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Digital Transformation of the Firm's Innovation Process — a Bibliometric Analysis

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Abstract

The innovation process is crucial for an organization to develop innovation, adopt changes and fight competition. Because it is ubiquitous across sectors, still highly dependent on the specifics of the developed innovation, the environment, and the market, its standardization, automation, and further digitalization is considered a serious challenge for innovation and for all organizations. In this study, we conduct a bibliometric analysis to reveal the current understanding and application of digitalization and digital transformation of the firm's innovation process, as well as to outline trends in research, identify knowledge gaps, and call for further research on some still underresearched and extremely impactful topics for the innovation performance. The bibliometric analysis stepped on 518 scientific articles indexed in the Web of Science, meeting our inclusion criteria. Methods such as co-word analysis, conceptual and factorial analysis, thematic mapping, and historical evolution of the interaction between the innovation process and its digitalization over the years reveal insights and contributions to the digital transformation literature in the context of the innovation management theory striving to optimize the innovation performance on a firm level. The results disclose the current evidence of how innovations that occur at an organizational level achieve their digitalization through emerging technologies.

Keywords: digitalization; digital transformation; innovation process; innovation management; bibliometric analysis

JEL: 031, 032, 033

1. Introduction and motivation

The firm's innovation process (FIP) is a crucial business process for many organizations and is known as the most structured means of systematically developing innovations. The importance of this process also comes from the innovation's growing significance for organizations because of the higher probability of increasing profit, competitiveness, and long-term organizational leadership that innovation might bring to firms that innovate (Urbancova, 2013; Zhang, Khan, Lee, & Salik, 2019; Domínguez-Escrig, Mallén-Broch, Lapiedra-Alcamí & Chiva-Gómez, 2019). Digitalization as a managerial approach has often been triggered by one of

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the following reasons: speed up processes and internationalization (Hervé, A., Schmitt & Baldegger, 2020), minimize errors (Bardakçi, 2020), overcome lack of human and material resources (Rosin, Proksch, Stubner & Pinkwart, 2020), and increasing quality (Krishnan, Arumugam & Maddulety, 2020).

Digitalization and digital transformation (DT) on the other hand have also been researched from many perspectives in the context of improving business processes and management (Kraus, Durst, Ferreira, Veiga, Kailer, Weinmann, 2022). Most often, digitalization has been analyzed from the prism of data-driven solutions (Mosch, Winkler, Eggert, Schumann, Obermaier & Ulaga, 2022), data analytics (Gürdür, El-khoury & Törngren, 2019; Hallikas, Immonen & Brax, 2021), implementing emerging technologies (Björkdahl, 2020), big data (Kraus, Durst, Ferreira, Veiga, Kailer, Weinmann, 2022) into the process's steps and decision making, introducing of digital twins automation. (Kurganova, Filin, Cherniaev, Shaklein & Namiot, 2019), etc. However, several recent studies have called for further and more in-depth studies of the firm's horizontal processes (Li, 2020; Rêgo, Javantilal, Ferreira, 2021) and how DT can initiate fundamental paradigm shifts beyond the benefits of the individual company (Kraus, Durst, Ferreira, Veiga, Kailer, Weinmann, 2022). This recently identified knowledge gap in the literature motivates this study by focusing on the firm's innovation process and trying to map and position the innovation process as an intensive objective of DT through diverse technologies and approaches.

In this study, we put under a common denominator all kinds and motivations of digitalization and DT of the innovation process that is found in the scientific literature, and therefore we conceptualize the variations in the occurrence of digitalization in the business process itself. We do this by revealing the current state of the art of digitalization of this fundamental, for the whole business entity performance, and business process and evaluating the accumulated knowledge and experience already analyzed in the scientific literature. We aim at bringing valuable insights to businesses and scholars to support them in the decision to undertake or further consider such an internal-firm revolution towards innovation process digitalization. This research has been motivated mainly by the widely spread discussions in the literature about the importance of FIP for the firm's overall performance (Loewe & Chen, 2007), the proven positive impact of scientific knowledge on both the inputs and outputs of the innovation process (Herrera, Muñoz-Doyague & Nieto, 2010) and the promises of digitalization for rendering and optimizing business processes and performance in the recent years (Nosova & Norkina, 2021).

