics used for measuring DSC performance in the identified scientific studies were recorded. A total of 243 different metrics were mentioned in these studies that were further analyzed and are reported in the following section.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).

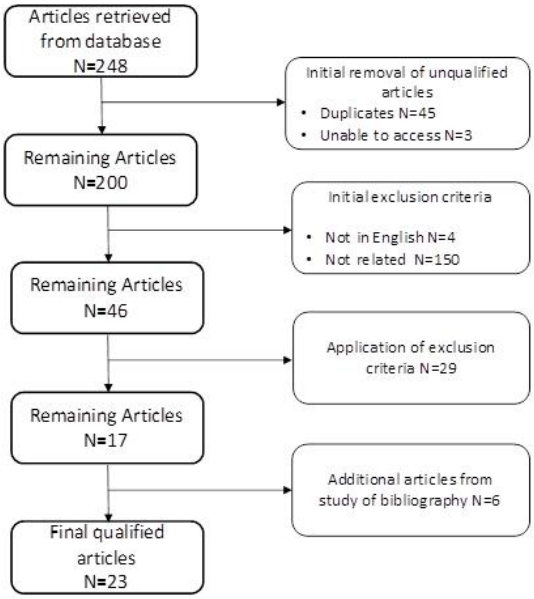

Figure 1. Flow chart of the literature search process

4 Results

The recorded 243 metrics were classified into the four BSC perspectives categories. Different metrics used with a similar focus were merged into one KPI. For example, "supply chain management cost", "transaction cost ", "system cost", and others were merged into the "Operational Cost" KPI. Similarly, "system response time", "data transmission speed", "number of steps in procurement cycle", and others were merged into "Operational Speed" KPI. To measure the performance in one KPI, the data from several metrics will be needed, and the sum of performances of individual metrics will dictate the performance in related KPI. As a result, a total of 37 KPIs were identified. The result of the analysis is presented in Table 3. The analysis results show that the internal perspective received the most attention, with seventeen KPIs (128 metrics). In comparison, growth and learning received the least consideration with only three KPIs (11 metrics), highlighting the fact that not an equal amount of attention is paid towards different performance perspectives.

Table 3: Identified KPIs in the digital supply chain

KPI	BSC Perspective	Metric Frequency	Source
Employee Skills	Growth and Learning	5	(Llach & Alonso-Almeida, 2015; Valverde & Saadé, 2015)
	It measures gain in employee skills through training, changes in responsibility and on-job		

	learning.		
On-time Delivery	Customer Perspective	9	(Dweekat et al., 2017; Marimin et al., 2017; Mezouar et al., 2016; Mukhtar et al., 2009; Valverde & Saadé, 2015; Youn et al., 2014)
	It measures on-time delivery to customers along with delivery cycle time and lead time.		
Operational efficiency	Internal Perspective	23	(Bayraktar et al., 2009; Futschik, 2018; Hafeez et al., 2010; Haoud & Hasnaoui, 2019; Kayikci, 2018; Lu et al., 2012; Marimin et al., 2017; Petrović & Mimović, 2019; Sambasivan et al., 2009; Sammon & Hanley, 2007; Schmidt et al., 2019; Valverde & Saadé, 2015) Sambasivan et al., 2009
	It measures efficiency in operations, internal communication, productivity, and job completion.		
Operational Speed	Internal Perspective	17	(Futschik, 2018; Jiang & Zhao, 2014; Kayikci, 2018; Sambasivan et al., 2009; Sammon & Hanley, 2007; Schmidt et al., 2019)
	It measures time taken to perform activities, process information, data transmission rate, and response time to sudden changes.		
System Reliability	Internal Perspective	17	(Bayraktar et al., 2009; Gilbert et al., 2017; Haoud & Hasnaoui, 2019; Kayikci, 2018; Marimin et al., 2017; Schmidt et al., 2019; Valverde & Saadé, 2015; Wiedenmann & Größler, 2019)
	It measures forecasting accuracy for production, maintenance, and inventory.		
Error Rate	Internal Perspective	14	(Futschik, 2018; Gilbert et al., 2017; Marimin et al., 2017; Petrović & Mimović, 2019; Sambasivan et al., 2009; Sammon & Hanley, 2007; Valverde & Saadé, 2015)
	It measures system, human, and production error rate.		
System Flexibility	Internal Perspective	12	(Dweekat et al., 2017; Futschik, 2018; Kayikci, 2018; Mezouar et al., 2016; Sammon & Hanley, 2007; Schmidt et al., 2019; Youn et al., 2014)
	It Measures flexibility levels in production volume, cycle time, product variety, including flexibility of suppliers and distributors.		
Information availability	Internal Perspective	9	(Futschik, 2018; Sambasivan et al., 2009; Sammon & Hanley, 2007; Valverde & Saadé, 2015; Wiedenmann & Größler, 2019)
	It measures level of access to real-time information and data availability points.		
Inventory Level	Internal Perspective	9	(Bayraktar et al., 2009; Haoud & Hasnaoui, 2019; Jiang & Zhao, 2014; Kayikci, 2018; Mukhtar et al., 2009; Ranganathan et al., 2011; Schmidt et al., 2019)
	It measures inventory level, cycle time and performance of inventory control measures.		
Communication with supplier	Internal Perspective	8	(Hafeez et al., 2010; Llach & Alonso-Almeida, 2015; Sammon & Hanley, 2007; Valverde & Saadé, 2015)
	It measures communication quality and frequency with suppliers.		
Resource Utilization	Internal Perspective	7	(Bayraktar et al., 2009; Haoud & Hasnaoui, 2019; Kayikci, 2018; Sambasivan et al., 2009; Schmidt et al., 2019)
	It measures utilization level of equipment, personal and other resources.		
Responsiveness to Supplier	Internal Perspective	6	(Sambasivan et al., 2009; Sammon & Hanley, 2007; Valverde & Saadé, 2015)

	It measures response time to suppliers' queries, complaints and time needed to process orders and make payments.		
Employee Satisfaction	Internal Perspective	6	(Marimin et al., 2017; Valverde & Saadé, 2015)
	It measures employee satisfaction with the work environment and the system.		
Supplier Relation	Internal Perspective	5	(Gilbert et al., 2017; Llach & Alonso-Almeida, 2015; Ranganathan et al., 2011; Sambasivan et al., 2009)
	It measures level of integration of suppliers in the system and their responsiveness.		
Operational Cost	Financial Perspective	11	(Bayraktar et al., 2009; Dweekat et al., 2017; Futschik, 2018; Lu et al., 2012; Mezouar et al., 2016; Ranganathan et al., 2011; Sambasivan et al., 2009; Valverde & Saadé, 2015)
	It measures costs associated with operations (management, transaction, system, data collections and storage).		
Return on Investment	Financial Perspective	10	(Dweekat et al., 2017; Lu et al., 2012; Mezouar et al., 2016; Valverde & Saadé, 2015; Youssef & El-Nakib, 2015)
	It measures return on investment related to both fixed and variable expenses.		
Labor Cost	Financial Perspective	6	(Futschik, 2018; Haoud & Hasnaoui, 2019; Marimin et al., 2017; Sammon & Hanley, 2007)
	It measures cost associated with human capital (salaries, training cost, and other benefits).		
Production Cost	Financial Perspective	6	(Dweekat et al., 2017; Mezouar et al., 2016; Shibin et al., 2017; Youn et al., 2014)
	It measures cost associated with production (energy, material cost).		
Inventory Cost	Financial Perspective	5	(Futschik, 2018; Schmidt et al., 2019; Valverde & Saadé, 2015)
	It measures cost incurred in managing and storing inventory (raw material, WIP, finished goods).		
Logistics Cost	Financial Perspective	5	(Kayikci, 2018; Petrović & Mimović, 2019; Schmidt et al., 2019; Valverde & Saadé, 2015)
	It measures internal and external logistics cost for both raw material and finished goods.		

*Only KPIs associated metrics having frequency rate of 5 or more are provided. The full list can be accessed at https://doi.org/10.6084/m9.figshare.12250205.v2

5 Discussion

A total of 243 metrics to measure DSC performance were collected during the literature review and were categorized into four BSC perspectives. Performance related to firms internal working; particularly in areas related to operations, product quality and financial returns were most widely measured, indicating these three areas of significant interest to adopting firms. The use of these collected metrics to measure the DSC performance into four BSC perspectives is discussed in the following subsections.

5.1 Financial perspective

Profitability, growth and shareholder value are common financial goals that measure the bottom-line improvements of firms' activities. BSC emphasizes on using financial measures for assessing firm performance by arguing that, contrary to the prevailing belief, firm operational performance has a minimal effect on its financial performance. Kaplan & Norton (1992) emphasized that well designed financial control measures can improve overall firm performance. Our review identified several studies that have measured and reported the positive impact of digitalization of the supply chain on the financial performance of firms (Di Vaio & Varriale, 2020; Haoud & Hasnaoui, 2019; Lu et al., 2012; Youssef & El-Nakib, 2015; Zhao & Jiang, 2013). Such studies argued that digital tools not only reduce the costs associated with supply chain activities, including inventory, warehouse, and logistics activities. But also increase the overall firm profit by increasing sales and profit margins. For example, Youssef and El-Nakib (2015) measured the impact of digitalization in three dimensions Return on Assets, Return on Sales, and Return of Equity. The authors reported that the introduction of digital technologies in the supply chain has a positive impact on all three dimensions. Also Lu et al. (2012) and Zhao and Jiang (2013) measured the effect of supply chain digitalization. They reported a positive impact on process performance, which in turn leads to the better financial performance of the firm. While measuring the performance of the DSC, Haoud and Hasnaoui (2019) concluded that the digitalization of the supply chain results in better resource utilization and quicker inventory turnover that contribute towards significant financial gains for the firm. They also reported that, with the introduction of digital technologies, less training is required by new employees to perform activities resulting in significant financial savings.

5.2 Customer perspective

Every business aims to fulfil customer demands at the right time, at the right price, and with the right product and supply chain is a crucial ingredient in serving those demands. BSC demands that these mission statements are converted into specific measures of measurable goals (Kaplan & Norton, 1992). The introduction of digital technologies has helped firms in achieving these goals. On the one hand, they have decreased firms' response time to customer demands by streamlining the process (Lu et al., 2012). On the other hand, they have also improved the overall firm performance that leads to increased customer satisfaction (Jiang & Zhao, 2014; Zhao & Jiang, 2013). However, performance management systems often fail to measure the impact of supply chain activities on customer satisfaction. Dweekat et al. (2017) authored a literature review about Supply Chain Performance Measurement systems. They argued that the majority of the models available are too inward-looking and ignore the importance of external parts of the supply chain, including customers, and focus should be paid to measure their satisfaction to thoroughly asses the performance of the supply chain. Some recent studies have measured

the benefits of digitalization on customer satisfaction and engagement and have reported positive results. With the help of a case study, Haoud and Hasnaoui (2019) confirmed that the processing time and the number of errors were reduced with the introduction of digital tools in the supply chain, leading to quicker and error-free deliveries to the customers resulting in higher customer satisfaction.

5.3 Growth and Learning perspective

Growth and learning measures focus on assessing the firms' learning curve to meet customers' current and future expectations. It concentrates on evaluating firms' ability to innovate, improve, and learn to meet emerging customer needs (Kaplan & Norton, 1992). Employee training is essential in this regard, as reported by Hafeez et al., (2010), after measuring the DSC performance in dimensions of coordination, efficiency, and finance. An attempt to measure employee learning curve was made by Haoud & Hasnaoui (2019), where they reported that not only worker productivity is increased with the adoption of digital technologies in supply chain practices but also a reduction in time needed to train the new employees is recorded for completing the routine tasks. Their findings were in line with Llach & Alonso-Almeida (2015), where they also reported an increase in employee skills with the adoption of digital technologies including reduction in time needed to train the new employees for completing the task, resulting in significant savings for the firm.

5.4 Internal Perspective

Internal performance measures are critical for assessing the performance and effectiveness of actions towards achieving firm goals. Factors related to cycle time, quality, employee skills, and productivity have a significant impact on firm performance and should be measured to assess the firm internal performance (Kaplan & Norton, 1992). One crucial action firms can take to improve its performance and flexibility in operations is by integrating customers and suppliers into their supply chain (Ranganathan et al., 2011; Youn et al., 2014; Zhao & Jiang, 2013). As a result, the quality of information (Youn et al., 2014) and the product quality (Pearsall et al., 2011) also significantly improves. The operational benefits of DSC measures include increased productivity (Hafeez et al., 2010; Haoud & Hasnaoui, 2019), overall supply chain performance (Lu et al., 2012; Ranganathan et al., 2011), better scheduling and resource utilization (Di Vaio & Varriale, 2020), and flexibility (Youn et al., 2014). In their literature review, Wiedenmann & Größler (2019) deduced that digital technologies could reduce the bullwhip effect of sudden changes in the value chain, hence, increasing the operational efficiency and reliability of the firm. Similarly, Hafeez et al. (2010) confirmed that the firms' operational efficiency is improved with the adoption of digital tools. Zhao & Jiang (2013), while measuring the effectiveness of the DSC, confirmed that it has a positive

impact on firms' overall performance. Llach & Alonso-Almeida (2015) reported that the introduction of digital tools not only improves supply chain performance but also increases firms' operational efficiency in micro firms. Haoud & Hasnaoui (2019) reported a positive impact on resource utilization, time reduction, and worker productivity that all lead to the operational efficiency of the firm after measuring the performance of four case study firms. Contrary to other researchers, while measuring the impact of digital tools, Valverde & Saadé (Valverde & Saadé, 2015) reported a significant positive effect on measures of operations, information and communication but limited impact on quality.

6 Conclusions and Limitations

Based on the methodology by Okoli (2015) to conduct a systematic literature review, this research reviewed 23 scientific publications to provide state of the art on metrics for digital supply chain literature and answer proposed the RQs. The first RQ "*What is the current state of research in DSC performance literature?*" is reported in details in the discussion section in the context of four BSC perspectives. The subsections reported on different studies that have measured and reported the performance of DSC. Several studies present metrics to measure DSC performance; however, still a gap exists. As reported in Table 2, the number of studies per year is somewhat limited, despite calls for more studies.

The second RQ, "*What are the most used metrics for performance measurement?,* was answered in the results section. In general, metrics related to Internal and financial perspective receive greater attention. The metrics focused on measuring performance in dimensions related to "operational efficiency", "operational speed", "error rate", "system reliability", "system flexibility", "operational cost", "return on investment", were used 10 times or more. The complete list of KPI and related metrics frequency has been presented in Table 3.

In response to the third and final RQ, "*Which aspects of the DSC performance measurement literature requires further attention*?", further studies should focus on developing specific metrics for measuring DSC performance. The only study that was identified during our literature review, focusing on developing metrics for DSC performance was by Sambasivan et al. (Sambasivan et al., 2009). This lack of metrics has resulted in a relatively small number of studies focusing on measuring the performance of the DSC. Particularly the call for quantitative measures (Lima-Junior & Carpinetti, 2017) and empirical studies (Ranganathan et al., 2011) is still not satisfied. Additionally, the reviewed studies do not pay equal attention to measure performance in all four perspectives suggested by BSC. For example, "internal perspective" received the overwhelming amount of consideration (61% metrics focus on it), and "growth and learning perspective" received the least attention (5% of metrics focus on it). Another fact that highlighted the need for further research was the inability of metrics to reflect the adoption and advantages of digital technologies used by firms. The majority of the studies

we reviewed used perception-based traditional measures to assess the performance of DSC.

Supplier performance is crucial for meeting a firm's flexibility, cycle time, and quality goals that are essential to achieve higher DSC performance. Surprisingly no or very little attention was paid towards measuring supplier's performance as a result of target firm adoption of digital tools, leaving a significant gap in this crucial area of research. Another shortcoming of the existing literature was noted in its inability to incorporate external factors, such as government (trade policies, environmental regulations), competitors (new units, price changes), and newer technologies. No efforts were made towards incorporating these factors into the supply chain to receive early feedback or warnings. In conclusion, we argue that there still exists not only a need for empirical studies to test available metrics but also a need for theoretical studies to develop appropriate metrics.

We recognized that there are some limitations to the study. First, although *Scopus* covers a wide range of peer-reviewed publications, it does not include all reputable peer-reviewed publications. Therefore, using different search terms and additional databases beyond *Scopus* may have resulted in the identification of other metrics. Additionally, the inclusion of technical reports might have been useful as well. Second, the use of BSC to categorize all available metrics may have wrongfully categorized them into one of the available four perspectives. We recognize here that the original study may have used the metric in a different context.

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Present Begets Future: Deciphering Challenges of New-Age Corporate University through Bibliometric Analysis (2000-2018)

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Abstract

This paper attempts to unravel the research works on challenges corporate universities are experiencing to date. Bibliometric method was used to analyses 21 journal articles on the challenges faced by new-age corporate university for the timeframe 2000-2018. These articles were selected from the Scopus database. For the timeframe 2000-2018 authors critically discuss the results on the lines of most influential authors, countries, institutions, overlay of research works. This study also provides co-word analysis to unearth the major challenges faced by new-age corporate university like Strategic integration of Technology in corporate university, Bottleneck in sustaining Innovation as a catalyst to the competitive advantage of corporate university, and Dysfunctional knowledge management of Corporate University. The findings of this study can help HRD managers to devise measures to address the challenges and provides new lines of inquiry for future research. This study makes a unique attempt to move ahead of the descriptive and procedural aspect of corporate university to critically discuss the challenges aspect.

Keywords – Corporate University, challenges, bibliometric, Scopus

Paper type: Academic Research Paper

1 Introduction

Over time, organizations began to perceive the corporate university concept not only as a tool to transmit internal knowledge but also as a process to ensure a company's survival in the long term (Singh et al., 2020; Alonso-Gonzalez et al. 2018). Since the 1990's there has been an exponential increase in the number of corporate universities (Abel & Li, 2012), this increase is grounded in the assumption that employees with requisite skills, which are aligned to the organization's objectives facilitate overall goal attainment.

Walton (1999) categorized corporate universities into three generations. The first-generation corporate university was repackaging of traditional training and development interventions requiring classroom presence. The second-generation corporate universities focused broader strategy to attain organizational learning whereas the third -generation dealt with virtual aspects of the learning process and possess a large spectrum of strategies of intellectual capital development.

However, corporate universities have a very high failure rate (Singh et al.,2020). It is believed that given today's difficult economic situation and limited support and resources for developmental initiatives, the effectiveness of the corporate university is under scrutiny from senior management. CUs need to be smart about how they spend their time, energy, and resources by aligning all learning activities with organizational goals (Abel and Li, 2011). Also, Corporate university made a paradigm shift from Walton's third generation to the New-age corporate university, which focuses on integrating innovation, technology, and knowledge management. Therefore, it is important to understand the trajectory of challenges that the new-age corporate universities are facing. The objective of this study is to understand the diverse challenges that corporate universities are facing while attaining and sustaining a competitive advantage.

The present study adopts bibliometric approach. Bibliometric analysis a systematic, transparent, and reproducible review process and, thus, improve the quality of the review (Bellis, 2009). It permits assessment of the scientific quality and effect of progress in knowledge in a specific subject (van Leeuwen, 2006; van Raan, 2005). Hence, the present study attempts to tie the fragmented research works on the challenges surrounding new-age corporate universities. The research includes a bibliometric analysis based on 21 research works on challenges faced by corporate universities from 2000-2018, retrieved from SCOPUS. This study adopted co-word analysis as a bibliometric technique to understand the challenges of the corporate university. The following section briefly discusses the methodology and findings.

2 Theoretical Background

It is assumed that organizations that consistently strive to leverage their human capital attain success. Therefore, the relevance of strategic human resource development has risen to improve performance with profitability (Alagaraja, 2013). In order to reorient human resource development to strategic human resource development, organizations in present times are establishing new-age corporate universities. The first corporate university was established by GE at Crotonville in 1955 (El-Tannir, 2002). Corporate universities are a paradigmatic shift from traditional training programs as they are more proactive with being 'purpose- driven' organizations (Rotatori et al., 2020). This dynamic environment wherein companies are rampantly establishing new-age corporate universities to address the complexity arisen due to environmental pressures and expectations can be understood through the integration of complexity theory and institutional theory. Complexity theory questions the conventional tenets of management

by adopting nonlinear and behaviors of systems. Therefore, there is a need for a shift in the traditional mindset of managers, wherein they can leverage complexities (Anderson, 1999). Institution becomes complex due to environmental pressures, norms, values impacting both the individual and institution. Hence, this complexity can better be understood from the lens of institutional theory, which argues that the key focus of the theory is on the institutional environment (Alagaraja and Li, 2015). Hence, the institutional environment influences both people and institutions. In order to acclimatize and address the external pressures, companies adopt legitimacy by devising patterns of responses and action routines that mature over time and become grounded in industry tradition (Peter, 2016). Rapid changes like innovation, technology, and faster transfer of information have compelled companies to discover measures towards human capital development at an exponential scale (Allen, 2007). Therefore, to address these institutional forces, companies started to establish corporate universities to attain shared purpose and meaning for workers and other stakeholders (Singh et al., 2020). Besides, through corporate universities companies were able to transfer their vision and mission across spaces. To summarize, corporate universities have shaped into institutional mechanisms to facilitate learning and performance, enable commitment to share best practices on varied aspects like technology, innovation, and knowledge management (Allen, 2007). Therefore, by adopting an integrative lens of complexity and institutional theory, we attempt to identify and understand the challenges that corporate universities are facing while transforming themselves from traditional training and development initiatives.

3 Methodology

The bibliometric analysis techniques are quantitative methods to analyze increasing literature in different research fields. More specifically, a bibliometric study focuses on investigating and understanding the pattern of the studies (Bhattacharyya and Verma, 2019). Although traditional systematic review of literature can offer in-depth understandings in the topic, bibliometric analysis can provide research breadth by comprehensively handling all the existing studies. Co-word analysis under the umbrella of the bibliometric analysis method utilizes keywords of articles to abstract scientific maps of an area (Singh et al., 2020). This study utilized VOSviewer tool to generate a vivid network diagram through co-word analysis. VOSviewer is an influential user graphic-interface technique that allows researchers to create network maps suitably (Eck and Waltman, 2009). The bibliographic records in the Scopus is searched using following keywords as proposed by Singh et al. (2020): (‘‘corporate university’’ or ‘‘corporate universities’’) AND (‘‘challenge’’ or ‘‘risk’’ or ‘‘barrier’’). Only peer reviewed articles published in journals were retained and a total of 21 articles were obtained in the final data set. This study analyzed the 21 articles using VOSviewer 1.6.8 (bibliometric tool). The dataset comprised of bibliographic information explaining varied aspects of the 21 Scopus indexed journal articles. This meta-data retrieved contained information like the

names of authors and affiliations, article titles, publication timeline and citation information. Descriptive analysis is conducted to comprehend trends associated with the development of the CU literature.

4 Results

In this section results of bibliometric analysis is inferred, the general results indicate the holistic assessment the number of documents published on the area along with its growth trajectory; highly cited publications, influential authors, influential countries and influential institutions. Furthermore, the overlay of documents depicts co-word analysis of challenges faced by the corporate universities on a temporal dimension. Lastly, the co-word analysis indicates what the major themes that have been investigates as challenges to the corporate universities.

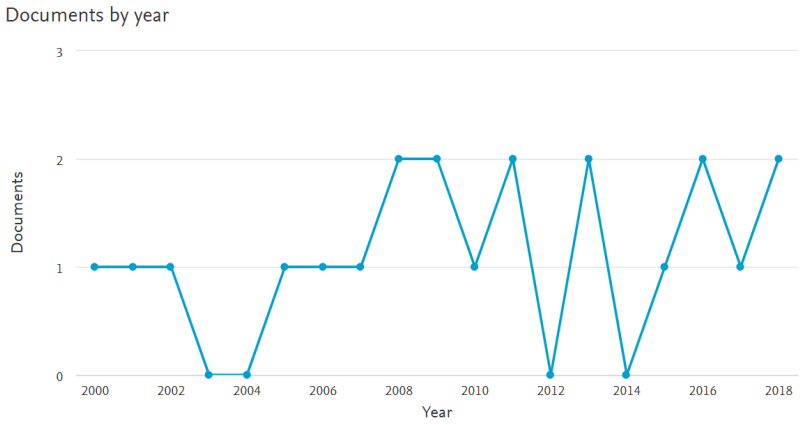

Figure 1 Distribution of publications per year on CU challenges during 2000-2018

Figure 1 indicates that documents in the area of corporate universities that are addressing the concern, challenges, and barriers have increased from 2004 onwards. In total, the field produced more than 21 articles. Post 2004 it is seen that there have been spikes in publications, indicating that output on the given topic has been inconsistent with sudden increase or decrease. For instance, in 2013 having 2 publications whereas 2014 having 0 publications.

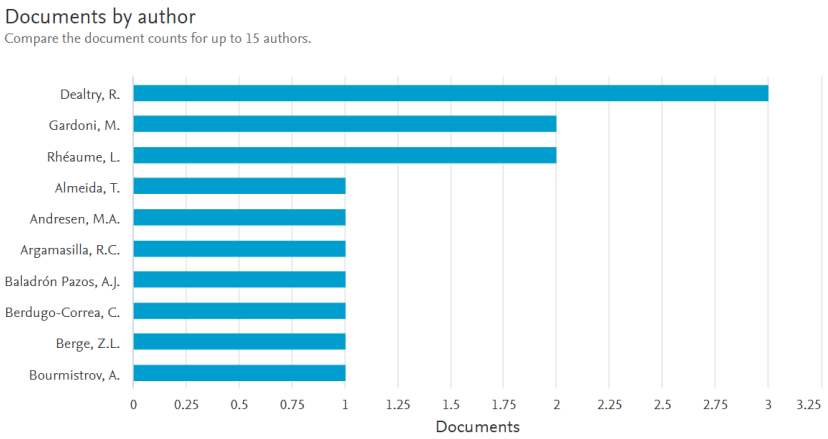

Figure 2 Highly cited authors on CU challenges during 2000-2018

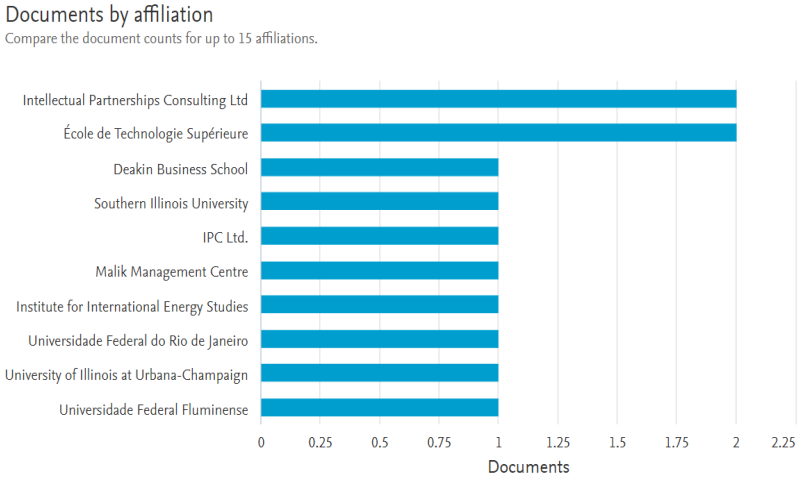

Figure 3 Highly influential institutions- CU challenges during 2000-2018

The leading authors who have widely discussed the challenges faced by corporate are Dealtry, Gardoni, and Rheaume with 3 and 2 documents respectively (See Figure 2). The leading institutions who have addressed this topic are Intellectual Partnership consulting Ltd, and Ecole de Technologie Superiure with 2 documents and Deakin Business school and Southern Illions university with 1 document (See Figure 3). Countries with the highest number of documents in this area Canada, United Kingdom, the United States with 3 documents (See Figure 4). 76.2% of documents are journal articles whereas 23.8% of documents are conference papers (See Figure 5).

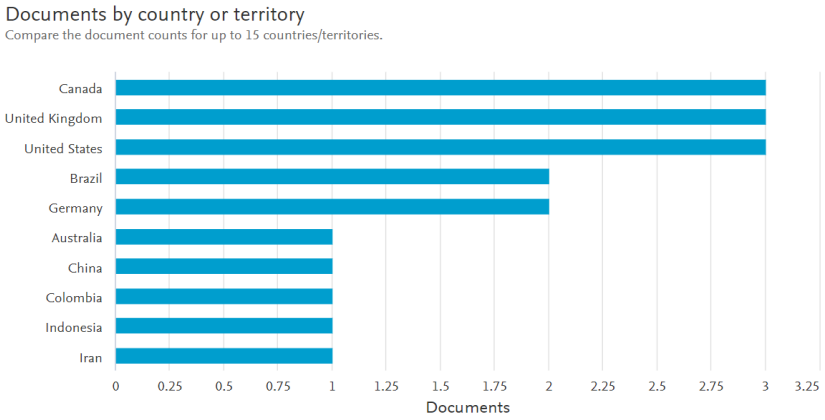

Figure 4 Top countries - CU challenges during 2000-2018

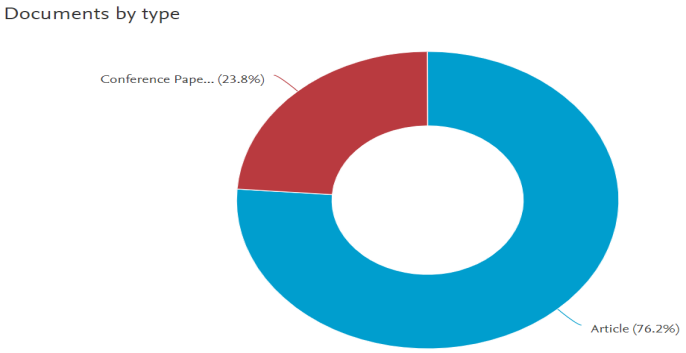

Figure 5 Distribution of documents type from 2000-2018

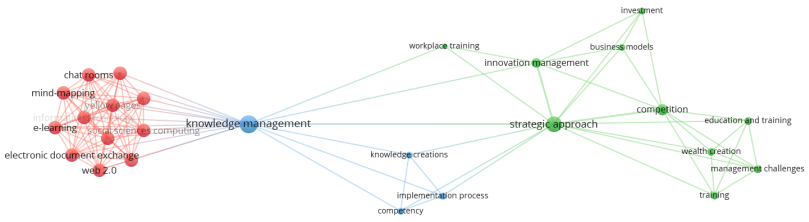

Figure 6 Visualized co-word network of CU challenges from 2000–2018.

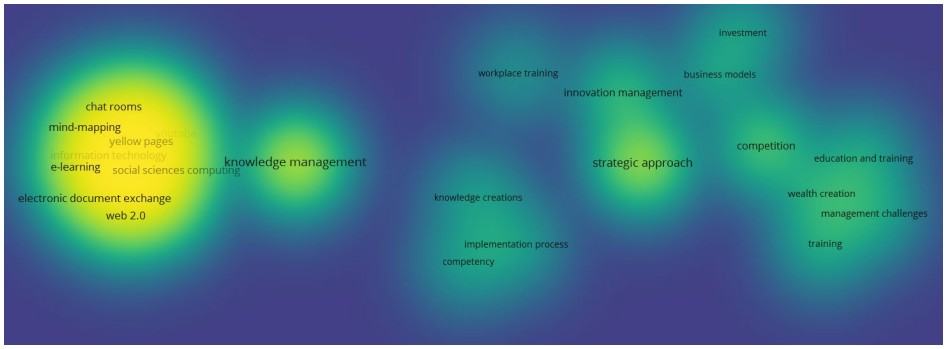

Figure 7 density diagram of CU challenges from 2000–2018.

Figure 8 Overlay of keywords of CU Challenges (2000-2018)

Figure 6 and 7 demonstrate that the co-word analysis aggregate keywords in three cluster including, (a) Strategic integration of Technology in CU (red) (b) Bottleneck in sustaining Innovation as a catalyst to competitive advantage of CU (Green) (c) Dysfunctional knowledge management of Corporate University (Blue). Figure 8 shows the co-word analysis of challenges faced by the corporate universities on a temporal dimension. It is evident from Fig. 8 that keywords like chat rooms, mind-mapping, e-learning, web 2.0, electronic document exchange appeared around 2010 and 2011 (Violet). Much of the focus of the challenges of corporate university research was on the integration of technology. Keywords that were used towards 2012 and 2013 (Green) included knowledge creation, implementation process, competency, strategic approach, training. Most research around this period focused on knowledge management in the corporate universities. Around 2014 and 2015 (Yellow) focused on leveraging innovation in a disruptive business environment. The most prevalent keywords included business models, innovation management, knowledge management, investment, workplace training.

5 Discussion

The present study attempted to investigate the challenges new-age corporate universities are facing through a bibliometric analysis of two decades (2000-2018). Co-word analysis identified three predominant challenges faced by new-age corporate universities (a) Strategic integration of Technology in CU (b) Bottleneck in sustaining Innovation as a catalyst to the competitive advantage of CU (c) Dysfunctional knowledge management of Corporate University. These emergent themes can be understood through the integration of complexity and institutional theories.

5.1 Strategic integration of Technology in Corporate University.

While the integration of technology in functioning corporate university has potential but the effectiveness of it is considerably restricted by the context which impacts the extent of sophistication and incorporation of technology and its capability to facilitate the learning process and output of corporate university (Homan and Macpherson, 2005). E-learning has several advantages for instance it gives required flexibility but this flexibility requires higher responsibility from the individual and higher learning expectancy in non-working time (Homan and Macpherson 2005). Another challenge in the incorporation of technology is learner style (Masie 2001, Homan and Macpherson,2005), if it remains unaddressed it questions the dependency on self-instruction and self-motivation is apt for a broader organizational structure. Dringus (2000) and Homan and Macpherson (2005) cautioned that e-learners may be inept to withstand their momentum without being self-driven, and unless they are ready for isolation. Masie (2001) corroborates with this argument and stressed that "learner acceptance" cannot be assumed to be present, therefore organizations need to address concern of marketing (to motivate participation), support (to facilitate retention), incentives (to give validation of completion of training), and technology (to aid collaboration and give integrated solutions).

5.2 Bottleneck in sustaining Innovation as a catalyst to competitive advantage

Despite the notable advantages attached to the corporate universities, they face certain bottlenecks to their road to attain a competitive advantage (Dealtry, 2001). The way forward is the acumen of the company to replenish their knowledge, which is knowledge innovation. It is believed that knowledge innovation is key to achieve a competitive advantage with excellence (Dealtry and Rademakers, 2005). Organizations in present times cannot afford to sideline the relevance of knowledge innovation as this ignore may make them corporate dinosaurs (Dealtry and Rademakers, 2005) Innovation is not merely technology adoption rather than focusing on market-driven and business-oriented innovation. In recent times, market-driven and business-oriented innovation comes under the ambit of the corporate university. The corporate university needs to reorient itself from reactive to proactive position to meet the expectation of market-driven knowledge

innovation. Furthermore, the challenge of taking strategic options in innovation in corporate university is accruing assets by reducing the risk of replica and imitation. Corporate universities that aim to become open innovation center come across challenges like loss of knowledge, rise in coordination costs, diminished control, and deeper complexity (Rhéaume and Gardoni, 2015).

5.3 Dysfunctional knowledge management of Corporate University

In strategic management literature, widely it is believed knowledge is considered to be an important ingredient to a company's pursuit of excellence and therefore provides a competitive advantage. Organizations trying to attain and contain a higher degree of knowledge and also capitalizing on it requires considerable effort on their end (Dealtry and Rademakers, 2005). Studies have reported corporate universities to be corporate knowledge management institutions (Shaw, 2005; Scarso, 2017). They are bracketed as institutions that are involved in continuing, structural, and strategic steered knowledge transfer, exchange, and development of processes within companies. However, knowledge management in these institutions is still an issue. The issues that corporate universities face is vacuumed thinking, hanging on to ideas, and ignorance. Furthermore, some studies have argued that knowledge innovation cannot be termed as prosperity of technocrats, human capital manager, or scientist (Dealtry and Rademakers, 2005).

It is believed that key emphases of knowledge transfer are restricted to the knowledge dissemination avenues, cross-border communication, and knowledge construction in the context of individual knowledge internationalization and externalization and knowledge triangulation (Crocetti, 2001; Clinton et al., 2009; Baporikar, 2015). Given the corporate universities functions being dynamic has made its knowledge network more complex (Chen et al., 2019). Therefore, corporate universities focusing on technical knowledge adopt basic repositories whereas those focusing on non-technical knowledge utilize more interactive tools (Scarso, 2017).

6 Implications for Researchers and Managers

Scholars need to investigate complex knowledge networks in the context of corporate university's functions. As extant literature as the connected corporate university with knowledge management in a generic manner, studies need to perform an in-depth investigation on knowledge management aspects of corporate university to unearth its pertinent characteristics and processes. Furthermore, researchers need to understand which of the available corporate university models are facilitators of innovation. HR managers need to decipher whether the adoption of e-learning through corporate university is a strategic call or a cost-based decision intertwined with other HR objectives. Managers need to a build learning culture, which is deemed to be a key input for the success of a corporate university to address the issue of pedagogy, locus of control, and quality control. Also, the organizations need to decipher the knowledge management

goals, process and contents that typifies organizational context. Organizations need to identify knowledge management issues and varied corporate university designs to churn out valuable inputs for managers who are keen to capitalize in this organizational solution.

7 Conclusion

Corporate university in academics is a popular but lesser empirically researched topic in HR in comparison to other established HR concepts. Several of CU failure at the time when it is deemed to be providing a competitive advantage to organizations. It is important to ascertain and understand what are potential challenges that are derailing the journey of CU. To address this objective, the present study used VOSviwer to ascertain the research epochs, influential topics, seminal documents, and researcher. On the basis of this input, we further analyzed different challenges faced by CU. Furthermore, we present future research avenues grounded in the current state of the field. Therefore, this study presents researchers with structural and thematic understand of the challenges that the new-age corporate universities are facing.

8 Limitations

The present study makes valuable contribution to the extant body of literature but it also has certain limitations. Firstly, the database of the study was limited to journal articles in the field of business and accounting. Therefore, themes and findings of the study may not be generalized to puritan higher education discipline. For instance, certain higher education journals have theoretical and empirical articles on corporate university. Corporate university as a research area is at a nascent and developing stage, therefore there is a need to replicate longitudinal review of literature to ascertain new themes engulfing the research area.

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The Role of Social Capital in the Cluster Evolution in Theory and Practice

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Abstract

In the last decades, the concept of cluster has gone through the vast conceptual development, resulting in its various definitions and categories - 'cognitive clusters', 'learning clusters', 'creative clusters', 'working cluster', 'effective cluster' (Capello & Nijkamp, 2019; Martin & Sunley, 2003; Lagnevic et al., 2004). Despite of their different approaches all above definitions share one common 'relational' context. Starting from the Porterian concept of 'industry cluster' as spatial networks of industries, which enjoy positive externalities from co-location and frequent interactions, to the more recent concept of a 'working cluster', where firms and other organizations maximize benefits from the synergetic effects coming from integration, cooperation, and competition (Porter 2008). Furthermore, Bochniarz-Faoro refer to 'effective cluster', which is characterized by the rich social networks that enables all participants to efficiently cooperate with one another (2016). Social networks have been also recognized as underlying factor for cluster development in other studies, including Phillips (2006), Ostergaard (2009). Nevertheless, the inherent complex configuration of every cluster, and its divergent patterns of evolution make it difficult to determine the mechanism of Social Capital formation and its impact on cluster growth. To identify this dependency a more case by case analysis maybe useful.

The study aims to explore and evaluate the role of social capital in the evolution of a cluster, using the example of the life sciences industry. Social Capital is defined here as a capital that results from investments in building relations, institutions and networks that produce collaborative attitudes, shared values, mutual understanding and trust. The notion evolution refers here to gradual transition from an emerging cluster to a functioning and growing cluster during the growth phase of markets. More specifically, the study takes an example of five life sciences clusters - San Francisco Bay Area (US), Cambridge (UK), Copenhagen-Lund (Denmark/Sweden), Seattle (US) and Poland, to answer: How does notion of Social Capital and its different dimensions operate within clusters' evolution? What is the contribution of Social Capital within different stages of clusters' evolution? Does Social Capital and social networks can exert a distinct influence on the performance of different clusters? What types of social networks induce cluster related positive externalities?

Keywords – Social capital, Networks, Cluster, Life sciences.

Paper type: Academic Research Paper

1 Introduction

There is a substantial amount of the high-tech-cluster-related literature considering the following success factors of the clusters: strong science and industry base, strong networks between industry and science, that facilitate the growth of both academic and industrial spin-offs, finance availability for new biotech companies (including venture capital and government funds), as well as traditions of local entrepreneurship (Maskell and Malmberg 1999; Su and Hung 2009). Relatively fewer sources mention the role of social networks between faculty, investors, students, intermediary agents, and local authorities in sharing knowledge, information and thus stimulating inventions and innovations (Broekel and Boschma 2016; Ponds, Oort, and Frenken 2009; Audretsch and Feldman 2004; Golejewska 2018; Adams 2002).

The following study focuses on a relatively less discussed factor – social capital and social networks or larger social structures as a key determinant of the success of the life sciences ecosystem. The study aims to deliver new insights in the discussion on the role of social capital, social networks and collaborative social environments in the leading life science clusters in Europe and the US.

The paper consists of the fourth main sections, followed by Introduction and Conclusions and Implications. The first one discusses the concept of social capital and its role in research collaboration, innovation networks in the high-tech clusters and innovation ecosystem contexts. Second one points out the evolution of the Triple Helix networks along the technology dynamics and the role of social capital in the latter process. The third one focuses on the role of social capital in the university-industry collaboration context. Finally, the fourth one, discusses the empirical study results based on the case study of life sciences clusters.

2 Social Capital – conceptual background

Various authors provide similar and slightly distinctive definitions of social capital. Social capital is broadly understood formal and informal relations between at least two people. Positive social capital creates relationships based on trust, cooperation, openness, while negative capital refers to the social relations that are characterized by the suspicion, hypocrisy and secretiveness (Walukiewicz 2007). In his comprehensive study, Pierre Bourdieu (1986), defines social capital as a private investment in social networks that brings the owner expected benefits, such as wealth, and "symbolic capital" (social position). James Coleman (1988), in turn, regarded social capital as an individual good that could be, however, traded through social networks for the advancement of broader human capital. Finally, the last two decades witnessed many new studies extending social capital from the individual or private good to more of a collective or even public good. This group of researchers include Fukuyama (2001), Putnam (2000), Rosenfeld (2007), Lin (2001), Landabaso et al. 2007, Woolcock and Narayan (2000) and others. According to Francis Fukuyama (2002), social capital is a set of informal norms and rules as well as

ethical values shared by individuals and social groups that enable them to cooperate effectively. For Robert Putnam, social capital does not belong to anybody, but is a public good representing a set of social norms and civic attitudes supporting common actions and trust for both interpersonal and in public institutions (Bochniarz and Faoro 2016). Social capital is defined by experts from the European Commission (2005) in a similar manner – "Social capital refers to those stocks of social trust, norms and networks that people can draw upon to solve common problems". The institutional and relational context is present in Roberto Camagni's definition of social capital, which is "the set of norms and values which govern interactions between people, and "(…) glue that holds societies together" (Camagni and Capello, 2012). The role of networks in the society was further extended in the study by Franz Huber who defines social capital as "…resources embedded in social networks which can be potentially accessed or are actually used by individuals for action…" (Huber 2008:19). Furthermore, he distinguishes "internal social capital" – resources mobilized through relationships between members of the collectivity – from "external social capital" – resources mobilized through relationships between members of the collectivity and actors outside of the collectivity. As an example of this dual character of social capital, Huber uses economic clusters, where the distinction depends on access to knowledge within the cluster and access to other clusters and outside individuals (Bochniarz and Faoro 2016).

Stuart Rosenfeld interlinks the notion of social capital in clusters that gives opportunities to "know-who" to the notion of "know-how". He also classifies social capital from the point of view of openness as positive and negative one (Rosenfeld 2007). Positive social capital creates economic advantages that are major forces for clustering. Negative social capital can develop when there are efforts to limit membership in clusters and "lock-in". Mark Granovetter (1973) distinguishes between "strong" and "weak" ties and states that the strength of a social tie is defined by a combination of the time invested, the emotional intensity between the actors. In other words, ties with a higher degree of emotional involvement are more important in the discovery of a business opportunity, and weak ties become more important when exploiting such opportunities. In the context of cluster interlinkages, strong ties describe strong relationships, based on trust and are characterized by frequent interaction (both formal and informal one) which lead to a greater exchange of knowledge (Burt 2009; Rowley et al. 2000). At the same time, weak ties could potentially add heterogeneity to the knowledge base of cluster actors. Table 1 presents the classification of the characteristics of bonding and bridging social capital.

Table 1. Bonding vs. bridging social capital

Bonding social capital	**Bridging social capital**
Within	Between
Closed	Open

Inward looking	Outward looking
Horizontal	Vertical
Strong ties	Weak ties
Thick trust	Thin trust
Network closure	Structural holes

Source: Ramos-Pinto (2012).

The classification made above may lead to an overly simplified and even contradictory image of the social capital networks. In practice, social relationships are far more complicated and usually accompanied by multiple overlapping relationships that individuals have with each other. Thus, a typical relationship would have some characteristics of both bonding and bridging social networks. Last but not least, bonding and bridging are not completely mutually exclusive and the final structure of the network configuration depends on the type of knowledge interlinkages present in a particular cluster, its technological dynamics, as well as the importance of other dimensions of social capital.

3 Social Capital, Proximity and Technology Dynamics

3.1 Social Capital, Proximity and Effective Cluster

According to Sztompka (2016), a cooperation, trust, and a fair exchange make up the so called "moral space" which is at the core of every community. In this sense, effective clusters and innovation ecosystem approach the same issue – the connections between the entrepreneurship process, localized economic and social contexts and knowledge spillovers (the importance of entrepreneurs drawing on knowledge outside of the firm to increase their competitiveness). As stated by Bochniarz and Faoro (2016), the 'effective cluster' is characterized by "rich social capital that enables all participants to efficiently cooperate with one another, which leads to the increased generation of positive externalities coming from co-location and building collaborative synergy within the cluster, as well as openness for cooperation with other clusters, which leads to knowledge spillovers among them and increasing innovations". This loosely-coupled structure helps to create a culture of innovation within the cluster ecosystem, allowing innovative ideas to not only be formed, but also to thrive and grow. In the effective cluster, groups involved in innovative projects will reach out to each other directly to solve problems rather than require a central office to mediate all communications.

The relation between innovation and social capital was also empirically examined by Hauser et al. (2007) on a sample of European regions. The authors` empirical results

suggest that social capital does have a considerable impact on the production of knowledge. Furthermore, different dimensions of social capital have different effects on the innovation rate, i.e. the positive relationship between the weak ties in social interaction and innovation. Similar study by Laursen et al. (2007) focuses on the structural dimension of social capital and combines the data on social capital at the level of 21 regions with data on innovative activities from a sample of 2,464 manufacturing firms in Italy. The authors argue that, after controlling the firms' characteristics and regional ones, co-location in regions characterized by high levels of social interaction leads to a higher propensity to innovate as well as a higher influence of externally acquired R&D on innovation. Similarly, Ostergaard (2009) analyzed knowledge flows through social networks in a communication cluster in North Jutland, Denmark. The author aimed to answer to what extent social networks contribute to channelling knowledge flows between firms and the local university among engineers and computer scientists. Ostergaard's study proves that there are differences between extent and frequencies for the two types of informal contacts (between the firms and between the firms and the university). Mainly, both in case of the university-industry and industry-university informal contacts are less frequent. These findings contradict the belief that knowledge sharing between firms is more likely to endanger their competitiveness, compared to university-industry knowledge sharing.

Finally, Feldman (1999) in her studies demonstrated that physical proximity is not the main condition for social proximity. In fact, she concluded that "pioneering faculty members to start a company lead other faculty members to found companies as well", suggesting that physical proximity might not be enough to create the 'contagion effect' for the local university-based ecosystem players and the occasions for learning and knowledge exchange seem to be facilitated by a high level of the embeddedness of their social relations with other actors.

