The role of information technology capabilities and innovativeness in organizational performance:
Evidence from the Public Sector

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Dedication

To Vanderli and Maria Dagmar.

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Resumo

O objetivo geral que balizou esta tese foi o de identificar o papel integrado das capacidades de tecnologia da informação e da capacidade para inovar no desempenho organizacional, no contexto do setor público. Para alcançar esta finalidade, o presente trabalho de investigação foi conduzido em duas grandes etapas, guiadas por questões de pesquisa e objetivos específicos. A primeira etapa buscou realizar extensas revisões da literatura científica sobre os temas capacidades para inovar e capacidades de TI, aplicadas à área de negócios. Para tanto, foram utilizadas variadas ferramentas tecnológicas para esquadrinhar diversas unidades de análise subjacentes a cada área, a fim de identificar as origens, as estruturas conceituais e intelectuais, bem como as principais frentes ativas de pesquisa, com a indicação de oportunidades abertas para evolução do conhecimento. De forma geral, os resultados indicaram que a produção do conhecimento sobre os temas é transversal, se relacionando fortemente com outros tópicos, como gestão estratégica, desempenho organizacional, gestão do conhecimento e orientação para o mercado (capacidade para inovar) e desempenho organizacional, gestão estratégica e valor (capacidades de TI). Ambos os temas são recentes na literatura e o interesse dos pesquisadores está em franco crescimento. Além disso, existem inúmeras oportunidades de pesquisa à disposição de futuros pesquisadores, tanto em relação a cada tema tomado de forma isolada, quanto combinados entre si.

Os conhecimentos reunidos na primeira etapa foram a base para a condução da segunda etapa, cuja abordagem, marcantemente empírica, buscou identificar a natureza das relações existentes entre os fenômenos organizacionais centrais deste estudo (capacidade para inovar e capacidades de TI), associados a outros elementos pouco explorados na literatura, como a capacidade de reconfiguração de TI e o capital humano de TI. Para tanto, foram analisados os dados fornecidos por 258 instituições públicas brasileiras, de diversos segmentos, coletados por meio de *survey* conduzida com os mais altos gestores de tecnologia da informação. As análises foram realizadas por meio da aplicação de modelos de equações estruturais baseados em covariância (CB-SEM). De forma geral, os resultados indicaram que a capacidade de reconfiguração de TI deve ser elencada entre as capacidades de TI das organizações públicas, bem como que a capacidade para inovar e as capacidades de TI exercem um importante papel no desempenho dessas organizações. Os resultados indicaram ainda que o capital humano de TI é um antecedente das capacidades organizacionais de TI. Por fim, os resultados indicaram que as capacidades de TI, por sua vez, exercem efeito positivo

direto sobre o desempenho organizacional, bem como indireto, mediado pela capacidade para inovar.

O estudo contribui com a evolução da literatura das áreas de TI e inovação, na medida em que ajuda a preencher a lacuna da carência de estudos que se utilizem de avançadas técnicas quantitativas, de caráter bibliométrico, para analisar a produção científica de alto impacto disponível. Além disso, o estudo apresenta, de forma detalhada, todos os passos seguidos pelo trabalho, inclusive o uso combinado de ferramentas de análise, a fim de possibilitar a replicação por futuros pesquisadores. O estudo inova e contribui para o avanço da literatura das áreas de TI e inovação ao identificar que as capacidades de TI são importantes antecedentes da capacidade organizacional para inovar, bem como o papel da capacidade de reconfiguração de TI e do capital humano de TI sobre as capacidades organizacionais de TI. Por fim, esta tese revela diversas oportunidades de pesquisa disponíveis e recomendadas por diversas pesquisas de alto impacto recentemente produzidas.

No campo prático, este estudo apresenta aos gestores recomendações sobre como podem criar e desenvolver equipes de TI mais efetivas e com habilidades mais abrangentes. Além disso, o capítulo ressalta a necessidade de que os gestores de TI se dediquem a desenvolver a capacidade das equipes com expertise para reunir, integrar e implementar recursos de TI, com o foco em atender as necessidades dos processos organizacionais. Finalmente, os gestores são apresentados a evidências de que a criação de um ambiente favorável à inovação, e apoiado pela tecnologia da informação, é um importante caminho para atingir melhores resultados organizacionais.

Palavras-chave

Capacidade para inovar; Capacidades de TI; Capital humano; Capacidade de reconfiguração; Bibliometria; Equações estruturais.

Abstract

The general objective that guided this thesis is to identify the integrated role of information technology capabilities and innovativeness in organizational performance in the public sector. We conducted the present research study in two major stages to achieve this purpose, guided by research questions and specific objectives. We extensively reviewed the scientific literature on innovativeness and IT capabilities applied to the business area first. For this purpose, we used several technological tools to scan several units of analysis underlying each area to identify the origins, conceptual and intellectual structures, and the main active research fronts, indicating open opportunities for the evolution of knowledge. In general, the results showed that knowledge production on the themes is transversal, relating strongly to other topics, such as strategic management, organizational performance, knowledge management and market orientation (innovativeness) and organizational performance, strategic management, and value (IT capabilities). Both themes are recent in the literature, and researchers' interest proliferates. In addition, there are numerous research opportunities available to future researchers, both about each theme taken in isolation or combined.

The knowledge gathered in the first stage was the basis for the conduction of the second stage, whose approach, markedly empirical, sought to identify the nature of the relationships between the central organizational phenomena of this study (innovativeness and IT capabilities), associated with other under-explored elements in the literature, such as IT reconfiguration capacity and IT human capital. To this end, we analyzed the data provided by 258 Brazilian public institutions from the most diverse segments, collected through a survey conducted with the highest information technology managers. We performed the analyses by applying structural equation models based on covariance (CB-SEM). Overall, the results indicated that the reconfiguration IT capability must be listed among the IT capabilities of public organizations, and innovativeness and IT capabilities play an essential role in the performance of these organizations. The results also indicated that the IT human capital is an antecedent of the IT organizational capabilities. Finally, the results showed that IT capabilities, in turn, have a direct positive effect on organizational performance and are indirectly mediated by innovativeness.

The study contributes to the evolution of the literature in IT and innovation to the extent that it helps fill the gap in the lack of studies that use advanced quantitative techniques of bibliometric character to analyze the high-impact scientific production available. In addition, the study presents, in detail, all the steps followed by the study, including the combined use of analysis tools, to allow replication by future researchers. The study innovates and contributes to the advancement of the literature in IT and innovation by identifying that IT capabilities are essential antecedents of organizational innovativeness and the role of IT reconfiguration capability and IT human capital on IT organizational capabilities. Finally, this thesis reveals several research opportunities available and recommended by several recently produced high-impact research.