The one-time adoption of digital technologies has already been proven to be not an impactful factor for a firm's innovation performance (Usai et al., 2021). However, digitalization has repeatedly confirmed its values in business process management (Baiyere, Salmela & Tapanainen, 2020) by combining the strengths of process orientation of firms' management with intelligent ICT solutions (Lederer, Knapp and Schott, 2017). Still, many companies do not have a clear plan of how to approach it (Fischer, Imgrund, Janiesch, Winkelmann, 2020). FIP is amongst the most cardinal business processes in firms, impacting all other internal processes as well as the overall firm's performance and leadership (Mahmood, Uddin & Fan, 2019; Sjödin, Parida, Leksell& Petrovic, 2018).

This is mainly supported by the crucial role of innovation for organizations, which are considered to be among the strongest tools for leadership, competitiveness, and profit (Carmeli, Gelbard & Gefen, 2010; Schoemaker, Heaton & Teece, 2018). From another perspective, digitalization would also provide much more data that could be analyzed and involved in the process of decision-making and innovation sustainability (Chen, Zhang & Wu, 2018). This data could also improve the performance of assessments of innovation, which has been identified in the literature as a knowledge gap by many scholars (Dewangan & Godse, 2014).

The growing number of publications examining digitalization (Hausberg, et al., 2019) reflects the urgency and importance of exploring in more depth the possibilities for digitalization of one of the most critical, for the success of a business organization, processes - the innovation process. As it has been largely discussed in the literature, organizations would innovate more rapidly if they incrementally improve their innovation processes (Benner & Tushman, 2002). This is what we strive to contribute to with this research - to extend the vision for innovation process improvement with the means of digitalization. For doing so, we conduct a bibliometric analysis in order to reveal the current application and manifestation of digitalization and digital transformation in FIP, so to map the literature and then to discuss and disclose some knowledge gaps and future trends already identified by authors in diverse innovation-related and digitalization-related studies. The method of bibliometric analysis is selected since it has been recommended for such goals as this study aims and it is a suitable tool in the field of business research (Donthu et al., 2021). To address more Digital Transformation of the Firm's Innovation Process – a Bibliometric Analysis

precisely the goals of the study, we designed it around these formulated research questions (RQ):

RQ1: What is the current application of digitalization of FIP?

RQ2: Which are the trending sub-topics in the FIP digitalization research agenda?

RQ3: Which ones are the topics and sub-field of research that are still under-researched?

To answer the research questions and to gain a one-stop overview and identification of some knowledge gaps, we investigated 518 articles that met the inclusion criteria for consideration in this study which we extracted from the Web of Science database (based on an extended list of words, referring to the innovation process and also covering technologies used for digitalizing business processes such as artificial intelligence, robotic process automation, big data, business analytics, etc., along with the obviously included words such as digitalization and digital transformation). To the best of our knowledge, the results provide the very first attempt of summarizing and discussing all insights around the digitalization and DT of the firm innovation process and its evolution narrowing the already identified evidence that DT and adoption of new digital processes contribute to firm's greater competitiveness in terms of innovation and performance (Ferreira, Fernandes, Ferreira, 2019). The structure of the research is organized around the research questions first the theoretical basis is clarified in order to shed light on FIP and its digitalization as a means of optimizing business processes and then is focused on the results of the bibliometric analysis and the discussion.