3.2 Triple Helix Networks and Technology Dynamics

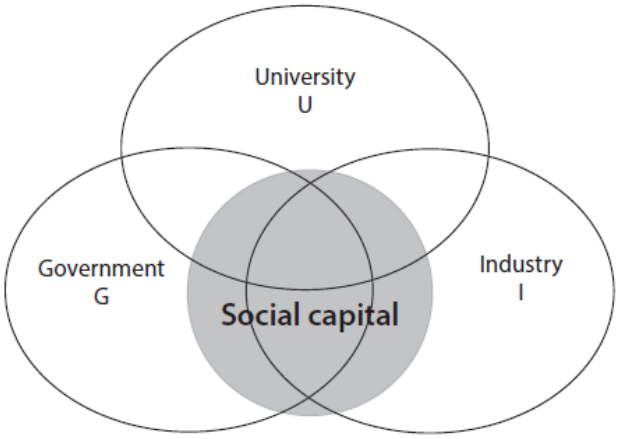
The interaction between individuals or various institutional entities (groups, organizations) plays a critical role in articulating and amplifying knowledge (Nonaka 1995). Yet, as Jensen and Tragardh (2004) put it, the institutional and social interactions architecture of particular Triple Helix relationships model may differ by sector and its technological maturity, e.g. in the case of aerospace, successful research and innovation strategies cannot be effectively formulated and implemented without the government support, whereas in the life science, successful innovation depends on the basic and preclinical research in the life science, the bulk of which is done at the universities. Thus, it is possible to assume that certain types of dynamic externalities and social interactions assist the industry along its life cycle – from a young to a more mature stage. The latter could be explained based on a stylized description of the typical life cycle model, which follows the logistic S curve, starting with the introduction of new products, followed by a

period of strong expansion of production, which then levels off and eventually leads to a decline. A new industry or industries at the introductory stage of their development benefit mostly from diverse knowledge infrastructure and inter-industry knowledge spillovers. Innovation intensity is high, as there are many unexplored technological opportunities (Neffke et al. 2009). At the growth stage of industry development, production becomes more standardized, which opens up possibilities for firms to exploit their divisions of labor and economies of scale. At the stage of maturity, firms typically face vigorous price competition. Profit margins are reduced and technological opportunities are exhausted. In terms of innovation, longer jumps in technology are less likely and so are radical innovations, as the industry has already invested heavily in technology and skill development. The R&D efforts require very specialized, fresh knowledge and skills. Such expertise is best acquired through processes of local tailor education, training systems and access to the university R&D labs and research output. The content of the social ties (both formal and informal ones) between the above actors is different, depending on the types of information and knowledge exchanged between them. In this context of social networking and co-location, next to the leading universities create positive externalities and are especially important for the industries that are undergoing rapid technological change or are in the growing stage of their economic life cycle.

In sum, the evolutionary cluster related literature goes beyond the institutional interlinkages of university, industry, government and society, by going deeper into the specific actors within each sphere, their identities, objectives and social interaction dynamics.

4 The Social Capital in the University-Industry Collaboration

In order to access new talent and technologies, significant investment is being made by high-tech companies in building relationships with research labs and academia. Companies offer doctoral and post-doctoral research funds at leading universities worldwide in order to take steps in the active recruitment of talents. This diversity, interdisciplinarity and connectivity make some high-technology clusters natural environments for the technological convergence. These clusters that created social and institutional mechanisms allowing new ideas to move from one domain to another (Figure 1).



Source: own elaboration.

Figure 1. The role of social capital in Triple Helix networks

For example, the research done by Steinfield and Scupola (2008) concludes that ICT use appears to strengthen the life sciences cluster in Denmark and Sweden (Medicon Valley), and that firms located within the cluster appear to gain some unique advantages from their ICT usage that are not necessarily available to firms outside the cluster. Moreover, the authors concluded that small firms would not gain as much from the use of the ICT infrastructure if not located in a cluster with a strong reputation. Their study emphasized the key role of clusters in creating innovation-friendly ecosystems in the life sciences sector. Yet, strong trust-based relationships are not easily built in the case of such different stakeholders as industry and academia. In fact, researchers from the industry and researchers from the academia work in a different culture and cognitive norms. One example may include the fact that the academic reward for scientific discovery consisting of quality publications or grant/research council funding is highly rank-conscious and individualized. In contrast, pharma industry researchers are salaried as contributors to a team effort aimed at helping invent marketable drugs. Thus, academic science researchers do not routinely operate with levels of collaborative interaction and cross-disciplinary teamwork environment, which is essential to drug discovery and the challenges of applying basic research to address therapeutic/medical needs (Janero 2015). The academic scientists are not equally trained in such matters as decision theory, collaborator relations, or risk and project management. Thus, preclinical university-industry discovery alliances can have discord over the fundamental laboratory findings, i.e. the overvaluation of procuring knowledge by university scientists and undervaluation of new knowledge by industry professionals whose expertise and vision are down the critical path toward market. Such organizational, social and cultural distinctions pose a challenge to discovery research collaborations between university and industry sectors. Establishing common ground for the university-industry discovery collaboration depends

critically on the individuals involved, who can break institutional barriers and inculcate focus, cooperation, inclusion, and trust among its participants. Even though social capital should not be considered a panacea for increasing the levels of innovative activity, yet, there is there is sufficient evidence that the positive influence of social networks reveals a strong contextual and environmental influence on this activity.

5 The Social Capital in the University-Industry Collaboration: Case Study of Life Sciences Clusters

In terms of methodology, most social science researchers acknowledge that the "social capital" and "social networks" are complex issues and therefore, they would benefit most from the integration of qualitative and quantitative approaches. In practice, however, effective quantitative research requires a larger sample size, which was not possible in the case of the following research study, due to the limited time and resources. The team of researchers conducted five qualitative case-studies research within the selected sample of the European and US life science clusters. The qualitative sample includes five case studies – life science ecosystems in San Francisco Bay Area (24 interviews), Cambridge (14 interviews), Medicon Valley (12 interviews), Seattle (10 interviews) and Poland (12) (see the full study in Runiewicz-Wardyn, 2020). The questionnaire contained mixed questions (open and closed ones) and was composed of four parts: (1) the mission, structure and types of social networks; (2) the methods of networking and the intensity of interactions; (3) the role of different types of proximities in social networking; (4) the impact of social networks on R&D collaboration and innovative performance. The authors conducted interviews with the heads and deans of departments, the technology transfer offices (TTO), related educational institutions and companies in the following life science cluster ecosystems.

5.1 Cambridge life sciences cluster

The Cambridge life sciences cluster ecosystem is rooted in the mature world-class cluster in life sciences. It is featured by more closed social networks with hierarchical structures and strong ties in the sense of Granovetter (1973). The intensity of networks is somewhat circulates around more powerful individuals (Deans and Heads of Departments) interconnecting the other actors in the ecosystem, as well as holding control over information that originates from other networking groups. In this sense, their closed hierarchical network structure is in line with the spirit of Coleman (1988), it provides the ecosystem actors with greater trust which might be very important when deciding whether to exploit a research/business idea or not. The role of "triadic closures" was significant, as many of these actors formed collaboration links with partners' partners. The physical proximity among Cambridge ecosystem actors allows them to engage in more informal interactions and serves as a precondition to strengthen social ties and trust. On the other hand, the geographic dimension can really matter when strong social networks already

exist, so one could state that physical proximity enhances and strengthens personal relationships within the existing networks.

5.2 Medicon Valley life sciences cluster

Medicon Valley is considered to be one of the strongest mature life sciences clusters in Europe. Its development and cooperation in life sciences was given a major boost in 2000 thanks to the European development funds, which resulted in the opening of the Øresund Bridge, joining Denmark and Swedish life sciences clusters in one dense innovative cluster. This provides benefits both from the learning perspective and exploitation of innovation perspective. In the last decade, many new partnerships have been formed by a mix of Danish-Swedish, public-private, academic-industrial representatives, as both countries share quite similar culture and institutions. Nevertheless, the existing differences in culture and language between Denmark and Sweden affect their differences in social set-ups. The relationships between the researchers and colleagues at the cross-border firm and university levels are based on educational and professional backgrounds rather than personal friendships and territorially contained trust and understanding. As in the view of Granovetter (1973), one could say that social networks in the Medicon Valley are characterized by the weaker ties, but greater openness, as in the sense of Coleman (1988). For this life sciences ecosystem, physical proximity remains a necessary condition for the social proximity to evolve and sustain.

5.3 Bay Area life-sciences cluster

The social networks within the Bay Area actors are characterized by the strength of the weak ties in the sense of Granovetter (1973), which are expanded via both vertical and horizontal interlinkages within the cluster and promote firms' specialization in the life sciences, while enriching them with new emerging (i.e. interdisciplinary) research and commercialization opportunities. The environment of dense networks and bonding social capital, driven by the geographical, interorganizational and cultural proximities also resembles social networks with closure in the sense of Coleman (1988). The research study demonstrated that when the technological dynamics-bridging type of social capital takes an active role (especially via intermediary organizations and personal contacts from one's previous jobs), the role of indirect ties to external collaborators ("triadic closure" that occurs through the shared collaborator inside and outside the cluster ecosystem) becomes active, too.

5.4 Seattle life sciences cluster

In the Seattle life sciences cluster rich academic culture shape a custom not only to collaborate across other disciplines and practice entrepreneurship (Bochniarz 2020). All these lead to a high level of invention and innovation. Following the major social capital

theories initiated by the studies of Coleman (1988, 1990) and Burt (1992), applied in the context of the Seattle region, by types of social capital – "bonding" and "bridging" – they are present in the Seattle life sciences cluster ecosystem, where the University of Washington's faculty and alumni, along with many local non-government organizations representatives, act as partners and intermediaries among the Triple Helices.

5.5 Poland`s life sciences cluster

The study shows that the Polish life sciences clusters stakeholders appreciate the role of social networks and collaboration within the Triple Helix in the development of the life sciences sector in Poland. Nevertheless, the role of social capital and network capital is rather low. There are numerous challenges and barriers to the social networks and social capital formation in the life sciences clusters` ecosystems in Poland (Kozierkiewicz 2020). The most prominent ones are: the low level of trust and the low level of organizational, social and cultural proximity between the scientists and business, little motivation and no mechanisms stimulating research co-operation, patenting and commercialization, legislative gaps and excessive bureaucracy in the scope of clinical trials, the lack of intermediary institutions, brokering university-industry collaboration, low interdisciplinary cooperation, a high level of individualism and little competition over the European research funds. The development of networks differs in various environments related to the development of life sciences technology in Poland. Scientists from the academic environment participate in scientific associations relevant to their specialization. The need for cooperation with business and the need to commercialize their scientific ideas 'is not obvious,' especially for scientists coming from universities.

In sum, the results confirmed that all the analysed university ecosystems have their own internal technological and social dynamics. Considering the intensity and scale of their interlinkages, the Cambridge and Medicon Valley clusters conform with Porter's concept of the 'functional clusters,' with the close synergy between the three Triple Helix components, namely university-industry-government. These ecosystems demonstrate close links between research and faculty staff in medical and related departments of the universities and local bioscience companies, either in the form of collaboration, funding or the employment of graduates as the commercialization channels of university-based research. In reality, both clusters could qualify as Quadruple Helix models (Runiewicz-Wardyn, 2020).

Furthermore, in the case of the two US-based ecosystems – in the Bay Area and Seattle – the clusters involve the mutually reinforcing interaction between several components in Porter's terms, which are characterized by "rich social capital" that leads to the positive externalities that contribute to building collaborative synergy, knowledge spillovers and increase of innovations within, in the sense of Bochniarz and Faoro's concept of an "effective cluster" (2016). Both offer high skilled talents and a very entrepreneurial and innovative culture. Both provide a multinational and diverse environment, facilitating

exchange of best practices and beliefs, in which universities take the lead in the establishment of university industry collaborations, result in cutting-edge developments and inventions which, in turn, attract more talent, firms, and investments. Furthermore, the key differences between the two Western European and US clusters are grounded in their entrepreneurship, social capital and network patterns which develop interdependently in the evolution of their cluster ecosystems. In the Bay Area, a strong entrepreneurship culture, history and social capital promote tight and dynamic networking. In contrast, social capital formation, entrepreneurship and network dynamics in the Medicon Valley and the Cambridge clusters ecosystems have been initiated to the significant extent by the intermediary organizations and "star" scientists. Finally, the research study demonstrates the different configuration of clustering and networking in the evolutionary processes of the European and US clusters ecosystems.

6 Conclusions and Implications

In the past two decades, social capital has emerged as one of the most widely discussed concepts in social sciences. There are many research studies providing evidence that social capital and its various forms play a significant role in the process of knowledge sharing and innovation capability building in the cluster ecosystems. Yet, this process does not always occur spontaneously. The overview of the above literature reveals several controversies around the role of the different types and strength of social ties in the social capital formation around the cluster ecosystems. One of them relates to the discussion whether the open or closed social networks promote social capital of high-tech clusters. Another controversy is related to the argument about the role of strong or weak ties in facilitating knowledge exchange and social capital formation. Finally, the last controversy is related to the role of brokerage and bridges in networks and social capital formation. Nevertheless, the research findings show that even though all life sciences clusters` ecosystems evolve from different origins and follow different evolutionary paths, their success factors lie not only in human and financial assets, but also in the dynamic forces generating and sharing these resources, which depend on the social networks and social capital.

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Smart Working and Public Administration: the Role of Management in the Redesigning Workplace Processes

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Abstract

In the recent decades, the digital revolution has transformed contemporary societies. New ways of carrying out work activities have spread across in organizations to respond to changes in the peoples' behaviours and aspirations, who ask for a new way of organizing work, more flexible and results oriented and the effective use of new technologies.
Starting from these premises, Smart Working has spread in organizations. This work model represents an opportunity to redesign work in public and private organizations given greater hourly and spatial flexibility, sustainability, effectiveness, and improvement of the organizational well-being of employees in the workplace and the sphere of private life.
This paper aims to understand the perception that public managers have of smart working as a model of cultural and organizational change in public organizations in order to the following aspects: the redesign of the workplace, the redefinition of organizational processes, the consolidation of the trust-relationship between public management and public employees.

In detail, a series of semi-structured interviews were conducted with Italian public managers of local administrations to understand how they manage ICT technologies as a tool to implement the Smart Working model.
Furthermore, this paper aims to contribute to the recent debate on Smart Working in the public sector.

Keywords – Smart Working, ICT, Digital Transformation, Public Management, Organizational Change

Paper type –Practical Paper

1 Introduction

In recent decades globalization and the technological revolution have conditioned and enormously influence the functioning of public organizations.

In detail, Information and Communication technologies have changed not only how work's activities are performed in organizations, but also how people live, work, communicate, and cooperate in organizations (Orlikowski & Barley, 2001; Orlikowski, 1996; Todisco et al., 2020). Moreover, ICT tools have changed, the role of public management in supporting a greater focus on results, relationships with employees, evaluating workloads, and monitoring performance.

Organizations that respond to modern social and economic challenges have been engaged in constant research to define effective, efficient, and innovative models for carrying out work activities (Lee & Kwak, 2012).

One of these models is Smart Working, whose implementation in the organization aims to improve the efficiency and effectiveness of work activities and work-life balance (Torre & Sarti, 2018, Chiaro et al. 2015, Gastaldi et al., 2014).

A focus on management is crucial to understanding the development of a Smart Working model in organizations.

According to many researchers (El Gamry & Heselwood 2018; Sarti & Torre, 2017), managers have a key role in leading organizations in the preliminary phase of the Smart Working introduction.

Starting from these premises, the paper aims to understand the perception that public managers have of technologies in the implementation of Smart Working and how they influence their role.

The remainder of the paper is structured as follows. The next section assesses previous literature on the relevance of digital transformation in the public sector. The third section describes the constitutive features of Smart Working, while the fourth analyses the research context and methodology. The fifth section presents and discusses the findings. The last section provides the concluding remarks and reports relevant theoretical and practical implications emerging from the study.

2 Information & Communication Technology in public sector

In organizational studies, a particular interest is placed on the role that technology has on many aspects of public organizations' life. On the one hand, digital transformation has accelerated new ways of exercising the self-determination of relevant State functions. Citizen communities were able to become acquainted with the so-called direct democracy's methods (Hilgers & Ihl, 2010, Michels, & De Graaf, 2010, Coleman, 2005, Bovens & Zouridis, 2002). Another significant impact of the technological revolution is on the provision of services. Citizens require the provision of increasingly efficient and quality public services that effectively produce visible improvements in the territories (Cordella & Bonina, 2012, King & Cotterill, 2007, West, 2004, Gascò, 2003, Guthrie & Dutton, 1992). Finally, the ongoing digital transformation has changed how organizations interact with the stakeholders and the standard modalities of carrying out work activities. According to many researchers (Dery et al. 2017; Ravenscroft et al. 2012; Benson et al. 2002), the digital transformation and the increasingly extensive technologies devices' application in organizations have allowed managers to redefine processes and organizational boundaries. This development of redefining the organizational processes takes place thanks to the enabling of new technologies that support and integrate the changes in the physical spaces in which the work activities are carried out. The use of ICT to redesign the workplaces and to adapt them to the work activities improves employees' collaboration and communication and puts public employees in better conditions to carry out their activities. Additionally, ICT solutions support the making of environments more efficient with a consequent reduction in fixed managerial costs for the organizations.

3 Smart Working: a revolutionary change for public organizations?

Since the beginning of the 1990s, significant projects for digitizing public administrations have been developed, often acknowledged under the label 'e-government'. The aim of e-government projects is to modernize public administration through greater efficiency, transparency, and administrative simplification, improving the quality of public administration – citizens relationships (Welch et al. 2005, Layne, & Lee 2001, West, 2004). The role of technologies in the transformation of public administration can be framed as the design of new organizational models. One of the first models to implement temporal and space flexibility was teleworking. The first definition of telework was crafted by Nilles, who coined the term 'teleworking' in 1975 to describe the first form of a work configuration in which employees have more opportunities to use different technological tools to improve the family-work balance. In addition to the potential for individual improvement, this company's organizational model was implemented to achieve greater competitiveness in response to the global market challenges. Teleworking helps organizations and management to reduce costs and to ensure greater efficiency and transparency in the organizational process (Baruch 2000; Bailey & Kurland, 2002). Nilles has argued that telework is a concept that covers a

different range of possibilities for working activities, including workers who work at home part-time or full-time. Due to the economic crisis of the early 2000s, public organizations realize the importance of preserving their full organizational potential, looking for increased competitiveness, productivity, and social cohesion. For this reason, many organizations have tried to simplify the teleworking system and make it more flexible, reconsidering employees' role with a new organizational model and approach defined as Smart Working.

3.1 Smart Working: constitutive features

According to many researchers (Ales et al. 2018, Sarti & Torre 2017, McEwan, 2016) Smart Working is a new managerial approach to carrying out work activities in organizations. It is based on the redefinition of people's social boundaries with the introduction of greater flexibility and autonomy in the choice of spaces, times, and technological tools (the so-called BYOD - Bring Your Own Device) to be used.

This definition highlights the essential role of management in guiding organizations towards new conditions of working flexibility and cultural change in Human Resource Management practices.

According to Torre & Sarti, (2018) and Riccò & Porta (2007), it is possible to identify three factors characterizing the Smart Working model: i) the effective use of ICT tools; ii) the workplace redesign; iii) a new Human Resources Management approach.

i) ***The effective use of ICT tools***: Developing an organizational model focused on Smart Working requires critical attention to the use of new technologies and a series of investments related to staff training on the use of the new digital solution. Smart Working is based on the use of ICT solutions to reconfigure and innovate organizational processes and make a flexible way of carrying out work performance. According to Hartog et al. (2015), the change in employee behavior in organizations. is an essential aspect of the development of a Smart Working model, especially in terms of training activities to perfect the use of ICT tools. Furthermore, new digital technologies also play an essential role in simplifying the sharing of information and files, facilitating better real-time interactions between employees and managers, and improving the flexibility of employee work overtime and space (Riccò & Porta, 2017; Alessandrini & Piglialberi 2016, Olsen & Dahl, 2010). Moreover, a Smart Working model operates on the logic of "Bring Your Own Device" (BYOD), which concerns workers' ability to use their digital devices during the execution of the work activities.

ii) ***The workplace redesign***: The implementation of Smart Working involves a redesign of the organizational model and the offices' physical spaces. These factors are fundamental to rethink the strategic processes of an organization

and allow more effective and efficient use of the most modern technological solutions (Tagliaro & Ciaramella, 2016). Coworking spaces, open space offices spread in organizations. The physical redesign of the workplace is an approach that also requires a profound cultural change in the organizational model and the rethinking of the ways that characterize work performance.

iii) ***A new Human Resources Management approach***: the digital transformation has had a significant impact on organizational processes, transforming the way that the management organizes, train, and motivate employees (Stone et al. 2015). Smart working revolutionizes the concept of classic work. Thanks to spatial and temporal flexibility, public employees can affect the autonomous and responsible organization of their work activities. From public management, this represents a significant challenge in increasing the employee empowerment (Zappalà 2017; Riccò and Porta 2017; Tiraboschi, 2017, Stone et al. 2015).

4 Smart Working in the Italian Public Administration

4.1 Research context

In the Italian public administration, the regulatory framework on Smart Working is defined by the following normative and regulations:

- Law n. 124/2015 (art. 14) "Delegations to the Government concerning the reorganization of the public administrations";
- Law n. 81/2017 (art. 18-24) "Measures for the protection of nonentrepreneurial self-employment and measures aimed at favouring flexible articulation in the times and places of subordinate work";
- Directive of the Council of Ministers (DPCM) n. 3/2017: "Directive of the President of the Council of Ministers containing guidelines for the implementation of paragraphs 1 and 2 of Article 14 of the Law of 7 August 2015, n. 124 and guidelines are containing rules concerning the organization of work aimed at promoting the work-life balance of employees".

The Italian Directive n. 3/2017 defines the Smart Working guidelines in the public context and clarifies the objectives imagined with its introduction.

Firstly, the introduction of a more innovative way of organizing work, based on the use of work flexibility and technological tools capable of making it applicable; secondly, a new cultural model of the public organization based on the evaluation of job performance on the objectives; thirdly the recognition of the needs of public employees to work-life balance.

The Italian normative framework assigns relevant emphasis on the role of public management.

Article 14 of Law no. 124/15 defines that all Italian public administrations must adopt Smart Working guidelines to reach at least 10% of public employees in Smart Working for over three years.

Furthermore, the adoption of these organizational measures is considered an objective of public management and is subject to an evaluation of the work of public managers. This part is relevant in the context of performance measurement criteria, both organizational and individual.

Another aspect that highlights the role of public management is that of the technological improvement of public organizations. The directive n.3/2017 recognizes the individual public organization's opportunity to guarantee at the public employees an adequate technological equipment for operating in Smart Working.

Directive n.3/2017 identifies the process that a public organization must follow to begin a Smart Working pilot project.

Initially, it must identify the objectives that the organization aims to pursue with the introduction of Smart Working. An analysis of potential costs and benefits must be recognized, and the organization's technological equipment must then be checked. The public employees must be equipped with tools that secure access to the organization's IT applications and the availability of adequate software and collaboration tools.

Once these elements have been defined, the pilot project can be started. The offices involved in the experimental phase and the number of civil servants who can access individual agreements must be identified.

The final step concerns the Smart Working pilot project monitoring, which highlights the critical issues and benefits encountered in order to redefine the organizational processes and develop it throughout the organizational context.

Source: own elaboration

Italian Government Directive n.3/2017 – Adopting process of Smart Working

4.2 Methodology

In order to examine the perception that public management has on Smart Working and the role of support that they have to improve this working modality in the public sector, a qualitative methodology was chosen.

We have carried out empirical research based on semi-structured interviews, and the research activity was organized in two closely related phases:

- A selection and a context background analysis were conducted with the selection of documents, conference presentations, reports, and regulations to define and to understand how the Italian public administrations began to define the Smart Working trial phase.
- The empirical investigation was conducted with semi-structured interviews with public employees of local and decentralized Italian public administrations.

The semi-structured interviews were conducted by telephone to public employees of Italian local and decentralized administrations who carried out advanced training courses aimed at public employees held at the Federico II University of Naples.

For this research work, it was decided to follow the concept of "elite interviews."

According to Dexter (1970) and Richards (1996), the interviews with managers who hold relevant roles in organizations allow us to understand the relevant decisions more effectively, explain the outcome of the events, and understand the organizational context.

Twenty-seven public managers of Italian local and decentralized public administrations were selected where Smart Working pilot projects had already started or are ready to start.

The semi-structured interviews were part of a larger study on Smart Working in the public sector and included specific questions on how public managers perceive Smart Working as a tool for changing organizational processes and how they were proceeding to implement Smart Working pilot projects in their offices. The time of each interview was approximately 40 minutes.

It was transcribed and coded by hand for each of the questions asked to the interviewees. The analysis of qualitative interview data started immediately after each interview. Additional concepts that were not mentioned in previous interviews were transcript and used for future studies.

It was transcribed and coded by hand for each of the questions asked to the interviewees. The analysis of qualitative interview data started immediately after each interview. Additional concepts that were not mentioned in previous interviews were transcript and used for future investigations.

5 Findings

The interviews carried out highlighted how public managers are performing a significant attempt to adapt the organization to technological changes. From a managerial point of view, they highlight how the use of technologies must be defined within a

perimeter not only of normative regulation or individual agreement but also from a cultural point of view.

> *In detail, one of the public managers of a local administration declared how: "Technologies have entirely changed the way work is organized in the administration. I am happy with this and the administration promoting changes that are essential and exciting compared to other organizational entities in the public sector".*

Another one of the public managers interviewed said:

> *"Operating in Smart Working is undoubtedly an effective way to manage the information flow we have and to achieve the objectives set by the administration effectively. This result is also possible thanks to the use of technology devices that the administration has already provided us".*

The interviewees highlighted how public managers have accepted the technological challenge, placing themselves in a positive perspective. In particular, this interview is intriguing in which a public manager said:

> *"Initially, there were some doubts about this additional burden. It is also due to the technological aspect, to the very complex information systems, to the presence of many applications that cannot always be replicated remotely regarding organizational standards".*

The interviewees also highlighted another positive aspect that they have encountered since implementing Smart Working. It is highlighted how, for a public manager, the effective use of technological devices represents a method of consolidating a work style that has already implicitly spread in public administrations.

Technologies represent an essential cultural consolidation tool of a trust-based organizational model. Indeed, the majority of participants highlighted how the use of technologies can effectively consolidate the already existing relationships in the office.

One of the interviewees said that:

> *"In managing relationships, Smart Working can hardly lead to a decline of relationships, but rather facilitate them, focusing on achieving the objectives."*

Another interesting aspect that emerged from the interviews is that concerning the sharing and transparency of information on the organization's strategy, values, objectives, and performance at all organizational levels. This expectation is strongly linked to the role that the public manager has to assume, based on multiple approaches oriented towards delegation and empowerment, defining the objectives to be achieved collaboratively, identifying the indicators necessary to measure the performance and results of the work, obtained both individually and at the level of the area or of the workgroup.

However, the majority of the public managers interviewed, regarding the employees-technologies relationship, highlighted main perplexities on the digital limits.

A first, concern was related to the different interactions that arise from digital relationships. Some public managers highlighted how communication can be less effective and more complicated due to possible connection problems.

In response to this critical point, the interviews highlighted how public managers spend remarkable consideration on the technical training of public employees and the need to identify ICT employees qualified to intervene in an emergency.

The second perplexity concerns the use of personal devices. As one of the primary elements for developing a useful Smart Working model, public managers pay particular attention to digital security. Indeed, accessing information about professional activities from anywhere and from any device needs developing internal infrastructures capable of protecting the privacy and private documents.

Finally, the last critical aspect concerns the issue of the right to disconnect. Smart Working introduces enormous temporal flexibility, and the risk is that of being permanently connected. The public managers interviewed highlighted how, even before the diffusion of Smart Working, their working activities were endless, through emails, virtual meetings, and instant messaging.

Table1 Public managers' perception of ICT advantages and weaknesses in Smart Working

ADVANTAGES	WEAKNESSES
Improving of work activities' performance	*Privacy and data security problems*
Workplaces' cost reduction	*IT skills*
Cultural change in organization	*Right to disconnect from digital devices*
More well-organized citizen services	*Risk of overlap between personal and professional life*
Internal communication improvement	*Mismatch between goals and effective employees' performance*
More collaboration between public managers and public employees	

6 Discussion and conclusions

In recent years, the academic and managerial debate on the public sector has underlined the relevance of the diffusion of new organizational models in response to contemporary digital and social changes to have public organizations more efficient and effective, more result-oriented, and nearest to the needs of public employees.

Smart Working represents a relevant cultural and organizational change for public organizations more closely linked to organizational models stratified over time and complex to be changed.

Our findings have shown that public managers confirm that digital technologies play a determining role in aiding and making possible new ways of carrying out work performance in an organization.

In detail, public managers perceive technologies as the fundamental driver of Smart Working.

As highlighted in the interviews, digital allows, on the one hand, to develop and virtualize the workspace (e.g., digital workplace) and on the other to improve communication and collaboration processes. Furthermore, the technologies allow the achievement of that hourly autonomy and choice of workplaces, which increases the empowerment of public employees and amplifies a trust-based organizational model.

Our paper contributes to the literature on the use of ICT in the public sector and also provides many interesting theoretical and practical implications.

In more detail, we contribute to the extant literature on the public sector on how technologies have allowed organizations to respond to requests from contemporary society, to define new organizational boundaries and to support public sector reforms.

Furthermore, the following paper confirms the recent literature on the role of ICT in the application of Smart Working. The organizational modality of Smart Working is consistent with the organizational ways of the last decades in which technologies have expanded the characteristics of flexibility and empowerment of public employees.

From a managerial point of view, this paper highlights how public managers' role is relevant for the effective implementation of Smart Working in public administration and how relevant their ability to use technologies to serve organizational change. Smart working represents a significant organizational and cultural innovation for public organizations that require a managerial vision capable of defining new organizational boundaries.

From the interviews carried out, it is relevant to highlight how the use of new technologies is a factor that must go hand in hand with that of cultural change for the effective implementation of Smart Working in the public sector. The majority of the public managers interviewed have the awareness that widespread adoption of Smart Working in all public administrations requires a substantial speedup of the digitization processes of the organization's services and operational processes. This aspect is particularly relevant in this period. During the coronavirus pandemic crisis, in Italian public administrations, with the Directive of Ministry of Public Administration n.2 and n.3/2020 Smart Working has become the primary way of carrying out work activities.

In this, public managers have the relevant task of supporting the development of suitable solutions to guarantee full public employee operations and providing services to citizens in safe, reliable technological environments and with trained employees.

This pressure on the diffusion of Smart Working in the public sector puts greater emphasis on the requests presented by the public managers interviewed on the critical issues of the use of technology in Smart Working. The analysis presented leads to support the need for a secure connection with employees' training, as highlighted in the interviews, and to guarantee high-security standards regarding privacy.

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Organizational Control in Automotive Sector: a Multicriteria Approach

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Abstract

The paper proposes the testing of mathematical models of multi-criteria analysis to support the organizational control functions in the automotive sector. One of the most critical aspects of the organizational control functions for automotive companies is the definition and prioritization of problems emerging from the implementation of production cycles. This issue is relevant for the purpose of defining organizational actions that can be used alternatively to solve a problem in the most efficient way possible.
The World Class Manufactring (WCM) methodology offers the automotive sector a series of tools to identify a problem, establish priorities among the criteria to be adopted for its resolution, find the root causes and possible remedies.
This paper describes the results of the first phase of the research project "Multi-critical analysis in support of organizational control systems in the automotive sector" and focuses on the theme of "priorization of errors and analysis of critical processes with the use of tools of multicriterial analysis".
The aim of the research work carried out in this phase of the project is to compare the priority definition tools provided by the WCM used in the automotive sector with the methods for selecting and defining multi-criteria priorities (MCDA). The research, in particular, starting from the study of the tools used in FCA plants for the definition of priorities and the classification of problems in order of importance, intends to develop an innovative theoretical and methodological approach focused on the use of multi-criteria methods such as AHP Sort . The use of multi-criteria methods offers, in fact, the possibility of simultaneously considering a varied set of criteria and of involving the Decision Maker and experts in the sector in the construction and definition of the multi-criteria model to support the decision. The empirical research work aims to verify the hypothesis that innovative multi-criteria analysis methodologies, inserted in the pre-existing control modules

adopted in the WCM methodological paradigm, can generate the possibility for management, not only to measure and govern organizational actions with different perspectives analysis, but also to evaluate the corrective action options with respect to the strategic objectives declared prevalent.

Keywords – Organizational control, Automotive sector, MCDM, Decision analysis.

Paper type: Academic Research Paper

1 Introduction

The work proposes the experimentation of mathematical models of multicriteria analysis to support the organizational control functions in the automotive sector. The domain of research is the automotive industry sector; one of the most important production sectors in the world, both in terms of volumes and turnover. The automotive sector is a sector driven by a continuous process of knowledge exchange that takes place both within companies and with the networks linked to them. The sector is constantly invested by a series of pressures to change, often conflicting, which require: organizational models able to minimize any waste of resources; methods and tools for continuously redesigning production and managerial processes; a strong orientation towards the development of human resources; a holistic approach to accounting information disclosure and organizational control, for the governance of every aspect of the company's operations. Often, however, the most consolidated managerial practices in the sector, although evolved (Global Powertrain Development Process, World Class Manufacturing, etc.), show critical points precisely in the ability of the control systems to incorporate different organizational logics and evaluation dimensions, slowing down in this way the driving forces for change for which the same managerial methods have been conceived. The case of study regards Fiat Chrysler Automobiles (FCA) that is one of the main industrial groups in the world operating in the motor vehicle production chain; a virtuous example, recognized internationally, of change management and lean journey. The directional systems for the control and management of quality adopted by the Italian giant, maturing, have given life in the various plants of the group engaged in research and development to new methods (such as, for example, Workplace Integration) that aim to combine the need for standardization with that of flexibility, especially for families of sensitive organizational processes, such as the launching of new car models in production. Within these management systems, research proposes the use of multi-criteria methods that enhance managers' ability to measure and evaluate the effects of specific organizational actions, balancing the technical and socio-economic dimensions of the same performance, stability needs and incentives to change. In fact, the research aims to build an experimental model for measuring the results of a multi-criteria approach, starting from the operating conditions of managerial tools whose use is now consolidated in the partner company. With multicriteria methods, large amounts of data emerging from the control performed in different areas (Pillar) can be processed in such a way as to

assign weights relative to the different dimensions investigated and in order to arrive at ranking of possible intervention decisions with different repercussions with respect to a purpose more binding identified by the management (cost savings, safety at work, environmental impact, quality, development of skills, motivation of people). In other words, we intend to test the hypothesis that innovative methodologies of multicriterial analysis, grafted into the pre-existing control modules adopted in the methodological paradigm of the World Class Manufactring, can generate the possibility for the management, not only to measure and govern the organizational actions with different perspectives of analysis, but also to evaluate corrective intervention options with respect to strategic objectives declared prevalent. One of the most critical aspects within the company is the definition and prioritization of the problems to be addressed in order to define the organizational actions that can alternatively be used to solve a problem as efficiently as possible. In this sense, the main focus of this work is to compare the WCM prioritization tools used within FCA plants with multi-criteria sorting and prioritization methods. Our research, in particular, starting from the study of the QA matrix which prioritizes and summarizes the problems in order of importance, taking into account of a series of criteria (frequency, severity, costs, intervention time, etc.), proposes a new way of prioritize problems through the use of sophisticated multi-criteria methods such as AHP Sort (Ishizaka, 2013). This study would allow to improve the genesis of knowledge from a network point of view, in fact the identification of problems and the subsequent decision-making on improvement actions take place with the full collaboration between the production line and all external actors such as suppliers. Furthermore, the proposed prioritization work to define a set of actions to deal with the analysis of human errors (Konstandinidou et al, 2006) that occur in the company with greater awareness.

2 Decision support systems and evolution of organizational control

Organizational theory has for some time investigated the evolution of business models inspired by lean thinking, understood as a modern orientation to design and business management, aimed at pursuing efficiency and effectiveness. At an operational level, increasingly sophisticated organizational methods and performance management methodologies (Ferreira and Otley, 2009) are continuously tested in the most advanced organizations, which aim to integrate the principles and techniques of different and consolidated work organization models, such as Total Productive Maintenance, Total Quality Management, Just in Time. In these approaches, a significant space is assigned to the standardization of activities, the measurement of results and the evaluation of the professional contributions of human resources. In them also great emphasis is given to the theme of decentralization and to the hypothesis that the organizational actors responsibly feed the circuits of control and reporting. Thanks also to the implementation of these managerial practices in organizational theory, the concept of control has evolved (Malmi and Brown, 2008) and has integrated components previously kept distinct or defined context variables. The integration of the different types of controls (Planning, Cybernetic,

Reward and Compensation, Administrative and Cultural controls) aims at the joint evaluation of each dimension of the organizational action. This raises stimulating questions about the design of managerial control systems and their requirements in terms of accessibility and involvement of human resources, the ability to activate learning processes, motivation, knowledge integration, and therefore innovation.

Multi-criteria methods can be used to support organizational control functions to manage complexity and stimulate participation, facilitating communication between the subjects involved, allowing decision-making problems to be faced even when the information framework is insufficient, the number of decision-makers is high, their interests vary and vary over time, the number of action alternatives is also high.

Multi Criteria Decision Aid (MCDA) is a multiple criteria comparison procedure that aims to contribute to the development of a learning process that feeds the decision-making process itself.

One of the most critical aspects within companies is certainly the definition and prioritization of the problems to be addressed in order to define the organizational actions that can alternatively be used to solve a problem in the most efficient way possible.

Defects generated in the production system and prevent defective products from entering the market. The improvement proceeds by looking back in the production process, identifying the main cause of a defect and taking countermeasures to avoid its generation and therefore not only find a way to intercept it. This goes through constant monitoring and improvement of the processes to strengthen their capacity and repeatability.

To this end, WCM offers quality control a series of tools to identify, prioritize, find the root causes and the relative solution for every quality problem of the plant.

3 Methodology proposal

The multi-criteria approach to decision problems arises from the need to consider, at the same time, points of view, objectives and criteria of a different and often conflicting nature; it renounces the paradigm of optimality, poorly operational, replacing it with that of the "justified" choice. We are not looking for a single result, but we try to identify the elements useful to clarify the priorities on which to base the choices (Ishizaka & Nemery, 2013). The multi-criteria analysis therefore aims to provide support to the decision maker to achieve an acceptable compromise between the various objectives pursued. The multi-criteria analysis represents today one of the major study areas of the analysis of complex organizations and as such has developed by inheriting the characteristics and principles of this matter in fact, does not attempt to analyze different disciplines in a single general theory, but analyzes the objectives through the structuring of a complex problem; the criteria for selecting the alternatives are expressed in terms of specific objectives and not in terms of basic rules; and the structure and model underlying the articulation of objectives plays an important role; in addition, the approach is closely linked to the analysis of decision-makers' preferences. The analysis of decision-making contexts, the

definition of resources, criteria, alternatives allows you to define a better knowledge of the situations to be analyzed and with it greater possibilities to find solutions more quickly.

When faced with a decision problem, a decision maker's first task is to identify the type of problem. Roy (1981) described four problematic formulations in the multi-criteria context: choice problem (P · α) in which the objective is to select a single best action or to reduce the group of actions into a subset of equivalent or incomparable actions; sorting problem (P · β): the actions are ordered in predefined categories ordered; classification problem (P · γ) in which the shares are ordered in a decreasing preference; problem description (P · δ): the aim is to help describe the actions and their consequences.

In literature there are a considerable number of multi-criteria methods, this on the one hand represents an element of strength, being able to choose from a very varied plurality of tools to support decisions; but, at the same time, the high number of available MCDA methods places the decision maker in the condition of having to make a selection, of the decision support tool that he deems most appropriate. None of the methods are perfect nor can they be applied to all problems. Each method has its limits, particularities, hypotheses, premises and perspectives (Ishizaka & Nemery, 2013). One way to choose the multi-criteria method to be applied is to examine the information requested in input. In this sense, it is possible to organize the methods taking into account the effort to be made in terms of data and initial parameters to be provided. The starting data and parameters range from the need to have only objective elements (for the methods that lead to choice and ordering) and to indifference and preference thresholds (for methods that lead to sorting) up to the maximum effort to specify a utility function. The use of the right multi-criteria method lies in a careful and timely analysis of the theoretical and application context where they want to be applied. Among the most used multicriteria methods in the literature is the Analytic Hierarchy Process (AHP) (Saaty, 1980). The AHP method has been very successful over time and has found space in different fields of application. The elements that have allowed its diffusion in decision-making analyzes are manifold and can be traced back to the type of data, both quantitative and qualitative, used in the construction of the model. The AHP provides a modeling of the decision problem through the use of a hierarchy that allows to break down a complex decision problem into the elementary units that compose it. Structuring a problem is part of the nature of man, that is, he always tries to identify the alternatives, objectives and compromises that exist in a choice he must make. Over the years, various variants of the AHP have been developed, including the AHP Sort (Ishizaka et al, 2012) used for sorting and ranking problems. In particular, the AHP Sort assigns the alternatives of the decision problem to predefined groups (or classes) in an ordinary way according to the preferences of the decision maker, this means that the classes are ordered from most to least preferred. The construction of the AHP Sort is characterized by three specific steps:

- *Definition of the decision problem.* This step represents the starting point for the construction of the model and in the first place provides for the determination of

the objective, criteria and alternatives of the problem; secondly, we proceed with the definition of the classes (the classes can be ordered and can have a label, for example: excellent, good, medium, bad); finally we proceed to the definition of the profiles of each class.[1] This can be done in two different ways: definition of the local limiting profiles, which indicate the minimum performance required for each criterion j to belong to a class C_i; o definition of local central profiles, as an element belonging to the class C_i respect the criterion j.

- *Valutation.* The assessments are defined with respect to the limiting or central criteria, alternatives and profiles. The evaluation of the importance of the criteria in pairs is first carried out g_j in order to derive its weight w_j with the AHP eigenvalue method [2]. Then a single alternative is compared in a pairwise comparison matrix a_k with each of the limiting profiles lp_{ij} or central profiles cp_{ij} for every criterion j. Finally, local priority is obtained p_{kj} from the comparison matrices for the alternative a_k.
- *Class assignment:* Class assignment involves the aggregation of weighted local priorities, which provide a global priority for the alternative k and a global priority lp_i for the limiting profile[3] or cp_i for central profile[4]. The comparison of p_k whit lp_i or cp_i is used to assign the alternative a_k to a class C_i (fig. 1) .

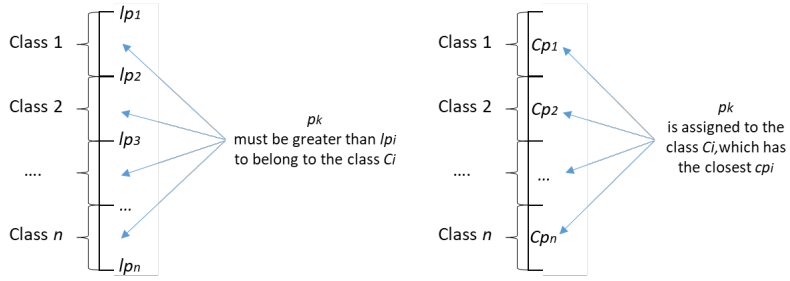

Fig. 1 - Sorting with limiting profiles and central profiles

Multi-criteria methodologies such as AHP Sort can be applied in the context of organizational control functions, in the automotive sector, for problems emerging from the implementation of production cycles. In particular, it can be used to support organizational control systems in the automotive sector, in particular on the subject of

[1] *To identify the separation point between one class and another, limiting or central profiles are defined.*
[2] *$A \cdot p = \lambda \cdot p$; dove: A è la matrice di confronto a coppie, p è il vettore priorità / peso, λ è l'autovalore massimo.*
[3] *If limiting profiles have been defined, the alternative a_k is assigned to the class C_i which has lp_i just below the global priority p_k*
[4] *If the decision maker has difficulty defining a limiting profile, he can define the central cpi profiles. The limiting profiles are deduced from (cpi + cpi + 1) / 2. The alternative ak is assigned to the class Ci which has the central profile cpi closest to pk. In case of equal distance between two central profiles, the optimistic assignment view assigns ak to a higher class, while the pessimistic assignment view assigns ak to the lower class.*

prioritization of errors and analysis of critical processes. The use of multi-criteria methods offers the possibility to contextually consider a varied set of criteria and to involve the Decision Maker and experts in the sector in the construction and definition of the multi-criteria model of decision support. The analysis of the existing tools used for the prioritization of errors in the WCM methodological paradigm shows that with respect to the construction of the criteria that contribute to the formation of the priority index, it is possible to intervene with multi-criteria methodologies on various points:

- Priority scales for alternatives. The analysis conducted shows that the scales used for attributing weights to alternatives (errors) are different depending on the criterion considered.
- Allocation of weights to the criteria. From the analysis of the criteria it appears that the criteria have different weights, however, this is not explicit. With this in mind, we believe it is appropriate to use methodologies that allow we to attribute weights to the criteria. In literature there are several methods for determining the most intuitive weights for the Decision Maker, for example, it could be the SRF method (Abastante et al., 2020)
- Aggregation and robustness of the priority index. The issues related to aggregation and the robustness in the construction of synthetic indices for prioritization are widely discussed in the literature (Greco et al., 2019). We believe that in order to improve the process of identification and construction of priority errors, it is appropriate to use more sophisticated techniques such as Sigma-Mu efficiency analysis (Greco et al, 2019b).

4 Conclusions e innovations of research

As highlighted, one of the most critical aspects of organizational control functions for automotive companies is the definition and prioritization of problems emerging from the implementation of production cycles and the prioritization of errors that occur in the factories. The WCM methodological paradigm offers a series of tools to identify, prioritize, find the root causes and the relative solution for each quality problem of the plants. The goal of this research lies in the comparison of WCM's own tools with innovative multi-criteria methodologies in order to improve and integrate knowledge in complex work environments. The use of multi-criteria methods, such as Ahp Sort, would allow the company to use a new multi-criteria methodology that can improve error prioritization mechanisms in the automotive sector. The experimentation of this experimental methodology will be tested in a giant in the automotive sector such as FCA; in this experiment we expect a more accurate prioritization of errors compared to the tools used in the company and consequent increase in knowledge of the phenomena in the company which will lead to an improvement of the organizational control models. The strength and innovations of the use of multi-criteria models in complex organizations are certainly identifiable in the construction of the models as it provides for the direct involvement of Decision Makers; in the construction of classes that allow to analyze the

problem in terms of priorities but also to have a certain range of overlap of the same; in consideration of a multitude of criteria and alternatives, in the possibility of adapting the model during implementation and in defining a flexible model with respect to the context and business dynamics.

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The Impact of Big Data on Board Level Decision Making

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Abstract

This paper investigates how board members perceive the reliability of Big Data (BD) as a new source of information for their decision making. To understand the dilemma "*real time and effective vs reliable and compliant information*", we analyse a real case, addressing this problem to reflect on the decision making of a board of directors. In detail, within the context of a digital bank, we explore how the board assessed the quality of BD, gathered from social media and processed in the form of indicators, to define worthwhile measures for monitoring the bank reputational risk.
Our data reveal interesting findings in two areas. First, there is evidence of a shortfall in cognitive capabilities concerning BD. Second, we show how BD impacts responsibility/control within the board context. This study points to areas for development at three levels of our analysis: individual directors' cognitive capabilities in relation to BD, the board as a collective intelligent decision maker and at the organisational level, supporting a broader view of the big data flows in and out the firm's boundaries.

Keywords – Big Data**,** Social Media, Board Decision Making, Reputational Risk

Paper type – Academic Research Paper

1 Introduction

This paper investigates how Board members perceive the reliability of Big Data (BD) as a new source of information for their decision making. As a matter of fact, BD has the potential to 'disrupt' the senior management of organisations, prompting directors to make decisions more rapidly and to shape their capabilities to address environmental changes (Merendino et al., 2018).

In the era of BD produced thanks to technologies that have allowed the collection and storage of an increasing quantity of granular information, as well as the processing and

extracting the information, even in the field of managerial reporting, expectations for new opportunities have emerged.

In particular, expectations concern the possibility of overcoming two limits of traditional reporting for decision making, that is:

a) Big data may enable real-time reporting (Serafeim, 2014),

b) Big data, thanks to the possible views they offer, allow us to extract valuable information that supports achieving corporate performance (LaValle et al., 2011; Lycett, 2013).

Hence, a board of directors may benefit from a wide range of data that offers insightful information for their decision making rather than financial transactions alone (Moffit and Vasarhelyi, 2013).

However, at the same time, there are many limitations to this kind of data concerning their reliability. Indeed, some authors have talked about big data mythology, which relates to the common belief that a vast pool of data provides true, objective and accurate knowledge (Boyd and Crawford, 2012). In practice, so far, chief financial accountants serve as gatekeepers of accounting-based information provided to the Board, which prevents reporting based on big data from leading to misrepresentation and unfair decision-making (Al-Htaybat and von Alberti-Alhtaybat, 2017).