This study presents managers with recommendations on creating and developing more effective IT teams with more comprehensive skills in the practical field. In addition, the chapter highlights the need for IT managers to dedicate themselves to developing the capability of teams with the expertise to gather, integrate and implement IT resources, with a focus on meeting the needs of organizational processes. Finally, managers are presented with evidence that creating an environment favorable to innovation and supported by information technology is crucial for achieving better corporate results.

Keywords

Innovativeness; IT capability; Human capital; Reconfiguration capability; Bibliometrics; Structural equations**.**

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List of Acronyms

A&HCI	Arts and Humanities Citation Index
AVE	Average Variance Extracted
BDA	Big Data Analytics
CB-SEM	Covariance-Based Structural Equation Modeling
CEO	Chief Executive Officer
CFA	Confirmatory Factor Analysis
CFI	Comparative Fix Index
CIO	Chief Information Office
CSC	Cognitive Social Capital
CR	Construct Reliability
D^2	Mahalanobis Squared Distance
DF	Degrees of Freedom
EO	Entrepreneurial Orientation
GFI	The goodness of Fit Index
IT	Information Technology
KS	Knowledge Sharing
Ku	Kurtosis
MI	Modification Indices
MIMIC	Multiple Imputation and Multiple Causes
OI	Open Innovation
PO	Psychological Ownership
RBV	Resource-Based View
R&D	Research and Development
RMSEA	Root Mean Square Residual
SCI	Science Citation Index
SEM	Structural Equation Modeling
Sk	Skewness
SQL	Structured Query Language
SRMR	Standardized Root Mean Square Residual
SSCI	Social Sciences Citation Index
SEW	Socio-Emotional Wealth
TLI	Tucker-Lewis Index
TQM	Total Quality Management
TPB	Theory of Planned Behavior
UBI	University of Beira Interior
WOS	Web of Science
χ^2	Chi-square

Chapter 1

1. Introduction

1.1 Justification

Increasingly, scientific literature in the area of management and organizational practice converge to recognize the growing need for organizations to expand their innovativeness, that is, to develop the propensity to create and support the generation of new products, processes, and services (Garcia and Calantone, 2002; Pesämaa, Shoham, Wincent and Ruvio, 2013). In this line, innovativeness can be understood as the ability of the organization to obtain new knowledge and stimulate the learning and exploration of knowledge from the organization's external environment (Tsai, 2001). Innovativeness also involves an organization's ability to exploit, recombine and redefine its resources and capabilities to achieve an innovative result (Ruvio, Shoham, Vigoda-Gadot and Schwabsky, 2014; Shoham, Vigoda-Gadot, Ruvio and Schwabsky, 2012). In this sense, innovativeness becomes, more and more, an important aspect to be developed in the culture of modern organizations (Story, Boso, and Cadogan, 2015).

The development of the concept of innovativeness in the literature has been carried out in a multidisciplinary way and form deep connections with other themes explored in the management area, such as the example of strategic management, organizational performance, knowledge management, and market orientation (Marchiori, Popadiuk, Mainardes and Rodrigues, 2020). Researchers worldwide have devoted more and more attention to the topic, which has generated significant growth in the global scientific production of knowledge. The literature presents several versions of the concept of innovativeness, applied at various levels and from different units of analysis, such as, for example, the individual (Chan and Parhankangas, 2017), the organizational (Story *et al.*, 2015), groups (Akhavan and Mahdi Hosseini, 2016) and countries (Lema, Quadros and Schimitz, 2015). The extent of scientific interest is reflected in the large volume of information, making it increasingly difficult for researchers interested in this topic to keep themselves up to date and know and monitor all the different research strands. Likewise, the task of those who are dedicated to identifying and understanding the intellectual and conceptual structures of the field is increasingly tricky, essential information for the formation of new researchers in a research area.

In parallel, the literature recognizes that the innovation process in organizations is driven by the availability of a wide variety of resources and the updating of technologies and practices used in business processes (Chen and Tsou, 2012; McDermott and O'Connor, 2002). In this sense, an

organization can better innovate if it correctly applies knowledge and information technology (IT) (Chapman, Soosay, and Kandampully, 2003). Research on IT management indicates that the performance of organizations is more positively affected by the increase in their IT capabilities than by direct spending on information technology (Mata, Fuerst, and Barney, 1995; Powell and Dent-Micallef, 1997; Ray, Muhanna and Barney, 2005; Stoel and Muhanna, 2009; Stratopoulos and Dehning, 2000). IT capabilities can be understood as the skills that organizations have to assemble, integrate, and implement IT resources to meet the needs of their business processes (Liu, Huang, Wei, and Huang, 2015). In other words, IT capabilities are a complex set of resources, skills, and knowledge related to IT, exercised through business processes (Stoel and Muhanna, 2009).

However, as well as the literature on the capacity to innovate, the production of knowledge about IT capabilities is increasingly attracting the attention of researchers, which has generated strong growth in world scientific production. However, this scientific interest has developed an increasing volume of information, which has made it more difficult for researchers to maintain adequate update levels and the identification and monitoring of the different research strands. Thus, the process of identifying and understanding the intellectual and conceptual structures of the field is increasingly complex, fundamental knowledge for conducting consistent research projects and identifying the main recent paths for the development of research involving IT capabilities.

The intellectual structure of a scientific domain refers to its research tradition, its disciplinary composition, the main research topics, and the pattern of their interrelationships (Shafique, 2013). The publications that make up the intellectual structure of a field are the foundations on which current research is being carried out, containing fundamental theories, pioneering works, and methodological canons (Zupic and Čater, 2015). In turn, the unit of analysis of the conceptual structure of a field is a concept, not a document, author, or journal. From the content analysis of words that co-occur in documents, it is possible to identify the concepts behind these words, which, in general, are closely related. The result is a semantic map that helps understand the cognitive structure (Börner et al., 2003; Zupic e Čater, 2015).

Research efforts have been conducted with the aim of identifying and systematizing the scientific literature with the most significant impact on the themes of innovativeness and IT capabilities, generally carried out based on traditional methods, such as systematic literature reviews (Garcia and Calantone, 2002, Li and Chan, 2019) or meta-analytical approaches (Rosenbusch et al., 2011; Song et al., 2008). However, even when carried out carefully, traditional reviews can present problems, such as researchers' bias, lack of objectivity, and difficulties in replication (Aria and Cuccurullo, 2017; Tranfield et al., 2003; Zupic and Čater, 2015). To minimize these problems, the management area has received contributions from companies built on a third approach: scientific mapping based on bibliometric methods. This approach can be applied transparently; it is perfectly replicable and suffers from a reduced bias

(Zupic and Čater, 2015). The implementation of advanced bibliometric methodologies, in addition to the recommended practices, is expanding in all fields, especially those with substantial research flows and which are subject to fragmentation and controversy (Aria and Cuccurullo, 2017). However, the literature lacks studies that apply advanced and varied bibliometric analysis, mapping, and visualization of scientific production on the theme of innovativeness and IT capabilities. Therefore, these are the gaps this study seeks to fill.