2. Theoretical background

2.1. The firm's innovation process (FIP)

Firm's innovation process (FIP) has attracted the interest of researchers since the 1950s and is still under research from management science as well as from any other field that targets innovation. Therefore, FIP is under the research and analysis of literally every science (Dogan & Pahre, 1990). In general, FIP is a sequence of activities for accomplishing the development and commercialization of innovative outcomes. Its evolution has gone through different concepts and theories starting from more general and industry-based theories to more-internalto firms models, systematized holistically (Rothwell, 1994) into 5 categories: The Technology Push Theory - the 1950s, The Market Pull Theory - 1960s, The Coupling Innovation Process Theory - 1970s-1980s, The Functional Integrated Innovation Process Theory (Imai, 1985) - 1980s, The Systems Integration and Networking Innovation Process Theory - 1990s.

Later on, more variations of FIP have been introduced meeting the specifics of the growing managerial innovation-oriented experimentations such as Open Innovation (Chesbrough, 2003), User Innovation (von Hippel, 1976), Lean Startup framework (Ries, E. 2011), chain-linked models (Kline & Rosenberg, 1986), the Information assurance of innovation process (Rothwell, 1994), Innovation process based on continuous improvement (Tidd, Bessant & Pavitt, 2007), etc. Opening the innovation process not only towards different stakeholders but also to different concepts (Gassmann and Oliver. including emerging technologies 2006) such as artificial intelligence (Ohlberg & Salmeron, 2020), technology acceptance models or BD (Brous, Janssen, and Herder, 2020) have clearly defined benefits in several case studies within the scientific literature. Nowadays, FIP has not been researched enough yet and modern techniques and design tools for creating innovation processes are not frequently applied (Lendel, Hittmár, Siantová, 2015).

Often, FIP is seen as a complex coordination of activities, organization of resources, pursuing of goals, and striving for leadership and competitiveness (Teece, 1992). It can also be considered as an organized and controlled sequence of activities in which inputs in the form of innovation ideas or problem statements are transformed into outputs in the form of innovations (Lendel, Hittmár & Siantová, 2015). From a strategic and managerial perspective, the innovation process is among the essential businesses processes in organizations which directly influence a firm's profits (Galanakis, 2006). A common definition of the firm's innovation process is missing in the literature, as it is quite complex, as well as specific to the firm's sector and the approach of application (Becheikh, Landry & Amara, 2006). Assuming this lack of common understanding of the innovation process, its digitalization becomes an even bigger challenge. Amongst the most important features of FIP the need of gathering information from and transmitting information to several internal and external information areas within and outside of the organization (Tushman, 1977) is identified. Another challenge is this process' dependency on data. Therefore, digitalization provides promising automation and tools to satisfy the needs of FIP (Chirumalla, 2021).

2.2. Digitalization and DT of business processes and innovation process

Digital technologies have become an increasingly important part of the firm's functional areas and in most cases – a tool for an organizational transformation and therefore. a primary project objective (Usai et al., 2021). The extensive use of digital technologies in the sense of firms' management has brought to the conceptualization and definition of digital transformation, explained in the literature as "a process that aims to improve an entity by triggering significant changes to its properties through combinations of information, computing, communication, and connectivity technologies" (Vial. 2019). Digital transformation has been categorized as "a top management priority and a defining trait of corporate business strategy" (Saarikko, Westergren & Blomguist, 2020). In fact, firms apply digital technologies not only to transform but also as instrumentation to survive (Climent & Haftor, 2021). A review of empirical studies shows that a firm's use of digital technology can enable the activation of all ingredients of business models: novelty, efficiency, complementarity, or lock-in, and thus support and boost a firm's performance (Climent & Haftor, 2021). Besides business processes, digitalization relates also to the relationship between the firm and the client, particularly to predict consumer behavior (Fernández-Rovira, Valdés, Molleví & Nicolas-Sans, 2021). All these give the motivation of many practitioners and scholars to discuss the digitalization of innovation processes in order to boost the firms' innovation performance.