To understand the dilemma, it can be summarised as:

"real time and effective vs reliable and compliant information",

therefore, we have analysed a real case addressing this problem to reflect on the decision making of a board of directors. In detail, within the context of a digital bank, we will explore how the board assessed the quality of BD, gathered from social media and processed in the form of indicators, to define worthwhile measures for monitoring the bank reputational risk.

Indeed, the literature on BD information quality for corporate decision making finds supporters and detractors who develop their analysis within the frameworks developed in their own disciplines (mainly information systems and accounting). Furthermore, in most cases, it does not offer case studies or surveys on how the quality of data is perceived within the company, with only some exceptions (Merendino et al., 2018). For these reasons, we believe that this preliminary paper could shed light on an issue that deserves greater attention and that it will be increasingly important in the future.

This paper is structured as follows: section 2 illustrates the debate on the quality of big data for decision making; the methodology is presented in section 3. Section 4 draws on empirical evidence and provides the main findings of our inquiry, while section 5 highlights the implications for research and practitioners.

2 The debate on Big Data for corporate decision making

The analysis of the benefits and shortcomings of BD can be approached from two different perspectives, namely that of the accountant and the BD expert. Therefore, we have proposed a parallel analysis which is summarised in table 1.

Table 1. Benefits and shortcomings of Big Data for decision making

	Accountant	*Big Data expert*
Benefits	Real time information useful when decisions need to be timely within a setting of limited rationality	Extension of the decision maker's ability to make sense of the present and anticipate future trends
Shortcomings	Possible lack of reliability compared to accounting models and existing regulations	Risk of over-perceiving the value of meaningless patterns found among large quantities of data

2.1. The BD expert perspective

BD has been recognised as a potential driver of disruption in the way firms operate as it enables managers to make decisions based on evidence rather than intuition (McAfee and Brynjolfsson, 2012). Usage of BD, especially when coupled with Artificial Intelligence techniques, is capable of equipping decision makers with both an extended understanding of the present circumstance through a deeper understanding of the market, consumer and competitors, and the anticipation of forthcoming events in the future. Insights and predictions can give firms a competitive advantage as they support an increase in productivity and an improvement in the speed and quality of decision making (Agrawal et al., 2018). At the same time, decision makers who are not fully equipped with knowledge about BD methods might make some wrong decisions as they fail to consider the level of confidence behind findings (Seely-Gant and Frehill, 2015). For example, a frequent limitation of BD models is overfitting which can lead decision makers to see non-existing patterns simply because large quantities of data can offer connections that apparently radiate in all directions, as noticed by Boyd and Crawford (2012). Until organisations obtain a minimal level of fluency in BD methods, data scientists and business analysts will have the additional responsibility to coach others on best practices, emphasising both the value and the possible shortcomings of analytics projects (Davenport, 2020).

2.2. The accountant perspective

In the field of corporate reporting, the contrast emerges because data scientists process information in an abductive way (Arnaboldi et al. 2017), while accountants ensure the quality of the data with respect to consistency with a determined accounting model (Demartini, 1999). Hence, accountants serve as gatekeepers of accounting-based knowledge, which prevents reporting based on big data from leading to misrepresentation, and unfair decision making (Al-Htaybat and von Alberti-Alhtaybat, 2017), which could be even considered as non-compliant with the existing legal or regulatory norms.

Namely, the biggest problem for an accountant is precisely to understand the "quality" of the data. This is mainly due to the fact that they need to use information that is certified

by third parties and that complies with the characteristics required by legal and compulsory regulatory norms. In this sense, the traditional distinction between the quality required for financial data and making well-informed business decisions is fading. This is even more true in contexts regulated by law such as banking.

2.3. The impact of BD on Board-level decision making

To inquire about how the quality of big data is perceived, analysed and discussed by the Board, it is appropriate to recall its functions briefly. In a nutshell, the Board of a company is responsible for the strategic supervision and monitoring of the firm's activities. To effectively perform these functions, both individual directors and the Board, considered as a collective intelligent system (Leimeister, 2010), must have adequate knowledge, competence and skill. For our purposes, it is also important to consider that required knowledge changes over time in light of new challenges businesses. So, it is also important to reflect on the dynamic capability (Teece et al. 1997) and knowledge (Spender, 1996) of the Board.

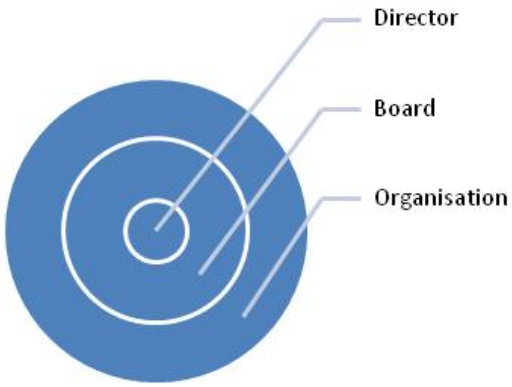

Figure. The different levels of analysis

This attitude should be considered at several levels (see Fig. 1):

- at an individual level, to avoid the negative effects of cognitive biases (Amit & Schoemaker, 1993), such as anchoring (i.e., the old way of thinking) and cognitive dissonance (i.e., holding conflicting beliefs or ideas) (Brennan & Conroy, 2013). The lack of cognitive capabilities of the Board of directors can also cause boardroom or organisational inertia (Tripsas & Gavetti, 2000);
- at the Board level, which acts as a collective intelligent decision maker (Leimeister, 2010);

- at the organisational level, by defining how to manage knowledge flows inside and outside the boundaries of the firm from a cognitive view (Cress & Kimmerle, 2008; Secundo et al., 2016).

3 Methodology

In the following section, we will analyse a real case, addressing the issues mentioned above, to reflect on the decision making of a Board of directors.

The choice of a digital bank stems from the fact that, as we said, the banking sector, on the one hand, has always made great use of new technologies to manage a large amount of data and, on the other, is subjected to strict compliance requirements established by law and numerous national and supranational supervisory bodies. In detail, the choice of a digital bank defines the context of reference even more analytically as we assume that the corporate culture is based on transversal skills with reference to the new communication technologies and that it is accompanied by a certain openness towards the search for innovative solutions, also concerning company reporting. Furthermore, it is expected that members with specific skills in digitalisation will also be present on the Board.

Therefore, we have conducted semi-structured interviews with the Board members of a digital bank to provide a discussion on a specific concrete situation concerning how and whether to use big data for high-level strategic decision making. The concrete situation concerns the design of a framework aimed at monitoring the bank's reputational risk, which will be briefly described in the following section.

3.1. The context of the decision making

The design of a reputational risk framework

The deterioration of stakeholder confidence exposes banks to reputational risk and effects their ability to maintain viability conditions over time. For this reason, and also on the basis of the indications of the supervisory bodies, many banks have adopted a framework for monitoring reputational risks.

The investigation of this specific topic is beyond our inquiry, therefore, only the elements relevant to our purposes will be provided below.

It is sufficient to recall that the reputational risk framework adopted by the bank for monitoring translates into a quarterly reporting dashboard, presented to the bank's Board, containing the management indicators for each stakeholder. The latter are intended to "measure" the quality of the relationship with each stakeholder.

The decision to be made

As part of the design of the bank's reputational framework, the decision on which we have focused our analysis concerns the identification of the indicators for the mitigation of the reputational risk called "brand capital". The latter expresses what the bank defines

as "the synthesis of the perception of customers and non-customers in terms of engagement, competence, integrity of the exchange, reliability and loyalty".

Specifically, we will focus on the discussion developed within the Board around two of the most significant indicators among those selected to monitor the components affecting brand capital, namely:

- Index of negative sentiment online (number of conversations with negative polarity/total conversations recorded in the Quarterly period)
- Litigation index (expressed as the number of complaints received by the bank during the Quarterly period)

The first indicator derives from an external survey conducted by a provider specialised in sentiment analysis and is based on the processing of non-structured big data present online, including web pages, online news, internet discussion groups, online reviews, web blogs and social media.

The second indicator is traditionally provided by the internal office that deals with complaints and has always been monitored by the bank.

This comparison will allow us to analyse how the Board considers the quality of information coming from sentiment analysis, compared to traditional information relating to complaints.

3.2 Data collection and analysis

Data were collected from 2019 to 2020 by one of the authors. Data used for the analysis come from different sources:

- internal reports and documents to analyse the design of the reputational risk framework (i.e., Board meetings minutes, technical reports);
- subsequently, semi-structured interviews with each director focusing on the discussion that arose within the Board on the reliability of the index of sentiment online to monitor the bank's brand capital.

Interviews were the primary source of data. A total of 7 interviews were carried out (see Table 2 for more details on informants and their theoretical and practical expertise). Conversations varied in length from one to two hours. All of them were recorded and later transcribed verbatim for further analysis.

Table 2-Interviewees' profile

No of interviews	*Role*	*Theoretical expertise*	*Practical expertise*
1	Chairman	Auditing and accounting	Professional, member of boards and supervisory board (Legislative Decree no. 231/2001)
1	Board member	Media communication	Founding partner and marketing chief of a digital company

1	Board member	Business administration	CFO/Chief risk officer in the banking sector
4	Board members	Legal and business administration skills and competence	Chief legal officer, Chief Commercial officer, HR responsible in the banking sector Professional

As suggested by Miles et al. (2014), data analysis was an ongoing process. Available data were iteratively analysed to allow a progressive elaboration of a general interpretative framework. In the first step of the data analysis, we created a detailed description of the case, putting together interviews and secondary sources. In the second step, we cycled through multiple readings of the data and, in line with the purposes of our research, in this phase, we identified the following three levels to analyse how the quality of big data is perceived for decision making: the individual director, the board as a collective decision maker, the organisation as a whole. With this purpose in mind, each author read the empirical material independently and categorised the stream of words into meaningful categories, via manual open coding. Furthermore, in our analysis, we found the use of excerpts highly worthwhile as they allow researchers to address the way the actors use language, think and make sense of big data usefulness and reliability.

4 Findings

4.1. The Individual level

At an individual level, directors need to develop the mental models and skills, or managerial cognitive capabilities, to perceive, analyse and process changes in the environment that affect decision making.

It did not surprise us that, apart from one of the directors with a specialist background, the others had not gained in-depth knowledge on big data. Nonetheless, none of the interviewees complained that they did not have adequate knowledge to be able to specifically evaluate the reliability and adequacy of the index of sentiment online for the defined purpose.

If, on the one hand, these affirmations manifest the mental openness of the directors towards the evaluation of new data sources, on the other hand, it can also be the signal of a shortfall in cognitive capabilities in assessing the quality of BD, given that no directors, during the Board meetings, asked for specific information on how the index was calculated. Except for the one with expertise on media communication, the other directors took the data for granted, also because online sentiment analysis had long been a source of information used by the bank's communication office. Hence, the index was used to provide information about technical content, whose quality assessment is up to specialist managers.

This offers valuable insights into why directors may act conservatively, clinging on to more traditional processes which have been institutionalised. Indeed, a more critical approach was only adopted by the director with greater BD expertise, who stated: *it is always advisable to know the sentiment analysis techniques used to understand the meaning of the information provided.*

4.2 The Board

In analysing the data collected, we adopted the view of the Board as a collective intelligent decision maker. The term "collective" describes a group of individuals that work together to find solutions to a given problem. The term "intelligence" refers to the ability to learn, understand and adapt to new circumstances by using knowledge.

In this perspective, it is interesting to observe how, through the dialectic and the contribution of the various actors, the Board reached the final decision through compromise decision making to include both indicators, the more traditional one of complaints and the newer one relating to online sentiment analysis.

In particular, the director with expertise in the field of risk control highlighted the potential predictive value of the information by stating that: "*the sentiment index online can provide an early warning, once the time series allows you to test the data".*

On the other hand, the chairman with experience in auditing and compliance underlined how: "*the complaints index, even if it provides information on the corporate reputation when the relationship of trust with the clientele is already damaged, offers precise indications for the implementation of remedial actions and, in particular, has always been the subject of attention by the inspectors of the supervisory bodies* ".

Overall, the analysis of the discussion within the Board shows that the combination of different skills and experiences gained by the directors offered a solution that also considered the risks and responsibilities of the Board.

4.3 The Organisation

The concept of an organisation as a collective cognitive system elicits that knowledge is no longer only accumulated and created within a firm but is co-created by different actors through collective intelligence.

The case examined highlights how the bank can use external BD suppliers. This specific point highlights a potential weakness of the bank, which does not process the information internally but acquires it from an external supplier. Hence it is necessary to know about the quality of the information acquired, not only because it becomes part of the company's decision-making processes but also because it must be possible to account for it when confronting the supervisory bodies

To sum up, in an organisation as a collective cognitive system, the focus shifts from the processes of internal creation of knowledge to the processes of knowledge transfer.

Hence, interdependencies and knowledge flows between different stakeholders become crucial.

5 Conclusions and future research

Our data reveal interesting findings in two areas. First, we have found evidence of a shortfall in cognitive capabilities concerning BD. Second, we have shown how BD impacts responsibility/control within the board context. This study also points to areas for development at three levels of our analysis: individual directors' cognitive capabilities in relation to BD, the board as a collective intelligent decision maker and a broader view of the big data flows inside and outside the firm's boundaries.

5.1. Implications for future research and practice

With reference to the first aspect, it is necessary to increase the knowledge of the board members in the field of big data, in addition to artificial intelligence and new technologies that increasingly impact the management of companies. We no longer believe that this knowledge is held by single specialist managers. The Board has strategic oversight and control tasks and, today, failing to understand the potential of new technologies appears to be a big shortcoming.

With reference to the second aspect, the Board as an intelligent collective body, we believe that, especially with particular reference to banks, its composition cannot disregard the presence of subjects who have skills in this area. As a result, we believe that there is matter to reasoning on the content of the so-called "fit and proper" regulation, issued on 2014 by the European Central bank which regulates the composition of the boards of European banks. Board members should have the theoretical (knowledge and skills) and practical experience that are indispensable to carry out their functions, which vary according to the specific role and institution. As a minimum, members of the management body must have basic theoretical experience in banking, and additional experience may be required depending on other factors that are important to the particular institution. In detail, the latter currently provides for the presence of members who have basic experience on legal issues and risk control (ECB, 2018 p.10) but do not deal with the issue of technological knowledge functional to the strategic management of a bank.

Finally, regarding the third point, which refers to the corporate level, we believe that another aspect that should be investigated by researchers but is also relevant for practice, is revisiting the design of corporate information flows in light of the relevance of big data. It is important to understand how and who generates the algorithms for the analysis of big data and not take them for granted. We think that a large part of corporate knowledge will be produced by leveraging on big data in the future, and as usual in the rules of the business, it is important to know how to feed, transfer and share knowledge, and also protect it.

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When Traditional Sectors go Circular: towards Sustainable Industry 4.0 Value Chains

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Abstract

Currently, a range of industries is undergoing a major competitive shift away from unsustainable, energy and resource intensive high-tech to more resource efficient greentech products as a source of competitive advantage. This sustainability turn (although still sluggish in the automobile sector) will force the whole value chain, including small and medium sized suppliers, to diversify as the manufacturing of electric cars will need much less capacity and labour than the production of the combustion engine did and parts can increasingly be printed on demand using 3D printers. At the same time, this shift is characterized by inconsistencies that render this endeavour a particularly difficult one. Wind turbine and electric car manufacturers (considered the core sustainability transition industries), for instance, rely heavily on rare earth elements (Chen and Zheng, 2019) although these elements are at the same time highly risky ecologically due to the extraction of radioactive byproducts, emissions and high energy usage (Pell et al 2019). Therefore, the global sourcing of these sustainability transition industries (Markard, et al. 2012) is highly unsustainable.
Although materials are central to the transition to more sustainable economies, the circularity implications of materials are currently often omitted from the discussion especially as regards design (Peck 2012). Complex materials (Fraunhofer Materials 2016) like plastics compounds used in a wide range of products from automobile parts to multi-layer packages pose particularly severe problems at the end of the use phase of products though. A higher sustainability level at the beginning of the value chain is therefore offset by a lower sustainability level at the end (due to highly complex waste streams) – hampering prolonged product usage and Recycling. Here is where an important role accrues to digitization and standardization in the transformation to sustainable value chains.
The paper analyzes the sketched role of digitization and standardization on the materials/technology level and makes reference to the approach of technological innovation systems (Malhotra et al., 2019, Markard et al. 2012). On a practical level, materials recovered from end-of-life vehicles and post-consumer plastics waste serve as illustrative examples. Based on this, preliminary management implications (derived from the conceptual analysis and to be complemented by an empirical analysis in the mentioned sectors) are formulated for knowledge-based sustainable value chains in traditional industries „going circular".

Keywords – sustainability, value chain, automobile, plastics, circular (max 5 words)

Paper type – Academic Research Paper

1 Traditional sectors and the challenge of circularity

1.1 The missing sustainability-digitization link

Currently, a range of industries is undergoing a major competitive shift away from unsustainable, energy and resource intensive high-tech to more resource efficient greentech products as a source of competitive advantage. This sustainability turn (although still sluggish in the automobile sector) will force the whole value chain, including small and medium sized suppliers, to diversify as industry 4.0-automatization allows for bypassing of suppliers by manufacturers (by way of 3D printing) and will cause disruptions in the labour market as well. The manufacturing of electric cars, for instance, will need much less capacity and labour than the production of the combustion engine did and parts can increasingly be printed on demand using 3D printers. At the same time, sustainability transitions like the ones mentioned are characterized by inconsistencies that render their implementation difficult. Wind turbine and electric car manufacturers (considered the core sustainability transition industries), for instance, rely heavily on rare earth elements (Chen and Zheng, 2019) although these elements are at the same time highly risky ecologically due to the extraction of radioactive by-products, emissions and high energy usage (Pell et al., 2019). Therefore, the global sourcing of these sustainability transition industries (Markard, et al., 2012) is highly unsustainable. As a crucial role in industry 4.0 accrues to digitization, concerns are on the rise that improved triple bottom line results like waste reduction and higher rates of recycling may be offset by higher resource and energy consumption resulting from a comprehensive digitization of production and logistics processes (Ghobakhloo, 2020).

In a similar fashion like standardization and modularization before, industry 4.0 has not been focused on sustainability, let alone circularity from the outset. It has originally been established as a concept aiming at increased productivity and facilitating the setup of digital business models based on real-time tracking of production and customer data, making it more akin to approaches like *Design for Assembly* than to *Design for Disassembly* (Bischof/Blessing 2008). Nevertheless, with products becoming data carriers a detailed picture of their 'biography' emerges departing from the production phase, spanning their use phase and encompassing, finally, the recycling/reuse/disassembly of components and materials. This opens up potential for establishing industry 4.0 measures which are not confined to making production processes more efficient but are compatible with the hierarchical levels of the Waste Framework Directive set up by the European Commission in 2008 (Prevention, Preparing for re-use, Recycling, Recovery, Disposal) (EC, 2019).

The Circular Economy (CE) aims at establishing high value material cycles through a cascading system of renewable energy and materials flows comprising both sustainable production and consumption modes which goes beyond approaches confined to recycling (Korhonen et al., 2018). CE models, however, on their part have rightly centred on

substitution and design (reduction of materials' use) at the expense of recycling (recovery) (Di Maio and Rem, 2015) and remanufacture (prolongation of the use phase) which are to be considered as equally important.

While the conceptual overlap between sustainability and the Circular Economy is broad, as exemplified, e. g., in Circular Business Models (Rossi et al., 2020), the case for a joint optimization of industry 4.0 and CE goals is standing on less solid ground. Although it is increasingly acknowledged that industry 4.0 is conducive to building a CE, this claim is poorly backed up by evidence or strategic models to guide further research (Yadav et al., 2020) which is why an industry focused approach is considered crucial, e. g. when developing indicators for building CE business models in sectors such as plastics, textiles and electronics (Rossi et al., 2020).

While the link between digitization and sustainability is obvious when it comes to services, e. g. in the energy sector (e. g., the establishment of smart grids, Radenković et al., 2020), it is far less straightforward in more complex products like lightweight cars made of compound materials which pose challenges for Recycling and Reuse. Also, the plastics (recycling) sector – being part of largely analogue value chains where a large share ends up in Downcycling (e. g., in the construction sector) rather than in Reuse – is still far from being circular. However, recent approaches have explored how digitization and industry 4.0 can contribute to creating high quality waste streams (e. g., by employing high-tech fluorescent markers reflecting light in a specific way depending on polymer type, exact composition and use of materials) thereby increasing circularity in the plastics sector as it reduces the usage of primary plastics and helps comply with the higher recycling quotas mandated in the German Circular Economy Act (BMBF, 2017). Although materials are central to the transition to more sustainable economies, the circularity implications of materials are currently often omitted from the discussion especially as regards design (Peck, 2012). Complex materials (Fraunhofer Materials, 2016) like plastics compounds used in a wide range of products from automobile parts to multi-layer packages pose particularly severe problems at the end of the use phase of products. A higher sustainability level at the beginning of the value chain is thus offset by a lower sustainability level at the end (due to highly complex waste streams) – hampering prolonged product usage and Recycling. Here is where an important role accrues to digitization and standardization in the transformation to sustainable value chains as will be explained next. Standardization both of the formal type (triggered by industry but conducted by standardization bodies) and in its informal variety (e. g., through consortia) will play a crucial role in the adoption of industry 4.0 which remains largely unexplored still (Stolwijk et al., 2017). Moreover, the paper argues that standards act as a linchpin between industry 4.0 and the CE making sure that the latter's potential does not fall short of delivering ecological and social results besides improving economic performance.

1.2 Aim and structure of the paper

The role of digitization in the sustainability transition to a CE is far from being unequivocal considering the sizeable carbon footprint caused by information technology, especially the various streaming services. In the course of the move towards industry 4.0 formerly analogous sectors are relying heavily and increasingly on digitization (manufacturing, the service sector and even agriculture) with the IT sector estimated to be responsible for 4 % of worldwide emissions and expected to exceed the emission share of the mobility sector in Germany within a few years (BMU, 2020).

One aim of the paper is therefore to shed light on the interrelation between high (and expectedly rising) levels of computerization and digitization (in industry 4.0) and the promise of CE. Besides, the role of standardization in the context of the circular economy is discussed and illustrated based on the cases of plastics and the automotive industry.

The paper analyzes the sketched role of digitization and standardization on the materials/technology level. On a theoretical level, the approach of technological innovation systems (TIS) (Malhotra et al., 2019) is combined with the sustainability transitions literature (Markard et al., 2012) to serve as a backdrop of the analysis. TIS are a stream of inquiry which – apart from a few seminal papers– has seldomly been used (compared, for instance, to its regional counterpart and particularly outside energy transition sectors) and has much to offer in terms of Management implications.

On a practical level, materials recovered from end-of-life vehicles and post-consumer plastics waste serve as illustrative examples. Based on this, preliminary management implications (based on the conceptual analysis and to be complemented by an empirical analysis) of how to build knowledge-based sustainable value chains are discussed that may help unleash the potential of traditional industries to „go circular".

The remainder of the paper is organized as follows. Chapter 2 provides a sketch of the function of standards in an industry 4.0 setting and overall for technological development and growth (Tassey 2000, 2017) and links it to the theoretical framework of technological innovation systems. Chapter 3 applies the theoretical background to two illustrative cases (automotive and plastics) acting as benchmark for progress towards not only digitized but also sustainable value chains. Chapter 4 concludes.

2 Standards in industry 4.0 and the Circular Economy

Much of the uncertainty involved in building a CE is rooted in a lack of information. To begin with, the exact composition of plastics compounds may not be available anymore by the time the product is discarded or has reached the end of its lifetime. On the other hand, market related information originating downstream the value chain on consumer acceptance, demand for recycled materials, etc. may not be available at the outset, complicating a coordinated decision making on eligible recycling and reuse channels (Labucay, Xiao and Zhao, 2019). Although high-end cars have been turned into

information platforms, the automobile sector is far from harnessing the potential of digitization to support the move towards more sustainable ecosystems.

The digitization-sustainability link has been mainly explored on the industry and product level (e.g., the dust bins of the ANTA SWISS AG gathering real-time data on replenishment levels in smart cities). Further upstream the value chain, however, the level of materials and technology has been less in focus. Facilitating knowledge and data exchange between materials and their digital twin (Fraunhofer Materials 2016, Blum, 2018) contributes to mitigating supply chain disruptions (Bugert and Lasch, 2018) and increases Recycling and Reuse thereby contributing to building a CE. This is efficiently supported by digitization and standardization (Labucay, 2018). Standards may serve as a linchpin between digitized, industry 4.0 production processes (which on their part require standards in order to run smoothly) and sustainable, CE production processes. With CE standardization still in its infancy, an overview of emerging CE standardization areas is provided in what follows with a particular emphasis on how these efforts may be combined with industry 4.0 standardization which is already farther advanced.

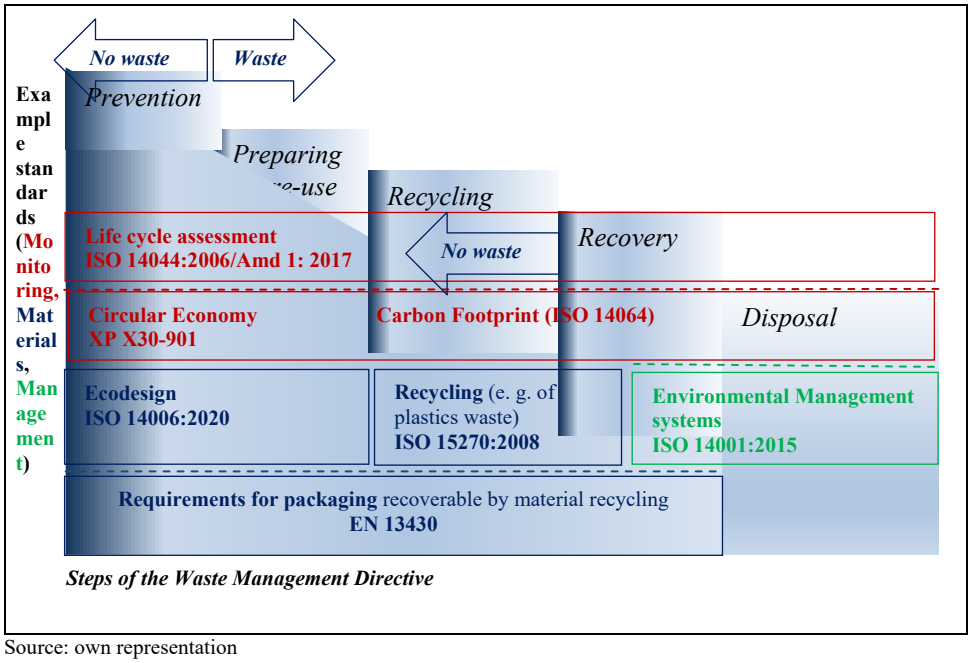
The "birth" of CE standardization coincides with France's presidency of the newly founded ISO technical committee "TC 232 Circular Economy" in 2018 (ISO 2019) which set the agenda by putting the energy sector centre stage in its standardization roadmap. While this appears natural in that the energy sector is amongst the economic priorities of the French government, this choice also helps in building a bridge to longer standing standardization activities in the area of industry 4.0 (with smart grids being the most prominent application area). This French CE agenda itself took shape in the standard XP X30-901 (ADEME 2020).

In the digitized production processes of industry 4.0, standards are required for ensuring interconnectivity between smart machines and existing traditional assembly lines (compatibility standards), for bundling and transmitting information (e. g., on digital designs and production data) to be shared between companies and their suppliers in inter-company supply chains (security and privacy standards for interoperability) and as a means to secure product quality and consumer's rights (quality and safety standards) (Stolwijk et al., 2017). Standards furthermore contributes to further undergirding regulatory measures, e. g. when sustainability standards are referenced in laws and regulations which positively impact on consumer trust building and investment climate. The technological lock-in in inferior lighting technology (unsustainable light bulbs) with LED technology taking decades to take hold in the market was due to the lack of quality standards (Tassey, 2017). Technology cycles are shortened if a timely standardization infrastructure is in place thereby acting as a channel for technology transfer (Frenz and Lambert, 2012).

The *Waste Framework directive* of the European Commission (established in 2008) was the first attempt to formulate EU-wide fields of action which are (in descending priority): *Prevention, Preparing for re-use, Recycling, Recovery, Disposal*. Although the EU directive has originally been designed for energy-intensive sectors it has come to be

applied on a wider scale to all products with high energy usage during their production and/or their use phase (European Commission, 2019) where naturally a range of products are eligible, plastics and compound materials being amongst the first and foremost due to their heavily relying on the chemicals sector.

The following graph provides an overview of how CE standardization is currently evolving. The previously mentioned Waste Framework Directive of the European Commission is matched by standards in the respective fields.



Source: own representation

Graph 1: CE standardization within the Waste Management Directive's hierarchy

Like with other technological innovation systems before, it is promoters and advocates of the CE who influence the dynamic interactions of the TIS components. They do so, e. g., by shaping the development of standards which increases legitimacy as a central function of technological innovation systems and is therefore crucial for the outcome, the technological categories which ultimately become dominant (Berg et al., 2019). In contrast to initiatives aimed at sustainability which reach back until the 1980ies the Circular Economy affords an across-industry and across-value chain approach, i. e. a combined endeavour of product designers, producers, consumers of (e.g., plastic packages) and the suppliers of functional materials (that those packages are made of). In the automobile sector, producers of functional materials, automobile producers and consumers are part and parcel of CE initiatives. This across-industry and multi actor approach to emerging technologies is mirrored in the Cooperative Patent Classification *Y02/Y04S tagging scheme* targeted at technologies which contribute to sustainable

innovation, e. g. by mitigating the adverse effects of climate change. Technological innovation systems come from sectors as varied as transport, building, sewage systems and manufacturing (OECD, 2016). As an illustration, an emerging technological innovation system (CE approaches in the automobile sector) is contrasted with farther advanced initiatives (in the so called CE plastics economy).

3 Illustrative case examples

3.1 The automobile industry as a late-comer CE sector

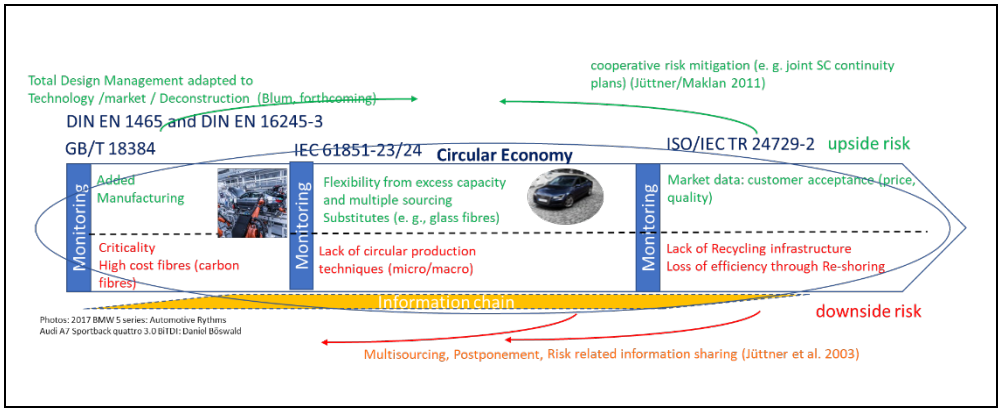
Circularity has not been amongst the priorities of the automobile sector so far. Approaches like Shared Driving (enabling a more sustainable mobility infrastructure especially in inner-city traffic) and Recycling of functional materials have been the first steps towards a more sustainable business model. In the past, the automobile sector has exclusively centred on approaches which lent themselves to increasing productivity such as standardization of parts and components (aligning suppliers' standards with their own product specifications) and modularity and flexible design (employing generic platforms and product families) which was targeted at *Design for Assembly* rather than *Design for Disassembly* (Bischoff and Blessing, 2008).

Nevertheless, modular and flexible design enabled by industry 4.0 production techniques (Birkel et al., 2019) may serve additional functions besides productivity enhancement, namely the prolongation of a product's life spans through Recycling, Remanufacturing and Reuse. By way of example, Added Manufacturing as a production technique where material and products emerge instantaneously allows for the design of targeted materials with required characteristics (e. g. hybrid materials) (Fraunhofer Materials, 2016) and saves both energy and valuable technology metals, in all relevant stages of production (design, manufacturing, transport, packaging, after sales repair), e. g. the use of tungsten in the moulding of car parts (Kerbrat, 2016). Both carriage and windows of the hybrid car Urbee 2 made by the Canadian company KorEcologica, for instance, are made from printed plastics which allows for different thickness depending on the stability needed as well as for less fuel consumption due to its reduced weight.

Degradation behavior and environmental impact of polymer composite materials over their entire life cycle however are currently still under research. For instance, the behavior of End-of-life-vehicles with heterogeneous compound materials in waste streams is ill-understood, leaving waste management (and accompanying standardization activities) a relatively blank spot (Labucay, 2018). Conflicting aims of sustainability and productivity have hampered a more sustainable design of cars so far. Lightweight materials like carbon fibre composites which are increasingly built in cars (used as stabilizing construction material and in sensors, e. g. in the body of BMW i3 electric vehicle) save energy and transport costs in the early production stages and reduce fuel consumption in the use phase. However, long-term social costs of disentangling the merged components of the

composite materials in the stage of recycling are incurred which are not internalized in current production processes (Labucay, 2018).

The following graph displays the beneficial interplay of digitization (mitigating downside risks by way of information sharing) and standardization (increasing the level of coordination and cooperation on the upside) over the life span of electric cars, starting with their production and including their Reuse and Recycling. A snapshot of relevant national and international standards supporting the different stages are indicated in blue colour.



Source: own representation based on Labucay, Xiao, and Zhao, 2019

Graph 2: CE visualization for the automotive value chain

The first automotive company to systematically track their Carbon Footprint (among other factors the amount of greenhouse gas emissions caused by their production processes) has been Audi. Processes at Audi have been certified in accordance with the standard ISO 14064 in addition to a comprehensive Life Cycle Assessment in line with ISO 14040 ff. and the implementation of sustainability standards for its most relevant lightweight material, Aluminium (Tropschuh and Biendl, 2015).

Recycling of NdFeB magnets (the ones built in electric cars) has only recently gained momentum in the EU, partly in the form of collection of magnet scrap from production (with about 40 % of the annual amount of 150 t of magnet wastes being exported to China and Japan for Recycling stemming from magnet production) and increasingly obtained through recovery from applications like wind turbines (Reimer, 2018).

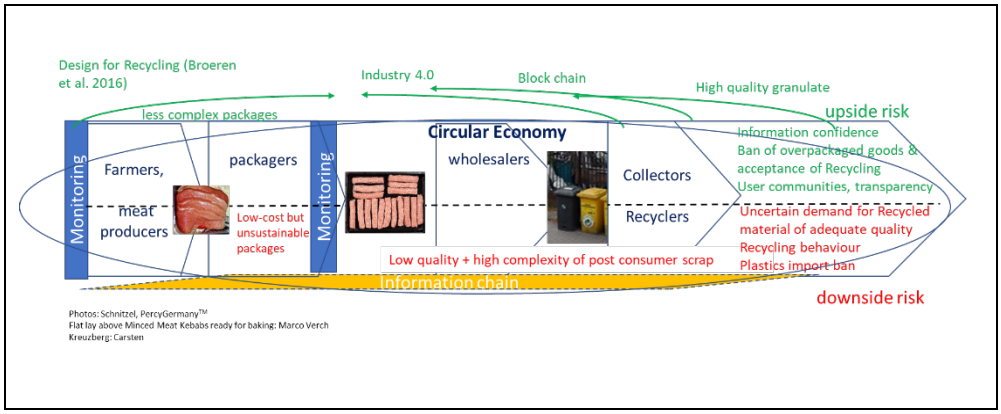
Although recycling of both electronics scrap and high performance magnets is still hampered by a lack of both technically feasible and economically viable techniques, for example at the stage of separation of rare earth compounds (Binnemans, 2013), it is expected that for larger magnets (1-3 kg magnet mass in traction motors of electric cars) containing high quantities of the technology metal Dysprosium (compared to smaller electronic devices), a recycling market will emerge in the near future (Glöser-Chahoud and Tercero Espinoza, 2015: 69f.).

3.2 The plastics sector as a front-runner in circularity

An important step towards a higher resource efficiency in the plastics producing and consuming sectors has been taken by Germany as early as 1996 with its first CE law (Closed Substance Cycle and Waste Management Act) although Japan had set up a national CE law as early as 1991, partly triggered by its lack of own natural resources and accordingly high import levels (Ogunmakinde, 2019). The German CE law has been last updated in 2012 in order to make it compatible with the mentioned *Waste Framework directive* of the European Commission by placing a higher emphasis on Reuse and Recycling (Circular Economy Act, Kreislaufwirtschaftsgesetz). In addition, a system of cascading Recycling fees has been introduced in January 2019 according to which companies pay lower fees with increased recyclability of packaging materials (§ 21 of the German Verpackungsgesetz (VerpG)).

The most pressing problems for managing the Circular Plastics Economy (European Commission, 2018) is the reduction of the usage of single-use plastics items (for which a ban has recently been put in place) and of short-lived plastics packaging.

The following graph provides an overview of how digitization and standardization can contribute to decreasing supply chain related risk (Jüttner, 2005; Jüttner and Maklan, 2011) and to increase the level of circularity along the value chain (e. g., by a higher degree of recyclability) of (especially short-lived foods) plastics packaging by way of employing (standardized) recyclable materials already at the level of Design (e. g., Broeren et al., 2016 for plastics). The WEF mandates the development of across-industry materials of standardized purity (WEF 2014), for example the "de facto standard" of recyclable PET bottles which can be reused for beverages and manufactured into fibres for secondary usage like in the textile and construction industry.



Source: own representation based on Labucay, Xiao, and Zhao, 2019

Graph 3: CE visualization for the food plastics packaging value chain

Companies like the German Werner & Mertz GmbH have rightly reminded that current German CE legislation does not distinguish between post-producer and post-consumer plastics scrap with the latter being a fast and easy way to meet recycling quotas although it cannot be considered to be real recycling as the underlying materials never left the factory; by contrast, the packaging of their Greencare Professional cleaner, marketed under the "Frosch" label, is made of recycled HDPE polymers stemming entirely from post-consumer plastics waste (Werner & Mertz GmbH, 2020).

Although prior approaches had already allowed for an intensive tracking of products along the value chain, e. g. by means of RFID sensor technology, the use of block chain technology in industry 4.0 enables the setting up of a decentralized infrastructure where events in the supply chain are immediately (in real-time fashion) mirrored in a changed information chain (Min, 2019). Data security concerns have to be addressed which can in part be done through a system of access rights, e. g. like in the evan.network of the textile industry which can be transferred to plastics producing and plastics consuming industries.

4 Conclusion

Considering that the majority (88%) of the 14.4 million tons of plastics consumed in Germany in 2017 have been made from virgin plastics and only 12 % from recyclates, it is clear that there is still a long way to go towards a circular plastics economy (CHEManager, 2018). However, some progress has been made towards achieving that goal when allowing for the fact that – for the first time in 2016 – the most heavily used channel of recovery/disposal of plastics has been Recycling (40%), for the first time slightly exceeding the ratio of energetic disposal (38%) and of landfill disposal (20 %) (Plastics Europe, 2018).

The role that standards have been playing in industry 3.0 processes (compatibility enabler, quality signal) are further reinforced in an industry 4.0 setting as the following expert statement from a survey into industry 4.0 risk management underscores: "The market requires technological standards, especially regarding communication and interfaces. The customer does not want to run several systems." (Birkel et al., 2019: 16).

In terms of management implications, a short summary ensues of how CE, standardization and digitization can be beneficially combined. As much of the uncertainty involved in building a CE is rooted in a lack of information it is of interest to monitor information-related supply chain risk (Labucay, Xiao and Zhao, 2019) and to unify the multitude of enterprise resource planning and manufacturing execution systems (Birkel et al., 2019) as their fragmented nature (and of the standards employed therein) poses a risk of its own kind. Cooperative risk mitigation measures by companies that reach beyond the immediate supplier have therefore to be put in place (Birkel et al., 2019; Jüttner and Maklan, 2011; Jüttner, 2005) revitalizing and enlarging existing supply chain risk management approaches (Jüttner, 2005). Apart from particularly risk-sensitive sectors (such as the pharmaceuticals industry, food retailers and chemicals industry), a holistic risk management across supply chain stages (let alone one catered to the needs of closed

loops supply chains) is hardly in place to date (Enyinda and Szmerekovsky 2008) although a recent screening of corporate supply chain risk models showed that 90 % of companies are at least involving more than only the direct supply chain partner (Bugert and Lasch, 2018) and are thus aware that they are part and parcel of larger networks and that management needs to mirror those dependencies. This is where digitization (in the setting of industry 4.0) making logistics data available in a real-time fashion, can help in building a CE at lower cost (e. g. in combination with block chains) and with a lower risk exposure. Technological innovation systems which emerge from making the automotive sector (e. g. the emerging electric cars sector) and the plastics sector more sustainable may induce social innovations, especially if combined with block chain technology (Stanford Graduate School of Business, 2019).

A field yet to be explored by companies is the prolongation of the use phase of products – through repair and reuse at the top of the pyramid of the Waste Management Directive. Particularly for high value machinery, business models have been established by US machines producers which reuse parts of the motor (rich in valuable technology metals) and offer the refurbished machines at affordable prices (Tait and Gereffi, 2016).

Facilitating knowledge and data exchange between materials and their digital twin contributes to mitigating supply chain disruptions (Bugert and Lasch, 2018) and increases options for Recycling and Reuse (e. g., by electronic materials‘ passports) thereby contributing to building a Circular Economy. Standardization and modularization (Gereffi et al., 2005) enable the flexible reuse of elements of the product architecture with the latter being a key element of the Circular Economy (Kalmykova et al., 2018) as reuse prolongs the lifetime of products and contributes to economizing on scarce resources.

The establishment of eco-industrial parks (e. g. of the automobile, chemicals and manufacturing industries) which function based on the principle of industrial symbiosis, like in China and Japan (Yeo et al. 2019), has shown promise as these can be considered seed beds for Circular Economy cycles on a more global scale.

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The Sustainable Way of Academic Knowledge Transfer: some Reflections in Agri-Food Organizations

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Abstract

Knowledge and innovation are the main strategic keys for creation of new sustainable value of organizations (Dankbaar, 2003; Hayter, 2016). In according to Pacheco et al. (2014), the introduction of new knowledge is a driver for smart and sustainable growth in economic sector. The main producers and disseminators of new knowledge are Universities and Higher Educational Institutions (HEIs). Moreover, the university is opening up towards the entrepreneurial system. The main effect of this strategic orientation of University is the creation of collaborative ecosystems oriented to Knowledge Transfer (KT). This collaborative ecosystem opens reflections, for management and organization studies scholars, on the process of knowledge transfer between universities and firms. In effect, the introduction of new knowledge in traditional sectors, such as agri-business, shows more effects and are more problematic than other sectors. Agri-food organizations are based on consolidated managerial (and knowledge) practices and a low propensity for innovation. The Agri-food sector requires new practices that increase the competitiveness of firms.

In particular, a growing area of research is focusing on the study of the academic knowledge transfer process and on the Key Organizational Factors (KOFs) that influence the KT process. For this reason, the present study intends to analyse the KT mechanisms (with particular focus on academic spin-offs) and KFOs with the aim of understanding the dynamics ecosystem for sustainable value in wine sector. This study is based on an exploratory and descriptive study. In particular, the first objective of this research is to understand the main theories on knowledge transfer phenomenon between university and agri-business firms. In this phase, we analysed some scientific databases (Scopus, Science Direct and Google Scholar). The second phase uses the interview method as a data collection tool on a sample of companies in the agri-food cluster. The

study offers a mapping of main theoretical framework on Academic Knowledge Transfer in agri-business. Furthermore, it provides reflections on knowledge transfer mechanisms between universities in the agri-business sector. The results of this research offer an overview regarding main theories of knowledge transfer and effects of the third mission in agri-food sector. The study can help universities to manage KT's mechanisms more effectively with the aim of generating new business organizations

Keywords – Knowledge Transfer, Academic Knowledge, Agri-business, Sustainable value, Key Organizational Factors (KOFs).

Paper type – Academic Research Paper

1 Introduction

Growth is the goal of any organization. In a hyper competitive context, such as that of the knowledge economy, organizations must adopt new strategies for sustainable growth (Buys et al., 2014). The concept of sustainable growth of organizations, taking as reference the Triple Bottom Line (TBL), refers not only to the economic dimension but also to the social and environmental dimension in which an organization is active. As a result, organizations aim to survive by creating economic, social and environmental value that meets customer needs and produces benefits within society (Romanelli, 2018).

The theme of sustainability, considered as a systemic concept (Buys et al., 2014), in managerial sciences, is recent. Organizational sustainability, in managerial terms, represents not only the economic but also the social and environmental pillar (Machado et al., 2020); that is, a set of guiding principles for the survival of organizations.

The results of Faisal (2010) highlighted how the concept of sustainability at the organizational level has received different meanings and the different meanings could lead to different corporate objectives.

In this perspective, not only economic resources but also environmental and social resources are limited and competition arises to acquire a greater quantity of resources.

From the reference literature, it emerges that the objectives aligned with the TBL should be transversal to the company (Infante et al., 2013).

Organizational sustainability, in its various meanings, focuses on knowledge management and innovation (García-Alvarez, 2015; Gaziulusoy et al., 2013). Innovation based on knowledge, environmental, social and economic criteria allows the creation of a sustainable basis for competitiveness in organizations (Buys et al., 2014). In other words, the innovative skills generated by knowledge can play an essential role for organizational sustainability (Sanders and Linderman, 2014). Developing sustainable new products adds levels of complexity to the traditional process of developing new products, but is equally a potential source of income for the economy, society and people (Thome et al., 2016).

By adopting a perspective based on the sustainable growth of the organization (Heikkurinen and Bonnedahl, 2013) knowledge, and knowledge management, becomes a transversal resource (Infante, et al., 2013) able to combine economic, social and

environmental objectives. This principle assumes a crucial role in the agri-food sector (Prahalad and Bettis, 1986 page 490). The integration of knowledge management into business processes aims not only to protect a company's intangible assets, but also to develop and exploit assets, stimulating the creation of goods and services more suitable for customers.(Nissen, 2005). Business processes are the main elements of connection between the work and skills of the members of an organization and the wishes of their customers (Seethamraju and Marjanovic, 2009), also becoming tools for the implementation and formalization of knowledge management in the company and for the realization of its potential benefits (García-Alvarez, 2015). To the extent that knowledge becomes an essential and strategic resource, organizational success increasingly depends on the company's ability to produce, collect, store and disseminate knowledge. Several studies have shown that agri-food organizations play a key role in terms of environmental and social sustainability. Baregheh et al. (2014) stress that the agri-food industry has a low level of innovation and development of new technologies compared to other sectors. In the conclusions of the work, Baregheh et al. (2014) underline the presence of a growing strand of studies dealing with the key role of innovation and innovative behavior, however, affirm that further research is necessary in relation to innovation drivers or obstacles to the same.

There is no single definition of "agri-food sector". The term "agri-food sector" is very broad and commonly used in research to indicate only the relationships with respect to the "agricultural sector" due to the limited availability of regional statistical data for the agricultural sector (CE, 2007). Therefore, in this study, we decided to adopt the term in a very broad sense in order to ensure the identification of the largest number of variables that influence innovation in the sector. So, with the term agrifood we mean, in this work, all the organizations that are active in the agricultural sector and in the production of food and drinks. Agrifood organizations find themselves in situations where it is necessary to find and implement new innovative ways of creating, providing and acquiring value in order to be able to face existing challenges and emerging opportunities. It is clear that the agrifood sector is unable to generate new knowledge on its own. Indeed, this knowledge could be outside the boundaries of societies (Gaziulusoy et al., 2013). knowledge begins to be acquired through partners, or together they acquire the skills necessary to generate innovation and knowledge thanks to their complementarity (Chesbrough, 2006). For this reason, the agrifood sector can generate new sustainable value through the transfer of knowledge. The concept of knowledge includes information, experiences, beliefs, values, intuitions, know-how and skills. In the knowledge economy, the main producers of knowledge are universities and Higher Educational Institutions (HEIs). The knowledge produced by universities or HEIs is called academic knowledge (Reina and Vesperi, 2018). The study tries to understand the main factors and determinants that can influence the transfer of knowledge from universities (or HEIs) to the agrifood sector and respond to the most important, indeed existential, concern of organization studies (OS).

The study contributes to develop contributions on Key Organizational Factors (KOFs) in agri-food sector. We present the study as follows: after this introduction, the theoretical framework on Academic Knowledge transfer, inter-organizational relationship and Key Organizational Factors, the methodology used; the analysis and results of test. Finally, the main conclusions and suggestions for future research.