In parallel, research recognizes the potential to foster the organizational capacity to innovate from the IT capabilities of organizations (Chen and Tsou, 2012; McDermott and O'Connor, 2002). IT capabilities can improve communication, information and knowledge sharing, inter-organizational exchanges, and organizational learning processes, which underpin the innovation processes (Carbonara, 2005; Kmieciak et al., 2012). Along this line, Chen and Tsou (2012) proposed that IT capabilities are critical in the innovation process. Dong and Yang (2019) indicated that IT capability assists organizations in capturing and recombining knowledge to create new knowledge and achieve success in the innovation process. In the context of the public sector, Hartley (2011) suggested that the public sector's innovativeness could be increased with the application of IT, as public sector organizations create new services that they would not be able to offer without the proper use of IT. Also, in this sense, Pang *et al.* (2014) indicated a positive relationship between IT capabilities and resources and the innovativeness of public organizations. However, there is little empirical evidence on the nature of this relationship, especially considering the public sector context (Hartley, 2011; Pang et al., 2014). This is another gap this study aims to fill out.

This thesis further advances on two complementary aspects that are under-explored in the literature on IT capabilities, namely, the role of IT reconfiguration capability and IT human capital on IT organizational capabilities. Regarding the first aspect, previous work has indicated that organizations must have the capacity to improvise and reconfigure their IT resources (Pavlou and Sawy, 2010; Pavlou and Gefen, 2006) from the creation, expansion, and modification of organizational resources (Helfat, Finkelstein, Mitchell, Peteraf, Singh, Teece and Winter, 2007). In this sense, Oliveira et al. (2016) found evidence, within the private sector, that the ability to reconfigure IT is one of the factors of organizational IT capabilities. Pavlou and Sawy (2010) pointed out that improvising and reconfiguring IT resources is fundamental for situations involving new technological applications, with a potential positive result for the organizational innovation process. However, there is a lack of empirical evidence on the presence and nature of this relationship within the public sector.

Regarding the second aspect, the nature of the relationship between IT human capital and IT organizational capabilities, previous studies highlight the importance of IT human resources in the context of organizations' IT capabilities, from aspects such as the technical and managerial skills of the IT team. Often, IT human resources, expressed by their skills and knowledge, are listed as factors in IT organizational capabilities (Bharadwaj, 2000; Chen and Tsou, 2012; Park,

Im and Kim, 2011). However, considering human capital theories and dynamic capabilities, this thesis proposes and tests an alternative way of operationalizing human IT capital and identifying its relationship with the IT capabilities of organizations. More specifically, the study suggests that IT human capital, an organizational resource, should be studied independently of IT capabilities, not as a factor. Thus, it is possible to identify the role of human capital more accurately on the IT capabilities of organizations. Despite the large volume of scientific work linking IT capabilities to IT human resources, the approach proposed in the present work is rare in the literature, representing a gap in scientific knowledge, which the present study aims to help fill.

1.2 Research questions and objectives

The context presented and the research gaps highlighted boosted the present research effort. In this sense, the general objective of this thesis was to identify the role of information technology capabilities and innovativeness in organizational performance in the context of the public sector. The research effort was segmented into research questions and specific goals to achieve this objective. Thus, with the present study, we sought to find answers to the research questions presented in Table 1.1, explored in Chapters 2 to 6 of this thesis, accompanied by the respective specific objectives.

Table 1.1 - Research questions and objectives

Chapters	Research questions	Specific objectives
Chapter 2	What are the conceptual and intellectual structures of research on innovativeness? What are the main research strands and opportunities for the evolution of scientific production?	Identifying, analyzing, and mapping the literature on innovativeness, revealing its conceptual and intellectual structures, as well as reviewing and presenting the state of the art of research on the field, accompanied by indications of opportunities for future studies.
Chapter 3	What are the conceptual and intellectual structures of research on IT capabilities? What are the main research strands and opportunities for the evolution of scientific production?	Identifying, analyzing, and mapping the literature on IT capabilities, revealing their conceptual and intellectual structures, as well as reviewing and presenting the state of the art of research on the field, accompanied by indications of opportunities for future studies.
Chapter 4	What are the relationships between innovativeness, IT capabilities, IT reconfiguration capabilities and organizational performance in the context of the public sector?	Identifying the relationships between innovativeness, IT capabilities, IT reconfiguration capabilities and organizational performance, in the context of the public sector.
Chapter 5	What is the nature of the relationship between IT human capital and IT organizational capabilities?	Propose and test a theoretical model for operationalizing IT human capital, as well as analyzing the role of human capital on the IT capabilities of

		organizations.
Chapter 6	How are IT human capital, IT capabilities and innovativeness related in an integrated way and what are the impacts of these phenomena on organizational performance?	Identifying the relationships between IT human capital, IT capabilities, innovativeness, and organizational performance, from an integrated approach.

1.3 Methodology

Different methodological strategies were adopted for the present thesis, according to the specific research objectives addressed in chapters 2 to 6. We produced Chapters 2 and 3 by applying a quantitative approach to analyzing the scientific production of bibliometric character, focusing on high-impact literature produced on the themes innovativeness and IT capabilities, respectively. The studies followed the five stages established by Zupic and Čater (2015) and were based on different units of analysis and several combined bibliometric methods, chosen according to each aspect under study (Aria and Cuccurullo, 2017; Zupic and Čater, 2015). The first stage was dedicated to planning the research project, involving the definitions of the research questions and the choice of analysis methods. The second stage involved the compilation of bibliometric data, passing through the choice of the database by identifying the search terms and conducting the search using the keywords. The third stage was dedicated to analyzing the data obtained, involving the choice of the applicable bibliometric software, the cleaning of the data, and the execution of the analysis procedures. The fourth stage was dedicated to constructing models for viewing bibliometric maps. The fifth and last stage involved the qualitative analysis of the main results.