The wide use of digital technologies allows extensive collaboration between the participants in FIP, provides a tool for managing team efforts, assists competitive advantages, optimizes the use and organization of Digital Transformation of the Firm's Innovation Process – a Bibliometric Analysis

resources, and also enhances coordination and communication (Bykovskaya, Kharchilava & Kafiyatullina, 2018). In most organizations, the digitalization of the innovation process is still in its beginning - at the first stage of innovation and covers only idea management. Being able to accumulate and put into action external ideas would boost innovation processes and digitalization (Apostolov & Coco, 2021). There are new projects aiming at introducing digital platforms to structure FIP, for the purpose of making it more predictable and quantifiable (Zaverzhenets & Łobacz, 2021). The study of Zaverzhenets & Łobacz (2021) provides insights into the usability of existing innovative digital tools for small and medium enterprises and their supporting potential for FIP in such organizations.

Going through the scientific literature, there is a growing number of publications analyzing different aspects of digitalization of innovation, in some cases specific digital tools or digital innovations (Bygstad & Øvrelid, 2021), in others - emerging technologies (Kong, Li, Peng & Wong, 2021) and their possible or already proven impact on business innovation. However, the overall picture of the potential and the current state of this digitalization at the level of the innovation process is still missing. This is the central focus and goal of this study - to pay attention to this overall picture and specifically around that purpose, the research methodology has been developed accordingly.

3. Research methods

The research design is organized following the main principles of bibliometric analysis as this method can extract relevant information from a large number of publications and to elicit the required information for answering the research questions in this study.

3.1. Data extraction and scope definition

The scope of this study was set by a Boolean search in the Web of Science (WoS) database for extracting high-quality publications on the matters of digitalization and the innovation process at the same time. As part of digitalization and digital transformation some widespread technologies and methods used for digitalization (artificial intelligence, automation, big data, data analytics, robotics, emerging technology, Augmented Reality, Internet of Things (IoT), Cloud Technology, Digital Twin, API, Machine Learning, Robotic Process Automation (RPA), Additive Manufacturing) were included. The selected dataset allows us to perform coword, conceptual, factorial, and content analyses as well as to map the current status of the analyzed problem. The formula used was the following:

(1) (ALL=(innovation process)) AND ALL=(digitalization or digitalization or digital transformation) AND ALL=(artificial intelligence or automation or big data or data analytics or robotics or emerging technology or Augmented Reality or Internet of Things or Cloud Technology or Digital Twin or API or Machine Learning or RPA or Robotic Process Automation or Additive Manufacturing or IoT) Refined By: Document Types: Articles and English Language

For transparency, this is the link to the dataset used: https://www.webofscience.com/ wos/woscc/summary/3c6fcbd0-e3b1-4660-9594-ade52d93636a-25129d89/relevance/1

We did not apply any other limitation except for refining articles in English, together with book chapter articles, early access articles, proceeding paper articles. The search resulted in 518 publications in English from 2000 until 2022. The extract from WoS took place on the 22nd of February 2022. Table 1 presents the overall information about the dataset in this study.

These are the sources that publish the most on the topic: Sustainability – 19; IEEE Access – 12; Technology and Forecasting Social Change – 12; Energies – 8; Journal of Business Research – 8.

Countries that are most active in researching the digitalization/digital transformation of the innovation process (based on authors' nationality and affiliation) are Germany, Italy, China, Finland, Spain, Australia, and the USA. The next figure reveals the hugely increasing trend of publication in this area (the dataset was downloaded in February 2022), which explains the lower number of publications in the last year but if it is calculated on an annual basis, it would also prove the trend).

Table 1.	Publication	types	in	scope
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MAIN INFORMATION ABOUT DATA		
Timespan	2000:2022	
Sources (Journals, Books, etc.)	346	
Documents	518	
Average years from publication	2.26	
Average citations per document	10.19	
Average citations per year per doc	3.079	

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Articles



Figure 1. Publications trend on digitalization of innovation process

The annual Growth Rate is 21,70%. Less than 10% of these publications were by single authors and all of these 518 studies were authored by 1888 researchers (2,94 authors per document). As pointed out by Kraus, Durst, Ferreira, Veiga, Kailer, Weinmann (2022), collaborative research projects appear promising in the context of DT specifically in business and management research.