2 Theoretical Framework

A vast literature has focused on analyzing the knowledge transfer process from universities (and HEIs). Few studies have focused on agri-food sector organizations and relations with universities. The process of knowledge transfer (especially academic) at an inter-organizational level, has focused the attention of scholars in recent years. The studies carried out by Szulanski (1996), Kostova (1999), Argote and Ingram (2000) laid the foundations for the study of knowledge transfer. To better understand the transfer of inter-organizational knowledge, and the Key Organizational Factors (KOFs) that influence the transfer of knowledge, it is necessary to deepen inter-organizational collaborations.

2.1 Inter-organizational relationship and Knowledge Transfer

Agri-food organizations, and in general all organizations, have different alternatives to acquire and exploit new knowledge. Some alternatives widely discussed in literature have an internal perspective (Osterloh and Frey, 2000), while other alternatives have an external perspective such as interorganizational collaboration (Jarillo, 1988; Kanter, 1989; Santoro and Gopalakrishnan, 2000; Franco and Pinho, 2019). The growing competitive drive and the need for new knowledge has generated a growing need for organizations to overcome organizational boundaries with the aim of safeguarding their own growth and survival (D'Aveni and Gunther, 1995). For this reason, focusing on inter-organizational collaborations, several studies highlight the complementarity between the two organizations that have distinct but mutually synergistic resources necessary to advance new knowledge (Teece, 1987). In inter-organizational collaboration, in the knowledge economy, they are born with the aim of creating and having available new knowledge and skills that individual organizations can hardly access. At the same time, complementarity is a key factor for I / U partnerships. Entrepreneurial organizations also rely on universities to have access to new technologies and knowledge, based on research results, highly qualified students and professors (Vesperi and Gagnidze, 2018). At the same time, business organizations can enjoy an improvement in corporate image and reputation or ease of access to economic resources or university structures (Gagnidze, 2019). On the other hand, universities (and HEIs) interact with the main objective of attracting additional research funding. In addition, universities from business relations access industrial techniques exposing teachers to practical problems and offer job opportunities to university graduates (Piirainen, et al., 2016; Secundo, et al. 2017). This was part of the

university's third mission, often linked to the concept of a triple helix (Stal and Babri, 2020)

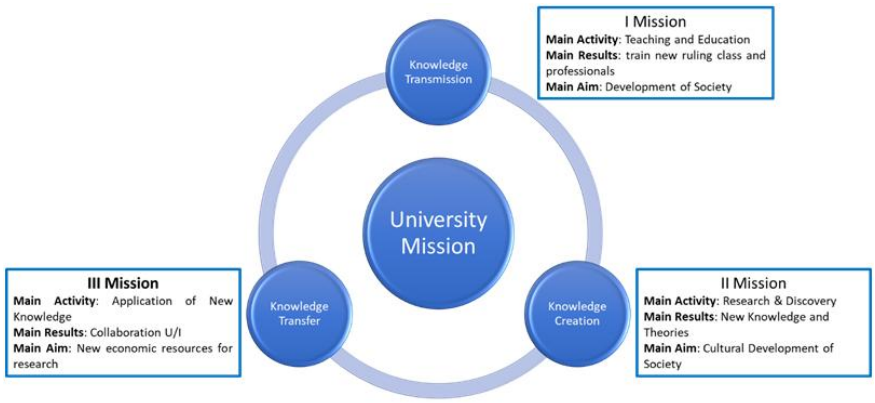

Figure 1 – Framework of the role of knowledge in university missions – Source: Our Elaboration

Although knowledge is characterized by intangibility (Teece, 1998; Mahdi and Nassar, 2019) the knowledge transfer process represents tangible results (Argote, et al, 2000). The process of knowledge transfer, especially academic knowledge, is a dynamic and complex one that requires modeled activities to share knowledge between different organizations. The inter-organizational collaborations, which take place between businesses and universities, consist of a series of specific activities such as joint participation in research consortia, staff exchanges, development of professional training courses or creation of new businesses (spinoffs and startups).

Figure 2 – Framework of academic knowledge transfer process – Source: Our adaptation on Szulanski and Cappetta (2003)

From a Resource Based View (RBV) perspective, the competitive advantage is determined by the ownership and use of a precious resource, regardless of the source, which allows better performance than competitors (Collis & Montgomery, 1995). Furthermore, the RBV suggests that the resource on which the competitive advantage is based must be heterogeneous and sustainable. The concept of sustainable value is not a new approach. The idea of sustainability offers a new way of thinking about organizations by offering new possibilities and new challenges such as an economic performance connected to social and environmental challenges. A definition of the concept of sustainability is given by the 1987 United Nations Brundtland Commission according to

which "sustainable development is development that allows the satisfaction of the economic, environmental and social needs of current generations without compromising the development of future generations" (ISEA, 1999). In knowledge era the sustainable competitive advantage is dependent on exploiting of core and new knowledge in business process. This new focus creates a new declination of RBV, in Knowledge Resource Based View (Halawi, et al., 2005). Creating sustainable value confirms the need to generate triple bottom line benefits for the environment, society and the economy (Evans et al., 2017).

In a complex context, such as that of agri-food organizations, sustainability is closely connected to the ability of agricultural systems to react and adapt to shocks and stress.

the long-term survival of the economic system depends on its ability to create and maintain sustainable economic processes, which involve the creation of value and the satisfaction of current needs without compromising the needs of future generations (Ghisetti et al., 2015).

3 Methodology

The study has an exploratory and indictive nature. In order to achieve the research goal, the methodology is based on a qualitative approach. A qualitative study seemed particularly suitable for the purpose of the research and the complexity of the phenomenon, since it allows to take into consideration the specific characteristics of the context (internal and external) of the organization (Eylon and Bamberger, 2000), as well as to explore the knowledge transfer process academic in agri-food organizations. For this reason, the study started from an analysis of the main literature on the topic of knowledge transfer, inter-organizational relationships and sustainable value. In particular, the study examined the main scientific contributions, in order to define the main Key Organizational Factors (KFOs) that influence the process of transferring academic knowledge to agri-food organizations. The collection of the articles took place through the consultation of scientific databases. Subsequently, the case study was identified. A cluster of small organizations (in Italian consortium) in the agri-food sector has been identified as a case study. The cluster is made up of around 50 small organizations, set up with the aim of helping participating organizations to be more competitive. Interview are used as collection method. Through a semi-structured interview, according to the methods and instructions suggested by Yin (2009), we tried to validate what emerged from the literature. The interview, lasting about 45 minutes, was conducted by a researcher who proceeded to record the conversation (with the interviewee's consent) anonymously. Subsequently the interview was listened to several times, in order to better understand the answers and the connection with the research question. The main results were emphasized in the discussion section. In order to increase the quality and quantity of the information collected, the authors carried out an analysis of the cluster documents. This methodology establishes its main limitation of the generalization of results. The aim of this study is not to draw conclusions of universal validity, but rather to draw some suggestions for further

and more in-depth analyzes on KOFs and the transfer of academic knowledge and its organizational impact.

4 Results and Main Findings

The results of this study can be divided into two categories: theoretical and empirical. The first macro category of results is derived from the analysis of the main theoretical references connected to the phenomenon under investigation. From the literature, we have identified a series of KOFs that can influence the AKT. The main theoretical reference is represented by the 7-S framework model proposed by Santoro and Gopalakrishnan (2004). The complexity of the AKT derives from the inter-organizational relationship between university and business (Gamm, 1981; Dill, 1995; Bozeman, 2000; Nieto and Santamaría, 2007). At the same time, the characteristics of knowledge represent an additional element of complexity. Although a vast literature on the subject identifies knowledge as a strategic resource (Yair, et al., 2001; Amin and Cohendet, 2004; Zaim, 2019), the characteristics of immateriality (Manikas, et al., 2019) and the connection with universities make the process of transferring it particularly complex.

Table 1 shows the main key organizational factors that emerged from the literature.

Table 1 – Key Organizational Factors (KOFs) – Source: Our Elaboration

Key Organizational Factors (KOFs)	Main References
Type of Academic Knowledge	Thorburn, (2000); Sekeran, (2003), Langford, et al., (2006); Susanty, et al., (2012); Vesperi, et al., (2016); Neves and Franco (2018).
Organizational Culture	Lahti and Beyerlein (2000); Lee and Suliman (2002); Gibbert et al., (2002); Cummings and B.S. Teng (2003); Chuang, (2004); Ko, et al., (2005); Yang e Chen, (2007); Susanty, et al., (2012); Alattas, and Kang (2016);
Organizational Structure	Lahti and Beyerlein (2000); Hall (2001); Lee and Suliman (2002); Gibbert et al., (2002); Goh (2002); Peachey, (2006); Girdauskiene, (2013); Gonzalez and De Melo (2018)
Information Technology System	Hendriks (1999); Bolisari and Scarso, (1999); Lee and Suliman (2002); Syed-Ikhsan and Rowland (2004); Malhotra and Majchrzak (2004); Yang and Chen (2007); Peachey, (2006); Pandey, S. C., (2018)
HRM	Szulanski (1996); Goh (2002); Tsai (2002); Cummings and B.S. Teng (2003); Zheng et al., (2010); Lee, et al., (2013); Sanchez-Vidal and Sanz-Valle, (2018)
Rules of University for KT	Bailetti, (2011); Berbegal-Mirabent (2015); Hayter (2016); González-Benito (2016); Vesperi, et al., (2018);
Intensity of collaboration with the university partner	Benneworth, and Charles (2005); Bstieler, et al., (2016); Ghomi and Barzinpour, (2018); González-Benito (2016); Guerrero, et al., (2016);

The results of this study identified some KOFs, in consideration of the ability to achieve the effectiveness of KT. The study identified some factors: IT system, human resource management, structure, culture, intensity of collaboration with the university partner and the university's role for KT. In literature, the authors have often given different names to these key organizational factors, even if they mean the same concept. For this reason, we have decided to adopt a very broad classification which could bring all the definitions provided.

The second category of results is of an empirical type deriving from the interview with the head of the cluster. In the first instance, they were asked to define their own concept of "sustainable value". The interview showed that the concept of sustainable value is certainly intended as the creation of economic, financial but above all social and environmental value. Hence, the creation of new sustainable value is generated by the search for a balance between the various aspects. In the agri-food sector, the connotation of environmental value emerges from the interview, is generated both through the bio treatment of plants and through the recovery of traditions. While, from a social point of view, the creation of value is generated through the hiring of young, unemployed or disadvantaged workers. This aspect generates an indirect value for society, namely the contrast to undeclared work and exploitation.

Subsequently, an attempt was made to investigate the KOFs, through an interview.

Key Organizational Factors (KOFs)	Main References in interview
Type of Academic Knowledge	The acquisition speed depends on the type of academic knowledge transferred. The transfer of new knowledge regarding the care of plants has very slow times, especially linked to a discussion of biological times. The introduction of new technology, on the other hand, is faster.
Organizational Culture	Organizational culture can represent the main obstacle to the transfer of knowledge. In particular, mainly manual and operational value, traditions and operating practices are deeply rooted in the culture of agri-food organizations. Furthermore, the presence of entrepreneurs who are not prone to change can slow down the process of absorbing academic knowledge
Organizational Structure	The organizational structure in agri-food organizations is rigid. There are small organizations in the cluster, often on a family basis. Not very relevant.
Information Technology System	IST in agri-food are of two types. Those related to the production and management of plants and those related to the sale and post-sale (tracking, packaging, etc...). The introduction of new knowledge in the first category is very difficult. Instead in the second category there is a great need
HRM	It is the main tool for introducing new knowledge within agri-food organizations. Hiring young graduates or those with international experience is a way to convey new knowledge. Same principle for the support and staff.
Rules of University for KT	The current relationships with the university consist of training placements and experimental theses
Intensity of collaboration with the university partner	It is very difficult for single small or micro-sized organizations to make agreements with research institutions or universities. The criticality also lies in the technical times for the stipulation of often very long agreements. There is a need for contracts and institutional relations with research bodies and universities both locally and nationally

The interview also shows that often the introduction of new innovation (or more generally of knowledge) is often hampered also by the financial aspect. A second revealing aspect is the morphology of the soil and the particularity of the plant.

5 Conclusions

The study identifies and analyzes the main organizational factors (KOF) that influence the transfer of academic knowledge in the agri-food sector. The results achieved are of

two types. The first deriving from the review of the main theoretical references, which brought to light the main KOFs identified by scholars. The second type of results, related to the interview, highlighted further aspects not emerged from the literature review. The study tested the KOFs identified with a case study.

In particular, "Type of Academic Knowledge" is a controversial KFOs. While in literature it represents a generic and very broad element, from the empirical validation it emerges that these KFOs must be divided into two aspects. The type of academic knowledge transferred assume a different relevance according to the phase of the production process in which it is inserted. In production, academic knowledge appears to be of little relevance, while, in post-production phases, it assumes a greater relevance. KOFs referring to "organizational culture" are very relevant, and can represent the main obstacle to the introduction of new knowledge. The KOFs "Rules of University for KT" and "Intensity of collaboration with the university partner" which in literature are often considered complementary, are defined in the interview as opposed to their importance. While the "Rules of University for KT" appear not very relevant, the degree of "Intensity of collaboration with the university partner" is instead considered very relevant. In this regard, organizational dimensions often impose agreements and programs shared at national or territorial level. This study may represent a first element of reflection in the debate on the transfer of academic knowledge and the influence and the agri-food sector. In particular, it can help understand how the results of academic research can promote value in a particularly complex sector such as agrifood characterized by a low level of innovation and absorption of new knowledge. The study is not without limits. In particular, the theoretical part needs further implementations. The theoretical results must be implemented and more validated through a greater number of interviews. In addition, he must understand if there are other factors that have not yet emerged. From a practical point of view, the study highlights how knowledge, in particular academic knowledge, has become a strategic resource for businesses. For this reason, those responsible for the transfer of academic knowledge and entrepreneurs are called upon to encourage the introduction of new knowledge within organizations in order to survive and compete on the market. Successful knowledge transfer therefore becomes vital for organizations.

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Digitalization Experiments – Does Support Needed Equal Support Offered

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Abstract

Seems that many organizational needs are to be matched with a simple solution of digitalizing the operation or a part of it in order to support and to develop it. The information technology (IT) -related skills and capabilities are different in different organizations and the level of know how varies similarly. In practice this interprets to the operation needing support to realization of the intended digitalization measures, basically in every case. We present two cases of digitalization. One, in which a smart city initiative was introduced and implemented to a city in Finland, large in its context and another in which a web-based open source service was implemented for municipalities and companies that enables digital application of construction permits and other permits related to infrastructure. The cases show that the quite technical-sounding issues require simultaneous human aspect to be taken into account. The support needed covers the technological aspect, but it is advisable not to forget the human side either. The organizations offer various kinds of measures to match the needs of their employees, but the ability to take on the support needed and presumptions to assess the need for this are different resulting in various amount of support offered, needed, expected, and accepted.

Keywords – Digitalization, Experimenting, Smart city, Support

Paper type – Practical Paper

1 Introduction

Digitalization is a 'buzzword' one encounters in many contexts and surroundings these days. In public discourse and in everyday news but also occasionally in more official statement's digitalization is sometimes seen as an omnipotent solution for many a problem and an answer to various challenges both in private and in public sector organizations. In our paper we focus on the phenomenon in the public sector and services related to public services to keep the observations within a manageable scope. The

previously mentioned problems and challenges may have something to do with the rigid and unyielding organizational structures or with costly ways of offering public services. The public sector is largely just about providing services to the citizens (De Vries et al., 2016; Higgins, 2017). One is also able to read news about digitalization being a solution to match a growing need of improved service offering; services come in various shapes and forms. This is obviously quite easily said. At the same time, the public sector in general is faced with a growing pressure to streamline its operation and to reduce costs. All these factors: the citizens' increasing expectations for better and more refined services, the public pressure to gain more outcomes from different operations and the pressure to reduce the use of resources, form a situation that gives a very difficult problem to solve. In order to respond to the demand public organizations have launched multiple various digitalization and smart city initiatives (Bakıcı et al., 2013; Denhardt and Denhardt, 2015; Taylor Buck and While, 2017). Digitalization, by definition to create and execute "changes associated with the application of digital technology in all aspects of human society" (Stolterman and Fors, 2004, p. 23), may indeed change the way employees interact with one another, their places of employment, and their actual objectives and goals of working as well as to how they perform their tasks (Parviainen et al., 2017). A fundamental question is whether this may be made into an 'everyone wins' type of situation, giving employees larger personal freedom and enable creativity at work, while simultaneously increasing productivity in organizations, and providing citizens with improved (self-)services. If this is indeed the case, how can it be achieved, what kind of support does it take to make this happen?

2 Cases and background

2.1 Case Digiprogram

The *Digiprogram* was a subprogram of a smart city initiative. The larger initiative was originated by the city's top management of which the CIO is a member of. The *Digiprogram* was initiated in the city's CIO's office where the headquarters of the program would be. A program manager was appointed along a few other staff members at the CIO's office, but the main focus would be elsewhere, in the service areas. Already in the planning phase some areas proved to be more eager, some at least willing, to take part in the initiative were recognized. The *Digiprogram* then committed a number of city employees from these areas to act as project managers, another number of people to be related development managers. In addition to these, there were also steering groups to oversee and guide the endeavors.

The program itself consisted of numerous experiments in the various service areas of public administration in the city. The ideas for the experiments stemmed from the service areas as there was the outlook and vision on what and how the digitalization could be made the best use of. The objective of these experiments was to scout whether there

would be emerging service innovations that may be later applied and upscaled to permanent service offerings of the city administration (Hellsten and Pekkola, 2019). In addition to the mere experimenting, the overall attitude towards improving the city administrative operation through experimenting with digitality was regarded as an additional target for development. Goes almost without saying, but these executed experiments varied by their nature. They came in various shapes and sizes; some were smaller (how to conduct day-to-day conferencing more effectively by using econferencing, such as Skype), some rethought their whole operational process anew.

The people involved were ordinary workforce of the service areas. Perhaps with the exception that they were more eager than average person in the city's payroll to participate in such initiative (as at least some of them volunteered to this program). Not necessarily always when it comes to their technical capabilities, but their attitude was the key. To summarize, the program aimed at finding out whether it would be possible to come up with innovations providing interoperable, high-quality public sector services via digital channels to improve cost-efficiency, create savings, and generate benefits. As beneficiaries may regarded everyone, from citizens, to businesses, to organizations and to local and government authorities. All these need new solutions that are easier to use for the end user but also cheaper to produce and use for the offering side (Helander et al., 2020; Hellsten and Pekkola, 2020).

2.2 Case Lupapiste service

Lupapiste is a web-based open source service that enables digital application of construction permits and other permits related to infrastructure. *Lupapiste* service was developed as a part of Action Program on eServices and eDemocracy (SADe programme) set by the Ministry of Finance in Finland (Saarijärvi et al., 2016). The program aimed at providing interoperable, high-quality public sector services via digital channels to improve cost-efficiency, create savings, and generate benefits to citizens, businesses, organizations and local and government authorities. Special attention was paid to the achievement of cost benefits to municipalities. *Lupapiste* was one of the sub-projects in the program coordinated by Ministry of Environment. After a competitive bidding, Solita Inc. was chosen as a service provider for *Lupapiste*. *Lupapiste* service was developed in co-operation with municipalities that worked as pilots in the project, and later during the evolution of the service the ownership was transferred to Evolta Inc. a spin-off company from Solita Inc (Helander et al., 2020).

Lupapiste service is today used in about 60 % of Finland's municipalities and there are currently about 100.000 users ("Lupapiste" 12.06.2020). In this case 16 interviews were conducted with corporate representatives operating in construction, city planning, architecture and electric engineering (Table 2.). The interviewees used *Lupapiste* service in their work regularly and applied for permits in various fields (architecture, electric

engineering etc.) and in different municipalities in Finland. The overall user experience was positive and the interviewees felt that the service has lightened the application process of different permits.

3 Research settings

In this paper, we report findings from two single case studies (Yin, 2008) involving *Digiprogram* in the city of Tampere, Finland (with appx. 230,000 inhabitants and 15,000 employees in +2,000 sites) and *Lupapiste*, a nation-wide service aimed at streamlining the building permit application and following up the possible granting thereof for various parties around this theme. The city officials recognized and acknowledged existing systems and services being no longer up-to-date or even appropriate.

The city has set up a smart city program, of which the *Digiprogram* is a part, to modernize its operations. The *Digiprogram* in the longer run aims at developing digital services to facilitate the everyday life of the city residents, improve their wellbeing and security, promote smoother migration to and mobility within the city, and create new businesses by enabling cooperation among various stakeholders ("Smart Tampere," 2017). Similarly, the authorities overseeing the area of services among the building and construction permit in the national ministry level together with *Lupapiste* administrators saw the need for updating the service model and possibilities to streamline the services as a whole through well-planned digitalization initiative. Various other development schemes and aspirations about digitalization also exist at the national level.

In the case *Digiprogram* the city CIO's office manages and provides ICT services to different departments and units, ranging from the top management to the city customer service. The stakeholders have different needs and capabilities in using various technologies for their work. The number and the complexity of the ICT systems pose challenges for users and the management as well as to the citizens. To understand the potential impacts of the smart city program as a whole and its *Digiprogram* in particular, we conducted a set of semi-structured interviews to collect qualitative data from different parts of the city. The CIO recommended interviewees from various projects within the *Digiprogram*. Snow-ball sampling (Morgan, 2008), ie. asking the interviewees to recommend potential candidates for future interviews, stakeholders with knowledge to share, was also used to seek the best sources of information. In total, 20 face-to-face interviews visible in the Table 1. were conducted.

Table 1. *Digiprogram*; interviewees in the city administration.

Position
CIO
Program manager
Productivity controller
ICT manager (AK)

Service designer
Enterprise architect
Digimarketing manager
Development manager (city planning)
Development manager (customer service mgmt)
Development manager (employm. services, SO)
Project manager (city concept)
Project manager (city planning)
Project manager (customer service)
Project manager (early education, pre-school HK)
Project manager (employment services, JT)
Project manager (employment services, MV)
Project manager (grammar school)
Project manager (infrastructure; tram project)
Project manager (space allocation, JS)
Project manager (town planning)

The interview themes were discussed with the CIO and some of his key staff member before starting the actual project and suggestions were dealt with in order to clarify the best ways to approach the theme. The studied themes were based on the city strategy and reflected the program objectives and their 'surroundings'. After the initial talks, the objectives were formulated into themes and subsequently questions. A plan on how to execute the interviews was made. The interviews focused on the initial phase and the foundations of the *Digiprogram*, including the resources, participants, and impacts. Additionally, questions about the process itself were included. The interviews, lasting 60 minutes on average, were audio-recorded and transcribed.

The data analysis followed the interpretive research approach (Walsham, 2006). The first author in the project acquainted himself with the material to form an overview of the topic and each interview. The issues identified as potential impacts and their background were labeled and listed for later use. Process diagrams and stakeholder maps were also drawn and iterated with the city representatives to see how they corresponded to the eventual issues. All findings were collaboratively discussed among the authors and with the city representatives to ensure the accuracy of the interpretations and the conclusions. Finally, the findings were compared with those of the existing literature.

The *Lupapiste* service empirical data consist similarly of qualitative interview data. The qualitative interviews (altogether 16, depicted in Table 2.) were semi-structured and they were mostly conducted by one researcher, whereas content analysis and multiple researcher triangulation was used in the analysis of interview results. The interviews contained a small survey (more later in Table 3) with the Likert number-scale to help to tackle especially the analysis of feelings regarding support and communications about and within *Lupapiste* service. This survey was analyzed by going through the empirical

material and recognizing and classifying the themes pointing towards various formats of support and other emerging phenomena.

Table 2. Lupapiste service; interviewees in companies.

Company	Roles of interviewees	Number of interviews per company
Architecture office	Construction design Design/Architect	2
Engineering office	Project manager	1
Energy company A	Project managers	2
Energy company B	Regional manager, Field planner	2
Energy company C	Network engineer	1
Energy company D	Developers of district heating, Network engineer, Developer manager of electronic network, Designer of electronic network	5
Infrastructure company A	Technical assistant	1
Infrastructure company B	Project designer, communications network, Planner, documentation	2

4 Findings

The *Digiprogram* entailed a number of experiments testing a number of various approa ches to ease the operation with digitality-related tools. The experiments comprised both functional and technological ideas, novel in their surroundings. This manifested itself through the fact that the idea of the 'digitalization' concept varied significantly between the departments. In some areas and departments, digitalization meant that they used Skype for conferencing or customer contacts while in others the whole process itself was considered when digitalization was planned to be implemented. The planned benefits of Smart city program were mostly the experiences from the experiments: how these issues should be addressed in the city operations and on what organizational level, not direct and simultaneous benefits for the citizens.

The support offered to different experimenting 'teams' thus varied significantly. Similarly, the level from which the personnel started their 'journey into digitalization' was quite heterogeneous. The CIO's office offered technological and technical support to consult and assist when and where needed as the area to which the digitalization was to be implemented varied as did the type of intended digitalization itself. This support was in forms of various technologies regarding the intended case-specific need. The CIO's office needed to use their resources to assist the project managers in their tasks, which meant familiarizing themselves with some newer features and technologies in addition to those they already had in their disposal.

The support in *Digiprogram* became physical in 'the program days'. Every Thursday was dedicated to the program issues. The project managers thus assembled on Thursdays on the invitation and under the command of the program director. The Thursdays contained training, for example in procurement and acquisitions in the public sector and to discuss current issues and urgent emerging matters, ie. offer and get peer support for

and from one another. The program days were very well-liked feature. The interviewees were in unison that this particular activity, trainings and discussions, gave them the most important support. Even if the precise training on a given day wasn't quite the most urgent theme, they were accepted because during the day the thoughts and opinions could be discussed with project managers in the similar situation. Also, the possibility that the issues in the trainings would emerge in one's own project was seen a noteworthy one, thus motivating the participation in the shared experiences.

We were able to recognize that the overall experience with the usage of *Lupapiste* was positive in the various companies and fields (Table 3). All the interviewees recommended the *Lupapiste* service to other companies. The system in itself was easy to use, most of the users only participated in the initial introduction seminar held usually together with the municipality and the service provider. The *Lupapiste* service survey reveals that nine out of 16 responders have not used the *Lupapiste* service customer support at all and at the same time 13 of them found the user experience satisfied (values 4 and 5).

Table 3. *Lupapiste* service survey.

Answer/responders 16	**0 (zero = has not used**	**1**	**2**	**3**	**4**	**5**
Lupapiste service helps significantly building license application process				5	6	5
I am satisfied with the features in the Lupapiste service				3	13	
I am satisfied with the Lupapiste service providers willingness to develop the Lupapiste service				5	6	5
I am satisfied with the company accounts characteristics and features				5	7	4
I am satisfied with the user experience of Lupapiste service			1	2	10	3
I am satisfied with the customer support and help of Lupapiste service	9			1	3	3
I am satisfied with the user training of Lupapiste service	5		2	3	4	2
I am satisfied with the communications regarding the Lupapiste service				8	7	1
I am satisfied with the municipalities' efforts regarding the implementation of Lupapiste service and the efficient use of Lupapiste service (one responder did not want to give an estimate)		1	1	5	8	

The communication in the system (front page news and chat) and from the system provider (emails, newsletters) was considered good and sufficient. However, the cooperation between the authorities within the various institutions of the municipalities was perceived as a challenge, and the operating methods were not the same in the

municipalities. This lead, to that the corporative users had to deal with a different set of rules depending on the municipality although the information system remained the same in each case (Helander et al., 2020).

The networks inside *Lupapiste* service as well as outside with project group, were considered essential and significant. The *Lupapiste* service is only a part of the construction project, but the network remains almost the same in the *Lupapiste* service during the project. The communication and chatting with the project network inside the service with the different participants was considered useful, for instance the municipality could inform the applicant that a new document was needed, or experiences were shared etc. The *Lupapiste* service was used in some cases as communication base for the different actors in the projects, and this was possibility perhaps not originally recognized when creating this digitalization project. A specific, more permanent, user group, ie. a network of related parties did not spur overwhelming interest, even if it was not completely rejected. Mainly the respondents were shy of this because it represented yet another time-consuming endeavor to an already packed daily life of everyday business. Instead, an annual gathering, a conference of a sort organized by *Lupapiste* itself was proposed.

5 Conclusions

We conclude that the support, whenever digitalization is concerned, cannot well be defined conclusively without acknowledging the intended target of implementation. Having said that, there are a few issues that stand out: sufficient technological expertise and consultancy to support emerged ideas, well executed communication about and around the operation, and sufficient peer support to give space to uttering the sentiments and getting confirmation to one's thinking from one's equals.

Perhaps the biggest impact of digitalization was that the objects benefited from learning a new culture and how to make this happen. The processes and the attitude towards the innovations as a whole were largely perceived positive. The city operations are now more visible for internal stakeholders, and the city's organizational culture has moved towards a more modern, innovation friendly atmosphere. Similarly, the *Lupapiste* has taken a step towards more modern modus operandi through the same motions and notions.

The change towards digitalization requires vision, knowledge, and technical skills, but also understanding of an overall situation as well as the context. The organizational culture and the processes facilitating the actions are essential. Thus, a need to replace the old ways of working with the newer ones emerges. Still, before this can happen, old practices need to be unlearned and new ways of working need to be learned instead. This whole process needs support from the organization. The support is needed from the organization itself, the management and the peers in order to make the innovation successful and the change happen. Some issues need to be further developed. These include for example the support to recognizing the uncertainties in the individual tasks

and their connections as well as to make them even. Similarly, defining and setting expectations and objectives need to be clear for all stakeholders, sometimes they cannot do this by themselves. Even if the improvement actions were commonly agreed, the actual steps how to meet them, were not always clear. For example, the mere definition on what is meant by digitalization varied; is it about the processes or the tools? And again, when something is 'good enough' and 'what is enough'. These kinds of initiatives are a combination of technological innovations with a change to prevailing attitudes. The relief of the humane resistance for change can be supported by actively involving the personnel into the initiatives and empowering them to active members of the operation.

There are several limitations for this paper. This is just of two cases, even if the other one has more experiments. However, we argue that it is plausible to assume that similar settings would provide comparable results. Hence, further research is needed. Secondly, we derived the conclusions from the data. This needs more validation.

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Supply Chain Finance on Blockchain Technology

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Abstract

A conceptual model focuses on the supply chain finance (SCF) built on Blockchain technology (BTC). The model, derived from the advantages of BTC, i.e., transparency, security, immucable, is assumed to construct information sharing among supply chain members to optimize the financial transactions across boarders, different currencies. Some use cases of BTC were illustrated by the definition of disruption innovation. The optimized decision of SCF can be drawn upon learned price discounts that are beneficial to supply and buyer sides.

Keywords – Blockchain, supply chain management, supply chain finance, disruptive innovation, decision optimization

Paper type – Practical Paper

1 Introduction

Blockchain is a distributed ledger technology that facilitates peer-to-peer transactions. First introduced in 2008, blockchain technology (BCT) was originally built as a platform for trading Bitcoin (Nakamoto, 2008). Some unique features of blockchain technology available to its users include anonymity, transparency, and immutability. Blockchain-based approaches can bring the opportunity to drive business value throughout their supply networks. By monitoring events and metadata associated with a product,

Blockchain can provide security, greater information transparency, access to trusted, secure, and unaltered information.

To understand better how Blockchain can help knowledge management, four key components of knowledge management are reviewed (Lawson, 2003):

- Knowledge creation: the conscious effort to search and define relevant knowledge and its sources from both within and outside an organization.
    - Certain standard operating rules or knowledge of platform will be established when introducing an innovative use of existing technology or adopting brand new technology.
    - Using historical transactional information to predict a new discount rate or bid information for the future transactions.
- Knowledge storage: at this stage, storage and retrieval mechanisms are developed to enable effective and quick access to knowledge.
    - Blockchain provides decentralized data storage features and relies on private keys (Deloitte, 2017) to securely store data locally.
- Knowledge transfer: it is the process of transferring codified knowledge to meet the specific needs of users for knowledge.
    - Blockchain offers transparency in transferring information or transactions.
    - Blockchain has immutable and irrevocable properties, which makes sharing information effective and ensures traceability (Deloitte, 2017).
- Knowledge application: denotes the use of knowledge in new situations where users can learn and generate new knowledge.
    - Transparency in transactions ascertains the origin of data though its linked chains (Ali et al., 2018).
    - While there are different customs, tariffs, and digital documents crossing national borders, the applications are modified based on the existing information or operational rules.

From a business perspective, enterprise blockchain possesses three main characteristics: 1) transparency to complex business processes; 2) tamper-resistance to business processes; 3) streamlined work orders across different currencies/borders.

2 A Disruptive Innovation - BCT

Do these characteristics make BCT a disruptive innovation? Is BCT a disruptive innovation? Its destiny is yet to be determined. Innovation is considered disruptive when a well-established incumbent business structure is successfully challenged by one with fewer resources (Christensen et al. 2015). Using technology in new ways to increase efficiency in business processes improves alignment with business goals. According to the third global survey of Blockchain by PricewaterhouseCoopers (2019), it found that only 15% of blockchain implementations went fully live. The rest was in progress, development, or in research mode.

BCT may have the capacity to transform the relationship between businesses (B2B), their customers (B2C), and also, regulators. The success of blockchain disruptiveness is heavily reliant on the modification of the blockchain system to fit business needs in specific industries. The BCT adoption interrupts the business processes of various industries. However, is it a worthwhile trade-off to endure the disruptions for more streamlined business processes?

Due to the increasing adoption of Blockchain, there are consortiums formed, i.e., R3, Hyperledger to provide necessary transparency to participating members enterprises, industry-leading standards from various industry leaders. The International Standards Organization (ISO), International Telecommunication Union (ITU), and the U.S. National Institute of Standards and Technology (NIST) are driven to formulate a protocol that prevents security threats, administrator risks, and cyber-attacks.

3 BCT Use Cases in Various Supply Chain Management (SCM)

SCM comprises stages involved in the planning, controlling, and execution flow of goods and services. These stages range from the early stage of acquiring raw materials, then the production of the goods/service, through distribution to final products. SCM helps organizations manage the information flow, financial transactions along with products/materials/assets beyond the physical boundaries of the organization. The complexity of supply chain networks depends on the different actors. They include suppliers, distributors, manufacturers, retailers, and end consumers. Members of forecast-driven supply chains generally focus on estimating demand at the next link in the chain and consequently often face problems created by poor forecasting, which results from a lack of transparency of the actual demand (Shih et al., 2012). An effective solution to such problems is to promote the efficient flow of information in the supply chain.

Lacking transparency, tracking, and security in multiple layers and facets of SCM, the BCT platform may alleviate these challenges to provide process efficiency/integration, multiple direction updates, concurrent planning. As indicated in Figure 1, innovation-driven enterprises may leverage change to add business values and realizations. For example, Walmart and Maersk are both located in the high disruption and high innovation quadrant. The innovation of Blockchain brings business values worthwhile for disruptions in business processes.

Using the traceability function of Blockchain, Everledger, RMG, and Mycelia have each used Blockchain to register and record objects of high value. Everledger is a hybrid model, i.e. a combination of public and private blockchains that is used to permanently record and digitally certify diamonds. Similarly, RMG keeps records of gold using this technology. Finally, Mycelia uses BCT to keep records of proof-of-ownership for artists. Because in these three cases, BCT is used simply to keep records with no major industry disruption, in a manner that has little to do with innovation, we place them in the low disruptive-low innovation quadrant.

Maersk partnered with IBM in a Joint Venture (JV) to design a trade digitization platform intended to completely transform the process of international shipping. In 2018, this JV debuted their trade digitization platform and made it available to other players in the shipping industry including their competitors as a way for them to revolutionize and streamline global trade by utilizing blockchain technology to drastically increase the efficiency and transparency of global shipping processes around the world. Should this platform be adapted across this industry, this highly innovative use of BCT would be highly disruptive to an existing process.

Although not nearly as disruptive as the global shipping industry, Walmart has also partnered with IBM to use BCT to facilitate origin tracking of produce from farmers to retail stores. This use of Blockchain digitally tracks the movement of products both domestically and internationally, keeping track of data such as farm origin, batch numbers, factory and processing data, expiry dates, and other shipping details. While this is a brilliant and innovative use of BCT by Walmart to food supply chain management and logistics, it does not revolutionize the entire industry as drastically as the Maersk platform. Hence, we consider this use of BCT to be less disruptive, as seen in our quadrant diagram.

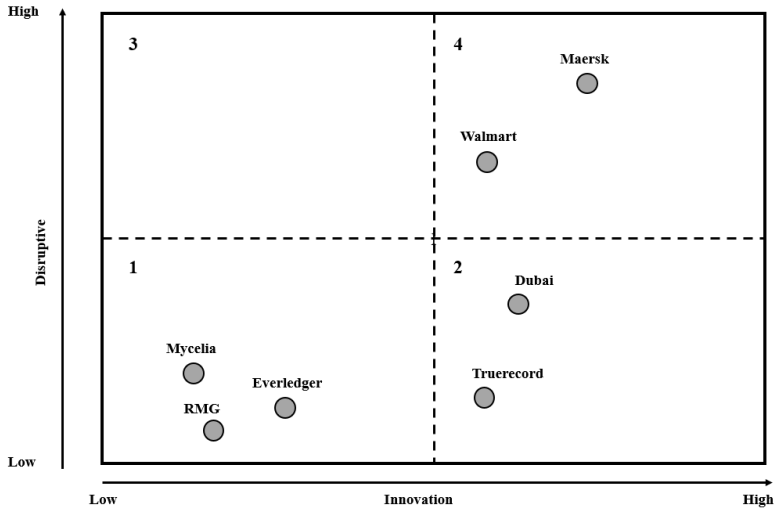

Figure 1: BCT Potentials to Accelerate Supply Chain Management

4 Supply Chain Finance (SCF) on BCT

Due to the increasing level of competition and risk from globalization, many enterprises encounter multiple challenges within their businesses. First, due to the information asymmetry, double financing, which means the same expenses are being financed twice from different sources, is considered a major concern within the supply chain. Another critical challenge is the difficulty of validating transactions, which makes

it an easy way for money laundering. System integration, trust and communication are problems among supply chain partners. The system integration is mostly centralized without scalability. Moreover, the inputs that are localized in the enterprises' internal databases make it impossible for supply chain forecasting, leading to low visibility among the supply chain partners. Indeed, a lot of unnecessary, redundant, procedures are not streamlined within their businesses. It is, claimed, the support of the business eco-system is lacking.

In SCM, the main challenges derived from complexity and uncertainty in business workflow come from different financial platforms to support each business transaction. The BCT provides digital footprints on each business transaction of SCM, as well as the shared information. The finance of each business transaction, however, may need to be strategically planned to save costs. The digitization of the whole value chain can bring all SCM channel members together into a digital, proactive, and collaborative environment while granting them access to real-time information related to material, data flows, and financial transactions.

4.1 Dynamic Discounting Mechanism

SCF uses short-term credit to balance working capital between the buyer and the seller. It reduces supply chain costs and increase liquidity by providing an efficient platform to streamline the payment process. SCF is used by many focal firms to optimize the workflow and allocation of financial resources in the supply chain (Omran et al., 2017). Because of forward financing or the contractual agreements, SCF reduces transactional costs and improves financial flows. In a broader sense, SCF optimizes liquidity with different payment options offered to all partners within the network. A dynamic discounting of SCF aims to relieve buyer and supplier payment tension (Omran et al., 2017). Further, using BTC to provide a secure, transparent technological platform to share data transaction information.

As shown in Figure 2, using BCT as an integrated infrastructure for the entire supply finance eco-system allows buyers, suppliers or actors to be electronically and financially connected. Therefore, they can build up a trust network by approving the performance parameters within the smart contracts. Ongoing relationship reduce buyers' concerns on seller performance and the sellers' concerns on buyer repayment risk. BCT is capable of improving the payment process between buyer/supplier and/or actors in SCM. The SCF built on the BTC helps to remove the inefficiencies in the financial flows.

As BCT applied to SCF via smart contracts, this will enable all participants in an SCF to communicate on a single shared ledger. Each participant, including the supplier and manufacturer, will only update, view, and share their parts of the transaction while achieving a high level of efficiency, trust, and transparency on an immutable ledger record. The buyer accepts an invoice with a discount at an earlier payment date and pays the supplier with a discounted payment. The dynamic discount triggers by a centralized

BTC platform. Then, the stored transaction data feeds into the future prediction of bids or discounted pricing of supply that benefits all partners in the supply chain. The learned data cycles optimize decisions on bids or discount pricing to supply chain members.

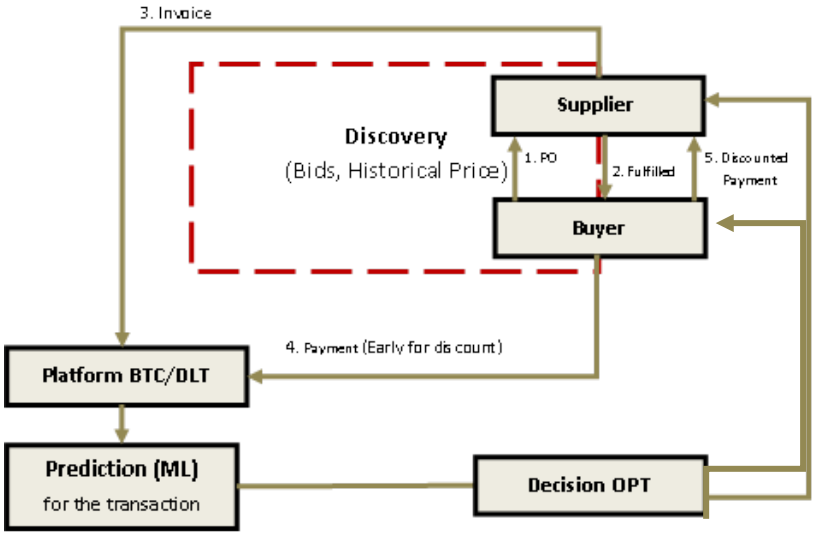

Figure 2. Proposed Application BCT to the SCF Eco-system

5 Conclusions

This manuscript provides a conceptual model to the advantages of BTC to revolutionize the financial operation in supply chains. BTC has proven its strength in ensuring visibility, transparency and efficiency to several industrial fields. The adoption of BTC may be higher than the fully implementation rate that is barely 15% in various industry (PricewaterhouseCoopers, 2019). The ecosystem may not be supportive of BTC. Some people in FiTech wonder if the digital ledger technology is totally enough. It is not necessary to change over to BTC, waste manpower, time, effort and drastic disruptions of operational routines. Changes can be painful but financial gains are foreseeable if the face-lift is successful like use cases -- Walmart, Maersk.

The BTC evolves over time. The supply chain on BTC makes sense, especially the standardization of currency exchanges, tariff, custom documents. BTC application to the SPF provides transparency, security, centralized/decentralized transactions and information sharing platform. Through information sharing among supply chain members, further discounted pricing and reduced costs can be predicted, then automated the optimized decisions to both supply and buyer sides.

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Extracting Insights from Big Social Data for Smarter Tourism Destination Management

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Abstract

The technological revolution and the intense use of digital devices have allowed people to generate huge amounts of much heterogeneous data, called Big Data. Especially in the tourism field, Big Data has continuously been exploited for the management of Tourism Destinations and marketing strategies. In particular, the generation of that subset of Big Data, called Big Social Data, through the voluntary sharing of personal information and content generation on various online social

networks, has created several opportunities for useful analysis for many tourism stakeholders, such as Destination Management Organizations (DMO), which can exploit strategic tools based on Big Social Data and analytics, for data-driven decisions with a growing emphasis on how generated insights are increasingly valuable when they come to anticipate visitor behaviour and shaping communication strategies.
This paper aims at describing the comprehensive valuable insights into tourists' behaviour through the analysis of Big Social Data. Data considered in this work consists of large dataset from Flickr online social network and Twitter micro-blog. A Big Data Analytics framework, that implements multiple tasks such as topic extraction, geographical data clustering, time series modelling techniques, sentiment analysis and image analysis, is presented and it constitutes the innovative contribution of this work. Results show that the generated insights could allow DMO to use new knowledge about unknown clusters of Point Of Interests discovery, trend and seasonal patterns of tourist demand identification, e-WOM monitoring, attractive places identification that, in turn, will allow the DMO to address its needs in terms of decision support for the management and development of the destination, the enhancement of destination attractiveness, the shaping of new marketing and communication strategies, and the planning of tourist demand within the destination. The approach described in this paper is adopted in the NEST (NEtworking for Smart Tourism development, INTERREG-IPA CBC Italia-Albania-Montenegro) project which aims at enabling a cross-border cooperation between Albania, Italy and Montenegro, in order to create a common branding of the Adriatic-Ionian area as a smart tourism destination at a macro regional level and to develop common tourist routes and products.

Keywords – Big Social Data, Decision Making, Tourism Destination Management, Tourist Behaviour, Value generation.

Paper type – Academic Research Paper

1 Introduction

In the last years, the technological revolution, on the one hand, and the intense use of digital devices, on the other one, have allowed people to generate huge amounts of much heterogeneous data, called Big Data. This topic has attracted more and more increasing attention by researchers and business decision-makers, with the aim of offering innovative services in data-intensive applications and domains, such as healthcare, banking, tourism, education, public administration and intelligent manufacturing (Elia et al., 2019a). A particular category of Big Data are Big Social Data (BSD), defined as Big Data "generated from technology-mediated social interactions and actions in digital realm, and which can be collected and analysed to model social interactions and behaviour" (Olshannikova et al., 2017) and representing about 90% of all Big Data (Gandomi et al., 2015). Especially in the tourism field, BSD has continuously been exploited for the management of Tourism Destinations and marketing strategies (Giglio et al., 2019). In particular, the generation of data through the voluntary sharing of personal information and content generation on various online social networks has created several opportunities for useful analysis (Miah et al., 2017). This has contributed to a common knowledge about visited places and people's behaviours, information that could be very important for tourism stakeholders within a destination such as local administrations,

professionals and intermediaries, Destination Management Organizations (DMOs) and so forth (Giglio et al., 2019). As emerged from literature, detailed information at the individual tourist level can be useful for the development of a segmentation of future tourism demand, for infrastructure development, and for service allocation and budgeting. Thus, there is the need to outline a solution method that, exploiting BSD, can provide a comprehensive insight into tourists' behaviour and better predict future tourism demand, to support the decision-making of destination managers in the context of smart tourism destination management (Song & Liu, 2017; Femenia-Serra et al., 2019; Kontogianni & Alepis, 2020). This paper aims at describing the comprehensive valuable insights into tourists' behaviour through the analysis of BSD. A Big Data Analytics process, that implements multiple tasks such as topic extraction, geographical data clustering, time series modelling techniques, sentiment analysis and computer vision analysis, is presented and it constitutes the innovative contribution of this work. Data considered in this work consists of large dataset from Flickr Online Social Network and Twitter micro-blog for the Italian south-eastern region of Salento that represents our first real case applicative scenario. Thus within the tourism destination:

- geo-tagged pictures data and user's context data in Flickr, have been analysed for the identification of both Point of Interests (POIs) and clusters of dense geo-located POIs in the area of interest;
- data coming from description texts in Flickr have been analysed for the extraction of emerging topics;
- user's profile data have been analysed for the estimation of tourists seasonal patterns and presence trend for each cluster of POIs;
- contents (such as tags, tourist destination geographical bounding box) extracted from Flickr is used to retrieve tweets from Twitter that has been consequently analysed to establish users' sentiment;
- pictures from Flickr have been analysed for the identification of the most representative picture for each cluster.

The approach described here is proposed in the NEST project which aims at enabling a cross-border cooperation between Albania, Italy and Montenegro, in order to create a common branding of the Adriatic-Ionian area as a smart tourism destination at a macro regional level and to develop common tourist routes and products. Working to implement the transition towards the paradigm of a macro region with a unique brand, means, on the one hand, managing a process of transformation, avoiding leaving the key steps to chance and, on the other, being able to integrate the interests and projects of local stakeholders involved. In this perspective, and in the context of cross border cooperation and smart specialization strategies, a framework of tools and techniques, based on smart technologies such as BSD, is crucial to favour the knowledge transfer between different regions belonging to the program area.

This paper is structured as follows: sections 2 presents the related literature background, while section 3 the analysis framework implemented has been described.

Section 4 describes the experimentation and the main results of our analysis for the case study of Salento. Finally, section 6 discusses the results achieved and highlights some limitations of the study, which can open new paths for further research.