Based on the knowledge base generated in Chapters 2 and 3, the elaboration of this thesis advanced and resulted in the production of three studies of a quantitative and empirical character, which are presented in Chapters 4, 5, and 6. For the three studies, the unit of analysis chosen was the public organization. More specifically, data were collected from 278 Brazilian public organizations linked to the three powers constituted in Brazil (Executive, Legislative, and Judiciary) and the three spheres of the Brazilian public sector (Federal, State, and Municipal). The answers were obtained through an electronic form sent to the respective chief information office (CIO) of the organizations, which played the role of key informant, a strategy in line with previous studies (Chen, Wang, Nevo, Benitez-Amado and Kou, 2015; Kim et al., 2011). The approach chosen for data analysis was the modeling of structural equations based on covariance (CB-SEM), with the application of two-stage confirmatory factor analysis (CFA) (Anderson and Gerbing, 1988).

1.4 Contributions of the thesis

Considering the two main approaches that guided the development of this thesis, that is, the bibliometric approach (Chapters 2 and 3) and quantitative data analysis (Chapters 4, 5, and 6), the contributions of the thesis can also be divided into two parts. The information presented in chapters 2 and 3, focusing on the innovativeness and IT capabilities, respectively, contribute to the advancement of scientific production by complementing previous studies that applied more traditional approaches, such as systematic literature reviews or meta-analyses, helping to form a broader and more consistent picture of high-impact scientific production on the issues in question. Methodologically, the study goes beyond traditional literature review by identifying and visualizing each area's intellectual and conceptual structures (Shin and Perdue, 2019). Thus, future researchers have at their disposal several information and insights that can serve as a basis for developing new studies. In addition, when demonstrating the simultaneous and complimentary use of three software for bibliometric analysis, this thesis contributes to the quality of future reviews of scientific studies in the most diverse fields of knowledge.

In addition, the information presented by the studies present in this thesis can be of great interest to professionals who wish to be attentive to the areas of research on innovativeness and IT capabilities, serving as a compass to guide the acquisition of knowledge on the topics, as well as to guide their choices in the day-to-day activities of organizations. In addition, this thesis supports researchers, academics, and professionals who wish to contribute to the evolution of the field more effectively and to the advancement of scientific progress, insofar as it presents managers and other professionals with the limits of the knowledge produced in the areas of innovativeness and IT capabilities (Dagnino, Levanti, Minà, and Picone, 2015; Köseoglu, Sehitoglu, Ross and Parnell, 2016).

The results presented in chapter 4 contribute to the evolution of the scientific literature. It assumes and tests theoretical propositions already identified in the private sector but insufficiently evaluated in the public sector. Thus, the chapter adds a small block in building knowledge about innovativeness and IT capabilities and can serve as a reference for comparison for future studies in geographical, social, and economic contexts different from those that served as the basis for the present study. In the practical field, the results indicate ways for public managers to make their institutions better prepared to face an ever-changing environment, focusing on improving organizational performance.

Likewise, the results obtained in chapter 5 have theoretical and practical implications. First, by presenting and validating an alternative approach to operationalize the IT human capital construct, the chapter provides future researchers with a more objective and empirically tested means of measuring and evaluating the impact of this concept on various aspects addressed by IT research in organizations. In the practical field, the results suggest ways for organizations to

select IT human resources better prepared to face constantly changing environments, from creating IT organizational capabilities.

Finally, the results and analyses presented in chapter 6 bring essential information to the scientific literature and organizations' practice. By identifying that IT capabilities are an indispensable antecedent of organizational innovativeness, this thesis contributes to the IT and innovation literature. In addition, by proposing an integrated model, the chapter helps to understand innovativeness, the nature of its relationship to organizations' ability to deal with technology, and the role of innovation-oriented culture on organizational performance. The chapter presents the human capital of IT from a new perspective, highlighting its conceptual uniqueness and statistically validating a model for its operationalization, which can be especially useful for future developments in the field.

In the practical field, recommendations are presented on how managers can create and develop more effective IT teams with more comprehensive skills. In addition, the chapter emphasizes to IT managers the need to dedicate themselves to developing the capacity of units with the expertise to gather, integrate and implement IT resources, focusing on meeting the needs of organizational processes. Finally, managers are presented with evidence that creating an environment favorable to innovation and supported by information technology is crucial for achieving better corporate results.

Chapter 2

Innovativeness: a bibliometric vision of the conceptual and intellectual structures and the past and future research directions

Abstract

The literature on the theme of innovativeness displays a multidimensional character and interrelates with diverse approaches and research perspectives. From the early 1990s, the scientific literature on the theme began to grow significantly, resulting in researchers in this field encountering rising difficulties as they attempt to remain updated regarding the different research flows. Furthermore, the volume of international production rendered it equally challenging to identify this field's underlying intellectual and conceptual structures. In this context, the present study applies a quantitative approach to these scientific outputs by combining diverse bibliometric techniques, including the co-occurrence of keywords, bibliographic coupling, and cocitation analysis. This gathered and analyzed 2523 of the scientific works available in the Web of Science, one of the most critical global databases of scientific knowledge. This identified the origins of the current literature on innovativeness and its core justifications and leading intellectual and conceptual structures, including strategic and longitudinal perspectives on developing this theme within the business studies field. Furthermore, we deployed three different software applications in a complementary approach: VOS viewer, SciMAT, and Bibliometrix. Finally, based on qualitative analysis, this study identifies a set of research opportunities that enable those approaching this field to plan, target, and disseminate future research efforts.

Keywords: Innovativeness; Co-citations; Bibliographic coupling; Co-occurrence; State-of-the-art.

2.1 Introduction

Researchers worldwide have dedicated increasing attention to the innovativeness theme (the capacity to innovate), which has generated significant growth in the global scientific production of knowledge, especially after the end of the last century coupled with the emergence of new technologies sub-fields new fronts for research. The literature contains diverse versions of the innovativeness concept across various levels and deploying different units of analysis, such as the individual (Chan and Parhankangas 2017), the organizational (Story et al. 2015), groups (Akhavan and Mahdi Hosseini 2016), and countries (Lema et al. 2015). The sheer extent of scientific interest reflects in the significant volume of information that renders it increasingly

difficult for researchers interested in this theme to remain suitably updated and aware of and accompanying all the different research fronts. For the same reason, it isn't easy to identify and grasp this field's intellectual and conceptual structures fundamental to the training of new researchers in this field.

The intellectual structure refers to the research tradition of the examined scientific domain, its disciplinary composition, influence on research topics, and the pattern of its interrelationships (Shafique 2013). The publications that constitute the intellectual structure are the foundations on which the current research is being carried out and contain fundamental theories, pioneering works, and methodological canons applied to the area (Zupic and Čater 2015). On the other hand, the unit of analysis of the conceptual structure of a field is a concept, not a document, author, or periodical. From the content analysis of words that co-occur in documents, it is possible to identify the closely related concepts behind them. The result is a semantic map that helps understand the cognitive structure (Börner et al., 2003; Zupic and Čater, 2015).