3.2. Bibliometric analysis

The bibliometric analysis was introduced as a systematically proven type of research by Pritchard (1969) and is currently considered one of the most effective scientific methods for understanding the research field from a historical, holistic and interdisciplinary perspective (Caviggioli & Ughetto, 2019). The bibliometric analysis facilitates the mapping of current research conducted as well as identifies knowledge gaps, streams of research already done, authors' information, and recognizes further research agenda (Donthu, Kumar & Pattnaik, 2020). This method is widely used in the domain of digitalization and innovation (Zhang et al., 2017). Bibliometric analysis is an effective method to explore the emergence of a research domain (Ellegaard & Wallin, 2015) and has the power to monitor the research status of a particular domain and forecast future research trends (Tseng et al., 2009).

In this study, we applied the following bibliometric analysis to address the core topic of digitalization of the firm's innovation process:

- Co-word analysis (titles, keywords, abstracts)
 - Relevant authors and journals
 - Factorial and conceptual analysis
 - Historical evolution
 - Thematic mapping

For the purpose of conducting the bibliometric analysis, R software was employed and its package Biblioshiny.

4. Results and discussion

Digital transformation is a primary motor for digitalizing business processes, and some



Figure 2. Most cited sources in publications dealing with Digitalization of firm's innovation process

research already partially revealed how this impacted innovation in the direction of integration mechanisms, top management support, centralization and control, goal incompatibility, resistance from core business and resources and capabilities through a case study in a bank (Sund, Bogers & Sahramaa, 2021). In this case, the designed innovation processes to support organizations were related to engaging effectively their employees, ideas, communications channels, and interactions within processes. However, the literature brims over with case studies as well as single-angled research, either on a company, industry, or approach level only. By conducting bibliometric analysis, we target achieving an overall picture of this topic's development so far.

The most cited sources in the area of digitalization of innovation processes are among the primary sources in the field of Technology and Innovation Management. These are presented in Fig. 2.

The country collaboration map, presented in Fig. 3 reveals the interdisciplinarity and collaboration opportunities of the topic, touching diverse sub-fields of management and engineering for which evidence is demonstrated further in the study through coword analysis.

The results from the co-word analysis show that the largest amount of research was done on digitalization (other research allocates on data, manufacturing, management, smart, artificial, industrial, capabilities, chain, IoT, etc.). In the next figure, we present a co-word analysis of titles using unigrams, bigrams, and trigrams to reveal some narrows.

From unigram analysis on titles, we can clearly conclude that DT in industries was at the epicenter of research from the whole scope of digitalization of innovation processes. No matter what the technologies used in the search for setting the dataset were, data appeared in only 4% of the titles and technologies in 2%. Figure 5 presents titles co-word analysis using bigrams and trigrams.



Country Collaboration Map

Latitude

Figure 3. Country collaboration map on digitalization of firm's innovation process

Tree								
digital 179 13%	innovation 56 4%	management 37 3%	business 31 2%	model te 31 2 2% 2		technology framework 28 24 2% 2%		learning 23 2%
	data 55 4%	manufacturing 35 3%	systems 22 2%	development 19 1%	systen 19 1%	n artificial 18 1%	intelligence 18 1%	performance 18 1%
		study 35 3%	technologies 22 2%	perspective 18 1% 1%		e challenge: 16 1%	⁵ industrial 16 1%	capabilities 15 1%
transformation 74 5% industry 72 5%	process 47 3%	digitalization 34 3%	approach 20 1%	design 17 1%	driven 15 1%	implementation 14 1%	research 14 1%	sustainable 14 1%
			role 20 1%	iot adop 17 14 1%	adoptic 14 1%	automation 13 1%	chain 12 1% information 12 1%	impact 12 1% agriculture 11 1%
	based 41 3%	smart 34 3%	1 70			13		
			analysis 19 1%	knowledge 17 1%	14 1%	strategic 13 1%	machine 12 1%	blockchain 11 1%