2 Related Literature

Big Social Data, but more in general Big Data, has opened up possibilities to directly apply in data-intensive industries such as tourism, particularly for DMOs in the context of Tourism Destination planning and operations. BSD has been defined as data "*generated from people's actions and interactions within social media services and platforms, sharing a subset of Big Data properties, that needs to be collected and analysed through specific technology and analytics to provide crucial insights into human behaviour, people's preferences and relationships, social interactions and transformations, and real-life event outcomes.*" (Elia et al., 2019). "Social Media" is one of the richest sources of BSD and it provides voluminous, varied and fast data of potential value to decision makers. Data from social media platforms are generated by using social networking applications and websites, such as Facebook, Twitter, LinkedIn, Tumblr, TripAdvisor, YouTube and Flickr. Contents are typically user-generated as blog posts about real-time activity, photos, short videos, comments or opinions and personal information.

BSD and analytics can directly apply in data-intensive industries such as tourism, particularly for DMOs in the context of Tourist Destination planning and operations. In this context, most analytics have been used earlier for travel recommender systems (TRS) as in Kurashima et al. (2013), where sequences of locations in tourists' shared geo-tagged photos were used to identify, recommend and personalize travel routes.

Lately also BSD have been used for social media data and thus designed for use by DMOs, demonstrating that insights emerging from BSD analysis were valuable in terms of tourist behaviours understanding (Xiang & Gretzel, 2010), tourism demands prediction and decision making support (Miah et al., 2017), new market trends identification (Sigala et al., 2012), and in creating contextualized real time offerings in relation to customer needs (Buhalis & Foerste, 2015).

In addition, other studies focused on the BSD visual contents analysis such as in Önder, et al. (2014) where Flickr geo-tagged photos have been used to assess the presence of tourists in Austria, showing that the method provides more reliable outcomes for cities than regions, or in Shi et al. (2011) where geo-tagged photos sourced from Flickr were used to recommend landmarks, personalised to individual users specific tastes. Finally there are many research works that provide a notable exception with sentiment analysis of a large corpus of user generated contents using machine learning techniques (Support Vector Machines, naïve Bayes classifiers, latent semantic indexing, etc.) such as in Menner et al. (2016), Saif et al. (2016) and Piryani et al (2017).

In this vein, Big Data, resulting from tourist generated content in social media platforms, along with their aggregation, interconnectivity, analysis, integration, real time synchronization and intelligent use of data (Tu & Liu, 2014; Gretzel et al., 2015) becomes

the major driver for value creation in smart tourism.

All these various studies point on one hand the underexploited potential for social media data to inform the DMO's strategic decisions and, on the other hand, the inability of most of the existing support tools to cope with the sheer volume and rich data diversity that characterises the domain.

This work, by making use of BSD and analytics, tries to provide DMOs with a tool for finding accurate answers to the following questions: which interests and which locations attract tourists when visiting a destination? How personal experiences at each of the visited attractions influence tourists so that it is possible to forecast future tourist demand? (Miah, 2017).

Answering these questions will allow a DMO to obtain comprehensive insights on tourists' activities, their experiences and personal reflections.

3 Analytic Methods based on Big Social Data

3.1 Research context

The NEST project aims at creating a cross-border smart tourism destination, also through the creation of a Tourism Intelligence Observatory (TIO) that will give insights about smart tourism destinations, generate market intelligence for orienteering decision making among companies and professionals, and generate specific contents for orienteering decision making among tourists. Moreover, for a DMO the TIO can represent a strategic tool allowing data-driven decisions for marketing strategies throughout the industry, with a growing emphasis on how generated insights are increasingly valuable when they come to anticipate visitor behaviour and shaping communication strategies. In fact, the TIO generates market intelligence also to orientate decision making in the public sector, strengthening tourism as a strategic activity for social and economic development of the Ionian-Adriatic macro area.

A subset of the services offered by the TIO exploits BSD and analytics, offering insights to destinations about visitors' behaviour that would be complex and maybe even impossible to get from traditional information gathering methods. For example, there's practically no way to economically implement a survey to find visitors' patterns of movement across Albania, Italy and Montenegro, but it's relatively simple to understand tourism flows if we measure their presence in different areas from the contents shared on social networks. Thus, the exploitation of this kind of information can be used i.e. for managing the destination's tourism supply or designing a unique marketing plan addressing different strategies for specific markets.

3.1 Research framework

Framed in the above premises, our research framework relies on the TIO as the environment for insights generation starting from two BSD sources (i.e. Flickr and Twitter) and focuses on an integrated approach considering multiple BSD sources, different analytics techniques on heterogeneous data types, and complementary expected results. Data ingested are user-generated contents, voluminous and with heterogeneous formats (i.e. pictures, geo-tagged information, text). Data feed different analytics tasks (i.e. clustering, topic extraction, sentiment analysis and time series modelling) to generate insights on tourist behaviour as emerged from their social media activities.

In particular, the tourism Intelligence Observatory will use data from Flickr such as geo-tagged photos with metadata, user profile public information and post's description (comments and hashtags); data from Twitter is textual contents within a geo-located box.

This data will feed the following analytical processes:

- Geo-tagged data clustering to detect users' areas of interest, starting from geo-referenced Flickr posts. A density-based clustering algorithm, DBSCAN (*Density-based spatial clustering of applications with noise*), was applied to identify the most photographed areas in the Salento region. The use of DBSCAN is motivated by the idea that clusters will be areas where many observations are densely packed together and makes no assumptions of cluster shape.
- Topic Identification to extract from Flickr users' posts which are the main discussion topics within a destination. The algorithm used is the *Latent Dirichlet Allocation* (LDA), which is a popular approach for unveiling latent topics through a multinomial probability distribution over terms. The LDA method attempts to give support in the identification of the key topics, their meaning, how much they are prevalent and how they relate to each other.
- Image analysis to identify the most representative image within a cluster of POIs. The analytic process implemented takes the pictures belonging to a cluster of POIs and extracts features through *Speeded-Up Robust Features* (SURF) (Bay et al., 2008), an advanced feature descriptor used for representing photo content. Then, K-means clustering is applied to construct a visual word vocabulary, from all the features extracted and then the most representative image is chosen by Kernel Density Estimator (*KDE*) after a dimensionality reduction.
- Time series decomposition to analyse trends of tourist demand and seasonal patterns based on Flickr user information.
- Sentiment analysis on Twitter geo-tagged posts to understand which was the sentiment related to the emerging topics within the destination. To this aim, Sentiment Analysis has been performed using a preliminary training set and then validating the polarity assigned to the different tweets available on Twitter social network platform. The approach used to establish the sentiment

is supervised, implementing *SVM* (Support Vector Machine) with cross-validation to classify feature vectors of textual information streams in three classes: positive, negative and neutral.

The generated insights allow DMO to use new knowledge about unknown clusters of Point Of Interests (POIs) discovery, trend and seasonal patterns of tourist demand identification, e-wom monitoring, attractive places identification that, in turn, will allow the DMO to address its needs in terms of decision support for the management and development of the destination, the enhancement of destination attractiveness, the shaping of new marketing and communication strategies, and the planning of tourist demand within the destination.

This research framework allow a DMO to take advantage of new knowledge acquired from multiple BSD sources, by combining several analytics tasks on heterogeneous (structured and unstructured) data types, with complementary generated insights.

4 Case study: Salento

4.1 Data collection

The geo-tagged photo dataset used in this study was collected from Flickr using its API. A bounding box (with coordinates lon_{min} 17.75, lat_{min} 39.78, lon_{max} 18.53 and lat_{max} 40.51), was designed to cover the entire geographical area of Lecce county within the Salento region. The photo timeframe was 5 years, covering the period from January 2015 to November 2019. In total, 17920 photos were collected from 748 tourist's accounts. Photo metadata were extracted, including geo-tags, textual tags, titles, descriptions and UserIDs. The actual photos were downloaded, using 'medium' size (as defined within Flickr), which is adequate to display content sufficiently clearly for subsequent processing stages while reducing computing costs.

From Twitter, tweets have been retrieved according to: a) the topic emerged from analysis on Flickr contents; b) time range (2016-2019); c) a radial search with centre in Lecce (Italy) and 85 Km radius. The total number of tweets retrieved is 15625.

4.2 Results

In order to discover unknown Point of Interests (POIs) in the destination, geo-referenced Flickr posts were analysed with the density-based clustering algorithm DBSCAN. In particular, DBSCAN has been used setting eps (the maximum distance between two observations to be considered as neighbour) to 0.08, min_samples (the minimum number of observations to create a cluster) to 3 and euclidean as the distance metric used by eps.

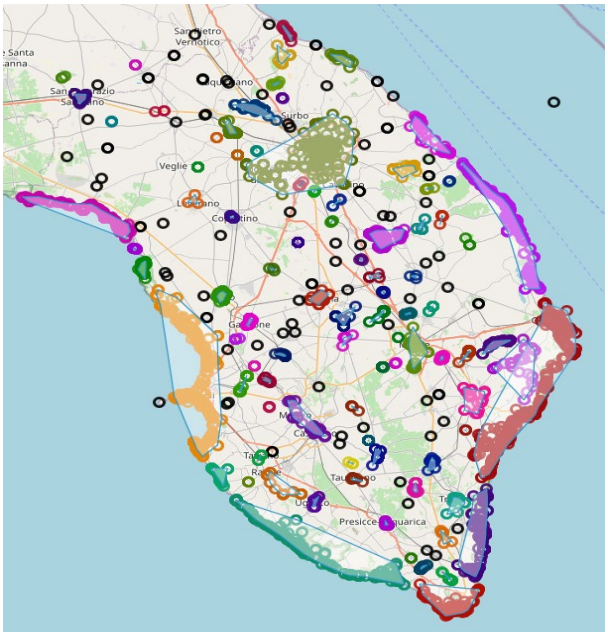


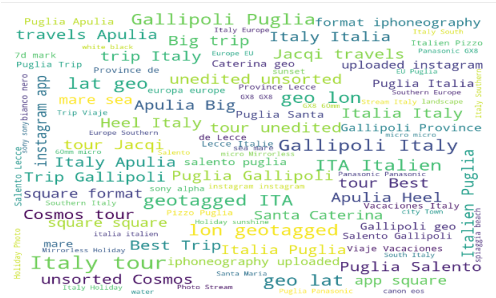
Figure 1. Identified clusters of POIs in Salento.

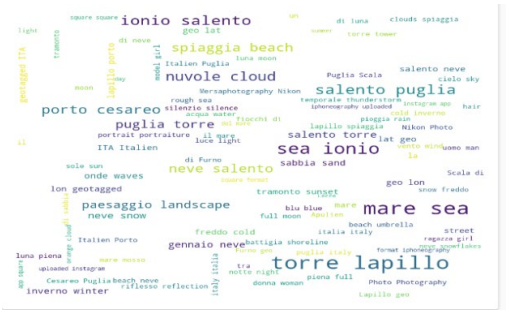
Results are shown in Figure 1. Between the 89 clusters of POIs identified, the most renowned touristic areas on Ionic and Adriatic coast have been spotted (Porto Cesareo Area; Gallipoli Area; Marina di Ugento Area; San Cataldo Area; Torre dell'Orso and Laghi Alimini Area; Otranto, Santa Cesarea and Castro Area; Tricase Area; Santa Maria di Leuca Area). Since they attract a high number of tourists due to the naturalistic and recreational attractions, the correspondent clusters are the biggest in terms of the number of POIs contained. Other smaller clusters identified are related to some villages and towns that are characterized by historical monuments or architectures (Maglie, Galatina, Matino-Casarano, Calimera, Poggiardo-Vaste). Finally it is worth noting that few other clusters, referring to areas whose distinctiveness is the wine production (e.g. Copertino, Leverano, Salice Salentino, Guagnano, San Pancrazio Salentino), the presence of prehistoric dolmen and menhir (Giuggianello) or recently renewed historical attractions (Santa Maria di Cerrate Abbey), have emerged only in the last two years within the monitoring time.

Once the clusters of POIs have been identified, "hot topics" for each cluster have been detected analysing the textual contents in Flickr's posts. This analysis could help the DMO to understand in which way tourists are talking on social media about destinations in the territory. LDA algorithm has been applied in order to extract and identify topics for each of the 89 clusters, Results for the most densely populated clusters are shown in Table 1 where, for each cluster, the number of posts analysed from Flickr, the most

representative topics (hot topics) and a tag cloud of all the topics emerged, have been represented.

Table 1. Brief description of the most densely populated clusters.

ID cluster: 1 - Lecce Area	
N. post: 3889	
Hot Topics: “lecce", "piazza sant'oronzo", "barocco", "lecce cathedral", "centro storico", "santa croce", "piazza duomo", "anfiteatro romano"	
ID cluster: 8 - Otranto Area	
N. post: 2309	
Hot Topics: "otranto", "castello otranto", "punta palascia", "cattedrale otranto", “mosaico", "santa cesarea terme", "castro", "grotta zinzulusa", "palombara", "bauxite", "cripta"	
ID cluster: 0 - Gallipoli Area	
N. post: 1831	
Hot Topics: "gallipoli", "santa caterina", "santa maria al bagno", "torre uluzzo", "porto selvaggio", "castello gallipoli", "punta suina", "gallipoli salento"	

ID cluster: 9 - Torre dell'orso Area **N. post:** 683 **Hot Topics:** "sant'andrea", "torre dell'orso", "melendugno", "roca", "alimini", "faraglioni", "grotta poesia", "san foca"	
ID cluster: 11 - Porto Cesareo Area **N. post:** 651 **Hot Topics:** "porto cesareo", "torre lapillo"	

In order to provide the DMO with a comprehensive set of insights that would allow it to monitor e-WOM, we have analysed tweets from another BSD source (e.g. Twitter) restricting the tweet search to the same destination of interest, time range, and including the topic previously emerged from Flickr. A sentiment analysis has been performed to allow DMO to monitor, besides the topics for each cluster, the sentiment associated.

Specifically, the textual sources have been pre-processed to obtain a noiseless and clean dataset through the use of filtering operators for a wide number of goals (e.g. removing HTML tags, tokenization, stop words removing, stemming). Features extraction has been performed by calculating tf-idf coefficient (Na et al., 2004) and finally, feature vectors have been used for classifying the sentiment using SVM (Support Vector Machine) with Cross Validation, to classify textual information streams in positive, negative and neutral sentences. Results of this analysis are shown in Figure 2.

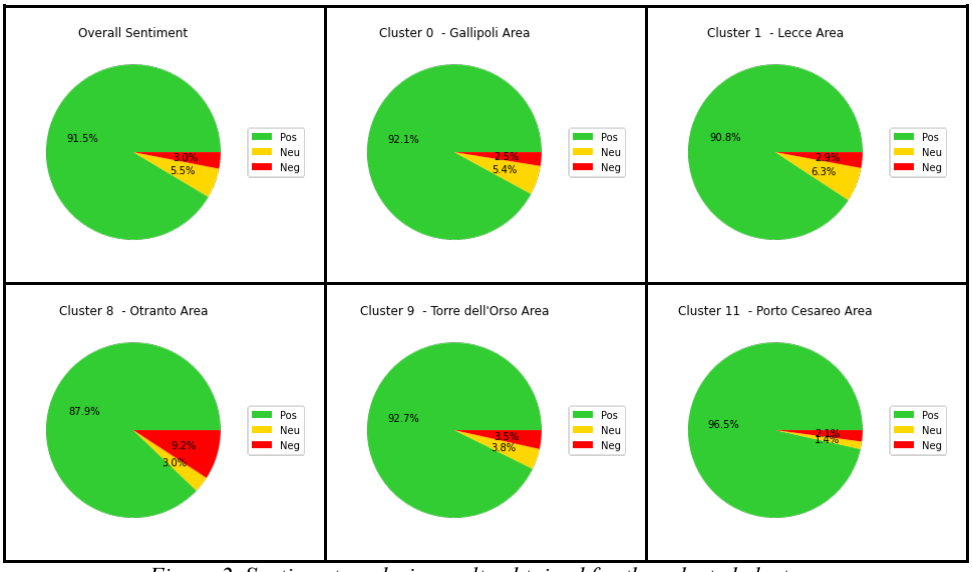


Figure 2. Sentiment analysis results obtained for the selected clusters.

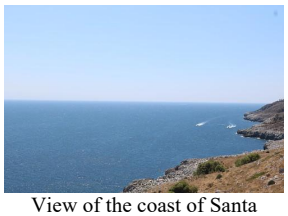
As it can be seen, a strongly positive sentiment has been detected for all the inspected clusters, with a positive overall sentiment of 91.5% (first panel on top-left in Figure 2).

For the attractive places identification, we have processed all the images taken from Flickr during the observational period in order to extract the most significant picture representing each cluster of POIs. An image analysis has been carried out to discover particular interests belonging to tourists' experience and provide DMOs with insights useful to enhance destination attractiveness and elaborate differentiated travel packages or personalized experiential paths.

In particular, for each cluster of POIs pictures have been processed through SURF for features extraction, a visual word vocabulary has been generated with K-means, finally the top images with highest probability densities have been identified by KDE as the most representative photos. Results of the attractive places identification, for the five most populated clusters, are shown in the next Table.

Table 2. Most representative images for the five most populated clusters.

ID cluster: 1 - Lecce Area		
View of Santa Irene Church in Lecce old town	View of bell tower of Piazza Duomo in Lecce old town	View of "Porta Rudiae". One of the three gate to the old town

ID cluster: 8 - Otranto Area		
Nightly view of monument to martyrs of otranto	View of the harbour of Otranto	 View of the coast of Santa Cesarea Terme
ID cluster: 0 - Gallipoli Area		
View of the Gallipoli old town	Details of a bell tower in Gallipoli old Town	Nightly view of the Puritate beach in Gallipoli old town
ID cluster: 9 - Torre dell'Orso Area		
Underwater picture of a jellyfish taken in Torre dell'Orso beach	Sunrise at Torre dell'Orso	Sunrise at Stacks of Torre Sant'Andrea
ID cluster: 11 - Porto Cesareo Area		
Lightning from a beach in Porto Cesareo	Stormy weather from a beach near Porto Cesareo	Dune beach with watchtower in background near Porto Cesareo

Finally, in order to provide the DMOs with information about trends and seasonal patterns, time series analysis has been performed on the number of pictures posted on the social network in the period of observation. Specifically, this analysis gives us insight on

patterns emerging from social network activities, useful for both strategic planning and decision-making.

In order to deeply understand the patterns behind our data, a time series decomposition has been executed. Generally, every time series may be split into four components: *Base Level*, *Trend*, *Seasonality*, *Error*. Thus, a decomposition of the time series has been applied by considering the series as a multiplicative combination of the base level, trend, seasonal index and residuals. Figure 3 shows the decomposition of data observation in Residual, Seasonal and Trend.

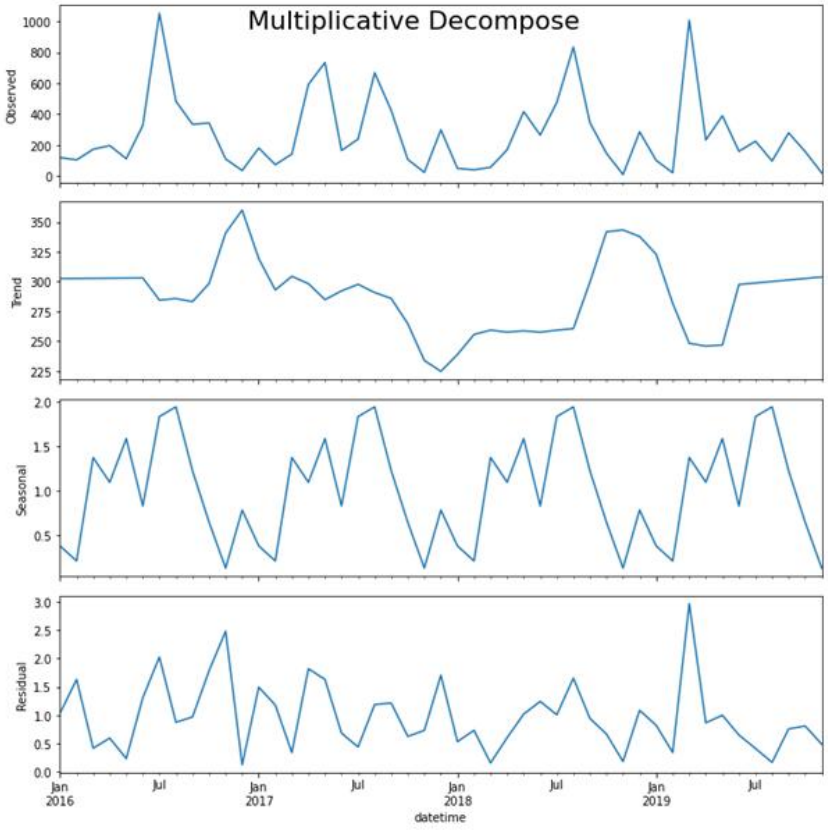


Figure 3. Decomposition of the time series in Residual, Seasonal and Trend.

Results show a strong seasonality component, with peaks during Summer, and a periodical component with a period equal to 12 months. Through this decomposition, the seasonal component is clearly visible and it is easy to observe how the trend can be distinct in four time intervals, during which it shows different behaviours. Specifically, between 2016 and 2017 the trend has been increasing, then, between 2017 and 2018, it

has been strongly decreasing, and, finally, it returned to increase starting from August 2018.

5 Discussions and Conclusions

In this paper a framework that, exploiting Big Social Data, helps DMOs to extract insights on tourist behaviour for their decision support needs has been presented. The originality of this work is in the use of BSD and analytics techniques for giving DMOs specific insights on a destination in a deep and wide fashion. In particular, grounding on the idea that large groups of people are collectively smarter than individual experts, the collection and analysis of the "wisdom of crowds", for extracting insights of tourist characteristics, images, attitudes and preferred destination attributes, can represent a unique mean for problem-solving, decision making, innovation and prediction. Thus, DMOs and tourism stakeholders can use BSD to plan seasonal promotions, plan the timing and placement of advertisement campaigns, create personalized advertisement and define which market segments are growing most rapidly (Del Vecchio et al., 2018; Karathiya et al., 2012; Magnini et al., 2003).

Geo-tagged cluster analysis of POIs has shown that besides well-known destinations, some others are arising in the last two years of the monitoring time and that DMO can take advantage of this information to shape in time new tourist offerings or ad-hoc marketing campaigns. Moreover, by extracting hot topics for each cluster and complementing the analysis with the sentiment of Twitter contents, gives the DMO the opportunity to monitor specific areas within the destination in terms of e-WOM and the related sentiment and, therefore, the opportunity to understand reasons underlying critical situations and thus intervene promptly when they arise. Results from most representative images show that insights into tourists' perspective and perception could help the DMO to design marketing materials, develop marketing strategies that suit the interests and perceptions represented by the images. In the same way, DMO could rely on these insights to promote less-visited parts of a cluster, which DMO has a responsibility to promote. Finally, the time series modelling has shown trends on tourist presence which has a strong seasonality component. This analysis could help DMO for launching ad-hoc initiatives for seasonal adjustments and then assessing their effectiveness and estimating whether social networks can proxy official statistics in a suitable manner.

This work presents some limitations: social media contains other valuable type of unstructured data (e.g. videos) that could complete the collected data. Moreover other sources of BSD from other social networks (e.g. Facebook, Instagram) could be included to provide richer insights. Finally, analytic tasks could be extended to provide DMO with a more comprehensive knowledge about tourist behaviour.

Implications of this work are twofold: for practitioners, this approach well supports the decision-making process for Destination management, as it allows to extract insights from available BSD useful for a DMO to better understand what kind of policy measures or tourism strategies could be planned and adopted in order to ameliorate the regional

tourism. In this perspective, integrated analytics techniques offer to practitioners comprehensive insights for destination management. In fact:

- geographical clustering helps to better understand how to reshape a destination with detected sub-regions and tourists targets;
- hot topics extraction and e-WOM monitoring help to better understand collective tourist sentiment and related destination weaknesses and strengths;
- image analysis helps to find representative user contents that can be used by the DMO to implement ad-hoc marketing strategies;
- time series help to highlight trends and seasonal patterns of tourism demand, assessing official data about tourists presence.

For researchers, this approach could be used along with other methods of data collection and analysis, in order to obtain more meaningful results. Finally, the approach of using integrated techniques of data analytics could be further developed for extracting added value from big data and applied in other domains than smart tourism.

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Exploiting Big Social Data for Measuring Citizens Opinions in Italian 2020 Regional Elections

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Abstract

Social media and its analogous applications allow millions of users to express and spread their opinions about a topic and show their attitudes by liking or disliking content. The amount of data accumulating on social media is known as Big Social Data which can be analysed to provide valuable insight in many application contexts. Measuring public opinion during events like elections is one of the most promising BSD applications either for predicting results or analysing online debate during electoral campaigns. In this paper, the analysis of political debate on social media during the 2020 regional election in Emilia Romagna (Italy) is presented. Candidates' programs have been analysed in order to extract topics within the official action plans. Leveraging Big Social Data, the interactions of Italian citizens on Twitter candidates' pages have been monitored and analysed, in order to understand how action plans within candidates' programs has been perceived by citizens through the lens of social media; which are the most relevant topics emerged from online debate in the social networks; which is the sentiment emerged in the overall debate; how the online debate have polarized on emerged topics and how certain communities of users have contributed to the information diffusion. Results have shown a mismatch between the action plans in the candidates programs and the topics emerged online debate, along with a unidirectional communication approach followed by the three candidates that has resulted in the polarization of the debate on some of the topics emerged during the campaign.

Keywords – Big Social Data, real time monitoring, opinion mining, regional election, polarization.

Paper type – Academic Research Paper

1 Introduction

Social media and its analogous applications allow millions of users to express and spread their opinions about a topic and show their attitudes by liking or disliking content (El Alaoui et al., 2018). All these constantly accumulating actions on social media generate high-volume, high-velocity, high-variety, high-value, high-variability data termed as Big Social Data (BSD). In general, this kind of data refers to "that subset of Big Data generated from people's actions and interactions within social media services and platforms, properly collected and analysed to provide crucial insights into human behaviour, people's preferences and relationships, social interactions and transformations, and real-life outcomes prediction" (Elia et al. 2019). BSD and analytics soon became a unique means for monitoring the hot topics on the Internet (Shang et al., 2015). Opinion mining on BSD has emerged as a notable direction of research with scientific trials and promising applications being explored substantially (Kumar & Sharma, 2017). In fact, the effective analysis of public opinion is valuable for both governments, which can better understand the public's views and aspiration, and for business, which can acquire the evaluation of products and services, and provide better personalized products and services (Tao, 2014).

In particular, measuring public opinion through the collection and analysis of relevant data from social media could also predict the outcome of elections (Robles et al., 2018) and be a useful supplement to traditional polling methods (Sang & Bos, 2012; Schober et al., 2016).

In this perspective, in this paper we present the analysis of political debate on social media during the 2020 regional election in Emilia Romagna (Italy). Candidates' programs have been analysed in order to extract topics within the action plans presented. Leveraging Big Social Data, we have then monitored and analysed the large interactions of Italian citizens on Twitter candidates' pages, in order to understand:

- how action plans within candidates' programs has been perceived by citizens through the lens of social media;
- which are the most relevant topics emerged from online debate in the social networks;
- which is the sentiment emerged in the overall debate;
- how the online debate have polarized on emerged topics;
- how certain communities of users have contributed to the information diffusion.

This paper is structured as follows: sections 2 presents the related literature background, while in section 3 the methodological framework implemented has been

described. Section 4 describes the experimentation, that has been carried out between November 2019 and January 2020, and the main results of our analysis. Finally, section 5 discusses the results achieved and highlights some limitations of the study, which can open new paths for further research.

2 Related Literature

Big Social Data (BSD) is a concept developed by Lev Manovich (2011) and it gained great interest in research on digital culture and society, and it has become lately an emergent research topic. BSD can be considered a particular category of Big Data argued to represent about 90% of all Big Data (Gandomi et al., 2015), and broadly refers to large volumes of data generated by users and describing social behaviour and interactions in digital environments. BSD has been studied from several perspectives (Manovich, 2011; Cambria et al., 2013; Cotè, 2014) and defined in different ways.

In the last years, some researchers have agreed on the peculiar aspects related to BSD sources and applications. In this sense, Olshannikova et al. (2017) refers to BSD as Big Data "generated from technology-mediated social interactions and actions in digital realm, and which can be collected and analysed to model social interactions and behaviour", while Elia et al. (2019) refers to BSD as Big Data "generated from people's actions and interactions within social media services and platforms, properly collected and analysed to provide crucial insights into human behaviour, people's preferences and relationships, social interactions and transformations, and real-life outcomes prediction".

In fact, BSD have been widely used for generating different forms of value and there have been a noteworthy number of research papers in which BSD are referred as the means to offer new insights to understand deeper user's social behaviour and interactions (i.e. Vepsäläinen et al., 2017). Besides, other researchers highlight value in terms of impacts on advancement on society, generation of relevant knowledge for users and companies, prediction of real-life outcomes, and generation of new opportunities to study city dynamics and urban social behaviour (El Alaoui et al., 2018; Del Vecchio et al., 2018).

Moreover, various computational social science studies demonstrated that BSD have been extensively used to foster democratic conversation about social and political issues such as the Arab Spring (González-Bailón, et al., 2011), Occupy Wall Street (Conover, et al., 2013a; Conover, et al., 2013b) and many other civil protests (Varol, et al., 2014; González-Bailón, et al., 2013; Bastos, et al., 2014), Twitter and other social media seemed to play an instrumental role to involve the public in policy and political conversations, by collectively framing the narratives related to particular social issues, and coordinating online and off-line activities. The use of digital media to discuss politics during election times has also been the subject of various studies, covering the last four U.S. Presidential elections (Adamic & Glance, 2005; Diakopoulos & Shamma, 2010; Bekafigo & McBride, 2013; Carlisle & Patton, 2013; DiGrazia, et al., 2013; Wang, et al., 2016), and other countries like Australia (Gibson & McAllister, 2006; Burgess & Bruns,

2012), and Norway (Enli & Skogerbø, 2013). Findings that focused on the positive effects of social media such as incrementing voting turnout (Bond, et al., 2012) or exposure to diverse political views (Bakshy, et al., 2015) contributed to the general praise of these platforms as a tool to foster democracy and civil political engagement (Tufekci, 2014; Yang, et al., 2016). Nevertheless, few research efforts have been made to understand the extent to which the political debate on social media differs from candidates' programs.

An important inquiry in disciplines across the social sciences, in which BSD has been exploited, is related to evaluate the extent of the influence of social media on political polarization (Bakshy et al., 2015; Barberá et al., 2015; Bond & Messing, 2015; Bennett & Segerberg, 2012). Results show that political polarization occurs in a so-called "echo chamber" environment, where individuals are exposed only to those information and communities that support their own views, while ignoring opposing viewpoints. The presence of political polarization on social networking sites, blogs and other various web 2.0 platforms may be explained by a well-known phenomenon in sociology called homophily (McPherson et.al., 2001), where people in social networks tend to group around similar backgrounds and interests, including shared political views. Gruzd & Roy (2014) suggested that there are some pockets of political polarization on Twitter, but at the same time Twitter as a communication and social networking platform may be able to facilitate open, cross-party, and cross-ideological discourse. There are a few exceptional studies (Garimella & Weber, 2017, Yardi & Boyd, 2010) that took a longitudinal approach to political polarization such as changes in opinions and emotions in social media messages. Therefore, our study examines whether individuals who use social media will develop polarized political preferences by directly measuring the aggregate shift in political opinions toward a greater extreme over time. We measure opinions and topics emerged in the online debate and verify how they vary from the candidates' public programmes.

3 Methodological Framework

In order to analyse the political campaign in the regional election, taken in January 2020, we considered many traits: i.e. social network involved, messages and tweets on social networks, polarity of the messages, topics emerged from the messages, interactions between users, community dimensions, etc.

In this section we present our framework designed to organize the data sets that will be analysed, which kind of analysis perform, how data sets and analysis are connected and interrelated and which analysis algorithms will be used. A methodological framework has been implemented which, through various steps, provides us with quantitative data that can be easily interpreted facilitating sense making and understanding.

Through methodological framework, researchers are allowed to systematically and logically approach a problem, setting a definite driving force behind their lines of investigations. Specifically, when developing a framework, the related issue should be break down into sub-components as to create a mental model that operates as a guide for

data collection and analysis (Chataigner, 2017). In Figure 1, it is presented the methodological framework used in this work.

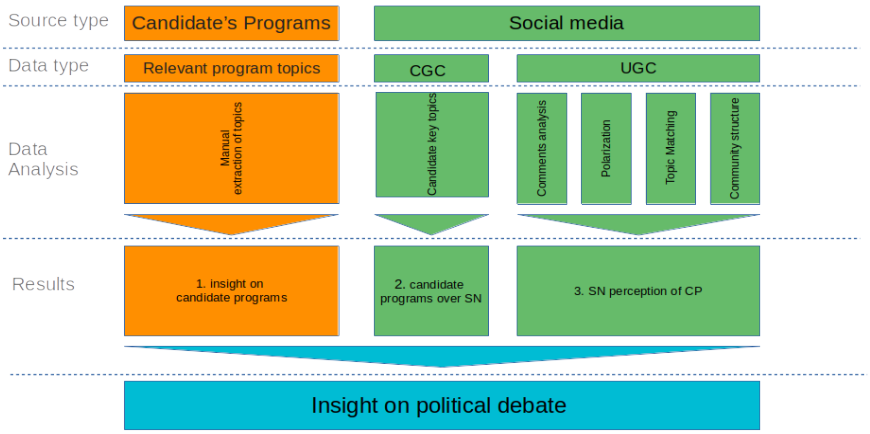


Figure 4. The Methodological Framework adopted in this paper.

In the designed framework there has been a Source Type layer composed by:

- **Candidate's Programs** (the official published candidate's programs) in which political actions are well described, rich in details, and summarized in self-consistent points.
- **Social Media,** referred to the Big Social Data source from which online data are extracted and analyzed. In our case the BSD source is Twitter.

The Data Type layer is made of the specific data type that feeds our analysis. In particular, this layer is composed by:

- **Relevant program topics** emerging from the analysis of candidate's programs.
- **CGC (Candidate-generated contents)**, that is the set of the contents published on the Social media by each candidate.
- **UGC (User-generated contents):** that is the set of the contents published by the community of users that have interacted with candidates. These contents are in reply to the candidate's posts.

The Data Analysis layer is made of the techniques used for analysing data. In particular, this layer is made of:

- **Manual Extraction topics:** the topics are manually extracted from the candidate's programs. This step was conducted through the reading of the programs by each author of the paper and the extracted topics are the result of the union and harmonization of each results.

- **Candidate key topics:** Candidate key topics, applying LDA algorithm (Latent Dirichlet Allocation), are extracted analysing all the messages text published from candidate on the BSD sources.
- **Comments Analysis:** Comments analysis, applying LDA algorithm, extract topics analysing all the messages text published from the community, as specified into "Social Network" on the BSD sources.
- **Polarization:** This step aims to extract the polarization of each topic, using *Sentiment Analysis*. The polarity of each message is calculated by a classification algorithm that marks the message as positive, negative or neutral.
- **Topic Matching:** it's identified either how the action plans within the programs have been perceived by citizens through the lens of social media and which is the ratio of action plan contents to the overall contents published by candidates.
- **Community structure:** how the online community has been structured and evolved using *Network Analysis* metrics.

As for the Candidate key topics and Comments Analysis, LDAvis, which is a python implementation of the LDA algorithm[1] has been used. LDAvis gives support in the identification of the key topics, their meaning, how much they are prevalent and how they relate to each other, by using *distinctiveness*, *saliency* (Chuang et al., 2012) and *relevance* (Sievert & Shirley, 2014). Furthermore, LDAvis allows to reveal the most relevant terms for each topic, to select a term and to reveal its conditional distribution over topics, to provide a global perspective of the topics, showing the inter-topic differences and the prevalence of each topic in the corpus.

Sentiment Analysis has been performed on the results obtained in the topic modelling, using a preliminary training set to validate the polarity assigned to different tweets. The textual sources have been pre-processed to obtain a noiseless and clean dataset through the use of filtering operators for a wide number of goals, then feature extraction has been performed by calculating tf-idf coefficient, and, finally, feature vectors have been used for classifying the sentiment using SVM (Support Vector Machine) with Cross Validation, to classify textual information streams in three classes: positive, negative and neutral.

Finally, SNA is a methodology that represents interpersonal communications as directed graphs and makes use of different metrics in order to determine the functional roles of the individuals within the network (Thomason et al., 2004). A graph is made up of nodes, that represent the actors of a network, and edges, that represent relationships between the nodes. In Table 1 the metrics here adopted have been briefly described.

[1] *https://pypi.org/project/pyLDAvis/*

Table 3. Social Network Analysis metrics adopted in this paper.

Metric	Description
Network density	The ratio of existing edges to potentially existing ones.
Average path length	The average number of steps along the shortest paths for all possible pairs of network nodes.
Modularity	The strength of division of a network into modules (also called groups, clusters or communities).
Degree distribution	How many neighbours a node has.
Closeness centrality	How close a node is to all other nodes in the network.
Eigenvector centrality	How much influence a node has on the network.
Betweenness centrality	Number of times a node acts as a bridge along the shortest path between two other nodes.

The Results layer encompasses results of the previous analysis tasks and offer insights on the whole political debate in terms of: how the campaigns have been polarized, how much users have influenced the spread and diffusion of the ideas of candidates, how the candidates have taken advantage from the Social Networks to communicate their ideas and how much important the Social Networks were for their campaign.

4 Findings

The experimentation here presented concerns the analysis of political debate on social media during the 2020 regional election in Italy, taken place on January 26th. To this aim, Twitter candidates' pages have been monitored during the period from 1st November, 2019 to 02nd February 2020. The whole dataset is made up of 60174 tweets, produced by 17489 unique users. The tweets are considered as unstructured data, meaning that they do not have a predefined data model, nor they are not organized in a predefined manner. Within this dataset, 1792 tweets belong to the three candidates, not uniformly distributed: 646 for Bonaccini, 1002 for Borgonzoni, 144 for Benini, while the rest of the tweets are user comments or the text of retweets. In Figure 2 the temporal trend of the number of tweets published by the three candidates is reported.

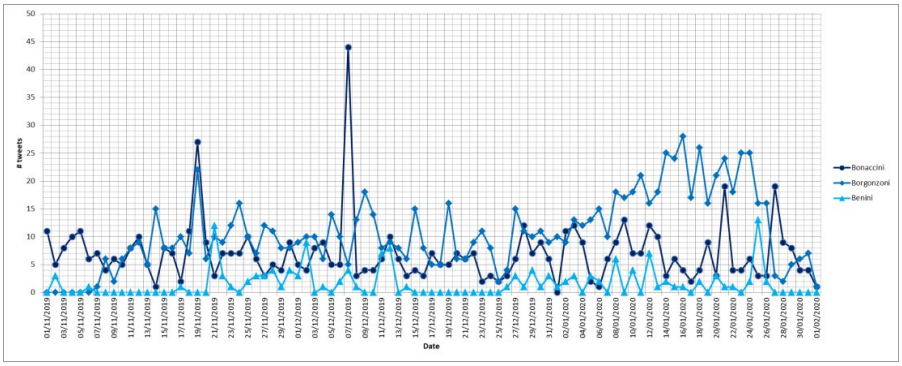


Figure 5. Temporal trend of candidates' tweets.

As it can be seen, during the last days of the election campaign the total number of tweets increased, as expected. Moreover, it is clear that, while a candidate has a low number of tweets published with his own twitter account, another candidate published more than the rival candidates. In the next paragraph, results from data analysis are discussed.

4.1 Topic extraction from candidates' programs

The analysis of the candidates' programs has manually been performed in order to extract relevant program topics within the action plans presented. This preliminary desk analysis serves as a basis for comparisons between candidates' programs and the debate that have taken place on social media. Despite the fact that all the candidates have presented their programs structured in a different way, they organized their action plans in macro-topics. Simone Benini has presented a list of 30 actions grouped in 15 macro topics[1], Lucia Borgonzoni has presented a list of actions grouped in 28 macro topics[2], while Stefano Bonaccini has presented a list of about 40 actions grouped in 4 macro topics[3].

4.2 Online Candidate's key topics analysis

In order to establish which candidate's key topics have emerged from all their tweets published on Twitter, a topic extraction has been performed using the dataset containing 1792 tweets with *LDAvis*. During the procedure of topic extraction for each candidate, the number of topics to be extracted and the final assessment of LDA results have been done by answering to these three questions:

1) is each topic interpretable?

[1] *https://www.simonebenini.it/wp-content/uploads/2020/01/programma5stelle2020.pdf*
2 https://borgonzonipresidente.it/programma/
3 https://stefanobonaccini.it/wp-content/uploads/2019/12/Vol_A5_Bonaccini_programma-1.pdf

2) Is each topic unique?
3) Are all the topics exhaustive (i.e. are all the documents well represented by the topics)?

Thus, in order to avoid the presence of different topics with the same words (which would make the second question to fail) 7 clusters for Bonaccini, 4 for Borgonzoni and 4 for Benini have been extracted. While in Figure 3 the distribution of the tweets for each cluster is shown, in Figure 4 it can be seen the most relevant terms of each cluster for each candidate.

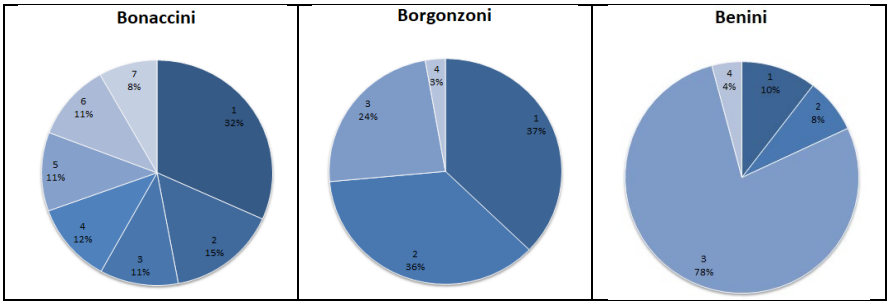


Figure 6. Distribution of tweets within the clusters for the three candidates.

Figure 7. The most relevant terms for each cluster and topic extraction.

As it can be seen, some issues relating to the action plans have been addressed by the three candidates: *Rights and duties* (i.e. right to health, prevention and well-being, quality of life, home plan, health, safety, dignity of work), *Culture* (i.e. free nursery, right to study, enhancement of cultural heritage, education in music and sport, digital, technical and scientific skills, film culture and music), *Work and opportunities* (i.e. NEET

reduction, 2030 manufacture, hospitality, trade, advanced training and research) are well distributed between the three candidates; *Sustainability* (i.e. maintenance, green economy, circular economy, renewable energy, water protection, sustainable agriculture) comes out only for the third candidate. Another difference coming to light from this analysis is given by the large presence of *Other discussions* (i.e. "sardine" cultural movement, the case of Bibbiano's children, the problem of illegal immigration) relating to Italian news events, whose occurrence somehow shifts the political debate focusing no longer on the electoral program, but on the relative regional and (sometimes) national events.

4.3 Comments, Polarization and Topic Matching analysis

In order to understand what kind of discussions emerged in the overall debate, the whole dataset of 60174 tweets has been processed using LDAvis. The assessment of the LDA results, as previously explained, has suggested the extraction of 10 clusters. In Figure 5 the distribution of the tweets for each cluster is shown.

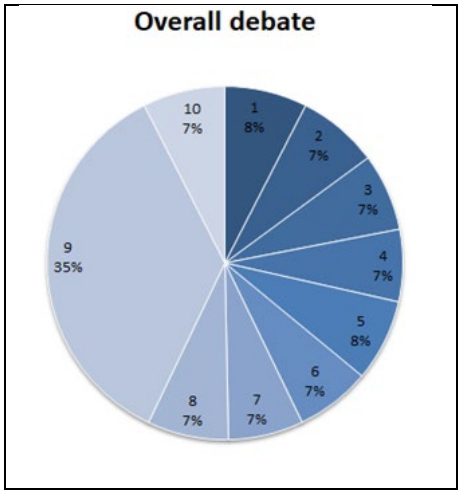


Figure 8. Distribution of tweets within the clusters.

A first analysis of these tweets has aimed to understand which is the sentiment emerged in the overall debate. As it can be seen in Figure 6, the overall sentiment for the whole debate, estimated on the whole dataset, is positive for the 73.7%. In particular, the sentiment analysis shows that the sentiment percentages are quite similar during the three months. Nevertheless, a growth of negative percentage in the last month has been observed, probably due to the vibrant tones used during the debate of the last few days before the vote.

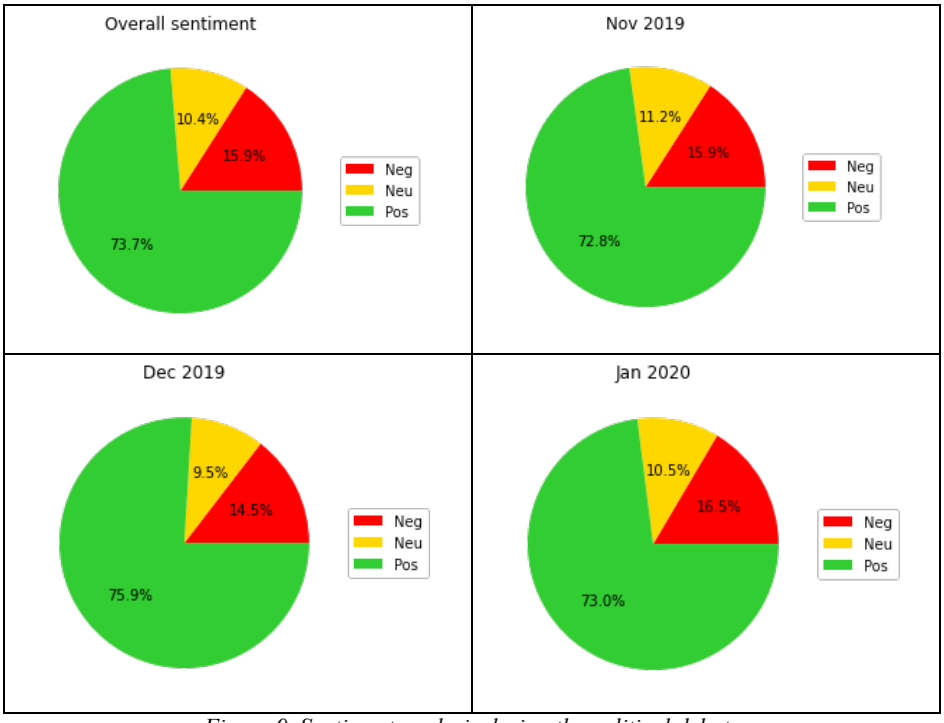
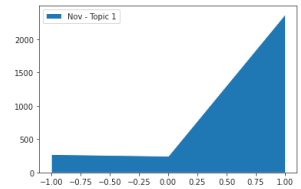
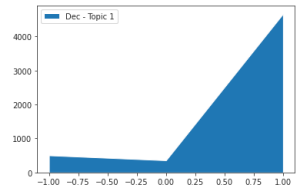
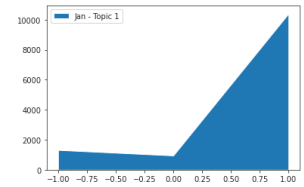
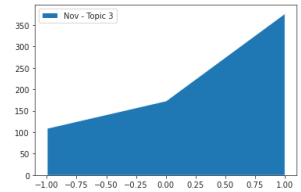
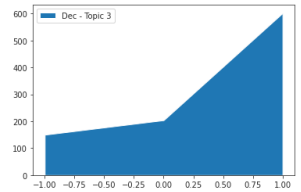
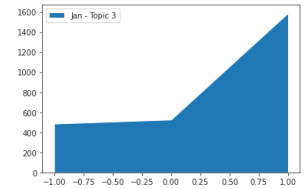
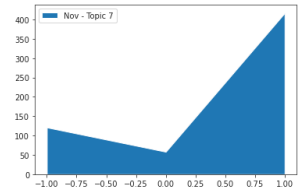
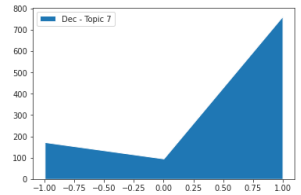
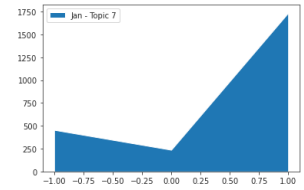
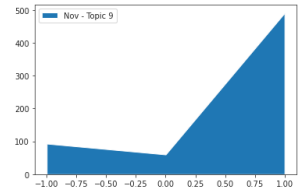
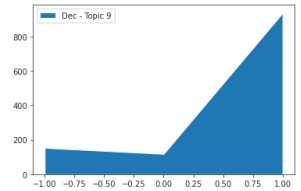
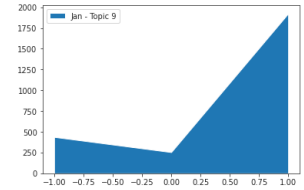


Figure 9. Sentiment analysis during the political debate

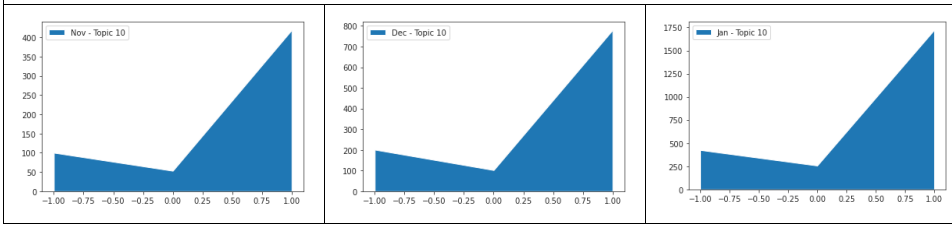
Moreover, it has been studied how the debate polarizes during the observation period. In Table 2, it is reported the details for 5 of the most significant clusters: for each cluster, the most relevant terms per topic and the variation of polarization is shown. The first evidence is given by the fact that in the overall debate a low percentage of topics are related to the action plans: *Rights and duties*, *Culture*. On the contrary, a high percentage of *Other discussions* dominate the political debate. Additionally, the debate is highly positively polarized for each topic. This is probably due to the low attitude of candidates towards a real "constructive" political online debate. In fact candidates' communication has been mostly unidirectional so that their answers to people's posts have not contributed to a flatten polarization curve.