Given this backdrop, various research studies have attempted to identify and systematize the scientific literature with the most significant impact on the theme of innovativeness, generally based on traditional methods, such as systematic literature reviews (Garcia and Calantone 2002) or meta-analytical approaches (Rosenbusch et al. 2011; Song et al. 2008). However, even when carried out thoroughly, traditional literature reviews may present problems, such as researcher bias, the lack of objectivity, and difficulties in replication (Aria and Cuccurullo 2017; Tranfield et al. 2003; Zupic and Čater 2015). To minimize such issues, a third approach to dealing with the management and organizational studies literature has taken on an increasing profile: scientific mapping based on bibliometric methods. Drawing on new and powerful software programs, this approach may be applied in a transparent, replicable fashion and with a minimum of bias (Zupic and Čater 2015). The deployment of advanced bibliometric methodologies, beyond recommended practices, is under expansion in every field, especially those with substantial research flows and that are subject to fragmentation and controversy (Aria and Cuccurullo 2017).

However, the literature still requires studies that apply advanced and varied bibliometric techniques to analyze, map, and visualize scientific productions on the innovativeness theme. Hence, this current study seeks to fill this gap by responding to the following research questions: i) what are the main conceptual and intellectual structures to research on innovativeness; ii) what are the main research fronts and opportunities for advancing this scientific field of knowledge? To this end, this study aims to identify, analyze, and map the literature on innovativeness, revealing its conceptual and intellectual structures and reviewing and presenting the state-of-the-art research on this field, and correspondingly setting out the opportunities for future research. The information presented in this study contributes to advancing scientific production on innovativeness by adding to the results obtained from

applying traditional approaches and thereby helping to establish a broader and more consistent panorama on the scientific outputs with the most significant impacts on this theme.

This work is an opportunity to develop the theory in research on innovativeness. It systematically analyzes the evolution of knowledge in field research, supported by applying quantitative techniques of broad scope and justified by the multidisciplinary nature of the theme. Thus, future research can benefit from this interdisciplinary approach to analyze the relationships among literature in more expansive fields and compare these results with existing innovativeness research. Methodologically, this research goes beyond the traditional literature review to identify and visualize intellectual and conceptual structures in the field (Shin and Perdue 2019). In this way and from a practical point of view, the information brought by this work can be of great interest to professionals who wish to be aware of the research field involving the theme innovativeness, serving as a compass to guide the acquisition of knowledge on the subject, as well as to guide their choices. In addition, the work supports researchers, academics, and professionals who wish to contribute to the evolution of the field more effectively and to advance scientific progress in the literature, including informing professionals to what extent scholars have investigated vital issues in the area (Dagnino et al. 2015; Köseoglu et al. 2016).

The mapping of the innovativeness research field intellectual structure allows to reveal the research traditions of the scientific domain, its disciplinary composition, influential research themes, as well as the pattern of their interrelations (Shafique 2013), which justifies the strategy adopted in the present study to identify and analyze the intersections between various disciplines in the management area, all of them underlying the guiding principle of the present study, that is, innovativeness. In addition, the mapping allows showing the conceptual changes in the field over time, which can relate to the detection and presentation of the most recent research fronts, which point to the most recent directions of development in the area.

2.2 Literature review

According to Hult et al. (2004), innovativeness encapsulates the abilities of an organization to engage in innovation, hence, to introduce new processes, products, or ideas. In turn, Tsai (2001) defines innovativeness as the capacity to obtain further knowledge such as the stimulus for learning and the exploration of external and relevant expertise. These definitions are widely accepted and presented by two of the most notable and impactful works in the area.

However, any understanding of the concept of innovativeness in the scientific literature on business studies should first point to its multidimensional character and its interrelationship with diverse approaches and perspectives (Garcia and Calantone 2002; Story et al. 2015). The

phenomenon of innovativeness manifests itself in the literature in different but complementary forms, as well as causing different results on organizations. In this sense, the studies branch out according to the context explored, forming semi-independent literature, but correlated, since it shares the same theoretical and empirical substrate (Garcia and Calantone 2002; Story et al. 2015). Thus, the present literature review section contextualizes the reader about the main branches of research explored in the field.

In this sense, whenever considered at the individual level, innovativeness might incorporate an evaluation criterion through which potential clients judge projects, individuals, and organizations (Chan and Parhankangas 2017). Within this scope, the literature describes how innovativeness has become a critical concept for areas such as marketing (Aroean and Michaelidou 2014; Slade et al. 2015). Furthermore, McKnight et al. (2002) proposed and validated a consumer confidence scale for e-commerce transactions and the relationships prevailing with other constructs, emphasizing innovativeness at the individual levels. In information technology, Agarwal and Prasad (1998) developed and validated a scale for personal innovativeness and identified its moderating role on the effects of antecedents and the consequences of individually held perceptions regarding new technologies. Another example of the role of consumer innovativeness stems from the study by Slade et al. (2015) that identified how innovativeness impacts positively on intensions to adopt mobile payment technologies.

In terms of products, approaches to innovativeness include measuring the "potential discontinuity" that a product may generate in organizational processes (Garcia and Calantone 2002). In this context, the relationship between product innovation and performance has been well explored in the literature. For example, Szymanski et al. (2007) set out a meta-analysis that identifies a correlation among the themes that emerge as more robust under certain contextual and mediation conditions. These authors also conclude that innovativeness may reflect a competitive advantage, mainly when focusing on products new to the market and not on the company. The evidence in the literature indicates that an innovative product may derive from two types of innovativeness, co-related but distinct: incremental innovativeness or radical innovativeness (Madjar et al. 2011; Subramaniam and Youndt 2005). Chan and Parhankangas (2017) highlighted that incremental innovation results from cumulative improvements in knowledge, capacities, or technologies. In turn, radical innovation involves excellent leaps forward or changes in paradigms characteristic of risk-incurring options, including the consumer perspective. For example, Chan and Parhankangas (2017) identify indications that crowdfunding campaigns involving incremental innovations are far more successful than campaigns involving radical innovations. The authors also observe that combining both radical and incremental innovation characteristics into the same product is possible, thereby boosting the success rates of the respective campaigns in keeping with the results returned by Parhankangas and Ehrlich (2014).