Figure 4. Co-word analysis on titles (unigram)



Figure 5. Co-word analysis on titles (up - bigrams; down - trigrams)

The results showed again DT as a leading topic. Along with it, more insights appeared such as the use of artificial intelligence, the relevance to business model innovation, datadriven approach, robotic process automation, and other of the keywords used for the search (digital twins, additive manufacturing, etc.). The author keywords associated the most with the publications in the scope revealed some possible opportunities for clustering the research on the matters of digitalization of FIP. Big data seems to be the biggest direction for searching for DT means to digitalize innovation processes so far.

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Figure 6. Most frequent words in author keywords

A deeper analysis of the keywords first shows the mixture of management and technology keywords, crossing multidisciplinary the co-parenting origins of the objective of the study: the digitalization of FIP. The dynamics of word and co-word identify the emerging topics in the field of the analyzed objective (Huang et al., 2021). In the case of the FIP digitalization, the abstract coword analysis gives evidence for some clear patterns towards DT, artificial intelligence, and business model innovation (the same as titles and keywords results showed)



518

Articles

Economic Alternatives, Issue 3, 2024



Figure 7. Most Frequent Words in abstracts

Fig. 7 is presents the same observation with time expression adding value to the trending perspective of the sub-topics. The

evidence confirmed that the trending clusters of research appeared to be contemporary only in the last years (2021 and 2022).



Figure 8. Trend Topics, titles, bigrams word analysis

The thematic map, sorting out four groups using a technique proposed by Cobo et al. (2011a), is a strategic thematic map, plotting the themes into four quadrants (clusters of keywords) including Motor, Transversal, Niche, and Peripheral themes according to their centrality and density rank values along two axes. The Motor Themes are both well-developed and important for the structuring of the analyzed research field (Cobo et al., 2011b). In this case, no such research has been identified meaning that the accumulation of 518 is not enough to formulate a clear and single agenda for structuring the topic. Themes in the upper-left quadrant are Niche Themes and they have well-developed internal ties but unimportant external ties which put them into a position of being only marginally important for the field (Cobo et al., 2011b). They have peripheral characters in the context of FIP digitalization. No such topics have been identified that calls for further research on relating the FIP

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digitalization to other dynamics in the level of intra-firm processes. Themes in the lowerleft quadrant are both weakly developed and marginal. The Emerging Themes (low and left in fig. 9) have low density and low centrality, mainly representing either emerging disappearing themes (Cobo et al., 2011b) and these are some external factors, effects, and acquisition. Themes in the lower-right quadrant are important for the research field but are not developed enough (Cobo et al., 2011b), they are called transversal and general or basic themes. This proper group shows the major answers to the research questions of this study. This thematic map analysis, shown in fig. 9, is based on unigrams based on words in titles to focus on more generic patterns in the current research agenda.

The conceptual structure, using the MCA method, demonstrates intuitive 2D graphics that use plane spacing to reflect similarities between keywords in these 518 studies in the scope of the research. Keywords approaching







Figure 10. Factorial analysis of conceptual structure map-method: MCA of high-frequency words based on author keywords

the center point indicate that they have received attentiveness in recent years (Xie et al., 2020). The results are interpreted based on their positions and their distribution along the dimensions. Cluster 1 (red color) consists of twenty keywords such as efficiency, digital economy, deep learning, and industry 4.0. Cluster 2 (blue color) is the less significant and consists of only five keywords: transformation, robotics, process, automation, and strategic management. These topics are clearly underresearched and call for further investigation.