Table 4. Most relevant terms per topic and the variation of polarization.

Topic 1 - bravo, volto, salvini, senato, montanaro, storia, vergogna, vita, fascista, sociale, padre, genitore → **Other discussions, Rights and duties**
  
Topic 3 - ragione, giusto, milione, euro, fiducia, ospedale, campanello, dimettere → **Rights and duties, Other discussions**
  
Topic 7 - vittoria, casa, sardina, paura, potere, opposizione, capitone, propagandare, minaccia, cultura, vivere, film → **Other discussions; Culture**
  
Topic 9 - Bibbiano, bambino, famiglia, parlaci, arroganza, gatto, ignoranza → **Other discussions**
  

Topic 10 - Sinistra, destra, buonista, povero, signore, clandestino, competenza, magistratura, risorsa, matteo, senso, serietà

→ **Other discussions**



4.4 Community Structure analysis

Finally, the overall dataset has been processed within *Gephi*[1] in order to understand how contents spread in the digital realm through social media and how some network of users contributes to the information diffusion. Analysing the data through the lens of SNA means building the graph with nodes, representing users, and edges, representing the action accomplished with other users: replying to or retweeting the candidates' contents. Many nodes have only one connection (meaning degree equal to 1).

In Table 3 the summary of the global network is reported.

Table 5. Summary of network properties.

Nodes	Edges	Density	Av. Path Length	Modularity
17312	57148	0.00	2.08	0.39

The *network density* is 0.00, meaning that this network is very sparse and contains a very low number of edges relatively to the maximum possible number of edges between all the nodes. The first evidence is that the candidates, while generating a lot of content on social networks, have paid little attention to user responses, thus a dense network of exchange of opinions between candidates and users has not been created. This is highlighted also by the low number of the *average path length*: the action of a user is able to influence another one following an averagely 2.08 casual path. Finally, the *network modularity* is 0.39, meaning that there is a low presence of structural clusters of variables in the network. Thus, in order to gather information about central nodes, it has been decided to reduce the graph analysis only to the core part of the network.

To this aim, in Figure 7 the graph obtained for *degree* values greater than 40 is shown. With these selections, the graph is made up of 107 nodes and 7596 edges. Edges are coloured by polarity, while nodes are coloured by degree (red for high degree, blue for low degree). The dimension of nodes is proportional to degree.

[1] *https://gephi.org/*

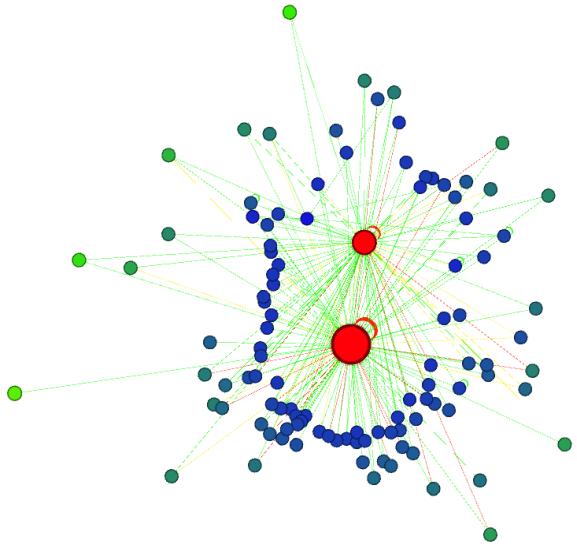


Figure 10. Social network graph obtained for degree values greater than 40.

It is evident that the red nodes correspond to two candidates (Borgonzoni and Bonaccini), while the third candidate is not visualized as his node does not have a degree greater than 40 (it is equal to 16). In the Table 3 the most influential vertices related to *degree*, *closeness*, *eigenvector* and *betweenness centralities* are shown.

Table 6. The most influential vertices related to degree, closeness, eigenvector and betweenness centralities.

Id	***Degree***	***In-Degree***	***Out-Degree***
2	30206	30198	8
1	26414	26303	111
9643	323	0	323
1938	220	0	220
1397	199	0	199
935	164	3	161
9420	146	0	146
1173	140	0	140
8697	136	0	136
1752	135	0	135

Id	***Eigenvector Centrality***
2	1,000000
1	0,404064
520	0,006908
3012	0,006908
594	0,006908
691	0,006908
43	0,006908
17191	0,001968
3819	0,000516
953	0,000166
1460	
1245	

	Closeness Centrality
1436	1,0
2902	1,0
2722	1,0
4705	1,0
5604	1,0
6285	1,0
9299	1,0
9643	1,0
9705	1,0
9888	1,0
12506	1,0

Id	*Betweenness Centrality*
1	0,041509
520	0,000167
3012	0,000087
594	0,000016

Id 1 and *id 2* correspond respectively to Bonaccini and Borgonzoni, while the other ids indicate common users. A high value of *in-degree* and a very low value of *out-degree* for both the two politicians confirms the thesis expounded above, namely that the candidates have paid attention to the publication of the contents but little to reading and responding to the users, thus not generating a real virtual political debate. *Id 9643* is the third node with a higher degree and it is also within the top ten nodes with higher closeness centrality, indicating which nodes are able to easily transmit a content throughout the whole network. Finally, it is worth noting that those nodes which have higher *eigenvector centrality* (*id 1*, *520*, *3012* and *594*) also show the highest *betweenness centrality* values. While *eigenvector* measures how much a node is important taking into consideration the neighbours, *betweenness* indicates those nodes which control the information flow between all the nodes. This means that these nodes, on the one hand, are levers within the network that intervene during the debate, and, on the other hand, are able to control the information flow.

5 Discussions and Conclusions

This paper aims at demonstrating the extent to which the political debate on social media differs from candidates' programs and the effect of the polarization in the political communication during the campaign. The originality of this paper is in the application of Big Social Data paradigm for monitoring of the political debate on social media, as it shows how the combination of Big Social Data and machine learning can lead to deeper insights into the relationship between social media and political campaigns.

Data from Twitter were collected and analysed starting from two months before the election date and analytics processes for performing multiple tasks (i.e. sentiment analysis, topic extraction, network analysis and social media metrics) are presented.

Results have shown that only a few of the action plans in the candidates programs have been treated in the online debate. For example, *Rights and duties*, *Culture*, *Work and*

opportunities, *Sustainability* were topics that candidates have dealt with on social networks, but they are just a small number respect to those in their action plans. Moreover, the large presence of *Other discussions*, which are related to national news events, often shifts the political debate no longer on the electoral program, but to regional or national issues. Finally, the analysis of the community network shows that candidates have used a unidirectional communication approach, so that while they have posted a lot, they have paid little attention to user responses. No real online debate has been created, and this has resulted in a sparse network of opinions exchange between candidates and users. Another resulting effect of candidates communication approach is the polarization of the debate on some of the topics emerged during the campaign. In fact, their rare answers to people's posts have not contributed to a flatten polarization curve.

This work has some limitations: for example, this study does not take in consideration whether the online political discussion has been influenced by the presence of social bots, which could have raised significant issues on the results achieved. BSD sources considered for this analysis could be expanded to other social networks such as Facebook. Moreover, social media metrics such as reach, mentions, and engagement could have been taken in consideration in order to better understand how candidates' contents disseminate through the social network.

Implications of this work are twofold: for researchers, this approach could be used along with other methods of data collection and analysis, in order to obtain more complete insights. In addition, many of our key findings need to be empirically tested in contexts broader than Italian regional elections debates. Nevertheless, this approach could be further developed for integration with existing elections prediction works based on Big Data analytics. For practitioners, this work gives the opportunity to study political discussions to media organizations and political elites. The multi-task analysis gives the opportunity to identify the drivers of political communication in terms of sentiment generated, topics and effectiveness.

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Who is Responsible and Who Takes the Credit? An Investigation of the Legal and Ethical Implications of the Digital Economy for the Intellectual Capital Development

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Abstract

This research paper explores the legal and ethical aspects of the digital technologies that offer opportunities for growth of the Intellectual Capital (IC). At the same time, the possible negative impacts are outlined, while it is argued that business ethics should be prioritized.

Keywords – Intellectual Capital, digital technologies, legal and ethical considerations, business ethics

Paper type – Academic Research Paper

1 Introduction

Private enterprises and governmental organizations all over the world are facing challenges to adapt to the changes brought by the digital economy (OECD, 2017), while focusing on the data-driven innovation (OECD, 2015). This encompasses various industries and sectors, from manufacturing to banking, from healthcare to agriculture, from infrastructure to smart cities. The ever evolving Information and Communication Technology (ICT) supports the digital transformation which affects not only the economy, but also the society, while forming the ground basis for sustainable development at the same time (ICC, 2017). Topics such as Big Data, ICT ecosystem, e-government, future of work, artificial intelligence (AI) ethics, privacy, data security, have become recurrent. New technologies drive new opportunities to develop the organizational Intellectual Capital (IC), new business models, improved management of resources and processes, while at the same time sudden technological advances can prove disruptive, or can raise legal and ethical concerns.

This paper aims at presenting an overview of the legal and ethical aspects related to utilization of data in the digital economy, and how they can impact sub-components of the Intellectual Capital. The first section will look into the opportunities offered by the digital economy and the underlying technologies for the development of IC. Next, the legal and

ethical challenges related to the exploitation of data for IC growth will be discussed. Finally, the paper will present the conclusions of the analysis.

2 Growth opportunities for Intellectual Capital in the digital economy

Edvinsson and Malone (1997) explained Intellectual Capital very briefly as knowledge that turns into value. As organizations endeavor to develop elements of their IC - human, structural and relational (op.cit.; Petty and Guthrie, 2000) - such as know-how, intellectual property, customer relations and networking systems, they employ ICT to expand intangible assets with the view to optimize business processes (Turban et al., 2013), to develop new products and services, to gain insights to ground strategic decisions and to achieve competitive advantage. The growth value brought by investments in intangibles like computerized information, innovative property and economic competencies based on ICT has been demonstrated in the literature (Corrado et al., 2005).

Data has become a commodity, a factor of production (Canavillas et al., 2015) and data-centric technologies provide opportunities for economic and social growth. In order to avoid poor decision making, data quality (characterized by relevance, timeliness, accuracy, easiness of use and security - Turban et al., 2013) is of utmost importance The key technologies for development are deemed to be the Internet of Things (IoT), especially when employed to monitor through sensor networks the health and activity of humans and animals, as well as the industrial and environmental processes; the Big Data analytics serving purposes such as business intelligence, decision making, machine learning; the artificial intelligence, utilized in increasingly autonomous robots; and the blockchain technology, which enables secure and trustworthy transactions (OECD, 2017). Other trending technologies that support business operations are cloud computing, social media, augmented reality (AR) and virtual reality (VR). Using the power of social networks and crowdsourcing opportunities, certain companies have expanded their profits and reach.

Most organizational operations and processes nowadays involve data collection, storage, processing and analysing, creating an intelligent learning ecosystem (Erickson and Rothberg, 2017). Digital technologies offer means for management of knowledge, for improved communication and real time connections with stakeholders, access to and management of data, information and knowledge resources, collaborative enterprises, smart machines and artificial intelligence endeavors. OECD (2015) called for a free flow of data among nations and organizations to promote innovation and societal well-being, while noting the need for corrective policies against information asymmetry, as a powershift from individuals to companies and from governments to data-driven enterprises takes place.

Big Data exploitation drives development, sustainability and disaster management efforts (UN Global Pulse, 2009), networking and connectivity of people and objects, e-government platforms and smart cities. Donation of medical data or DNA information for research purposes (Prainsack, 2019), processing of electronic health records and data

sharing (Kaplan, 2016), create opportunities for better healthcare and comprehensive public health strategies (e.g. WHO influenza monitoring program). In addition, ICT based progress in medicine has led to the bionic prostheses that extend physical capabilities beyond the regular human ones, the beneficiaries being referred to in the literature (Leenes et al., 2017) as the first cyborgs. Ubiquitous technologies and data sharing sustain education, civic initiatives, transparency and accountability (OECD, 2015).

Powell and Snellman (2004) stressed the blurring of the distinction between manufacturing and services, as smart products incorporate new technologies, which allow companies to offer additional services in relation to their products. At the same time, as part of their intellectual capital, firms utilize stocks of knowledge besides R&D, to increase productivity and to gain competitive advantage. To transfer such knowledge, companies rely on ICT. However, the authors underline the findings of research which showed that technologies also allow extensive monitoring and control, possibly leading to what Clarke (1988) named ''dataveillance''. More recent developments, where certain private companies have access to an unprecedented wealth of data, escalate the debates sometimes at international level, to the realm of state sovereignty and information asymmetry (Wired, 2019). Some authors (Hooker and Kim, 2019) even refer to the possibility of a new social contract between business companies and society.

Smart technologies can support not only the operational management (e.g. transport and distribution, quality checks), but also strategic tasks (like resource planning, staff selection) thus changing the work function and structure, though impersonal autonomous systems that interact with people might also interfere with the employee's freedom of decision (Gerst, 2019). Other concerns have been expressed with respect to the "amazonization" of work in industrial environments, where the customized production is combined with rigid operations and low-skilled work (Butollo et al., 2017). Frey and Osborne (2013) have noted the deskilling of workers, because of digitization. An ever increasing number of countries are pressured to review the labour regulations and policies, in light of new forms of work enabled by the ICT e.g. teleworking, informal work contracts favored by the sharing economy, open co-working platforms or crowd sourcing, human-machine collaboration, and others (OECD, 2017).

For individuals the main concerns related to the digital economy advancement and the utilization of data as economic resource gravitate around job security, work environment, privacy and personal data rights. As organizations introduce advanced technologies to increase efficiency of work processes and reduce costs, certain categories of employees are at increased risk of being made redundant. Various authors (Frey and Osborne, 2013; Gerst, 2019) have addressed the polarization of the labor market, which favors jobs where high cognitive skills are required. In the data based economy the workforce' competences are shifting more towards STEM fields (science, technology, engineering and mathematics), while interdisciplinary approaches (e.g. technical and legal in security, compliance and business analysis) and soft skills (creativity, problem solving and communication) are sought after. Frey and Osborne (2013) have concluded based on their

research that 47% of the total jobs in the USA pertain to the high risk category, deemed to be replaceable by computerized technology. Other authors (Gerst, 2019) have challenged these findings, underlining that decision lies with the companies and new technologies, while replacing jobs, have created others.

Big Data and AI based robots will push self-reliable automation even further in the workplace, from enhanced surgical robots to driverless cars. Robots replace humans in dull, dirty or dangerous activities (Lin, 2012). Intelligent vehicles development aims to better traffic safety, decrease fuel consumption and CO2 emissions, and improve comfort (Cheng and Lai, 2011). In order to achieve these goals, vehicles are endowed with sensors, technologies for wireless communication, geolocation, video cameras and others, which can be used to collect data about the product and the way it is being used. AI can serve many beneficial purposes, including monitoring compliance with norms and detecting violations thereof. AI based algorithms have been employed e.g. to offer services in financial investment, based on machine learning, though concerns remain in respect of inappropriate decisions because of design faults or high fluctuations in data patterns, which could make the provider liable for damages. However, there is currently no legal definition of robots or a legal framework for their use and development (Fosch-Villaronga et al., 2019), nor for many other trending technologies for that matter.

The Japanese authorities stated that the country's strategic goal is to become the world' s most advanced IT nation, and as a consequence they have published a strategy for promoting the use of robots in all socio-economic sectors (Japan, 2013; 2015). As noted by Nambu (2016), Japan needs next-generation robots to assist the elder, as the country has seen a decline in birthrate and an ageing population. However, the use of such robots is not covered by the legislation, unlike the industrial robots, which are pervasive in Japan. In addition, for fully autonomous vehicles to be allowed on public roads, the legal framework should change, as a (human) driver should be by law in the control of the car. As is many times the case with advanced technologies, export authorizations are required, which could slow down investments in next generation robots or autonomous vehicles for the global market (Nambu, 2016).

A range of topics related to the utilization of AI based autonomous robots have been debated in the literature, from the robots' interactions with humans in the workplace; to psychological effects of rejection induced by intelligent, human like entities, represented by Mori (1970) in "the uncanny valley" graphic (in Bekey, 2012); to ethical dilemmas linked to the use of robots for military or law enforcement purposes (Sharkey, 2012) and responsibility of military robots (Lockhorst and van den Hoven, 2012); to robots and privacy invasion (Calo, 2012). Sharkey and Sharkey (2012) have particularly addressed the long term effects that robot carers could have on the right to liberty and privacy of children and the elder, as well as the effects of lack of human contact and socialization on these categories.

The legal standing of AI based autonomous robots has been widely analyzed by various authors, and there seems to be an understanding that, as long as robots cannot

pass the Turing intelligence test (where an interviewer should not be able to tell the difference between a machine and a human), robots do not qualify as moral agents (Abney, 2012) and are not entitled to personhood as legal subjects (Asaro, 2012). Though robots are already capable of (co-)creating intellectual products guided by humans, they cannot enjoy authorship and cannot hold intellectual property rights (Holder et al., 2016). A robot does not have rights under the civil law, and cannot be held criminally responsible (Nambu, 2016).

This section has had the purpose to provide an overview of how various digital technologies can be employed by private and public organizations in order to support their work processes and ensure sustainable growth. Nevertheless, as the organisations collect, store and manage data from internal and external stakeholders to develop intellectual capital (Secundo et al, 2017) and to expand their profits, they find themselves entangled in a growing legal and ethical debate. But the most affected by the consequences of poor decisions because of faulty design, inappropriate data quality, unethical business models or security and privacy breaches are in the end the individuals (Wigan and Clarke, 2013).

3 Legal and ethical challenges in the digital economy

The philosophy of law and ethics have developed in parallel in the Western philosophy (Del Vecchio, 1940). Socrate believed that to know and to do is one and the same, as virtue is the application of knowledge. Virtue implies abiding by the laws, both written and unwritten. Kant has made a clear distinction between law and morals, as in his view the law is concerned only with the external, physical action, while ethics grounds the motives, the internal actions and it is imperative and rational in substance. Kant stated that moral duties extend greater than the legal ones, and that duties to the other people are based on the respect they are entitled to. Therefore people should always be treated as a scope and never as a means. Later on, the utilitarianism through J.S. Mill underlined the role of the individual's conscience in promoting the general happiness of the society.

Practice has constantly shown that entrepreneurial efforts in the realm of the digital economy, while focused on profit, seem to overlook legal and ethical aspects related to the use of data for profit. This might be favored by a lack of or inadequacy of regulations to address specific new technologies, and sometimes by the absence of insight into the consequences of treating data just like any other commodity. Though the limited legal provisions in some respects might induce the conclusion that everything which is not forbidden is allowed, all members of the society, either natural or legal persons should inform themselves and involve themselves with the implications of the legal and ethical consequences of the pervasive, ubiquitous and always connected society.

As dependency on digital technologies and pervasive connectivity increase, so do security and privacy challenges. Smart home technology, as well as wearables are designed to interconnect with other devices, or to send feedback through producers' applications, increasing the potential for major breaches, which should make security a

priority, both in terms of personal data, as well as business confidentiality. Even though, in principle, customer data is to be anonymized, re-identification is possible, especially when it comes to wearable technology (Sahmiri, 2016). Robots and IoT can facilitate monitoring or even surveillance of users, either by design, when accompanying applications which collect usage data connect to producer's servers, or through cyberattacks. Biometric, AR and VR technologies can be used to acquire personal data about users and even analyse their medical or psychological state (Royakkers *et al*., 2018).

Algorithms based on machine learning and statistical analysis process users' data e.g. for speech recognition or can provide recommendations by analyzing the customers' specific interests. But biased or erroneous analytical models have disruptive consequences on people's lives, from credit score calculation, to pre-employment screening, to performance appraisals. When prejudiced assumptions based on race, income or geographical location make their way into the algorithms, the results can prove disastrous for those concerned, given three elements - opacity, scale and damage inflicted (O'Neal, 2016).

Data concerning the customers' shopping habits, electronic financial transactions, and movements is being collected on online platforms sometimes beyond the business scope, allowing insights into private matters. On the other hand, selective provision of information, advertisement and targeted content on social media can hamper the freedom of information and objectivity (op.cit.), while diversity could collapse (Helbing, 2015). Web based service platforms generate and control great volumes of data as byproduct of their main business, amplified by the network (OECD, 2017). Such business models profit from data based services on all sides of the market, and given their size and power, they are no longer mere participants in the data market, but they appear as market regulators. In fact, such companies have access and control to more information than governments.

Persuasive technology promotes psychological manipulation not always for the user's benefit. Location based marketing and geofencing track users' mobile devices and employ big data analytics and social information to profile, select and target customers (Brown and Harmon, 2014; Goncalves *et al*., 2013), which raises privacy concerns. Similarly, web search engines accumulate a substantial volume of data about the users, to provide better search results and customized advertisement, but at the same time profiling can reveal sensitive information about somebody (Rodrigo-Gines *et al*., 2018), like political views, sexual orientation, health issues, or movements. This is a matter of actual interest, as the Covid19 pandemic has given a new impulse to such applications, justified by public interests arguments.

In the workplace, the potential of digital technology for monitoring has been underlined by Munier *et al.* (2013), who have noted the risk of using metadata for tracing users and their activities online e.g. in teleworking, for establishing when staff has logged on to a platform, and the potential of using this data as evidence in later legal

proceedings. Furthermore, technology is a driver for the gig economy, where more people are left with short term jobs and the possible solutions that are discussed are the universal basic income - though it is seen as limiting self-determination and the right to a fulfilling work life – and economic incentives by stimulating participation of individuals to profit sharing (Hooker and Kim, 2019).

Another area of concern is the data privacy breaches in relation to healthcare data, which forms a major market, while patients might not be aware of how their data is being used, by both public and private organizations (Kaplan, 2016). The processing of such data is sometimes outsourced to companies in countries with more permissive legal regimes. In other cases, data collection takes place on sites which promote exchanges of data and information for a common good e.g. obtaining insights on how effective specific treatments are for certain diseases, but data can be further sold to pharmaceutical or other companies for aggregation. As in other situations, people contribute the data voluntarily, and this is further used in ways unintended by the provider, who does not make a pecuniary gain (op.cit.). Furthermore, genetic data could be used for screening of personnel assigned to be deployed for specific posts or tasks, and people could face discrimination based on propensity to future health problems (Armstrong *et al*., 2010).

The processing of personal data is governed in the European Union by the General Data Protection Regulation 2016/679 (GDPR) since 2018, which covers such activities undertaken not only by the EU organizations, but also by foreign companies conducting business in the EU (Murphy and Barton, 2014), or concerning EU citizens. The GDPR has set down principles like: technologically neutral protection of personal data processing of identified or identifiable person, by design and by default; clear, affirmative, informed consent, which can be withdrawn by the data provider; transparency of data processing, which must be adequate, relevant and limited; data security; the data subject has right of access, opposition to processing for direct marketing and profiling, rectification and erasure (the right to be forgotten); responsibility and liability of controllers and processors for regulation breaches and the obligation to notify the supervisory authority and the data subject when rights and freedoms can be affected; the data portability right and the right to obtain a copy of the data in a commonly used electronic format; the right to judicial remedy and compensation. According to art.9 of GDPR processing of specific categories of personal data "revealing racial or ethnic origin, political opinions, religious or philosophical beliefs, or trade union membership, and the processing of genetic data, biometric data for the purpose of uniquely identifying a natural person, data concerning health or data concerning a natural person's sex life or sexual orientation shall be prohibited", unless prescribed conditions are met.

A specific problem in the digital economy is that services based on data processing would be denied to customers who would not agree with this processing. Such clients do not have real alternative options. Even when users tick the box confirming acknowledgment of terms of service, for most of them they may be ambiguous, tedious to go through or even of no interest as long as the consequences are not immediately visible

to them. A welcome solution is privacy by design, based on the notion of privacy as ‘‘informational self-determination’’ (Ishii, 2017). In the EU the GDPR has aimed to overcome this, by transferring more responsibility to the companies, by imposing a much stricter legal regime, enforceable under the EU jurisdiction and which prescribes more severe pecuniary sanctions in case of breaches of legal provisions.

Privacy and consumer protection should be a business priority (OECD, 2017). The right to privacy is protected by article 12 of the Universal Declaration of Human Rights (UDHR, 1948), as well as art.7 of the EU Charter of Fundamental Rights (EUCFR, 2012) which enshrines the right to respect for private life and communications. Art.8 of EUCFR establishes the right to protection of personal data. Art.21 of the Charter sets down the right to non-discrimination, while art.31 foresees the right to working conditions that respect the worker’s dignity, health and safety. The extent of the right to privacy can vary, and protection of privacy can be restricted depending on the legal system applicable and priority of other public or social values to be defended.

Certain business models have already clashed with existing regulations or revealed the need for the extension thereof, as exemplified by the experience of business models based on sharing economy in several countries. Breeching public transport safety regulations can be an issue in the peer to peer economy, as stressed by Costantini *et al.* (2015), as drivers must comply with legal requirements on skills, record of good behaviour and technical certification of the vehicle. As for the business side of the equation, other legal and ethical concerns to be considered are the labor rights, competition regulations, tax law and non-discrimination breaches, data security, malicious acts facilitated by lack of governmental oversight. Such businesses take advantage of the information shared by users, by controlling the data about offer and demand, by facilitating communication and matching of needs, by providing easily accessible ICT based services.

In what concerns the legal and ethical issues related to autonomous robots and AI-based vehicles, a project conducted for the European Commission (2019) has identified aspects like testing, certification, liability, insurance and management of risks as areas in need of further regulatory clarification and harmonization. While most Member States assign legal responsibility to the driver for traffic violations, the manufacturers are liable for damages caused by the product. However, it can happen that both parties are held responsible in various degrees. A similar solution has been identified by Cheng and Lai (2011) for the US market. In such cases, it is expected that data compulsory collected and stored by the vehicle and service providers to be used as evidence. Additional complexities are envisaged as automation is predicted to come gradually, which could imply other actors responsible for the products and services they provide e.g. software, connectivity etc, while malfunctioning and cybersecurity risks (hacking, phishing, eavesdropping, malicious manipulation) to products, data and privacy, and data rights should be resolved. When it comes to robots, general rules on product liability apply for regular industrial robots, which are treated as machines. Exoskeletons would fall under the legal regime applicable to the personal protective equipment, or possibly medical

devices. Intelligent and autonomous robots e.g. collaborative robots working interactively with humans, would have to comply with the labor safety and health regulations. In Japan, civil liability for damages produced by robots would apply accordingly, based on product liability, labor safety breaches or negligence (Nambu, 2016).

4 Conclusions

Various elements of the IC can be affected by unlawful or unethical use of the digital technologies. Violations of rights and freedoms such as non-discrimination or work safety, have the potential to harm especially the human and structural capital, while breaches of privacy could extend from corporate culture to the relational capital, by affecting customer loyalty, trust and company reputation. Security and protection of privacy and human rights should be prioritized and embedded in the managerial philosophy. Compliance with regulations and attention to business ethics are part of a company's corporate social responsibility assessment (GRI) and important building blocks for sustainable growth.

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Patterns of External Fragmentation of Production in the Republic of Moldova

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Abstract

In the modern world, most of the trade between countries is carried out within Global Value Chains (GVCs), which have become a strong driver of global economic growth. Also, not all countries are sufficiently penetrated into these chains and can benefit from integration in there. Most developing economies and former communist countries not only suffer from the lack of strategy framework of including local intermediate products in GVC, but didn't have developed country's research on this topic. Our research will fill in the gap for the Republic of Moldova. We paid special attention to the exploitation of the potential of Foreign Trade Agreement (FTA) between the Republic of Moldova and EU and elaboration on the adequate economic mechanisms for this scope. We explore the measure of engagement of RM in external fragmentation of trade, using the wide range of WEB simulation tools of International institutes. The study showed that backward participation is the predominant type of engagement of the Republic of Moldova in the external fragmentation of production. It also revealed that the list of products engaged in external fragmentation of the country is highly concentrated as well as their markets. Articles of apparel, accessories are the main product of external fragmentation of production, provided in the customs regime of inward processing. Our research found that Moldova did not make enough use of the benefits of FTA between RM and EU to deepen the penetration of products into the value chains of European space, being represented in their low-medal and low-income nets. The results of the study can be used in the process of implementation of FTA with the EU by decision makers and the private sector.

Keywords – Regional economic integration, Global Value Chains, Fragmentation of production

Paper type – Academic Research Paper

1 Introduction

Regional integration through trade and investment agreements in Central and Eastern Europe has been connected to the large international networks of production. At present Europe is one of the most important hubs in complex GVC networks activity and the main attention of this study will be painted in this region. A number of empirical studies demonstrate the dynamic integration of the entire region of Central and Eastern Europe with the global economy, especially with the European Union. Grodzicki M.J. (2014) has summered that detailed case-studies demonstrate an ongoing industrial upgrading in the GVC the of Visegrad region. If initially, their exports were based on

commodities and natural resources and were focused mainly on assembly operations, in time more and more tasks of higher complexity are being fulfilled in the region (Hotopp et al., 2002; Zaghini, 2005; Fertö, I. & Soós, K.A., 2008).

Implementation of Foreign Trade Agreement between RM and EU is at the government agenda, beginning with moment of ratification. Valorification the economic potential of this agreement should be through elaboration of adequate mechanisms and policies. It is related first of all to the deeping trade between partners. Patterns of external fragmentation of production via processing trade are not studied in country's research at present. In this context the study of the participation of the Republic of Moldova in processing trade, as well as estimation of the share of European countries in it, is important. To be mentioned that economic integration by the processing trade can be considered as a new conception for industrial and economic recovery of country.

Besides its introductory part, the paper has four parts, including the theoretical and methodological background of research as well as all outlining the aspects external fragmentation of Moldova, determining the place of the country in GVC, and concluding remarks. The theoretical part of the study examines recent GVC features and is constructed in such a manner as to be useful in the explanation of experimental findings of research and formulation concluding remarks.

2 Theoretical background of research

Last decades in the economic literature dedicated to trade topics have discussed the importance of trade liberalization for fragmentation of production that consistently led to the appearance of global value chains (GVCs).

It is a consensus regarding that trade tariff reduction has stimulated trade exchange between countries that in line with the growth of the volume of international trade was expressed in the global fragmentation of production.

The evolution of this concept can be seen in a number of studies of past years.

In the economic literature increasing trade of big parts and components of manufacturing goods between countries has been variously called.

Besides mentioned above, for a description of this globalization process has been used the following notions: vertical specialization, processing trade, slicing up the value-added chain, outsourcing, offshoring.

There are differences in the reflection of international fragmentation of production in the economic literature of the end of twenty century and in the recent studies of the twenty-first century accompanied by the analysis of accumulated experimental dates.

At the earlier studies, there have been to explain the fragmentation of production based at classical theories of the trade, using Ricardian and Heckscher-Ohlin type models (Deardorff, A. V., 1998; Jones, R. W., and H. Kierzkowski, 2000; Görg, H. ,2000). So, the main drivers of these phenomena were the big production firms in high developed countries that have been interested in reducing production costs in order to increase their

competitiveness. They pursued this strategy by the vertical division of the production process at the stages replaced in different countries.

At present GVCs are often taken as a determinative peculiarity of the current wave of globalization. According UNCTAD estimation, at present about 80% of trade takes place in international production chains linked to multinational companies (UNCTAD, 2013).

GVCs have become the main driver of global economic growth. In the global world, trade and transport tariff reduction as well as IT dissemination allowed further international division of labor and specialization by countries, transferring competition from the firms to their departments and individual jobs through participation in global value chains.

One of the undeniable features of contemporary economic development is that services play an extremely important role in external fragmentation of production. GVC activity in manufacturing reveals that a large fraction of the value-added is created in services. Services often are important inputs (such as research, design) in the production process as well as link the different stages (such as marketing and distribution) of value chains of manufacturing goods (World Bank, GVC Development Report, 2017).

With essential and evident global economic and welfare benefits, trade segmentation enhanced wage disparity, especially between developed and developing economies.

In context, to be mentioned some of the important studies that contributed to the economic analysis of the modern picture of the world by estimation of consequences of the current wave of globalization for EU as well the profound critical evaluation of classical trade theories.

So, one of the main conclusion from the Baldwin (2006) study is that the globalization opened new opportunities for rising productivity of EU's firms. To use this opportunity it should be made adjustments in a set of government policies, preponderant in R&D, labor market and education. It has important implications for competitiveness Strategy of EU the same, because the study argued that the second wave of globalization is favourable for high skill sectors/workers in Europe and vice versa.

From the study of Eric Sheppard (2012) is following that classical trade theory in explaining of the globalization process is not sufficient. The similar conclusion was made by Krugman (1995) that noted the vision of traditional theoretical approaches is limited for explaining the tremendous growth and changes of world trade landscape.

Some recent studies highlight the relationship between GVCs and different aspects of production: the influence of the international fragmentation of production on trade and specialization in the manufacturing of country (Laura Dell'Agostino, Silvia Nenci ,2018), correlation between GVCs and productivity (Constantinescu, C., A. Mattoo; M. Ruta, 2017), others studies pain attention on sustainability in global production networks(Alexander, R., 2018 and 2019). According to Stollinger (2016) and Sampath and Vallejo (2018) since the advent of the GVC, the manufacturing sector has undergone significant structural changes towards expansion and has become a major driving force of economic growth.

Besides the works studying the development of trade fragmentation, to be mentioned the research dedicated to its measurement. Traditional trading indicators (gross export / import, trade balance and their trends) are also limited as traditional theoretical approaches to explain the external fragmentation of production.

In economic literature notes that trade in intermediate goods between countries is often used as a suitable indicator for trade fragmentation (Götz Zeddies ,2007; Beltramello, A., K. De Backer and L. Moussiegt, 2012).

Also in the economic literature is mentioned that analysis of the new global trade landscape is suffering from lacking appropriate models and good data and is difficult to interpret (Hubert Escaith, 2009).

Recent OECD studies are based on the approach to the measurement of GVC participation, elaborated at the synthesis of the number of experimental research. According to this "value chain participation is defined in terms of the origin of the value added embodied in exports both looking backward and forward from a reference country: backward when it comes to foreign value added embodied in exports, and forward when it refers to domestic value added which is used as inputs to produce exports in the destination country" (Kowalski, P. et al.,2015, p.13).

Some aspects of applied this approach are explained in the next sections in the determination of engagement of the Republic of Moldova in external fragmentation of production.

3 Methodological background and objectives of research

This study is based on the analysis of trade flows of intermediate goods between countries for measurement engagement of countries in external fragmentation.

The methodological base of study is a wide range of WEB simulation tools of International institutes that allow estimating the engagement of Republic of Moldova in external fragmentation of production and the best ways it can be done, among which are: Trade in Value Added (TiVA) instrument, developed by OECD for the comparative analysis of GVC integration across countries of different levels of development, the Market Analysis Tools of International Trade Center (ITC) of the World Trade Organization and the United Nations.

TiVA database incorporates important information regarding to the trade in goods by the end-use categories, including intermediate goods. It offers information dealing with participation in GVCs via intermediate imports embodied in exports (backward linkages) and domestic value added in partners' exports (forward linkages) the same. At the same time, trade statistics included in TiVA database is not completed in the case of Moldova. So, domestic value added content of gross exports is not separated from foreign value ones in the case of Moldova.

It should be noted that the simulation results extracted from the databases are additional in the study. However, this approach is limited to the various product classifications used in databases. The International Standard Industrial Classification of

All Economic Activities ISIC Rev. 4 will be used for the information incorporated in TiVA database.

Trade map of ITC contains bilateral trade statistics of goods that are re-exported in the country from which was imported previously. It allows the determination of goods that have acquired domestic origin through processing and are engaged in backward participation. Republic of Moldova is included in the list of 70 countries that having reported their reexport.

Based at the methodology, there are following objectives of the study:

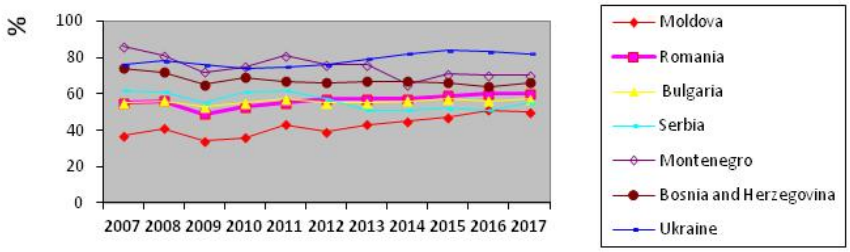
- Comparison records of external trade by intermediate goods of Moldova with other Eastern European countries,
- Determination of particularities for backward engagement of Moldova in GVC,
- Estimation of product' specialization and predominate market concentration of trade fragmentation of country.

4 External fragmentation of production of the Republic of Moldova

4.1 Records of external trade by intermediate goods of country

Trade in intermediate goods between countries is one of the suitable indicators for an estimate of trade fragmentation of the Republic of Moldova.

In comparison with Moldova, all countries have the initial (2007) and final (2017) levels of expansion of intermediate goods in export to be higher. It speaks that they are more profound integrated in regional and global value chains in comparison to Moldova **(Figure 1**).



Source: Elaborated by the author at the Bilateral Trade Database by Industry and End-use category

Figure 1. Shares of intermediate goods, by industry in export, % selected Eastern European countries

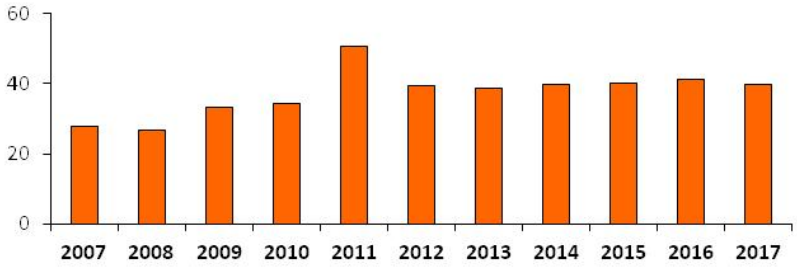
It can be observed that the share of intermediate goods is reduced in 2009 - the first year of economic crisis and it already recovered in the second 2010 in all counties.

Ukraine, as well as Montenegro, Bosnia, and Herzegovina, show the highest shares of intermediate goods in export.

Romania and Bulgaria demonstrate similar trends in developing trade by intermediate goods. During the 10-year period of the country's EU membership (2007-2017) it was changed insignificantly. Romania's share in the trade-in intermediate goods increased between 55% and 60%, but Bulgarian's one between 55% and 57%. Moldova's export has unlike structure to all countries included in the analysis. Household consumption has prevailed category of export for the exception of recent years when the structure was changed. So, Moldova's share of household consumption was reduced from 56% (2007) to 43% (2017) while the export of intermediate goods has expanded from 37% to 50 % during this period. To be mentioned that in Moldova the rate of growth of intermediate goods was higher than the rate of growth of exports in general. So, if the country's export increased in 1.8 times in 2017 in comparison with 2007, the intermediate goods export expanded in 2.4 times in the same period.

Analyzed records approve indirectly the extension of penetration of Moldova in external fragmentation of production as well as the efforts for identification of their niches.

It should be mentioned that 39.8% of the total import of intermediate goods of Moldova in 2017, was embodied in export, it is above the share in 2007(27.8%), but lower than in 2011(50.3%), when produced the recovery of the economy (Figure 2**)**.



Source: Calculated by the author at the Bilateral Trade Database by Industry and End-use category and Market Analysis Tools ITC

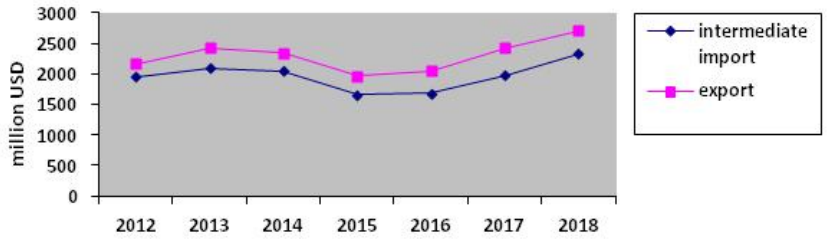
Figure 2. Reexported intermediate import as % of intermediate import of Moldova

Figure 2 also reveals that the share of reexported intermediate import was increasing till 2011, including the crisis years of 2009 and 2010 thanks mainly to a decrease in imports.

In Moldova, beginning with 2012 it stabilized on the level of about 40%, close to Romania of 37.8% but below the share of Bulgaria (54.6%) there were in 2016. Taking into attention that the indicator provides a measure of intermediate imports as a source of

international competitiveness, it can to speak that reexported intermediate import of Bulgaria are more competitive than of Moldova and Romania.

It can be observed a strong correlation between intermediate import and total export of Moldova (Figure 3). This means that Moldova uses significant share of intermediate imports in its export production.



Source: Elaborated by the author at the Bilateral Trade Database by Industry and End-use category

Figure 3. Intermediate import and total export of Moldova

To be mentioned further that the reexported intermediate import has reached 57 % of total intermediate export of Moldova in 2018. So, intermediate import embodied in exports has acquired domestic origin through processing and are engaged in backward participation.

Following analysis will be based at the study of engagement of Republic of Moldova in backward activity.

4.2 Backward engagement of Republic of Moldova in network activity

At present list importing markets for products reexported by Moldova includes the 15 countries that demonstrate significant shares in value in Moldova Republic's reexport that are considered for this study more than one percent during one of the years 2010-2018. But only few countries dominate in list of importing markets. (Table1)

Table1. Share the main importing markets for the products reexported by Moldova

importers	**Share in value in Moldova Republic's reexport,%**								
	2010	2011	2012	2013	2014	2015	2016	2017	2018
Romania	24,9	22,3	11,1	12,3	17	19	24,3	26,8	31,9
Italy	16,9	11,9	7,6	8,8	17,1	17,7	18,5	18	18
Germany	5,4	4,1	2,2	2,3	3,9	4	5,8	6,1	7,6
Russian Federation	24,1	37,9	53,3	49,4	30,2	21,6	14,8	11,1	6,8
United Kingdom	7,7	4,8	3,9	4,6	7,9	8,1	6,7	6,1	6

Turkey	5,2	3,1	4	3,3	3	3,1	3,5	3,2	3,4
Ukraine	3,5	3,6	3,3	2,7	2,7	1,8	1,8	2,4	2,6
World	100	100	100	100	100	100	100	100	100

Source: Elaborated by the author at the Trade map of ITC

It can be observed that tree European countries: Romania (31.9%), Italy (18%) and Germany (11.1%) composed more than sixty percent of value in Moldova Republic's reexports in 2018.

Further analysis shows that the share of European countries has a tendency for increasing beginning in 2013 in the reexport of Moldova. More huge reexported growth in value was reached for Romania (30%) and Germany (37%) in comparison with total growth (9%) for 2018.

The opposite trend is observed regarding the Russian Federation. So, the Russian Federation's share is decreased from 53% (2012) to 6.8% (2018). At the same time, the reexported value of Russian Federation has essentially decreased between 2013-2018 years, and especially in last three years. In 2018 the decline in the reexported value composed about 86% compared to the 2012 year.

Similar to Russian trends, Ukraine's share in the reexport at the end of the analyzed period has reduced in comparison with its beginning.

Reexport of Republic of Moldova is geographically divided mainly between former USSR republics and EU countries. It can be observed the same that it concentrated in Romania from European states as well as in Russian Federation from ex USSR countries. Republic of Moldova will been included into industrialization process historically after World War II and now has been oriented at the assembly production dealing with this region as a result of the actions taken by the governments.

The most important conclusion from our analysis that can be deduced is the Moldova's reexport is leaving the countries of the former USSR to favor the EU states. It can be explained by the impact that produce the implementation of Deep and Comprehensive Free Trade Agreement between Moldova and EU that started to take effect on 1 September 2014. In turn, it is the extreme important for economic modernization of the country.

It should be mentioned that the list of products reexported by the Republic of Moldova is limited the same. So, from the 97 product groups, selected according HS4 trade classification, reexport is highly concentrated only in three groups: electrical machinery and equipment and parts thereof; sound recorders and reproducers (23%); articles of apparel, and clothing accessories, not knit or crochet (22.7%); articles of apparel, accessories, knit or crochet (9.6%) in 2018.

Table 2. List of main products reexported by Republic of Moldova

Product label	Share in value in country's cluster import,%								
	2010	2011	2012	2013	2014	2015	2016	2017	2018
Electrical machinery and equipment and parts thereof; sound recorders and reproducers	17	16,7	5	7,9	11,1	12,7	17,1	20,7	23
Articles of apparel, and clothing accessories, not knit or crochet	19,3	14,1	9,6	11	19,8	20,9	21,1	22,1	22,7
Articles of apparel, accessories, knit or crochet	14,4	10	8,1	8,8	11,2	10,4	10,5	9,6	9,6
Pharmaceutical products	8	6,5	10,2	11,7	13	8,2	4,8	5,6	6,3
Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings	5	7,3	10,6	5,7	4,4	3,7	5,6	4,7	3,2
Footwear, gaiters and the like, parts thereof	4,2	4,4	3,6	2,5	3,6	3	3,2	3,2	3,1
Nuts, fresh or dried, whether or not shelled or peeled	6,5	4,3	5,8	4,7	5,1	8,7	2,4	2,3	3,1
Vehicles other than railway or tramway rolling stock, and parts and accessories thereof	1,6	3,4	5,1	4,5	2	1,5	3,3	2,7	2,2
Machinery, mechanical appliances, nuclear reactors, boilers; parts thereof	5,2	6,8	5,7	4,9	3,7	3,6	2,7	2,4	1,9
All products	100	100	100	100	100	100	100	100	100

Source: Elaborated by the author at the Trade map of ITC

The share of above product groups in value in country's cluster import was more than half in 2018. The portion of other 94 product groups varies from few percents till to hundredths percents. Analysis shows that the articles of apparel, accessories are the major specialization product of trade fragmentation of country.

At the same time main goods included in processing trade of Republic of Moldova are concentrated at the different importing markets. (Table3).

Table3. Selected products reexported, destined to main importing markets in 2018

countries / products	Share in value in Moldova Republic's reexport,%								
	Russian Federation	Romania	Italy	Germany	United Kingdom	Turkey	Netherlands	France	Ukrain
Electrical machinery and equipment and parts thereof; sound recorders and reproducers		69,4	3,7	10,3					1,4
Articles of apparel, and		21,5	45,5	9,1	15,3	0,9			

clothing accessories, not knit or crochet									
Articles of apparel, acces sories, knit or crochet		7,4	34,7	1,4	23,7	30,4			
Pharmaceutical products	74								19, 2
Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings	4	5,4	3	23,2			21,7		
Footwear, gaiters and the like, parts thereof		74,4	21,2						
Vehicles other than railway or tramway rolling stock, and parts and accessories thereof	6,7	57,4		13,3					7,5
Machinery, mechanical appliances, nuclear reactors, boilers; parts thereof	17,3	35,8	1,5	23,3	2				2,9
Nuts, fresh or dried, whether or not shelled or peeled		0,7	3,3	15,8		1,6	5,7	52,9	

Source: Calculated and elaborated by the author at the Trade map of ITC

About the 70% of *electrical equipment* is reexporting in Romania.

Reexports of *articles of apparel, accessories, not knit or crochet* are divided between European countries, more than 45% of which are importing by Italy.