At the organizational level, innovativeness represents an organization's propensity to innovate or develop new products (Garcia and Calantone 2002) and indicates the extent to which the organization encourages and supports new processes or services (Pesämaa et al. 2013). Based on interviews with Japanese company executives, Deshpandé et al. (1993) studied the relationship between corporate culture, client orientation, innovativeness, and organizational performance. These authors then reported how innovativeness, primarily related to market innovations, positively impacts organizational performance. According to Story et al. (2015), most authors understand organizational innovativeness as the cultural propensity to innovate. However, the authors warn about the tension between innovativeness as culture and innovation as behavior. Hence, this differentiates between the cultural and behavioral perspectives with innovativeness, related to the organization's willingness to change or its innovation adoption rate. In the field of entrepreneurship, innovativeness represents one of the dimensions to the entrepreneurial orientation (alongside proactivity and propensity to accept risks), and that reflects in the trend for organizations to get involved in supporting new ideas, novelties, experimentation, and creative processes susceptible to resulting in new products, services, or technological processes (Lumpkin and Dess 1996; Rodrigues and Raposo 2011). The evidence in the literature points to how organizational innovativeness may be driven by inter-organizational collaboration within the scope of turbulence in the surrounding environment, market heterogeneity, and competitive intensity (Alexiev et al., 2016). Practices interrelated with the development of organizations' human and social capital may also shape their levels of innovativeness (Donate et al., 2016).

Within the team working context, innovativeness appears as a set of organizational characteristics that support and facilitate innovation strategies and highlight the sharing of knowledge, the prevailing organizational climate, management support, reward systems, and information and communications infrastructures (Akhavan and Mahdi Hosseini 2016). Based on these antecedents, the innovativeness of working teams may positively impact their performance and that of the organization in general terms (Kim and Lee 2012). Therefore, at the team level, innovativeness may also serve as an indicator for organizational performance (Akhavan and Mahdi Hosseini 2016).

We may also highlight the studies of innovativeness at the national level. According to Furman, Porter, and Stern (2002), innovativeness reflects the capacity of a country to produce and commercialize a flow of innovative technology over the long term, which depends on the strength of the shared innovation infrastructures of a country and the innovation environment prevailing in the industrial clusters existing as well as the strengths of the bonds between these two factors. According to Lema et al. (2015), international business studies have registered a crucial evolutionary movement in national innovativeness. Multinational corporations, which would previously only transfer the results of innovation from their home countries to markets in developing countries (Lall 1993; Pavitt and Patel 1999), have now begun to locally drive innovations interrelated with adapting products to the destination markets (Coe and Bunnell 2003; Narula and Zanfei 2003). Subsequently, the literature observes an increase in innovation

in developing countries interconnected with how the lower cost of specialist labor also drives local production (Ernst 2005; Lewin et al. 2009). More recently, in keeping with the surge in importance of emerging markets to multinational corporations, the literature has reflected an intensification in the transfer of research and development activities to these countries. This movement simultaneously encapsulates the means of meeting the locally prevailing demands (Reddy 2011; Wang et al. 2012) and reaching out to global markets with the results of these efforts referenced in the literature as reverse innovation (Doz and Wilson 2012; Govindarajan and Euchner 2012).

The literature presents a diverse range of evidence about the relationship between innovativeness and organizational results. For example, the study by Hyytinenet al. (2015) highlights the positive relationship between innovativeness and the survival of organizations. In turn, the literature explores in depth the positive impacts returned by innovativeness on performance (Hult et al. 2004; Kyrgidou and Spyropoulou 2013; Panayides and Lun 2009; Parida et al. 2017; Rhee et al. 2010; Rosenbusch et al. 2011; Salge and Vera 2009; Story et al. 2015; Subramanian and Nilakanta 1996). One of the pioneering studies interrelating performance and innovativeness was by Subramanian and Nilakanta (1996), motivated by earlier studies' conflicting results. These authors advocate the application of a multi-dimensional scale for innovativeness containing both technical and administrative dimensions in contrast with previous studies that deployed the concept in a unidimensional format. According to Hult et al. (2004), the antecedents of organizational innovativeness lack clarity and information about the factors driving innovation and how they influence performance. The authors focus on the effects of orientations towards the market, entrepreneurship, and learning for innovativeness and the direct impact on performance. As a result, this identified how performance experiences a positive influence from orientations towards markets, learning, and entrepreneurship through the resulting innovativeness.

The literature also spans a varied range of connections between innovativeness and organizational related phenomena. For example, Panayides and Lun (2009) studied the effects of trust on innovativeness and the supply chain's performance. The results corroborate the hypothesis that trust positively impacts innovativeness within the context of the logistics sectors in the United Kingdom and identify how trust and innovativeness represent antecedents to higher performance standards. Intending to study the relationship between the factors generating innovativeness and the mediating effects of a learning-focused orientation, Rhee et al. (2010) analyzed data from small Korean technological firms. Among their results, there came evidence that the learning orientation functions in terms of mediating the ongoing relationships between the orientations towards the market, entrepreneurship, and innovativeness. Story et al. (2015) compared the performance of new product launches by companies in developed and emerging markets based upon the innovativeness of products. The authors correspondingly report that the relationship between innovativeness and the performance of new products is curvilinear. The strength and shape of this relationship alter by different levels of market

orientation, access to financial resources, and the prevailing environmental dynamism. Based on the perspective that the network capacity constitutes a vital organizational capacity, Parida et al. (2017) studied data on high technology Swedish firms. They identified the importance of their organizational innovativeness-based networking capacities to the organizational performance of these companies. Hence, the literature surrounding the innovativeness concept is broad, fragmented, and transversal to various fields of business studies. This context is correspondingly favorable to the application of quantitative approaches to analyzing the literature as indeed proposed by this present study (Aria and Cuccurullo 2017).

2.3 Methodology

This study took place according to the stages set out by Zupic and Čater (2015) and correspondingly applied different units of analysis and various bibliometric methods in keeping with each respective aspect under study (Aria and Cuccurullo 2017; Zupic and Čater 2015). The field of innovativeness includes systematic reviews (Garcia and Calantone 2002) and meta-analyzes (Rosenbusch et al. 2011; Song et al. 2008) that identified and systematized the scientific literature produced so far. However, due to many published works, complementary research of a quantitative character, as is the case of the present work, is a necessary and desirable complement to provide future researchers with clips of information that will contribute to the evolution of the field (Aria and Cuccurullo 2017; Tranfield et al. 2003; Zupic and Čater 2015). In these terms, Figure 2.1 presents, in a visual manner, a summary of the applied steps.

Step 1: Research project

a. Definition of research questions
b. Selection of analysis methods
    - Keyword co-occurrence (conceptual structures).
    - Cocitation analysis -> (intellectual structures).
    - Bibliographic coupling (Research fronts).

Step 2: Compilation of bibliometric data

a. Choice of database:
    - Main collection of Web of Science.
b. Identification of search terms.
    - Exploratory research.
c. Conducting the research
    - Titles, abstracts, and keywords.
    - SCI-Expanded, SSCI and A&HCI.
    - Articles and literature reviews.
    - Writings in English.
    - Management and Business.
    - Published until 2018.