Applying bigrams co-word analysis on titles employing the MCA method. two clusters appear, but the second is infinitesimal. General phrases turned to be around dynamic capabilities, IoT enables solutions/technologies. robotic processes. process automation, digital technologies, model innovation, business model, service innovation, etc. In the second cluster (the blue one), the topic of the 4th Industrial revolution takes place and its distance from the other themes demonstrates the missing bridge and the existing chasm between technologies that might enable the innovation process and the knowledge framework that motivates this digitalization, i.e. the industrial revolution.

The conceptual structure of the existing research shows the links between the different themes and indicates the scarce under researched topics. Such missing insights are how the innovation process during its governance to be organized and optimized through digitalization and technologies and how that would bring value to the firm.

From the conducted bibliometric analysis and discussion of the results, clear directions of the existing research are identified as well as discussed technologies in the context of



Figure 11. Conceptual structure based on titles (bigrams)

the innovation process. However, no evidence exists that DT of the innovation process could automate, optimize or improve it significantly through combinations of information, computing, communication, and connectivity technologies.

5. Conclusion

In conclusion, this study provides insights for practitioners and scholar interested in the field of DT and digitalization of the innovation process as a specific field of a firm's digitalization and digitalization of the innovation management as a generic approach. Main research streams, authors, sources, and countries performing research are identified. These are Germany, Italy, Finland, and Spain. Most frequent keywords used, out of the centrally scoped digitalization and innovation process are 'business models' and 'competition'. The core topic of this

research is surely a hot one since most of the research citations come from toptier journals in the field of Technology and Innovation Management such as Research Policy, MIS guarterly, Technovation, Journal of product innovation research, etc. An insightful contribution from the conducted bibliometric analysis is the identification of the trending topics in the field of FIP digitalization which are: business models, COVID-19, digital innovations, and DT as well as FIP in the public sector and FIP digitalization impact on the innovative outcomes of enterprises. Another focus of the research addressing the research questions was the revealing of some underresearched topics such as: system innovation and its digitalization, innovation management for digitalization, and digitalization in service innovation. With this study, we call for further research on the themes concerning different knowledge areas of digitalization

of business processes being impacted by emerging technologies such as: big data, the internet of things, business analytics, artificial intelligence, blockchain, etc. The biggest gap found during the research turned out to be the missing common research on technologies that may lead to DT of the innovation process and the framework and processes part of the industrial revolution theory. The relevance and urgency of FIP digitalization further research has been evidenced also by the lowering of the costs of acquiring these technologies (Sterev, Gerardo & Rosillo, 2019), which could be the game changer in transforming firms into innovative performers.

Theoretical implications

The theoretical conclusions from this study lead to the awareness that the innovation process in its entirety and systematicity is a goal of digitalization and DT, but not yet fully digitalized according to the definition adopted by Vial (2019) and adapted for DT purposes of the innovation process: as a process leading to innovation that significantly improves the process itself and its results through combinations of information, computer, communication, and connectivity technologies.

Another theoretical consequence is the lack of a combined approach of two or more emerging technologies applied to the same innovation process and the possible outcome of such. Missing in the literature are comparisons between different industries and innovation strategies and how potentially DT of FIP would impact the innovation performance and therefore, the firm's profit.

Managerial implications

The managerial lessons learned from this study for practitioners are possible attempts to combine different technologies and communication solutions so as to influence the innovation performance. These examples could give managers a common vision of how to organize their initial research and adaptation of emerging technologies and bring them together in order to cover the entire innovation process of the company and to digitize it systematically.

Limitation of the research

This study steps only on the research agenda already examining digitalization and DT of a firm's innovation process as a managerial and holistic attempt including certain technologies potentially supporting these digitalization efforts. There are plenty of studies discussing diverse technologies or tools apart from their relation to optimize or support the innovation process itself and these are not included in the scope of the research as we are focusing only on the digitalization and DT as a generic approach. Secondly, this study limits its research boundaries to the innovation process as an ingredient of innovation management and does not touch upon other innovation management-related ingredients and tools to achieve digitalization and optimization through digital means (for instance such as innovation performance and product development).

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