Subcontracting relations between Moldavian enterprises and Italian firms have been constructed in 90-th years based at the cheap and qualified labour force. As one of the good examples should be mentioned the largest clothing factory in Moldova - “Ionel” that produces clothing based on Italian technology, is modernized with equipment from European branded companies. The company promotes such brands as Ionel, Giovanni Primo, Bella Prima, and makes articles for successful brands from which are Luisa Spagnioli, Pizza Roma, Patrizia Pepe, J.W. Tabacchi, Oviesse, UPIM, Conbipel, Trussardi, etc.

The other example of the clothing industry from Moldova engaged in the external fragmentation is the “Tricon” factory. It is one of the main producers of apparel knitted or crocheted. It fully modernized the equipment, implement new technologies in the collaboration with famous brands from Germany, Italy, and other counties.

Importing shares of articles of *apparel, accessories, knit or crochet* belong preponderant Italy (34.7%), Turkey (30.4%) and United Kingdom (23.7%).

The assortment of products reexporting in Russian Federation is including the leading positions *in pharmaceutical products* (74%).

Furniture and its accessories are mainly reexported in Germany (23.2%) and Netherland (21.7%).

It attracts attention that dried apricots, prunes, apples, peaches, pears as well as dried leguminous vegetables and fresh or chilled vegetables are absent in the list of main products reexported by the Republic of Moldova. Taking into attention that the vegetal products are the main export category with a share of 25.4% in 2018 according to official statistics, it seems the big contrast. In fact, the fresh and processing fruited and vegetables are mainly engaged in forward external trade.

It can be observed the same that only pharmaceutical products participate in trade fragmentation with former USSR countries: Russia (74%) and Ukraine (19.2%). The markets of trade fragmentation for all other products are divided between former USSR countries and EU countries.

Taking into attention the large assortment of goods reexported in Romania and significant importing shares in electrical machinery and equipment *(*70%), *footwear and parts thereof* (74.4%), *machinery* (35.8%), and *vehicles and parts and accessories thereof*(57.4%)it is one of the main markets for trade fragmentation of Moldova. Italy and Germany are important markets for backward trade fragmentation the same for seven product groups from Moldova.

It can be mentioned some measures of economic policies that have had an influence on this structure of reexport.

First, from the analysis of the reexported products is fallowing that the materials and accessories were imported in the Republic of Moldova in the customs regime of inward processing where products were transformed, and then were reexported from Moldova to EU countries, especially, when it comes to clothing articles and textiles, footwear, articles of leather etc.

The customs regime of inward processing allows that the foreign goods to be used in Moldova in one or more processing operations (processing, including erecting or assembling or dropping them to other goods), that intended for removal from the customs territory as compensating products without payment of import duties and without application of economic policy measures.

So, the created situation is not favorable for economy of Republic of Moldova, for the reason that the reexporting, based at the customs regime of inward processing, is not part of the gross additional value process and the process of taxing the company's income.

Second, the list of operators entitled to extension of the deadline for payment of VAT and customs duty for during the production cycle, but not more than 180 days at raw materials, materials, accessories, and primary packaging and completing items imported exclusively for manufacturing goods destined to export, was approved according to Government Decision Nr. 359 of 26.05.2014.

List of goods of Republic of Moldova engaged in external fragmentation of production is mainly gets into one from two mentions above economic regimes.

5 Conclusions

The backward participation is predominant type of engagement of Republic of Moldova in external fragmentation of production. At the same time the backward activity is concentrated in four markets, including Romania, Italy, Germany and Russia. This collaboration is based on the previous long-standing relationships – with Russia when the Republic of Moldova was a part of Soviet Union, but with European countries – with first years of independencies - beginning with 90-th years. At the same time Moldova's reexport is leaving the countries of the former USSR to favor the EU states. It is explained by the impact that produce the implementation of Deep and Comprehensive Free Trade Agreement between Moldova and EU that started to take effect on 1 September 2014.

List of products reexported by Republic of Moldova is highly concentrated the same, primarily in three groups. This is a consequence of the extensive process of deindustrialization, which took place in Moldova during the years of independence. According to our calculations based on the World Bank provided data, the share of the manufacturing industry in GDP decreased by about 2 times in 2016 compared to 1995, from 22.3 to 11.8 percentage points. Despite the fact that the program documents calculated the annual growth rate of electronics production up to 16 -18 percentage points (the Program for the development of the electronic industry until 2015) and an increase in the industry in GDP - up to 20-22 percentage points (the Development strategy of the industry for the period up to 2015 year), a decline was achieved in 2015.

Articles of apparel, accessories are the main product of external fragmentation of production, provided in the customs regime of inward processing.

The most part of Moldovan external commerce is characterized by the vertical specialization that involves the use of import components (the technologic, design, and capital intensive) for the assembly or final production of goods which are exported afterward. This specialization of Moldova implies intermediate import and export of goods simultaneously that take part in the same commercial category but on the different stages of technology processes.

Goods from Moldova are insufficiently penetrated in income value chains and mostly presented in low income nets of European countries.

Advantage of geographical approximation to Europe the one of the main manufacturing hubs around of which is organized GVC activity is practically unused by Moldova. It should elaborate strategy framework of penetration of local intermediate products in global value chains.

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Technology Innovation and its Role to Enhance Regional Development

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Abstract

Research, technological development and innovative activity are currently one of the most important factors influencing the competitiveness of both the economy and the individual regions. The accumulation of know-how, knowledge acquired from experience (learning by doing) and the results of diffusion of knowledge (spill over effects) related to the development of technology; allow the existence of self-sustaining self-sustained endogenous growth for the regions.
The main objective of the work is to focus on examining the role of innovative activity and in particular the role of the results of research and technology policies in relation to the assistance of regional development.
It will examine the role of the use of research and technological development policies in the less developed regions with a view to creating proposals for the development of procedures that will allow the gap with the most developed regions to be reduced. More specifically, work will analyse the supply of technology at regional level, examine current research, technology and innovation programs supporting technological infrastructure and research and technological activity in regional level, will analyse the region's environment that supports and facilitates innovative activity, including the financial system, industry, research canters and other technological Infrastructure, will examine and analyse the needs of the productive sector, the role of the markets at regional level in the selection of appropriate technologies and will examine the needs in technology of small and medium-sized enterprises at regional level, will make analysis of the gap between the demand for technology from businesses and consumers and the supply of technology from the state infrastructure and from businesses, will analyse the needs for technological development and finally will examine the relationship between technology and employment at regional level. Businesses face significant problems in developing their technological and innovative activities. They speak of a lack of communications and communications infrastructure, problems of financing and cooperation between universities and production, and the absence of an effective and decentralized organisation of public administration and policy. The lack of a basic technological infrastructure leads to technological and economic underdevelopment of the region and thus to an increase in regional disparities.
A general conclusion is that all successful innovative companies worldwide were forced to compete with other companies in the domestic and international market. In most cases, because the domestic market is not great, if companies do not compete in the international market, they cease to be competitive.

Keywords – innovation, technology, regional development, human capital, innovative entrepreneurship

1 Introduction

Technology is one of the key factors contributing to both economic growth and the social and regional development of an economy. This chapter attempts to refer to the delimitation of the basic conditions relating to innovative and technological activities, as well as a presentation of the key statistical measurement and evaluation indicators of innovative activities (Holtermann, 2010).

Technology can be defined as a set of elements of practical or theoretical knowledge concerning know-how, methods of procedures, experiences and also machinery and equipment, which through technological knowledge can be combined for the production of goods and services (Hughes, & Meckling, 2018). .

In other words, technology is a combination of productive factors, qualitative and quantitative, in relation to certain outputs of products and services or production processes through scientific, technological, organizational, economic and commercial activities. An effective combination of production factors requires knowledge, which can be distinguished in integrated and non-integrated. Integrated technological change refers to design improvements or the quality of new capital goods or intermediate inputs and concerns existing machinery and equipment (Graafland, 2020). The unintegrated technological change concerns a shift in the production function over time and refers to: (a) competences, (b) experiences of effort and technological solutions and (c) knowledge and achievement (Volberda, Mihalache, Fey, & Lewin, 2017).

Innovation is the process through which an economy creates and transforms new knowledge into useful products, services and processes, leading to both value creation for entrepreneurs and a higher standard of living for society. In more detail, innovation can come from a range of changes and improvements across the entire range of the production process and extends to all production activities, from basic production methods and workforce performance, to external promotion and disposal markets for a product or service. A technological innovation is considered to be implemented if it has been introduced to the market (in the case of product innovation) or if it is used in the production process (in the case of process innovation), and a company introduces new products or services to the market either when it adopts new ways of producing new products or services.

In recent years, the literature on the intrinsic development model in which innovation is produced through the structures of the enterprise has explored the idea that investing in knowledge and learning can influence the growth of economic aggregates in the long term, in which case the position has emerged that the productivity of human resources in the future is influenced by the moods of the present, i.e. , decisions to make the necessary financial and technological resources available and to encourage business executives to diffuse knowledge and take initiatives (De Souza, Ying, & Yang, 1998).

It is equally important to see the difference between innovation and invention: the term innovation is vague and ambiguous; in scientific research it means both a process and its result. So invention is an idea of how existing technological knowledge could be

transformed into new and different applications while innovation is the transformation of an idea into a new product or service of commercial importance. To turn a business into an invention, it needs to combine knowledge, skills and financial resources. For this reason, there are time gaps between invention and innovation, usually due to the lack of appropriate conditions for commercialization of the invention. Invention is neither necessary nor capable of innovation as it can lead to a patent, however, most of the time, it does not result in a commercial transaction.

On the other hand, developments in the theory of economic development have renewed interest in the role that innovation plays in the development process, underlining the links between investment in innovative activities, technological change and economic development. The exploitation of innovation offers new solutions to economic problems and thus makes it possible to meet some of the needs of the individual and society. As a driving force, it pushes businesses towards long-term development objectives and the renewal of their production structures in order to maintain elements of growth, competitiveness and employment, with investments in the introduction of new technologies (Marion, & Friar, 2019) aimed at modernizing the production process and enhancing competitiveness. The reason is that new technologies lead to increased productivity of inputs, contributing to the long-term improvement of competitiveness and sustainable development. This approach leads to a theoretical shift, from the view of an economy based on productive factors, to an economy based on innovation and knowledge through innovative entrepreneurship.

In this context, the innovative process is considered a complex and interactive process of technological and economic development. Technology is one of the key factors contributing to both economic growth and the social and regional development of a country (Hagedoorn, Koetse, Van Beukering, & Brander, 2020). .

Important, however, is the observation that despite the remarkable contribution of research and technology to economic development, their connection with more and more productive resources does not automatically lead to economic benefits, nor is knowledge equally distributed in space, between countries or regions, nor is it to the same extent accessible to each region. Although innovation usually takes place in nearby enterprises or sectors, the economic benefits do not automatically spread to the regions in which the innovative activity takes place. In order for a region to benefit from research and development, it must also have developed a local industrial base that can use new ideas and new knowledge; otherwise they may go to more organized regions that can exploit them.

In the age of globalization, research and technological development are developing rapidly thanks to the exchanges of researchers, information and scientific results, which move from one country to another more freely, more rapidly, through the encouragement of cooperation between partners from different countries through framework programs (Hyland, & Soosay, 2008).

2 Innovation in the Places of Business

Entrepreneurship is now recognized by all international organizations as an important factor that defines economic growth, competitiveness and employment and is an important driver of innovation. The management of innovation, namely how a new idea is created, how and by what criteria it is evaluated, how it is financed, etc., is a particularly arduous and demanding process which is a key element of effective entrepreneurship.

As part of the development of a strategy to promote innovative activities, the company should define the objectives, instruments, framework within which the effort will be initiated and the criteria for the adoption of ideas or proposals. It is necessary to integrate creative thinking for the production of truly original innovations but also to control the "products" of creative thinking in terms of their applicability (commercial sustainability). In a small business there is a greater need to transform innovation because a single failure can lead it to bankruptcy. The need for methodical development and introduction of new products to the market is essential and in the large enterprise, which usually deals with a range of products, risks larger capital has a more complex and cumbersome organization.

In order to be constantly innovative, companies should make strategic choices in critical areas. Firstly, strategic options for target markets to which a company wishes to enter are important and the identification of the kind of innovative products or services it will introduce into them. In other words, it chooses the market that interests it in principle and immediately after the competitive and innovative product or service with which it will be placed within it (Voutilainen, Turunen, & Ojala, 2020).

This category includes options regarding the design of a prototype, its development and testing and further research for improvements, before its promotion in mass production and then its "placement" on the market. In the third category we have options that play an important role in the development of innovation and business performance, such as new production technologies, the purchase of know-how, development or hire of special executives, equipment, or intermediate inputs that incorporate innovations.

The concepts of technology, knowledge and innovation are directly linked. Technology refers to the result of the application of (theoretical) scientific knowledge with the aim of creating an object with practical benefit. Sometimes, it refers to the methodology that characterizes such a procedure. Technology is the systematic application of scientific or other organized knowledge for the execution of practical purposes. Technology consists to a large extent in the application of knowledge created by both science and practice and experience (Olsson, & Paik, 2020).

Technological knowledge has characteristics of a public good if: (a) the cost of making it available to a general user public is low in relation to the cost of development and (b) after its diffusion; access to it can no longer be prevented. The latter feature creates two main problems for individuals who attempt innovations. The first relates to the fact that the social performance of innovation is usually higher than private, i.e. with positive exogenous effects. The second problem, which is a sub-case of the former, relates to the fact that knowledge cannot be self-interested. However, when an innovative company

cannot reap all the benefits generated, its incentives to invest in innovative activities are reduced. Thus, where technological knowledge has characteristics of a public good, there is a malfunction in market forces that would push companies towards innovation.

3 Entrepreneurship and Innovative Activities: An Analysis of the Impact on Competitiveness and Economic Development within the European Union

3.1 Innovation in the Places of Business

Companies invest in innovation to create new products or production processes but also to develop and maintain their capacity to adopt and exploit technological information available from external operators. Furthermore, the exploitation and improvements in the skills of the workforce play a particularly important role and contribute significantly to enhancing productivity. As the life cycle of products and services decreases and the emergence of new technologies is becoming ever faster, businesses are forced to innovate more often. Market access time is becoming increasingly important as factors of competition. The dissemination of new techniques, products and services makes it possible to exploit innovation in full in relation to competitiveness. The main factors that motivate businesses to undertake innovative projects are:

• The incentive to undertake a profitable investment where the efficient allocation of resources to innovative processes enables the company to reduce its costs, strengthen its relative position in the industry and its market and increase its profits.

• The incentive for a strategic advantage consisting in obtaining a strategic advantage by introducing and operating improved products and processes that can increase the company's market share.

Human resources, and in particular teachers and research organizations, play a key role in growth and competitiveness. Investment in human resources has a direct positive impact on the rate of development of technological change. The growing importance of technological change in global production and employment has been one of the hallmarks of recent decades. Technological changes determine a country's place in international competition and affect its level of modernization (Tazzara, 2020). Developed countries tend to give greater weight to policies aimed at encouraging development and strengthening the development process through research and technological activities. New technologies play a particularly important role in a country's productivity and competitiveness. The fact is that small and weak technological countries have fewer resources than larger countries. Small and weak technological countries are usually forced to choose only 'certain sectors', where they have the opportunity to invest and develop their research and technological priorities. Advanced technological countries usually have a longer-term strategy and planning, while the priorities in the areas of research and technology they choose are for high-tech sizes.

The existence of skilled human resources and the large investments allocated to research and technology and technological activities, as well as the availability of resources in large countries, give an additional advantage to developed countries, which identify and "drive" trends in the fields of research and technology. Therefore, small countries usually tend to follow the "directions" set by developed countries. Development policies are directly related to human resource development policies, as well as to improving technological progress and modernization of the production base (Thapa, Kumar, Roy, & Joshi, 2020).

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3.2 Innovation and regional development

Technology and innovative activities now play an important role in wealth creation and economic development, directly affecting economic operators, institutions, social norms and governance structures. The capacity to develop a region is usually linked to innovative activities and business productivity, their ability to 'unite' networks and exploit human resources and institutional framework, influenced by geographical proximity.

Innovation is analyzed not simply as an economic process, but as a social activity and process that includes the dynamics of many different enterprises, research bodies, universities and regional development actors in general. The innovative potential of the region depends both on the capacity to learn and produce innovation and on the ability to interact and collaborate on network operators (Vanhaverbeke, 2017). .

In the context of regional analysis, regional competitiveness can be approached as the capacity to produce goods and services that meet the demand of international markets, while maintaining high and sustainable levels of income or more generally the ability of regions to create, while exposed to international competition, comparatively high incomes and jobs.

In other words, regional competitiveness is a region's ability to create or maintain an 'attractive' microenvironment for the development of economic and social activities under conditions of domestic and international competition. The aim of regional competitiveness is to improve the well-being of the citizens of a region, i.e. in terms of income, employment while improving opportunities and quality of life.

Based on the definition of regional competitiveness, i.e. the capacity to maintain and improve the well-being of the region's citizens under conditions of domestic and international competition, which is seen as a complex and continuous process that refers to a wide range of determinants. More specifically, the main determinants are considered to be:

- the quantity and quality of the production factors;
- the degree of accumulation
- productivity,
- the immediate regional environment,
- the structure of the markets;
- integration with international markets;
- Investments in social, human and material capital.

Strengthening competitiveness contributes to the achievement of the objectives of an economy and a region, including, for example, competitiveness, increasing employment and real income, reducing unemployment, and enhancing opportunities and opportunities, both within and outside national borders, as well as improving the standard of living of citizens (Vahidian, 2018).

Regional competitiveness depends on a region's ability to generate satisfactory levels of exports and maintain an increasing level of income by ensuring full employment for citizens. A determining factor in this effort is the productivity of inputs for goods and services produced at local and regional level. The competitiveness of a region depends both on the competitiveness of the enterprises established therein and their cooperative or competitive strategies and on the business environment of the region, i.e. local institutions, social capital, public and regional services, and social culture.

The competitiveness of a regional economy depends on its economic activity. Regions where declining sectors and productive sectors of low value added and low-integrated technology are concentrated usually have a serious 'development delay' and severe structural difficulties in adapting to competition. On the other hand, regions with a diversified economic structure and dynamic industries based on technological innovation, learning capacity and business networking have a comparative competitive advantage.

A region, as part of the country, is affected by 'general macro-competitiveness'. More specifically, the determinants and "forces" of competitiveness are directly related to:

- Economic policy;
- Social, political conditions and the institutional framework;
- The wider 'long' international environment;
- Innovative activities and new technologies;
- The opening up of markets and exposure to competition.

The differences between the competitiveness of economies can largely be explained by the existing differences in the performance of innovative activities between economies, as well as differences in levels of technological development. Regional disparities occur, in particular, due to disparities in productivity and competitiveness, while affecting the rate of economic growth seen as a function of the capacity to innovate in the production process, the introduction of new products, the reduction of costs with innovations and the increase in market adaptability (Rojas, 2020).

Strategic planning is a process of defining long-term objectives and selecting implementation policies based on scientific analysis, international experience,

participatory processes and specific conditions prevailing in the economy, society and infrastructure of each region. In shaping the regions' development priorities, particular attention must be paid to taking account of both the exploitation of comparative advantages and the treatment of the development problems and weaknesses of each region. Regional disparities are defined as disparities in opportunities in individual spatial units: opportunities for economic activities, investment, employment, career, study, care, recreation, cultural activity, etc.

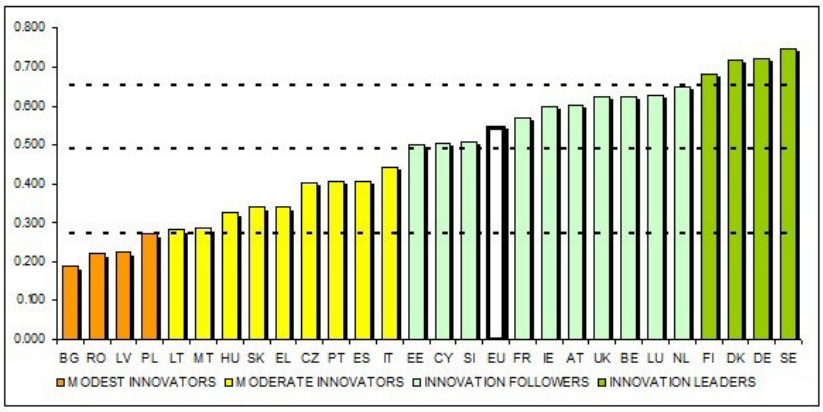

Figure 1: Innovation performance of EU Member States

Innovation performance in the EU has improved year-on-year, despite the ongoing economic crisis, but the innovative gap between Member States continues to widen. While the most innovative countries have further improved their performance, others are not making progress.

The overall ranking in the EU remains relatively stable, with Sweden at the top, followed by Germany, Denmark and Finland. Estonia, Lithuania and Latvia are the countries that have seen the biggest improvement since last year. Factors for the development of innovation in the EU are SMEs and the commercial exploitation of innovations, as well as excellent research systems. However, the decrease in business investment and venture capital investment in the years 2008-2012 has adversely affected innovation performance. The most innovative EU countries have a number of common characteristics in terms of the advantages of their national research and innovation systems, including the key role of enterprises and the higher education sector in innovation efforts. The business sectors of all innovation pioneers are performing very well in terms of research and development spending and patent applications. They are also characterized by a highly developed higher education sector and strong links between industry and science (Noor, Van der Kroef, Wattam, Pinnock, Van Rossum, Smit, & Brussaard, 2018).

Of paramount importance is the development of macroeconomic policies that contribute to the creation of a stable business environment, facilitate access to investment and protect intellectual property. At the same time, macroeconomic and development policies should focus on establishing sufficient incentives to develop innovations and ensuring the creation of new knowledge, with the state taking responsibility to finance basic research, while also improving the effectiveness of government spending on innovation by introducing competitive processes in the selection of state-funded actors, as well as addressing organizational and administrative deficiencies that appear to affect business involvement in innovative activity. Policies related to the identification of innovative systems, weaknesses and their capabilities, the creation of information centers and technology centers, the broad and flexible financing of innovation and technology transfer programs can be initiated in this direction.

The level of state policy also includes policy on enhancing interaction between the actors of the existing innovation system and the cultivation and exploitation of networks between enterprises. This should focus on actions such as establishing contacts through industrial circles or sectoral groups and facilitating the rapprochement between enterprises, encouraging the creation of ombudsmen or exploiting existing structures that could take on the role of communication and mediation (Hansen, 2020). Specific actions could include the organisation of a dialogue on strategic issues, the provision of strategic information through technological perspective studies and the effectiveness in informing enterprises of the advantages associated with the transfer of innovative technologies and the existence of effective mechanisms to support enterprises in the process of dissemination and transfer of technology, through the creation of information centers and technology centers.

4 Conclusions

The examination of factors that enhance the competitiveness of the company and ensure its sustainability independently of the sector in which it operates has become a point of analysis of economic research at international, national and regional level. In the knowledge economy, competition is not based on low production costs, but on the advantages of know-how and innovation. The innovative performance of a company consists both in the endogenous development of technological and scientific knowledge achieved by the participation of highly qualified and qualified scientific staff and by the effective absorption of technological inputs. Moreover, with new markets constantly emerging, technology evolving rapidly and with good ideas quickly copied, there is a constant pressure to provide new and better products and services faster. The fact is that innovation is now one of the most important parameters for growth, both at the enterprise and national level, and is placed in a high priority position in the policy of almost all countries in the world. In fact, the differences in competitiveness between national economies can at least be attributed to different levels of technological and innovative returns (Novak, 2019).

The investment in knowledge is linked to the increase in the production capacity of all other factors of production and contributes to the development of new products and production processes. Since knowledge is characterized by increasing returns and is not exhausted by the use, it is necessary for companies to develop systematic and methodical mechanisms for the administration and development of organizational knowledge, reducing the shortcomings of their cognitive resources.

Since innovation is a collective phenomenon with obvious spatial dimensions, economies of concentration and in particular business clusters due to the creation of positive externalities are becoming capable of creating an innovative environment. The geographical proximity of economic factors within the clusters facilitates the exchange of inextricable knowledge which is an important factor in innovation and since inextricable knowledge is distinguished by a high degree of locality, the business clusters give a boost to the development of innovative activities. The geographical proximity of economic factors or not within clusters transforms regions into learning organizations as through learning the know-how is disseminated, a common information code is acquired and knowledge is more efficiently integrated into the organizational culture of enterprises.

However, it was not only the government that had no vision. Insufficient demand was perhaps a major cause of technological stagnation. Most of the licensing contracts concerned low-tech sectors that could well have been developed domestically, while the relatively more advanced technology sectors only introduced simple assembly methods. There has been no attempt on the part of companies to adapt even these simplistic technologies to local conditions. There was no feedback mechanism between the productive experience and problem solving and therefore there was no accumulation of knowledge. The technology was used as another influx and the licenses to use know-how as a substitute for in-house development activities. Businesses face significant problems in the development of their technological and innovative activity. They talk about a lack of transport and communications infrastructure, problems of funding and cooperation between Universities and production, and the absence of an effective and decentralized organisation of public administration and policy (Cao, Weersink, & Ferner, 2019). The lack of basic technological infrastructure leads to technological and economic underdevelopment in the region and thus to an increase in regional disparities.

In the light of these problems and their adverse effects on the development and competitiveness of the region and the economy as a whole, national and local policy makers are invited to take measures to promote research, technology and innovation at regional level. The policy measures which may be implemented are summarized as follows:

- The technological infrastructure of many regions shall be considered inadequate. It is necessary to increase public investment in infrastructure, in particular in laboratories, training bodies, as well as in cooperation and networking bodies between operators.

- Better information is needed for businesses on policy measures supporting innovative activity. A large number of companies are ignorant of policy measures – national and regional – that support research, innovation and technology.
- Policy measures relating to funding bodies and cooperation facilitation bodies shall not be effective. These measures have little or no effect on funding and cooperation institutions in the field of research, innovation and technology.
- Finally, there is a need to reduce the bureaucratic procedures of the State and improve public services.

It is therefore necessary to review the nature of these measures. For example, measures to support the development of venture capital entities are desirable. A general conclusion is that all successful innovative companies worldwide have had to compete with other companies in the domestic and international market (Balan-Vnuk, & Balan, 2015). In most cases, because the domestic market is not large, if companies do not compete on the international market, they cease to be competitive.

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Towards an entrepreneurial education approach of Universities in WBC

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Abstract

Higher Education Institutions nowadays are getting attention for their special role in attracting students to the market needs for education skills and knowledge, and serving to business for their needs. More than creating centers within them, or just trying to put students forward to the business models, their role must be evaluative and challenges. Research in entrepreneurial education is a young field that is still in need of legitimation in terms of theoretical, conceptual and methodological foundations

In this paper some theoretical aspects regard to differences between traditional and entrepreneurial HEI, the concept of Entrepreneurial HEI and entrepreneurial education, and are given some insight that how universities can itself evaluate their proper dimensions towards entrepreneurial education, and some strategies that how they can sustain not only business but even the student, serving meanwhile to the whole educational market for more knowledge and skills. The aim of this study is to take better insight in entrepreneurial universities and challenges that face Universities of Albania to take this orientation considering the emergence of entrepreneurship education in higher education as a research field.

Main conclusions and recommends, with objective of going toward entrepreneurial education, underline the fact that universities must apply not only administrative tools to adapt their strategies to business (and other stakeholders), but need to have a new challenges approach in entrepreneurial education which is quite different from those that attend traditional or administrative approach. This means that with the aim of being of an entrepreneurial university, an HEI need to include in its philosophy the following elements/dimensions of entrepreneurial marketing which will allow to path of EE: Innovation, consumer intention, risk taking, opportunity driven, proactivity, value proposition, resource leveraging. Also, universities should position themselves not only between among competitors but even to other stakeholders as: students, businesses, community, parents, investitors, etc.; so some entrepreneurial positioning strategies need to be followed and developed by HEI in order to get more entrepreneurial.

Keywords: Entrepreneurial education (EE), HEIs, Innovation, co creation, value proposition

Paper type – Academic Research Paper / Practical Paper

1 Introduction

Research in entrepreneurial education is a young field that is still in need of legitimation in terms of theoretical, conceptual and methodological foundations. Higher Education Institutions nowadays are getting attention for their special role in attracting students to the market needs for education skills and knowledge, and serving to business for their needs.

Theoretical aspects regard to differences between traditional and entrepreneurial HEI, the concept of Entrepreneurial HEI and entrepreneurial education are still missing in the orientation of HEIs to EE. But being oriented towards an entrepreneurial education philosophy for a non-traditional university means that HEI need to include in its philosophy the following elements/dimensions of entrepreneurial marketing which will allow to path of EE: Innovation, consumer intention, risk taking, opportunity driven, proactivity, value proposition, resource leveraging. Also, universities should position themselves not only between among competitors but even to other stakeholders as: students, businesses, community, parents, investitors, etc.; so some entrepreneurial positioning strategies need to be followed and developed by HEI in order to get more entrepreneurial.

2 Methodology and Data

This descriptive research is built upon:

- a series of reports and studies on entrepreneurship education, which treat widely on European experiences;
- As well as on some very important data from Ministry of Education and Science, Institute of Statistics of Albania (INSTAT).

Official statistics of admissions to public and private universities show that within a span of less than 10 years, the number of admissions to Bachelor programs has almost doubled, from 16588 students in the 2004-2005 academic years to 34874 in the academic year 2011-2012. And in total, from 63257 students in the 2004-2005 academic year, to 174421 in the 2012-2013 academic year (Report on Higher Education Reform and Research, p. 38).

Other data on the structure of the workforce; internal migration of the population from rural to interurban areas (according to INSTAT 2011, 53.7% of the population lives in the city and 46.3% in the village); prioritizing employment in the private sector (non-agricultural and livestock) as well as the business structure in Albania, where 99.8% of businesses created are SMEs and 96% of all businesses are microbusinesses (INSTAT, 2010), thus being 1 -4 persons, prove that personal enterprises constitute the largest source of employment in the country.

3 The emergence of entrepreneurship education in higher education as a research field

The main strategic references of the European Union suggest and direct towards the structuring of initiatives capable of stimulating the entrepreneurial spirit through education, learning and the development of synergies between education-training and the world of work.

Education is one of the most powerful things a country can have, as education is the strongest weapon of any individual. Also the education of a people also affects the social welfare of the country. Education is the link of a long chain that has to do with technology, economic growth, employment, etc.

Research in entrepreneurial education is a young field that is still in need of legitimation in terms of theoretical, conceptual and methodological foundations (Fayolle et al., 2018)

Despite the importance of higher education in Albanian economy, *it has received little attention in focusing the EE, which will end in creating entrepreneurial mind-set of universities*.

The predominant focus has been on the career choice to become an entrepreneur, and almost all the efforts of universities has been concentrating on how to orient student to become entrepreneur through start up, new venture or different entrepreneurial portal. But orienting, working and focusing on student skills in efforts to create an entrepreneurial behaviour within them is quite on important stage/part of EE within higher education.

Entrepreneurial education in not only about "creating and producing" entrepreneurs and universities must be concentrate for sure not only on this if they seriously want to adapt an entrepreneurial education approach. Entrepreneurship education is widely promoted by European Union and is considered one of the eight key components for lifelong learning (EC, 2006). From an EU perspective, EE should be both increasing entrepreneurship through the creation of new ventures, as well as about educating change agents who will create value in society in settings beyond entrepreneurship, through application of entrepreneurial competences (Longva, 2019).

The emergence and evolution of entrepreneurial education must be analysed and a research field, and with the rise of entrepreneurship as a research field, research on entrepreneurial education has emerged as a sub-field of entrepreneurship that aims to describe and understand the development that is taking place. In fact, entrepreneurial education is now a frequent feature worldwide and at all educational level.

4 Toward some entrepreneurial mind-set of universities

Nowadays the concept of being or going towards being entrepreneurial is becoming a must, especially for public sector and sector of services. In east European public

universities it is noted a huge sense of traditional policymaking while a lot of potential for an entrepreneurial approach is needed.

From the other side, the market to which is serve and furnishing public universities are requesting more and more entrepreneurial skills, capabilities and knowledge, and concept of entrepreneurship in all disciplines. Also, an entrepreneurial education (EE) sense needs to be faced even in everyday lives of public universities like:

- Creating an *entrepreneurial positioning strategy* which through competences and profits for all stakeholders will deliver e *better unique proposed value* than others. The proposal of a unique value constitutes the public communication of the promise of a basic and essential value that consumers will receive from the HEI's entrepreneurial education and that they will not receive from others HEIs. All this, i.e. the construction of a unique value proposition is based on the distinctive competencies of a university in the path of EE creating so sustainable competitive advantages. Further, on such a basis an effective marketing plan should be further built.
- Basing not in only one marketing plan (or even one strategy of institution/university), but *more than one plan is needed*. Entrepreneurial universities needs multiply plans to go ahead to entrepreneurial thinking and leading: a plan for all stakeholders (business, community, etc.), a plan for human resource (administrative and academic staff), for investitures, etc.
- *Co-creating value* instead trying to create one value for market. This mean that value that is perceived and delivered must be create by together with students, business community, and all other stakeholders.
- *Bottom up model*, which means that instead of trying to begin research from up to down, universities must attract all stakeholders and other units that are directly involved in this entrepreneurial mindset to co create value that start from needs of market, businesses, institutions to up towards creating value in the home of entrepreneurship: university;
- Instead on basing in the model with 3 main topics that triplex model propose other elements to be added that sustain or add sustainable value to any sized company must be aid: branding and capital share, or even more elements that flow from an entrepreneurial mindset.

5 Public university against private university as education service providers

Universities are public and/or private service providers whose marketing mostly is more difficult to be done. This means that public universities as providers of public teaching services find it much more difficult to market their services in the target market than private universities. This is due to the fact that:

1. The concept of service itself is difficult to marketing in relation to a physical product. So a company that offers tangible products has it easier to do marketing compared to companies that offer services. Hospitals, culture and education providers, due to service concept of their product has to use tangible element as infrastructure or persons/professors/doctors, etc. in their marketing campaigns to market their institutions, to promote their products, etc., to their target market.
2. Public universities suffer from luxury infrastructures or modern capabilities. For this reason, public universities therefore have more difficulty because they have little or no tangible elements that they can use to market their service. While private universities use good and quality infrastructure, giant campuses and tangible infrastructure investments to market the name of their private university.
3. Private universities invest a lot in digitalization of their services, in creating and communicating with alumni and other stakeholders. Private universities are more concentrate in creating extra value through other services than public universities.
4. Public universities since mostly are longer in market, has more problem with burocracy, transaction, applying in projects, are more oriented in teaching that in researching. But what is evident is related that due to their lifelong education services in market, public universities are more qualitative in regard to: quality service offered and quality of students.

What is missing in Albanian public university is related with:

- a study of university curricula, not just of economics, because business schools are not the only place to learn entrepreneurship; business ideas and innovation most likely come from technical, scientific and creative studies;
- A study to determine how much the Bachelor-Master study cycle creates the premises for developing an entrepreneurial mindset and self-confidence among students that self-employment is a way to enter the job market.
- Alumni database for public universities as a strategic tool for creating networks, links, value and further steps;
- A close related link between at least triplex model which connect university, students and business, in order to give milestones on what is the value that university is creating for the business through knowledge of students.
- Study initiated from universities which gives a panorama on:
- Are universities creating knowledge, skills and capabilities for those gaps that business needs and faces?
- Creating, launching and developing of curricula is a process bottom up, co creating value and strategic oriented?

All those analyses has create in a massivitation of students that get a diploma in a university and extended of variety of diploma, without knowing if really is relate to the market needs. No matter the problems that arise from this increase in the number of students, no vision and market study, no exclusion of all the issues of the quality of diplomas and teaching, this massivization has brought about studying at university, it is a right for anyone now in Albania, but getting a degree is no longer a privilege to be converted into a job.

6 Situation in Albanian universities: The Challenges of adaptation in Albanian Universities

Albania has taken steps towards education over the years, but of course there are still gaps and it should improve the quality of education. Education is not going to solve every problem that our country has, but it is an investment for every individual to make sure steps towards a better future and social welfare.

If you educate an individual, you have educated a whole nation. At the moment we are talking about an individual its key point is education. Education leads to the growth of an individual's knowledge, both socially, culturally, and in the labor market. In all countries of the world education has its downsides, and of course Albania is no exception. Of course, the universities in Albania to meet European standards need a lot of work and investment.

In Albania, we have noticed that in recent decades, education has expanded, noting the connection with citizenship, economic development, equality, culture and so on. Of course, educational institutions and pedagogues have a key role in promoting social progress, who must work every day to move education up and down. Education has four goals, which are: humanitarian, civic, economic promotion and justice.

If a university is or not going towards entrepreneurial path, this is oriented by multi-disciplinary areas, which means that if a university is not entrepreneurial this means that there are a lack of finical funds in research, curricula's are not oriented towards market and business need, there is not value creation and other strategies that lead towards innovation and creativity, etc.

Albanian universities are also a victim of low government funds. While a few private universities, especially located in Tirana, have the financial means to initiate extra curricula activities in areas such as entrepreneurship, public universities, in particular those located in other cities of Albania, are faced with decreasing student's numbers, resulting in lower budgets provided by the government. Additionally, even though the government aspires to a triple helix model of innovation, little can be seen of these aspirations at a university-level. Research is stalled by lacking funds and the need for additional income generating activities by academic staff, leaving little time and scope for research. Adding to this challenge, PhD programmes in universities located in the regions are scare. Innovation and entrepreneurship are thus not on the agenda of many

universities. However, while entrepreneurship promotion is gaining traction in universities in Tirana, to most public universities in other cities than Tirana, it remains an unknown concept. The few structures supporting entrepreneurship that are currently being implemented in public universities outside of Tirana are mostly part of European funded programmes. (Entrepreneurial & Innovation Ecosystem in Albania, Author: Kate Hach & Eileen Trenkmann, NOVEMBER 2019). There is a need to promote entrepreneurial education in the Albanian higher education, as a very important way to promote creativity, innovation and self-employment; the need for universities to gradually transform into entrepreneurial universities, as there is a need to stimulate entrepreneurial mentality among young people, encourage start-ups of innovative businesses and foster a culture that is entrepreneurial friendly. Other directions that show a low level of entrepreneurial efforts is directly concerned with the link university-industry collaboration are currently very low with both sides not recognizing potential to cooperate. Universities are unable to provide structures and methods for start-ups to develop innovative solutions as they on the one side miss the outreach to the industry that could create demand for start- up products and services, and on the other side miss knowledge on entrepreneurship and commercialization of ideas that aspiring entrepreneurs could learn from. (Entrepreneurial & Innovation Ecosystem in Albania, Author: Kate Hach & Eileen Trenkmann, NOVEMBER 2019).

7 An entrepreneurial university in the theory of entrepreneurial marketing approach

Concept of an entrepreneurial university is related directly with element of marketing and entrepreneurship. The idea of connecting one university as service provider with the concept of marketing and entrepreneurship, is because the effort of trying to include a university in an entrepreneurial education system means first of all to deal with concept that link marketing and entrepreneurship inside this university.

So, looking inside the entrepreneurship theory, while trying to identify those element that make a university going towards the entrepreneurial path, the following element can be identified:

- Proaktivity than reactivity
- Inovation in offering education services but also even other services for other stakeholders than only students;
- Risk taking;
- Opportunity oriented.
- From other side the main elements that one university should take from marketing in order to be toward an entrepreneurial path are as:
- Value proposition. This means that the main value that one diploma (level of study even in bachelor, master or PhD level) should have in market is relate

with fulfillment with the market need for the knowledge that diploma (as a product/service) offer for all stakeholders starting from business, start up, etc.

- Customer intensity. This is related with the main concern that universities as education service provider must furnish market with knowledge for what is really missing in the market, for example knowledge in tourism skills, increasing sustainable education capabilities. The customers that are serving from the universities are not only students, but other different stakeholders that are missing and looking for skills, capacities and capabilities related to the knowledge.
- Resource leveraging.

So, the highlight of an entrepreneurial university in the theory of entrepreneurial marketing means that it is necessary that a university to be oriented towards the entrepreneurial paths, needs to fill out some dimensions/elements of entrepreneurial marketing. An entrepreneurial university does not mean that a university should be always entrepreneurial in all elements, during all its lifetime, but must be oriented to some elements and to convert its effort in other elements in different time. So for a period of time, one university can profit from a financial/ecological/economic crisis and chose/take an opportunity in order to develop new capabilities to further develop new ideas or products due to this opportunity. After some years that university can be oriented to value proposition or being proactive than reactive. This means that the same university which before some years ago profit from a national crisis and took an opportunity, now can be oriented towards a new value proposition. This means that the same university can leverage its resources and offering a new product in market with a customer intensity. For example, one department of University of Tirana, Faculty of Economy, can launch not a simple product/service in the form of a simple diploma for the market, but can try to co create a value proposition form the market needs identified by all stakeholders. Stakeholders can be all business that will profit from this diploma in the future. And, Faculty of Economy in University of Tirana (FEUT), in order to be competitive and entrepreneurial in serving to the business needs lead to a new concept and role that can in fact can held in this process: together with all other business and stakeholders identify their needs and lacks in knowledge, transfer those lack of needs in needs for skills and competencies, translate them in key terms, and include in new curricula. So the launching of new diploma is not a simple and common traditional way of developing a curriculum, but is a way which leads to entrepreneurial path, since is based in:

1. *Co-creation of value*: this means that the perception, needs, lack and missing of skills are identified from all stakeholder and business that their need will be fulfill with the knowledge that this diploma will offer and cover. This values is the knowledge that diploma include and is co-created not only from on actor (FEUT), and not based in a simple market research, but is co create from all the necessary actors that will profit from human resource that will be deliver from FEU with this knowledge.

2. *Community based model:* Considering community all actors involved in the network of knowledge need for a simple curriculum, this is community based model.

8 Conclusions and recommendations:

Research in entrepreneurial education is a young field that is still in need of legitimation in terms of theoretical, conceptual and methodological foundations.

In east European public universities it is noted a huge sense of traditional policymaking while a lot of potential for an entrepreneurial approach is needed

With objective of going toward entrepreneurial education, universities must apply not only administrative tools to adapt their strategies to business (and other stakeholders), but need to have a new challenges approach in entrepreneurial education which is quite different from those that attend traditional or administrative approach.

This means that with the aim of being of an entrepreneurial university, an HEI need to include in its philosophy the following elements/dimensions of entrepreneurial marketing which will allow to path of EE: Innovation, consumer intention, risk taking, opportunity driven, proactivity, value proposition, resource leveraging.

Also, universities should position themselves not only between among competitors but even to other stakeholders as: students, businesses, community, parents, investitors, etc.; so some entrepreneurial positioning strategies need to be followed and developed by HEI in order to get more entrepreneurial.

Towards EE, HEIs must develop models that are based on at least the following:

1. *Co-creation of value*: this means that the perception, needs, lack and missing of skills are identified from all stakeholder and business that their need will be fulfill with the knowledge that this diploma will offer and cover.
2. *Community based model.*

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Rethinking Social Innovation and Entrepreneurship within Urban Communities

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Abstract

Promoting social innovation and fostering social entrepreneurship help drive value creation processes within communities opening up to new opportunities to develop sustainable social and economic growth. Rethinking the role social innovation and entrepreneurship act within social-driven economies and societies helps to understand the drivers of shared and social value production within communities. Cities are moving into the future in order to drive and design a sustainable, inclusive and healthy urban growth over time. Cities are drivers of social growth and can support social entrepreneurship that benefits urban planning and environments. Urban social innovation practices and strategies contribute to driving urban growth and development. Urban communities emerge as contexts where social innovation and entrepreneurship contribute to promoting shared social value creation within cities and urban communities.

Keywords – social entrepreneurship, social innovation, urban communities, social value.

Paper type – Academic Research Paper

1 Introduction

Within contemporary world and open societies and communities, increasingly entrepreneurship and innovation jointly develop to benefit the communities and contribute to generating social, economic and public value within territories and urban spaces (Angelidou and Mora, 2019; Carvahlo, 2017). Within global economies, social innovation and new social value creation are the issues of social entrepreneurship. Thereby, social entrepreneurship normally leads to innovation or pattern-breaking change (Munshi, 2010). The aim of this study is to rethink the role of social innovation and entrepreneurship as drivers of shared and social value within urban communities. Even if studies and research provide evidence about distinction of the concepts, the need to view organizations, institutions and citizens as actors that provide various inputs to value creation within communities is opening up to considering social innovation and entrepreneurship along a *continuum* whereas the organizational framework and infrastructure help bring together social innovation as the issue of organizational forms and structures that rely on social entrepreneurial projects as the strategic choice for driving social shared value creation processes. Cities of tomorrow achieve sustainable

urban development fostering inclusive economy and society, enabling social innovation practices and sustaining and bringing together social entrepreneurship opportunities and urban planning, developing bottom-up collaborative and governance processes, contributing to urban development policies (Korosec and Berman, 2006; Angelidou and Mora, 2019; Garcia, Eizaguirre and Pradel, 2015; Carvahlo, 2017). Cities have to contribute to sustainable urban development (Haughton and Hunter, 2004).

With an increasing attention to social issues of economic activity socially responsible individual behaviours, bottom-up provision of services by group of citizens and social innovation practices emerge (European Commission, 2013). Social economies and enterprises contribute to engendering value in several ways (European Commission, 2016): high quality and inclusive job creation and development; social inclusion and poverty reduction; integration and inclusion of migrants and refugees; reinforcing territorial and community based economy; gender equality and solidarity. Within social and responsible economies and societies the key driver of strategies of companies and organizations relies on the concept of shared value to be defined in terms of policies and operating practices that enhance the competitiveness of a company while simultaneously advancing the economic and social conditions in the communities in which it operates. Social innovation was emerging as a new view to engender public value creation Learning how to create shared value helps legitimize business again driving companies as leaders in bringing business and society together. Shared value is a new way to achieve economic success (Kramer and Porter, 2011). According to Carvalho and Jonker (2015) value propositions relate to economic, social to the impact on the community, environmental to ecological issues and psychological to contribute to a new state of mind. Entrepreneurship, communities, and social transformation are becoming increasingly related because social entrepreneurship leads to social change relying on organizations that generate value for citizens (Daskalaki, Hjorth and Mair, 2015). In following the strategic entrepreneurship construct and view (Ireland, Hitt and Sirmon, 2003) only firms that engage in both opportunity-seeking and advantage-seeking behaviours have a chance to actively contribute to wealth and value creation for their customers and their owners by developing competitive advantage and innovation to benefit society and communities. In particular, social entrepreneurships stresses the discovery of opportunities that contribute to driving social change (Robinson and Woods, 2005).

According to Cunha, Benneworth and Oliveira (2015) social innovation and social entrepreneurship contribute to driving social change and development in the structure of society in order to achieve a progressive purpose and human well-being, increasing the capacities of individuals and groups. Promoting market-oriented social innovation has a crucial role in the development of social entrepreneurship for new business models meeting the needs of people and communities towards societal well-being, by promoting shared and multiple value co-creation processes (Carvahlo, 2017). According to Cunha, Benneworth and Oliveira (2015) a social entrepreneur creates something new taking existing ways of doing things and creatively transforming them into an effective way of

meeting needs, social innovation focuses on the process of change identifying a potential reality and bringing together the resource to make that happen. In particular, Cunha, Benneworth and Oliveira (2015) have defined social value like the value that accrue to society from social entrepreneurship/social innovation initiatives and that allow to solve social problems and create social capital. The concept of social refers to the development of new way of thinking about or doing something that reflects in a social change.

Social innovation and social entrepreneurship contribute to developing innovation as a source to meet and solve social needs and problems (Farinha, Sebastião, Sampaio and Lopes, 2020). In this scenario, social innovation is strongly related within any social entrepreneurship venture opportunity and to the concept of entrepreneurship too. Howaldt, Domanski and Schwarz (2015) have elucidated that «social entrepreneurs can be understood as actors which invent, develop and achieve a new frame of reference of entrepreneurial action and thereby a new social practice in the society» (p. 96).

With regards to entrepreneurial failure, it is emerging the potential of successful social entrepreneurships to contribute to value creation within society (Dacin, Dacin and Matear, 2010). A social entrepreneur plays a proactive role for change and behaves as an agent of change by adopting a mission to create and sustain social value, recognizing opportunities of social value creation, and engaging in a continuous process innovation-oriented promoting accountability without being limited by available sources (Dees, 1998). Howaldt, Domanski and Schwartz (2015) have stated that «social entrepreneurs are agents of social innovation by acting entrepreneurially in a new frame of reference and thereby inventing, developing and achieving a new social practice in the society» (p. 95). In particular, «social entrepreneurship represents a specific form of social innovation, which has manifold interactions with other forms of social innovations» (Howaldt, Domanski and Schwartz 2015, p. 96). In particular, entrepreneurial principles serve to promote social innovation (Howaldt, Domanski and Schwartz, 2015).