Step 3: Analysis

a. Choice of bibliometric software
    - SciMAT, VOS viewer and Bibliometrix.
b. Data cleaning
    - Pre-processing with SciMAT.
    - Importing of the “clean” base” (SQL and Python).
c. Data analysis
    - Clustering.
    - Network analysis.
    - Strategic mapping.

Step 4: Visualization

a. Visualization methods
    - clusters (keywords, documents, and authors).
    - maps (co-occurrence of words, strategic, cocitation, evolution of publications, worldwide scientific production, interest of journals).
b. Simultaneous use of tools (SciMAT, VOSviewer and Bibliometrix).

Step 5: Interpretation

a. Qualitative approach
    - Higher impact jobs (clusters)
    - Full reading (research fronts)

Figure 2.1 - Summary of the applied steps
Source: Own

To identify the conceptual structures of this field, we opted to deploy keywords as the unit of analysis and apply the keyword co-occurrence method (He 1999). To identify the intellectual structures, we adopted the references cited as the unit of analysis and used the co-citation analysis to this end (Small 1973). In turn, we defined the research fronts through recourse to the bibliographic coupling technique (Kessler 1963) applied to articles published in high impact journals and exclusively for the last five years (Zupic and Čater 2015). This more recent group of publications, thus those that make up the literature state-of-the-art on this theme, was also the basis for identifying the scope for yet unexplored research areas selected by a qualitative approach.

We collected the studies from the main collection of the Web of Science (WoS) database, the most traditional indexing platform worldwide (Zupic and Čater 2015). The choice of the database was because the WoS database gathers and allows easy access to a wide range of multidisciplinary scientific studies, with recognized scientific relevance (Fetscherin and Heinrich 2015), providing the necessary data to achieve the objectives of the present study. In addition, the data available in the WoS database are the most used to assess the academic impact of scientific production at various levels of aggregation, such as institutions, journals, and individuals (Wang et al. 2020). We correspondingly applied the following search terms associated with the Boolean operator "OR": "INNOVATIVENESS", "INNOVATION CAPACIT*", "INNOVATION CAPABILIT*", "INNOVATIVE CAPABILIT*", "INNOVATIVE CAPACIT*", "CAPACIT* TO INNOVATE", "CAPACIT* FOR INNOVATION*", "CAPACIT* OF INNOVATION*", "CAPABILIT* TO INNOVATE", "CAPABILIT* FOR INNOVATION*", "CAPABILIT* OF INNOVATION*". This search spanned the titles, abstracts, and keywords of the publications indexed to the Science Citation Index Expanded (SCI-Expanded), Social Sciences Citation Index (SSCI), and Arts and Humanities Citation Index (A&HCI). We covered articles and literature reviews published through to 2018 and exclusively in English. Considering the focus of this research, business studies, we selected the Management and Business categories. The search took place on 6 February 2019 and returned 2523 studies. As highlighted by Cobo et al. (2011b), the academic community may currently draw on various software programs to aid in bibliometric research studies. However, these tools deploy complementary characteristics that commonly require researchers to adopt more than one software program. For example, some software programs deploy efficient functions to assist pre-processing data, while others are more closely focused on constructing and visualizing bibliometric maps. Within this framework, this current study made recourse to three different tools: (1) SciMAT (Cobo et al. 2012); (2) VOS Viewer (van Eck and Waltman 2010); and (3) Bibliometrix (Aria and Cuccurullo 2017). SciMAT represents a software program developed by researchers at the University of Granada (Spain) that broadly covers the flows that emerge out of scientific mapping with a particular emphasis on its resources for the pre-processing of data, its wide variety of techniques for constructing bibliometric networks, and means of measuring for similarities as well as presenting a longitudinal vision of the evolution of scientific themes. VOS viewer, in turn, is a tool developed by the Centre for Science and Technology Studies, part

of the University of Leiden (Netherlands). Its main characteristics encapsulate the capacity to represent, in large maps, the variety of bibliometric techniques available and its ease of application. However, this program contains only limited resources for the pre-processing of data. The Bibliometrix program arises from a recent contribution made by researchers at the Italian universities Federico II (Naples) and Luigi Vanvitelli (Caserta). Programmed in R and with correspondingly flexibility in utilization and evolution, this provides various resources for analysis and visualization, some of which are not otherwise available in SciMAT and VOS viewer. However, the package also lacks efficient mechanisms for undertaking the pre-processing stage. Hence, we opted in favor of the combined deployment of these three tools that ensured we framed the literature on innovativeness according to diverse and different aspects without ever compromising the coherence and robustness of results.

In this sense, all of the actions involved in pre-processing the data took place through recourse to SciMAT. To this end, we applied the creation options for groups of authors, documents, and references. Thus, we were able to identify various problems surrounding duplication and other information errors. For example, when pre-processing the authors, which involved the application of the Levenshtein distance, this resulted in the grouping of authors with slightly different name spellings (for example, Byrne, J and Byrne, JC or Stock, Ruth Maria, Stock, RMV, and Stock, Ruth M.). We paid particular attention to ensure that the outcome did not involve grouping authors under the same name, such as Kim, D (Daejoong and Daekwan) or Lee, H (Hyunjoo, Hyunsuk, Hwansoo, and Haesang). This preliminary action reduced the scope for inaccuracies entering the co-authorship analysis.

Similarly, the application of the co-occurrence analytical technique, the foundations for the thematic mapping undertaken, would be compromised had there not been a prior pre-processing stage. For example, various studies reference the term “New-Product-Development” as “NPD” or “NPD(NEW-PRODUCT-DEVELOPMENT).” We were also able to standardize the identifications attributed to the authors in the core cited references. For example, this identified how various lists of references referred to Dr. Robert G. Cooper, an essential author in the product innovation field, in different ways (Cooper RG, Cooper R.G, COOPER, RG), which might interfere with the co-citation analysis results. However, considering the sheer quantity of the authors referenced (53,155), we opted to carry out this stage only on references receiving at least 100 citations. The pre-processing of the references also served to standardize the different versions of books, especially those related to research methodologies. Therefore, as duly highlighted by Cobo et al. (2012), the pre-processing data stage constitutes one of the most important in scientific mapping flows and otherwise incurring risks of severe distortions in the results.

Following this refining of the data exclusively through recourse to SciMAT, we then exported this “clean” database to enable their uploading into the other software programs. Therefore, we produced a script based on Structured Query Language (SQL) and Python programming

language. Through this means, we were able to ensure that the data imported into VOS viewer and Bibliometrix were the same as those refined in SciMAT, which guaranteed both the consistency of the information and the scope for comparing the results generated by the different software. Subsequently, we deployed these software programs to identify the core clusters about the keywords, documents, lead authors in producing scientific knowledge on innovativeness by each aspect of the research questions. To this end, identifying sub-fields constitutes one of the main advantages of applying bibliometric methods and the recommendation to use different techniques for grouping the data (Zupic and Čater 2015).