The paper is structured as follows, After the introduction, a literature review on social innovation and entrepreneurship is presented. In the third section, cities aiming to become sustainable urban communities are spaces where social innovation and entrepreneurship drive social value creation. Finally, conclusions are outlined.

2 Methodological section

The study is theoretical and relies on understanding the relationship between social innovation and social entrepreneurship considering the urban context where cities aim to design sustainable future for their tomorrow in terms of social and economic growth of urban communities over time. The selected contributions refer to the relationship between social innovation and entrepreneurship as sources and issues that contribute to advancing cities towards sustainable urban development. The selected contributions are interpreted in a narrative synthesis to elucidate new perspectives and advance theoretical frameworks on emerging issues (Denyer and Tranfield, 2006; Dixon-Woods, Agarwall, Young, Jones and Sutton, 2004).

3 Social entrepreneurship as a source for social value creation

Entrepreneurship is a promising and relevant field of study because of both lacking a conceptual framework and relying on different social science disciplines (Shane and Venkataraman, 2000). According to Schumpeter (1964) entrepreneurs are agents of change and innovators that contribute to identifying new ways of doing things moving the economy forward. It is important to define what is social entrepreneurship and elucidate who are social entrepreneurs. «Social entrepreneurs can be understood as actors which invent, develop and achieve a new frame of reference of entrepreneurial action and thereby a new social practice in the society» (Howaldt, Domanski and Schwarz, 2015, p. 96). According to Martin and Osberg (2007) the successful social entrepreneur takes direct action and generates a new and sustained equilibrium. In particular, «the social entrepreneur should be understood as someone who targets an unfortunate but stable equilibrium that causes the neglect, marginalization, or suffering of a segment of humanity; who brings to bear on this situation his or her inspiration, direct action, creativity, courage, and fortitude; and who aims for and ultimately affects the establishment of a new stable equilibrium that secures permanent benefit for the targeted group and society at large» (Martin and Osberg, 2007, p. 39).

As elucidated by Marti and Mair (2006) the concept of social entrepreneurship is still poorly defined also in terms of its boundaries. Thereby, the wide goal of social entrepreneurship as action for change within society is to promote social changes to advance progress in the society. Studying the conceptual development of social entrepreneurship helps us understand how organizations both create social value and develop competitive advantages (Short, Moss and Lumpkin, 2009). As stated by Dees (1998) social entrepreneurship contributes to driving social change to advance the progress of societies. The author has proposed a working definition of social entrepreneurship as a process involving the innovative use and combination of resources to pursue opportunities to catalyse social change and/or address social needs. So, social entrepreneurship refers to a process oriented to create social value or meet social needs and to support the creation of a new organization in order to serve as entrepreneurial venture innovation. In particular, opportunities at the heart of entrepreneurial can develop in social entrepreneurship (Corner and Ho, 2010). Perrini and Vurro have defined social entrepreneurship «as a dynamic process created and managed by an individual or team (the innovative social entrepreneur), which strives to exploit social innovation with an entrepreneurial mindset and a strong need for achievement in order to create new social value in the market and community at large» (p. 78).

According to Sullivan Mort, Weerawardena and Carnegie (2003) social value creation is the goal of social enterprises, and «the social entrepreneur then is one who is *socially entrepreneurially* virtuous, and whose mission is to create social value for the social organisation with which they are associated» (p. 83). Weerawardena and Sullivan Mort elucidate that «social entrepreneurial organizations need to adopt a culture aimed at innovativeness, proactiveness and risk management» (p. 33).

Social entrepreneurship, a sub-discipline within the field of entrepreneurship, differs from the traditional conceptualization of entrepreneurship in terms of its ability to combine business and volunteer sectors' elements (Certo and Miller, 2008). Social entrepreneurs are agents of social innovation by acting entrepreneurially in a new frame of reference and thereby inventing, developing and achieving a new social practice in the society. According to Carvalho (2017) social entrepreneurship supports social innovation as social issue that occurs when a social entrepreneurial action has success in the market and contributes to driving social and economic, ecological and psychological sustainability.

Social entrepreneurs play a vital role by generating new and disruptive models of organizing human activity focusing on creating social value (Auerswald, 2009). Entrepreneurial activity in markets and the reinvestment of residuals enable the possibility for engendering economic growth and social progress. Entrepreneurs act to create social value by engaging in activities socially impactful beyond what they are doing by breeding positive externalities (Auerswald, 2009). According to Dees (1998) «social entrepreneurs are one species in the genus entrepreneur. They are entrepreneurs with a social mission» (p. 2). According to Korosec and Berman (2006) *social entrepreneurs* are defined as individuals or private organizations that take the initiative to identify and address important social problems in their communities.

Despite of many definitions about the concept of social entrepreneurship, it interesting refer social entrepreneurship as a means for driving social change. In this vein, Roberts and Wood (2005) defined social entrepreneurship as the construction, evaluation and pursuit of opportunities for social change that are part of a construction process that involves the working and reworking of ideas and possibilities. Social entrepreneurs as special breed of leaders are moving the society forward and drive social improvement of communities (Dees, 1998). Entrepreneurship is a creative process that pursues an opportunity to produce something new. Austin, Stevenson and Wei-Skillern (2006) identify innovation and social value creation occurring all the sectors and interaction as distinctive features in the concept of social entrepreneurship. According to European Commission (2011) «a social enterprise is an operator in the social economy whose main objective is to have a social impact rather than make a profit for their owners or shareholders. It operates by providing goods and services for the market in an entrepreneurial and innovative fashion and uses its profits primarily to achieve social objectives» (p. 2). According to Austin (2006) social entrepreneurship stresses the concept of innovation because entrepreneurship is a creative process that opens up to an opportunity for something new, and enables social value creation transcending sectors and organizational forms occurring across collaborative interactions among sectors. Social entrepreneurship leads to social change and drives sources and forces towards sustainable development (Bansal, Garg and Sharma, 2019).

4 Understanding the meaning of social innovation

According to Edwards-Shachter and Wallace (2017) innovation is a learning-based process that refers to social change and sustainable. According to Nicholls (2010) a social innovation view considers social entrepreneurship as a process of change in the delivery of public goods and social and environmental services. Social innovation is a source for enabling shared public value creation (Moore, 2003). Thereby, social innovation stresses the need of governance change and bottom-up participation, protection of the rights of citizens and collective decision-making systems (Moulaert, MacCallum, Mehmood and Hamdouch, 2013). Phills, Deiglmeier and Miller (2008) have defined social innovation as «a novel solution to a social problem that is more effective, efficient, sustainable, or just than existing solutions and for which the value created accrues primarily to society as a whole rather than private individuals» (p. 36). According to Cajaiba-Santana (2014) social innovation is emerging as a driver of effective social change. «Social innovation takes form when a new idea establishes a different way of thinking and acting that changes existing paradigms» (p. 44). Thereby, «social innovations are new social practices created from collective, intentional, and goal-oriented actions aimed at prompting social change through the reconfiguration of how social goals are accomplished» (Cajaiba-Santana, 2014, p. 44). According to Cunha, Benneworth and Oliveira (2015) social innovation changes social systems and refers to novel solutions that contribute to creating social value and promoting community development by fostering collaborative process and action by involving social institutions and citizens. According to Mulgan (2006) «social innovation refers to innovative activities and services that are motivated by the goal of meeting a social need and that are predominantly diffused through organizations whose primary purposes are social» (p. 146). Social innovation is considered as the issue of social entrepreneurship intervention and choices. As stated by European Commission (2011) «social enterprises contribute to smart growth by responding with social innovation to needs that have not yet been met; they create sustainable growth by taking into account their environmental impact and by their long-term vision; they are at the heart of inclusive growth due to their emphasis on people and social cohesion» (p. 3). In particular, «the social or societal objective of the common good is the reason for the commercial activity, often in the form of a high level of social innovation» (European Commission, p. 2). However, despite this growing awareness of the significance of social innovation, a sustained and systematic analysis of social innovation, its theories, characteristics and impacts is still lacking. The innovation occurs at the level of social practice. An innovation is therefore social to the extent that it, conveyed by the market or non-/without profit community is spread through society or certain societal sub-areas as a result of imitation practices (Howaldt, Kopp and Schwarz, 2015).

5 Fostering social entrepreneurship and promoting social innovation for building a pathway for sustainable and inclusive cities

Cities contribute to shaping urban growth of communities living in urban spaces. As reported by Korosec and Berman (2016) «communities benefit from having a cadre of energetic social entrepreneurs who bring solutions to the common problems they face» (p. 457). As engines of economic, social and cultural growth in urban areas, cities aim to become sustainable communities promoting social interaction and innovation by improving the wealth of community and driving people to experiment high quality of life (Bencardino and Greco, 2014). As services providers, and social incubators of change and innovation cities help develop sustainable growth for change. As knowledge-oriented communities, cities tend to achieve social, economic and environmental issues. Today, cities are becoming urban spaces that enable new opportunities for opening up to new entrepreneurial ventures and businesses that contribute to creating social and shared value within urban contexts and places. Cities of tomorrow should be inclusive, liveable and sustainable communities that contribute to wealth and social and public value creation, promoting sustainable urban development (Haughton and Hunter, 2004).

Cities of the future achieve sustainable urban development fostering inclusive economy and society, enabling social innovation practices and sustaining and bringing together social entrepreneurship opportunities and urban planning, developing bottom-up collaborative and governance processes, contributing to urban development policies (Korosec and Berman, 2006; Angelidou and Mora, 2019; Garcia, Eizaguirre and Pradel, 2015; Carvahlo, 2017). Attractive, creative and innovative cities aiming to design the future urban development have to support social innovation projects and issues in order to drive urban communities into tomorrow. Social innovation can act for the enhancement of social cohesion and for new and more sustainable ways of living that benefit citizens and people living in urban communities. Fostering social innovation helps shape sustainable urban governance leading cities to become more inclusive communities by involving civil society in sharing common values of cooperation and social cohesion (Gerometta, Hausserman and Longo, 2005). With regards to smart urban development Bencardino and Greco (2014) have stated that the practices of social innovation offer both an innovative answer to some needs and new ways of decision-making processes and action by enabling networks, coordination and cooperation mechanisms. Social innovation practices and actions in urban communities enable forms of democratic resistance to neo-liberal vision (Moulaert, Martinelli, González and Swyngendouw, 2007). With cities becoming smart and innovative places in order to be social urban communities «the innovation becomes a catalyst for social change, a collaborative process through which citizens participate actively in the development and implementation of projects, programs and services aimed at them». The use of information technology helps cities move to technocratic to social change becoming social cities enabling people to act as co-creators of liveable and lively cities strengthening a civic empowerment. In this sense, smart urban growth leads to social urban innovation that contributes to social value creation processes within urban communities (Bencardino and Greco, 2014).

Innovation is the structured development of new ideas to place them into more effective solutions to facing and solving social needs. Innovation is emerging as social attribute in urban growth questions. Cities become innovative social urban communities. A socially innovative city has to generate ideas in response to changing needs and translate ideas into action and processes for continuous sustainable development of urban communities. Engaging with multiple stakeholders, fostering relationships and networks, and placing people at the centre of social innovation projects helps drive urban and social growth of cities. Bottom up social innovation practices contribute to fostering community development by involving private and public organizations that interact with citizens. Social innovation strategies rely on proactive citizens and civil society organizations that contribute to shaping new forms of urban governance (Garcia, Eizaguirre and Pradel, 2015).

Promoting social innovation and entrepreneurship helps support local and national development policies (Carvalho, 2017). With regards to social innovation within urban communities, it is possible to appreciate the real experience of people participating in developing social systems and institutions as central elements of social innovation (Cajaiba-Santana, 2014). Increasingly, social entrepreneurship is seen as a key driver of urban innovation. In particular, identifying a relationship and coordination between urban planning and social entrepreneurship helps drive and promote increased social value within urban communities (Angelidou and Mora, 2020). Social entrepreneurship helps develop culture of openness and social inclusion within urban communities. Increasingly, it is acknowledged the important role of cities in sustaining and promoting social entrepreneurship initiatives and projects as a source to drive sustainable, inclusive and healthy urban growth. In particular, cities aiming to adopt a smart approach to urban growth invest sources to stimulate and develop social entrepreneurship in urban context. Social ventures contribute to increasing the smartness of cities (Bernardino and Santos, 2018). According to Korosec and Berman (2006) cities that aim to successfully improve their local environments for both citizens and businesses encourage social entrepreneurs to be proactive in urban context and provide support to social entrepreneurship by enhancing levels of social entrepreneurship in their communities. Cities aim to support social entrepreneurship in order to create a sustainable local business ecosystem, enable fair and decent jobs and inclusive labour markets, promote community development and social inclusion, enhance urban innovation and smart solution bottom-up, and to experiment new business models for high social returns, to promote community-drive forms of social care and social investments. As reported by Korosec and Berman (2006) cities working on community engagement and involvement help successful development and implementation of social entrepreneurship ventures because «the development of comprehensive support programs and policies for social entrepreneurship often reflects prior engagement with private individuals and organizations, as local managers may feel comfortable with these individuals and organizations based on their track records and community acceptance» (p. 456).

6 Conclusions

Today, the orientation to providing opportunities for social and economic sustainable value is opening up to strengthening social entrepreneurship in order to create new organizations that contribute to sustaining processes of social innovation as issue and source for driving change towards sustainable development. As proceeding towards a sustainable pathway, cities rely on bringing together social entrepreneurship development and social innovation issues and processes in order to build an urban community that is sustainable, liveable, healthy and inclusive for citizens and people living in the city. Healthy, liveable, inclusive and sustainable cities need to shape the urban environments and spaces as a place that enables opportunities for strengthening social innovation practices by fostering social entrepreneurship opportunities to drive social and urban change within the community.

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Cross Cluster Co-operation – Strategies and Tools for Emerging Industries

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Abstract

More and more innovative technologies and business plans are formed at interfaces of highly divergent disciplines as a result of an increasing demand for specialized solutions combining different sectors and competence fields. This market driven evolution requires new cross-connections between regional industry clusters that had no, or only a few connections before. But especially in Europe the cluster landscapes have grown very path-dependent and cluster managers still follow traditional concepts. The paper introduces strategies and tools that were designed and proofed within the two-year-project "Cross Cluster Cooperation C3-Saxony" (Germany) co-funded by EU (2014-2015) and also in follow-up sessions rethinking regional industry clusters and their management.

The paper describes novel approaches for cross-cluster strategies using three different views on clusters: a) "Cluster Landscape" describing the different clusters in one region, b) "Cluster Network" standing for all organisations in one cluster, and c) "Cluster Management" being responsible for the performance of one cluster.

Up to now, cross-clustering processes are only described from the organisational perspective of companies or research institutions initiating cross-sectoral projects, or from a systemic point of view focusing cluster landscapes. The paper brings the discussion to the core of cluster development – the cluster management – and introduces novel approaches as well as guiding principles to trigger and increase cross-cluster performances.

The described strategies and tools help ministries and cluster managers to classify current cluster performances and deduce measurements to re-orientate in gridlocked economic situations.

Keywords – Cross Cluster, Co-operation, Entrepreneurship, Start-Up, Open Innovation

Paper type – Academic Research Paper

1 Introduction

In the past, big companies with a narrow focus and a high specialization were the dominant sources of innovation. But more and more novel technologies and business models appear at interfaces of highly divergent disciplines. The demand for specialized solutions combining different branches and competence fields is increasing (Wei 2012). It is a market driven evolution that demands new cross-connections between regional industry clusters that had no, or only a few connections before (Fang, Yang & Hsu 2013). It follows the principle of friendly co-opetition that is based on the mutual dependency to dominate or even survive market dynamics (Brandenburger & Nalebuff 1996).

But especially European companies are struggling with this new development. The historical background is that companies and also cluster landscapes have grown very path-dependent in Europe and did not have to leave their ivory tower (Gräning, Roettger & Noennig 2013). Thus, there was no need to deviate from traditional concepts (Porter 1991, 2000). Now alarm signals are on and within, and also between clusters new consortia have to be formed (Schmiedgen & Noennig 2014). But while trying to trigger cross-sectoral innovations in their member companies and with other networks, many cluster managers themselves forget to be part of this change process too and do business as usual (Billington & Davidson 2013; Chesbrough 2011; Langford 2010; Schüßler, Decker & Lerch 2013).

The paper describes new strategies and tools that help to kick-off cross cluster approaches and that were developed and proofed in the two-year-project "Cross Cluster Cooperation C3-Saxony" (Germany) co-funded by EU (2014-2015) (Noennig et al. 2015). Upon this introduction, chapter two explains the novel methods on three different levels and lines out how they were applied in specific workshops. Chapter three shows results and learnings and the paper closes with the conclusion and an outlook.

2 Methods

To understand the field of application of the novel approaches for cross-cluster strategies three different views on clusters have to be clarified: a) "Cluster Landscape" describing the different clusters in one region, b) "Cluster Network" standing for all organisations in one cluster, and c) "Cluster Management" being responsible for the performance of one cluster. Every level plays a crucial role in fulfilling the goal of highly innovative cross-connected industries. In the following novel methods and tools are explained for every level empowering cross cluster co-operation:

- Cluster Landscape: cross-cluster strategies
- Cluster Network: cross-cluster matchmaking
- Cluster Management: cross-cluster service sharing

2.1 Creating cross-cluster strategies

To develop cross-cluster strategies ministerial experts for regional economic development in Saxony (Germany) were invited to discuss a target-actual-comparison of 2000 and 2015 to find out which strategies were successful and which one have to be rethought or replaced by new ones. The workshop started with a retrospective analysis. Ministerial experts had to name the positive and negative status quos in all three levels (cluster landscape, cluster network, and cluster management) in 2000. Then, the ministerial experts lined out the strengths and weaknesses for their industry politics, SME politics, and innovation politics and tried to remember the defined goals in 2000. Based on that, all measures in the time between 2000 and 2015 were collected. The results of the first step provided an insight what were the starting points in the past and how were the goals and measures defined.

In step two, the ministerial experts had to look at the present. So they described what are the current positive and negative aspects in all three cluster- todays. Then they discussed what strengths and weaknesses theirs industry politics, SME politics, and innovation politics have today. By looking back in the year 2000 and also reflecting current pros and cons they defined new goals for a cross-cluster strategy and pointed out measures with high potential to solve nowadays challenges. At the end, these measures were broken down to the level of cluster management. Figure 1 shows the structure that was used twice – a) as a tool to lock back and evaluate the performance of the past and b) to analyse the current situation and find a new strategy.

		STATUS QUO		GOALS
CLUSTER	*Cluster Landscape*	STATUS QUO Cluster Landscape positive +	STATUS QUO Cluster Landscape negative −	Cluster Landscape Goals
	Cluster Network	STATUS QUO Cluster Network positive +	STATUS QUO Cluster Network negative −	Cluster Network Goals
	Cluster Management	STATUS QUO Cluster Management positive +	STATUS QUO Cluster Management negative −	Cluster Management Goals
		STRENGTHS	**WEAKNESSES**	**MEASURES**
POLITICS	*Industry politics*	Industry politics Strengths +	Industry politics Weaknesses −	Industry politics Measures
	SME politics	SME politics Strengths +	SME politics Weaknesses −	SME politics Measures
	Innovation politics	Innovation politics Strengths +	Innovation politics Weaknesses −	Innovation politics Measures

Figure 1. Cross-Cluster Strategies

2.2 Cross-cluster matchmaking

To trigger cross-cluster co-operations all cluster managers of Saxony were invited to a matchmaking event in December 2015. In the first part of the workshop all managers had to name three co-cooperation demands of their clusters. To visualize it they wrote down three competencies that are needed in their clusters. All these competencies were placed on the right side of a poster-wall. On the left side the names of the attending clusters were already placed. Then, all managers had to connect their own clusters (one the left) with clusters that need their competencies (on the right) (see fig. 2). While doing so, mutual co-operation interests for named demands appeared line by line until there was a big network for cluster co-operation.

In the second part of the workshop pairs of cluster representatives with most cross-connections were formed and they started discussing potential co-operation projects more precisely. In detail, they filled out templates where they noted on the one side needs for action and own project ideas, and on the other side offers got more concrete by explaining competencies and experiences as well as existing projects.

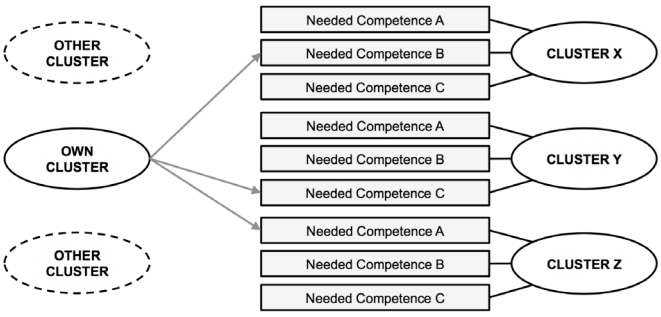

Figure 2. Cross-Cluster Matchmaking

2.3 Cross-cluster service sharing

To develop novel cluster concepts with cross-cluster focus, lean business models for shared services should be considered (Vanderstraeten & Matthyssens 2012). One example is to form a joint Open Cross Cluster Incubator (OCCI) that combines incubation services and providers of different clusters supporting start-ups at their intersections in a virtual network (Schmiedgen 2015). To create an OCCI, in first step all necessary players should be identified. In the following a suitable workshop concept is explained.

Managers of different clusters, incubation service providers, and other stakeholders were invited to a workshop and separated in five groups based on their main incubation competencies: business consulting, providing spaces and infrastructure, offering access to networks, financial support, or product development. In the first step, they had to a) name

services that were already offered by them or also third party providers and b) share opinions of services that could be created especially addressing cross-sections in the future. In step two, they differentiated a) existing roles and their functions and b) roles that could ideally support co-operation projects or early stage start-ups especially in their inter-sectoral needs. In the third step, the target-actual lists of services and roles were combined by designing novel use cases and sketching the processes behind it. The results were presented to all groups so that the other participants had the change to add and also place themselves as experts in these defined fields of service offers or roles. Figure 3 gives an overview showing the template of the workshop.

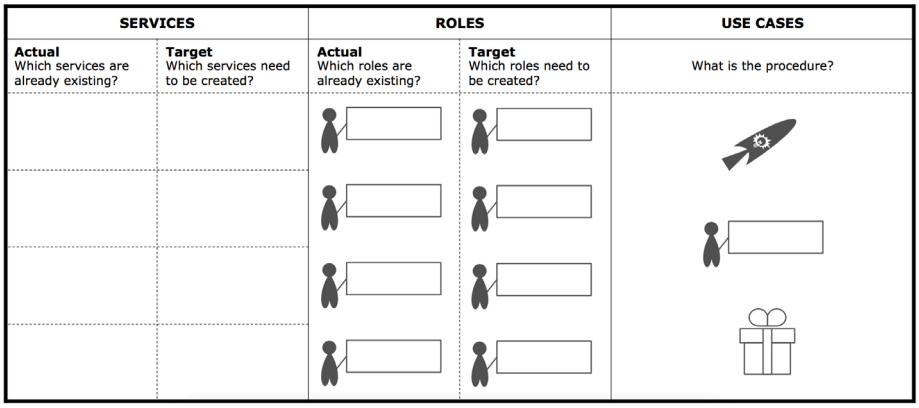

Figure 3. Cross-Cluster Service Sharing

3 Results and discussion

The application of the introduced tools and workshop formats produced a variety of concepts and project ideas and also provided important insights on the status quo of cross-cluster co-operations and how clusters and their managers are facing the challenges in connecting different, specialized branches. The process of connection is still at the beginning but the fundaments were built in the workshops. In the following, the main results of the workshops are presented and discussed.

Creating cross-cluster strategies: A main consent of the ministerial experts were that there should be an instance coaching and controlling cluster managers in building cross-sectoral networks. For that, a new understanding of cluster management has to be established forming modern types of cluster managers. Especially for cross-cluster activities cluster managers have to train additional qualifications far beyond classical skills. In former times, site marketing and networking events within one cluster were the essential tasks. But cluster managers have to move further and should also have the capabilities to build lean clusters that are able to filter and concentrate on effective activities based on market dynamics. By reducing inflationary handshake-smile- and shotgun marketing events, resources are released for more advanced activities. For

example they can run regular cross-sectoral visits in member organisation and circulate concrete co-operation plans. For that, they have to scout permanently rising trends and develop visionary thinking. Furthermore, cluster managers must be able to spot business models with high potential and offer custom-tailored incubator services by arranging packages of contacts and merging cross-sectoral knowhow. These criteria will be translated into future guidelines for cluster managers. The fulfilment of these guidelines will also be a condition for upcoming cluster funding programs.

Cross-cluster matchmaking: A prototypical cross cluster map was a central result of the workshop with all cluster managers (see fig. 4). It helps them to keep the overview of the cluster landscape showing the grad of connectivity between clusters (arrow thickness), the direction of interests (arrowhead), and a set of first project sketches (docs on arrows). The map is still growing by adding new co-operation needs and clusters. And also first projects that were triggered at the workshop and popped up at the connections are now in the planning phase for realization. The quintessence of the workshop was that all clusters decided to start this format for project ideation as a series.

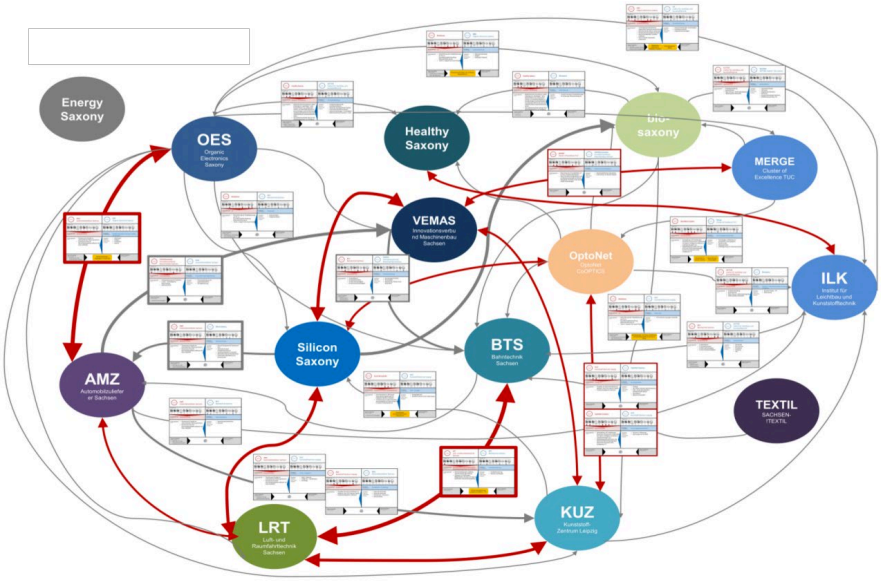

Figure 4. Cross-Cluster Map

Cross-cluster service sharing: This workshop was the kick-off for developing cross-cluster incubator concepts and supported the crucial first step of identifying all necessary service providers in an inter-sectoral ecosystem. In contrast to the long-term benefits of the cross-cluster strategies and cross-cluster matchmaking workshops, the cross-cluster sharing got stuck after some months. The reason was that the cluster managers were not able to activate personal resources building up databases and co-operations with

incubation service providers. Instead of cleaning out timewasting activities releasing manpower or creating sustainable revenue streams around their connector role, the managers asked for (more) public funding.

And here the circle closes. As explained before in the cluster strategies, a new type of cluster manager is needed who is able to support businesses at intersections but also who can create business models for offering incubation consulting and services – in this case an independent OCCI as an virtual NPO. Without these capabilities they will sooner or later lose their expert role and fail to innovate and prepare their cluster members (or potential new ones) for upcoming market trends and dynamics. In the worst case, they are digging their own graves when their performance and (in the end) their work are questioned by their member organisations.

4 Conclusions and outlook

Up to now, cross-clustering processes were only described from the organisational perspective of companies or research institutions initiating cross-sectoral projects, or from a systemic point of view focusing cluster landscapes. The paper brought the discussion to the core of cluster development – the cluster management – and introduces novel first-step-approaches, methods, as well as guiding principles to trigger and increase cross-cluster performances. For that, three workshop formats and tools were introduced on every defined level: Cluster Landscape (cross-cluster strategies), Cluster Network (cross-cluster matchmaking), and Cluster Management (cross-cluster service sharing).

The results have shown that the first two formats were successful and that crossing disciplines is a crucial trend as well as a future success factor. Especially the cross-cluster strategy brought to light that the old-fashioned cluster manager concentrating only on site marketing and undirected events is an obsolescent model. New managers with entrepreneurial spirit, visionary thinking, and effective approaches are needed and their performances should be monitored by a controlling instance. But the road from the strategic view to the operational level is a long one. Most of the cluster managers are not aware of the pressure to radically change their concepts or are not equipped with necessary capabilities. The ability of creating a lean contact point for inter-sectoral incubation services is just one example. The quintessence is that for the future cluster managers have to gain or buy-in more professional skills in business developing, trend scouting, and incubation within cross-sections to keep up with market developments and not to be overrun by them. It is a long way and it is better to start now.

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Virtual Learning Spaces for Business and Entrepreneurial Education: Background, Strengths and Weaknesses, Conditions and Implications

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Abstract

Business and entrepreneurial education encompasses a number of methodologies used to provide students with basic and advanced skills concerning the processes of decision making, management, business start-up, operational procedures and others. According to the challenges and the characteristics of the new economic and social scenarios - also determined by the effects of the COVID-19 - business and entrepreneurial education is asked to be reinvented in a continuous innovation perspective. The centrality of the digital transformation and of the information and technology-driven innovation suggests to identify and analyze new conceivable learning patterns that stimulate mindsets and capabilities of the students. (Vanhuele, 2019). Digital technologies have already changed the learning experiences; communication and access to information are the fields where most of the transformations have occurred. Excellent educational contents are often freely available, information about any different topic are easily accessible and the communication is effortless. The lecturers can experiment innovative forms of pedagogy, deciding to implement and use, in an effective way, digital tools inside the classroom, to support students' learning. (Meriaux, 2019) In order to verify the effects of the 4.0 technologies and exploit their potential for the learning patterns, there is the need to make some strategic decisions capable to align pedagogical objectives with the use of innovative tools. A good management of the educational experience starts

with the understanding of solutions and tools that can give a real value added to a business course, and what are the best ways to implement them. Educators are always more willing to share teaching materials, create online activities or assignments, deliver small online courses, interact with live-polling, telepresence robots, video, podcast and so on. These tools, if used in an effective way, can create engagement and increase students' attention. Concerning the entrepreneurial and business education, beyond the already mentioned technologies, many specific trends are arising that combine new technologies with new ways of teaching and learning. Among the most diffused ones there are: flipped classrooms, immersive and augmented reality, business games and blended labs. (Arvind Mallik, 2018; Finch, 2018). Despite this relevance, there are still limited contributions related to the analysis and the assessment of the effectiveness of the virtual learning spaces for the business and entrepreneurial education. In order to contribute to fill these gaps, this paper aims to analyse the background, the state of art and the level of implementation of the digital contents and technologies in business and entrepreneurial education, trying to identify strategic patterns, potential of the ICTs, enabling and hampering conditions and implications both for theory and management, with a particular focus on the possibilities of adoption by small and medium universities.
The first phase of this research will be carried out by reviewing the existing literature – in terms of contents, experiences, cases, practices - in order to gain a complete picture and the state of art of the virtual learning spaces for the business and entrepreneurial education at a national and international level. On the base of the main insights of the first phase, the second phase will be aimed to identify and delineate a set of implications and suggestions for the successful implementation of the virtual learning spaces for the business and entrepreneurial education in medium and small universities.
The main value of this study is the identification and the critical analysis of contents and practices related to the elaboration and the implementation of the virtual learning spaces as well as of the modalities that detemine a better understanding of the conditions grounding the success or the failure of the business and entrepreneurial education courses and experiences. The results consist in the identification of a set of characteristics and conditions for each of the innovative methodologies, in order to decide to frame and follow the patterns of the technological innovation to enhance the business and entrepreneurial learning experiences.
The analysis and the set of implications deriving from the study could be useful to many actors as, for example, lectures, universities, educational institutions, consultants, companies and public administration offices to inspire and drive them in following projects and initiatives capable to stimulate and support virtuous cycles of learning and innovation.

Keywords – Business and entrepreneurial education; Virtual learning spaces; Digital transformation; Gamification.

Paper type – Academic Research paper

1 Introduction

The introduction of new technologies in the everyday life attracts interest from different research fields as e.g. tourism, healthcare, biology etc. In this picture, the role of the new technologies in the education field is largely debated. Within this debate, many learning theories arose. They highlight new learning methodologies different from the traditional transmission mode as, for example, connectivism, lifelong learning, blended learning and e-learning. (Siemens, 2006; Barnett, 2010). The integration of new technologies in the field of the education emerges as a key theme that radically transforms and innovates the way of teaching and learning (Umachandran and Jurčić, 2018). The

advantages that the technologies can bring in education - if used in an effective way -are many as, for example, optimization of access and utilization of the resources, improvement of the student – centered learning, connection to shrike the distances, real time transfer of knowledge, digital infrastructures that facilitate the learning by doing approach and so on.

Despite the relevance of the research, there are limited contributions related to the effectiveness of the virtual learning spaces, mostly in the field of business and entrepreneurial education. Exploiting the potential of the technological innovation for the learning patterns has a strategic importance and means to make decisions that align pedagogical objectives with the use of innovative tools. A good management of the educational experience starts with the understanding of solutions and tools that can give a real value added to a lesson, and what are the best ways to implement them (Meriaux, 2019) Specific solutions capable to combine new technologies with new ways of teaching and learning can be identified, among the others, in the *flipped classrooms immersive and augmented reality*, *business games* and *blended transversal labs*. (Arvind Mallik D.M., 2018; Finch S., 2018). Creating a set of implications and conditions for the innovative methodologies in business learning is fundamental both for academic and scientific purposes as well as for managerial and policy implications. For this, the study aims to analyse the state of art and the diffusion of the digital technologies in business and entrepreneurial education, trying to identify strategic patterns, potential of the ICT and barriers for their implementation, mostly for business and entrepreneurial education in medium and small universities.

2 Background and Main Insights

In the current digital world it is widely acknowledged the growing importance of the business education. It involves not only cognitive approaches but also emotional processes and, for this, it influences and empowers student's values, attitudes, behavior, knowledge and skills. (Schworm et al, 2015). Business education provides students with basic theories of management and production, decision making, business start-up, use of business tools and operational procedures and it encompasses a number of different methodologies (Oladunjoye, 2016) All the aspects are fundamental for a student's learning experience because aim to enhance important skills and competences as leadership and managerial skills, communication skills, brainstorming, time management, research and analysis, business ethics, writing skills, public speaking, intellectual capabilities, critical thinking, ability to process and filter elaborate information, problem solving and others. (Tarabasz et al., 2018) According to the challenges and the characteristics of the new economic and social scenarios - also determined by the effects of the COVID-19 - business and entrepreneurial education is asked to be reinvented in a continuous innovation perspective, also to fill some gaps concerning required competences for the real world and academic knowledge provided by the universities. (Farashahi and Tajeddin, 2018) The centrality of the digital

transformation and of the information and technology-driven innovation suggests to identify and analyze new conceivable learning patterns that stimulate mindsets and capabilities of the students. (Vanhuele, 2019) Otherwise, younger generations will have a lack of competences and skills concerning this system that could penalize them and their competitiveness in the future (Umachandran and Jurčić, 2018). A disruptive innovation, through digital transformation, could become a key for the success of the educational institutions and foster a competitive advantage. The educational sector has the opportunity to reinvent the learning experiences in a perspective that anticipates the challenges of the business ecosystems. (Tarabasz et al., 2018) The integration of the technologies in a business classroom is a complex process, not a passive approach and the key role for a successful implementation is of the human resources that manage the virtual learning space. Today, educators are always more willing to share teaching materials, create online activities or assignments, deliver small online courses, interact with live-polling, telepresence robots, video, podcast and so on. Digital technologies have already changed the learning experiences; communication and access to information are the fields where most of the transformations have occurred. The educators can experiment innovative forms of pedagogy, deciding to implement and use, in an effective way, digital tools inside the classroom, to support students' learning (Meriaux, 2019). Before the implementation of an innovative tool in a business learning environment, there is the need to design innovative learning experiences aimed to foster a skillset that enable learners to respond to the challenges and develop a successful career in the future. When an educator designs an innovative learning experience, he must take into consideration three fundamental concepts: technology, pedagogy and space. The overall ecosystem surrounding an individual can be considered the learning space, the classroom burdens have to be broken, all the students are connected and can access to the information thanks to the ICT. (Tarabasz et al., 2018) Among all the learning topics, business and entrepreneurial education could obtain real value added from the technologies because of its nature, its structure and the interconnections that already exists between business and technologies. Business leaders have always considered technology as an important means for the success of their business strategies, but recently a new approach to strategy development called technology–driven business arose and underlined the importance of the interrelation between the two realities for growth and innovation perspective. (Berman and Hagan, 2006) First of all, an advanced and dynamic management of the business and entrepreneurial learning experience can provide it with immediate actions and transformations that support learning to become more innovative and technology oriented. The ICT can provide immersive experience that foster a high level of engagement, social connections, personalized learning, student centric learning and new ways of discovery and achievement. In order to provide insights and conditions useful to improve the management of the virtual learning spaces for business and entrepreneurial education, this study focuses on four specific approaches: flipped classrooms, immersive and augmented reality, business games and blended transversal labs.

2.1 Flipped Classrooms

A *flipped classroom* is a paradigm change in education that revolutionized the idea of traditional lecturing. It can be considered as a specific type of blended learning design: the lectures are done, with the support of technological tools, outside the classroom and, inside the learning environment, the students are allowed to spend valuable time immersed in practical activities. (Arvind Mallik, 2018) Learners, outside the classrooms, have their first exposure with the didactics material provided by the educators through video lessons, podcast, images, business scenarios to solve and other interactive contents. They work at home, by deepening the materials provided and answering to the educators' requests. In class, they are involved in teamwork, practical activities, problem solving situations and can revise their materials with the support and the continuous feedbacks of the educators. The personalization is chosen over the traditional lectures and many synergies are created between learners. Considering different studies (Huang and Lin, 2017; Arvind Mallik, 2018; Cohen and Sanders, 2014), business learners involved in flipped classroom activities claimed to be more confident in their ability to learn because this non-standard type of classroom has many strengths. It is considered as way to meet educational needs of each learner because it engages a wide spectrum of them; they have more incentives to be prepared in class, the assessment of their understanding is easier and the in-class activities can be focused on cognitive approaches that involve also value and ethics. Moreover, this approach foster student-centered activities, collaboration, team-working and interactive guidance. The result is an active involvement that promotes engagement, satisfaction, achievement and motivation and make learners able to clarify their thinking and enhance their learning experience. To assess the overall functioning of a flipped classroom it is important to take into consideration also some limitations that characterize the approach. First of all, the educators find themselves to face an increased workload; a more detailed preparation for the lessons require more efforts and activities that are time consuming. On the other hand, the success depends also on all the students' motivations and self-paced learning. Sometimes learners can find difficult to focus on some topics and, for this, not all ideas and contents are collected in depth. Furthermore, the teamwork is inspiring, but there can be some cases in which students are embarrassed to ask for too much help to their peers or cases where some team members work more or less than others. (Huang and Lin, 2017; Arvind Mallik, 2018) The implementation of a flipped classroom can bring a real value added to the business and entrepreneurship education, however it is important to design clear and helpful programming lines, in order to obtain successful results for business students.

2.2 Immersive and augmented reality

It is widely recognized that immersive and augmented reality have the potential to radically transform the educational experiences. They can change the ways to teach, learn and communicate and can be used to foster learners' engagement, creativity, curiosity and

attention by recreating and showing vivid experiences (Finch, 2018) Virtual reality reproduces artificial environment that can represent imaginary or real word that users accept as a real environment. With the augmented reality, the immersion is not complete; it is a virtual interface that enhances the real world by adding information and digital contents (Elmqaddem, 2018) In brief, both tools support the human – machine relationship and create entertainment and stimulating conditions for meaningful learning experiences. In business and entrepreneurial education, particularly, learners can experiment creative ways to access to contents, virtual trips, language immersions and training with simulators to improve communication and management skills (e.g. with practice for public speaking) (Hwan et al, 2017; Stenger, 2017) In comparison with traditional lectures, it has been proved that VR and AR improve the level of attention and involvement through presence, immediacy and immersion (Elmqadden, 2018; Stenger, 2017) They support cognitive development and efforts of the learners, reduce the time for the processing of information and help to enhance cooperation and learning of practical skills to apply in the real business and entrepreneurial scenario. At operative level, educators should be able to implement and integrate VR and AR into learning settings by choosing to emphasize role, location or tasks of the students. (Wu et al., 2013) For instance, engaging learners into roles means to recreate participatory simulations where they become managers, scientists, investigators, doctors a so on. In this way, they learn practical skills in a motivating, engaging and entertaining way. The researches in this field are still in an early stage in the education sector, even though its development is fast. The methodologies show some weaknesses such as the high costs and the complexity for their implementation that challenge the educators. (Kaufmann, 2003; Dunleavy et al., 2009) Professionals with technical capabilities must careful reflect to actually transform the AR and VR potential into educational efficiency. Beyond the technical issues there are also some potential learning issues because learners could be overload by a large amount of information that make them fell confused and overwhelmed. (Wu et al., 2013) In conclusion, AR and VR do not meet all the educational needs but it is an option to consider in a continuous innovation perspective in the field of education.

2.3 Business games

The educational institutions are making efforts to implement unconventional and experiential leaning methods and, among all the recent trends, the *gamification* is one of the most valued, not only in schools and universities but also for employees' training. The gamification can encourage virtuous cycle of learning, through the classical game's leverage. A likable and enjoyable interface, the immediate feedbacks, the humanisation of the human-machine interaction and the trial and error approach stimulate the development of competences as social intelligence, motivation, empathy, agility and collaboration. (Fiertler, 2020) In the context of business and entrepreneurship education, the *business games* are simulations aimed at increasing competences with the learning by doing

approach, useful to stimulate attractiveness and engagement of the students. They are diffused as training tools that, though the simulation, «*reproduce the dynamics and logics of a particular economic scenario*[1]». The students involved can take part, individually or as a team, to different simulations and scenarios with the aim to solve some companies' problems or to support their business development. According to recent studies concerning the assessment of the effectiveness of business games (Fu et al., 2009; Zantow et al., 2005; Urquidi and Tamarit, 2017; Hernández-Lara et al., 2018; Oluchi, 2016) the strengths of this innovative tool are various because they create the ideal conditions to enhance general and managerial skills. The simulations are linked to concrete business actions or support the increase of knowledge in the business and management field and the lecturers become active builders of their knowledge. (Lacruz, 2017; Hernández-Lara et al., 2018). This process widens the learning perspective and provides different benefits directly linked to the game's structural aspects (e.g. professor, team, duration, competition, feedback, debriefing etc.). Generic skills that stem from business games are great autonomy, intrinsic motivation, competitiveness, team working, problem-solving and leadership. However, they are becoming more valuable in the business market because of their ability to foster specific skills, linked to the different academic disciplines. Despite this, they are not always easy to implement, and their success strictly depends on a set of variables, from the effort and the preparation of the educators to the learners' cultural, social and ethical backgrounds. (Hernández-Lara et al., 2018) In order to make a valuable assessment of the business games, more empirical researches are needed and educators should be aware of all the conditions and the possible gaps before to implement them.

2.4 Blended transversal lab

Teaching environments (Lab) are virtual or blended spaces of applied didactics that allow students to apply in practice what they learnt at the university. The blended transversal labs are more general approaches, in respect to ones showed previously and, additionally, they can foresee, during their activities, immersive experiences or business games. Labs are becoming widely diffused tools for teaching and learning in higher education mostly in scientific, technological and engineering fields (Potkonjak et al., 2016; Govaerts et al., 2013; Faulconer and Gruss, 2018). In Business Education, labs can be focused on a specific topic, as, for example, potential of the qualifying technologies of the 4.0 industry, smart manufacturing, business transformation, applications and potentials of the green economy and rearrangement of activities of the health supply chain in an economics – managerial perspective. A blended transversal lab can involve students from different areas of interest and its purpose is to increase the participants' knowledge and to create relationships with the business and entrepreneurial environment. Online Labs, if implemented in an effective way, could foster many advantages and benefits;

1 www.artèmat.it

they are cost efficient and flexible systems where many students can access at the same time and participate to lectures, test their knowledge, gain contents and information, receive immediate and enhanced feedbacks and cooperate with other students and educators. (Potkonjak et al. 2016; Heradio et al., 2016; Faulconer and Gruss, 2018) Like the other approaches, even the blended transversal labs show some weaknesses that could prevent a successful implementation. First, in less interested students, online labs can provoke lack of seriousness, responsibility, and carefulness. Moreover, educators can find some complexities from the use of technological tools and platforms. (Potkonjak et al. 2016; Faulconer, and Gruss, 2018).

3 Conditions, Implications And Conclusions

The literature concerning virtual learning spaces in business and entrepreneurial education is highly fragmented. Generally, every methodology has some peculiarities and factors that determine the success and give a value added to a Business Course. Choosing the best methodology and tool to implement requires an in- depth analysis of the state of art and the conditions that characterize the school, university or other institution where the virtual learning space is applied. Concerning the national and international diffusion of technologies in the educational field, the elements to take into consideration are different. Even though the health crisis provoked by the COVID 19 has given an impulse to the adoption of digital technologies, there are some obvious gaps that mostly the national educational context discloses from the digital maturity point of view. The use of 4.0 technologies, indeed, continues to be fragmented and discontinue or restricted to situations of crises. There is the need to stabilize the increase of the digital maturity level in the Italian educational context, by ensuring a support even in the post emergency period and by rethinking and enhancing the learning ecosystem vision, more oriented to a digital perspective (Giovannella, 2020). The non-homogeneous diffusion of the technologies in education strictly depends on the general degree of use and integration of the digital tools in a state or in a local territory. By considering the DESI index (2020), the AGCOM study (2019 - *Educare in digitale*) or the Eurydice Report (2019) it is possible to notice that the level of adoption and use of digital technologies is different for each country and one of the most influential factor that determine the gaps is the rate of digital literacy and competence. Different territorial backgrounds show totally different rates of adoption and the efficiency, therefore e-learning cannot be the same everywhere. The most important condition for the application of the methodologies analysed previously is a deep analysis of the territorial conditions because the reactions to the virtual learning spaces are different concerning cultural, social and ethnic background. The maturity of the technological offer and of the local context should be at the same level. (Hernández-Lara et al., 2018; Tricarico and Bielli, 2019) The tool chosen should be the easiest to use in respect to the conditions of the territory where it is applied. For example, it is not recommended to implement a VR where the digital maturity is still low because, otherwise, its potential cannot be exploited and it enhances complexity and high

investments, mostly for small and medium universities. (Elmqadden, 2018; Stenger, 2017) In this vein, the educational institutions and the educators have to be technologically prepared in order to inspire the change of the educational system. Small and medium universities should make investments connected to an adequate development of the digital culture and the needed competences before to choose the right methodology. (Tricarico and Bielli, 2019) Another important condition is the development of a plan that starts from the definition of objectives and results to achieve. The plan should follow a step by step implementation that foresees design and contents of the lectures, matched with the tool and methodology that is better suited with the pedagogical objectives and the context. (Arvind Mallik, 2018) At the end, it is needed a case by case assessment of the results obtained and the factors that contributed to the successful or unsuccessful implementation for each reality in order to support a digital innovation process even in those contexts that have lack of digital maturity.

This paper have tried to provide a contribution in this direction, presenting some conditions and implications that small and medium universities must take into consideration if aimed at implementing a virtual learning space for business education. On these basis, the idea is to develop a wider research project with the purpose to increase the knowledge in this area of research. Through the development of business games and blended transversal labs in a small university, the project will aim to enhance the value of a business and entrepreneurial course, by assessing all the features, factors, enabling and hampering conditions of application.

In sum, integrate technologies in a learning space is a long and complex process, not limited to an easier access to contents and information. All the innovative tools have to be used in an effective way, by emphasizing the key role of the human resources involved and by designing a plan that highlights all the steps and the competences required. Another assessment to do before the implementation is the level of digital maturity of the territory taken into consideration, by understanding if the territory is mature enough to embrace a specific technology. Small and medium universities can be inspired by global best practices, e.g. prestigious universities such as Cambridge, Polimi, Harvard and so on that already integrate the most advanced digital technologies in learning settings, but it is important to adapt every methodology to the context and create a connection with the peculiarities of the business and entrepreneurial reality.

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