The visualization of the results stems from the construction of the maps following selected units of analysis. For example, to identify the conceptual structures of this field, we applied the keyword co-occurrence technique (He 1999). Through recourse to the SciMAT tool, we built up strategic maps, including longitudinal profiles, following the recommendation from Cobo et al. (2011a). Furthermore, to identify the intellectual structures underpinning the literature on innovativeness, we applied co-citation analysis (Small 1973) based on the assumptions that the strength of the connections between the two articles rises in keeping with the number of times they are jointly cited (Marchiori and Mendes 2020). Hence, by the list of references provided by these articles and following the application of the VOS viewer software, we produced a map that identifies the main clusters present in the literature defined according to their conceptual bases. We also created other visualization outputs, such as the chart depicting the trends in publications (SciMAT), the world map of scientific results (VOS viewer), and the chart with the dynamics underlying the interests adopted by the leading journals on the theme of innovativeness (Bibliometrix).

Finally, following the recommendation made by Zupic and Čater (2015), we adjusted the focus to analyze recent scientific outputs (2014–2019) to identify the intellectual structures at the cutting edge of research in this field as well as portraying the still unexplored areas of study and correspondingly deploying the bibliographic coupling technique (Kessler 1963). The references made by scientific articles reflect the intellectual environments surrounding their authors. Hence, the strength of the connection between any two studies rises by the level of their shared references (Marchiori and Mendes 2020). To improve the precision of the analysis by comparing the results, we simultaneously applied the three software programs selected for this current study (SciMAT, VOS viewer, and Biblometrix).

Applying a quantitative approach to the literature did not replace the reading of these works. Still, it did assist in revealing the structures underpinning a field and providing an objective guide to an analytical examination under that proposed by Zupic and Èater (2015). These same authors maintain that bibliometric studies may adopt three distinct approaches: i) analyzing the relationships and mutual influences existing between the structural features of any field (focus on structures); ii) accompanying the development of a research field over time (focus on the dynamics); iii) analyzing specific relationships prevailing throughout the research field. The

present study adopted the first two approaches and thus identified and analyzed the literature's conceptual, intellectual, and social structures on innovativeness and undertook a longitudinal analysis of the core themes that shaped the development of this field. Finally, the results obtained from the bibliographic coupling analysis of the recent literature were analyzed by a qualitative approach based on the complete reading of the works interrelated with each identified research front.

2.4 Results and discussion

2.4.1 Description of the field

The first article identified as approaching innovativeness in business studies was Hilfiker (1969). Meanwhile, scientific outputs remained incipient through to 1993 when there were 11 articles published, double the number observed in the previous year. Henceforth, the volume of scientific results underwent a sharp acceleration. Figure 2.2 displays the trend in the number of publications dealing with the theme of innovativeness. The purpose of this division was to provide readers with a clear view of the evolution of scientific production from a longitudinal perspective. Thus, the definition of a fixed, balanced, and standardized time interval for the different types of analysis carried out in the present study can contribute to a direct and comparative understanding of the evolution of the theme.

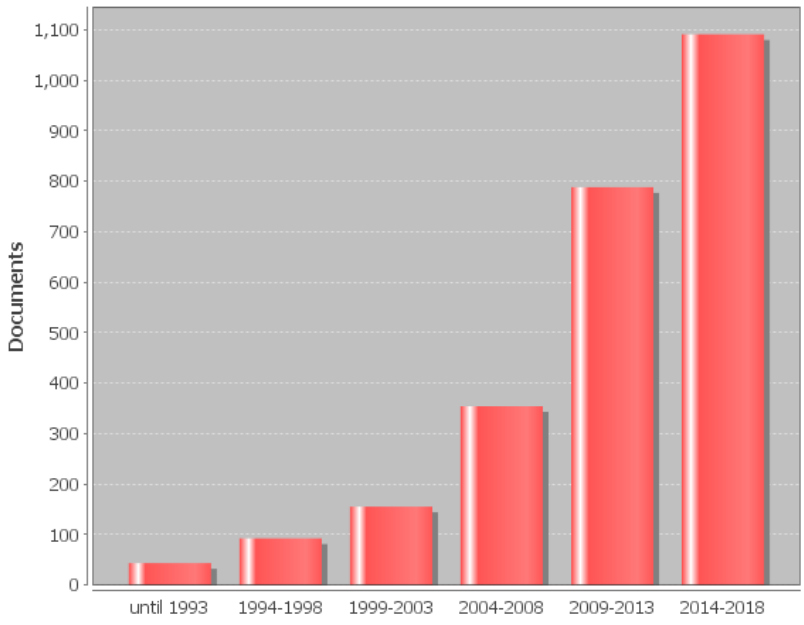

Figure 2.2 - Evolution in publications
Source: Own (SciMAT)

We would note a rise in researcher interest in this business studies theme, with the most significant surge between 2004–2008 and 2009–2013 when the number of studies more than

doubled about their preceding periods. Furthermore, there was also a slight downturn in the level of interest over this final period (2014–2018). Nevertheless, the production in this period accounts for 43.2% of the total, reflecting how this theme remains on the research agenda. Table 2.1 sets out the 20 studies with the most significant impact on the studies of innovativeness. Keeping with the list and the respective journals, we would observe that the theme holds a multidisciplinary and transversal character while highlighting Marketing, Information Technology Systems, and Entrepreneurship.

Table 2.1 - Studies with the most significant impact

Article	Title	Source	Total of citations (WoS)	Annual average
Deshpandé, Farley and Webster (1993)	Corporate culture, customer orientation, and innovativeness in Japanese firms: a quadrad analysis	Journal of Marketing	1580	58.62
Mcknight, Choudhury and Kacmar (2002)	Developing and validating trust measures for e-commerce: An integrative typology	Information Systems Research	1471	81.72
Hurley and Hult (1998)	Innovation, market orientation, and organizational learning: an integration and empirical examination	Journal of Marketing	1463	66.50
Agarwal and Karahanna (2000)	Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage.	MIS Quarterly	1323	66.15
Karahanna, Straub and Chervany (1999)	Information technology adoption across time: a cross-sectional comparison of pre-adoption and post-adoption beliefs.	MIS Quarterly	1272	60.57
Garcia and Calantone (2002)	A critical look at technological innovation typology and innovativeness terminology: a literature review.	Journal of Product Innovation Management	1142	63.44
Subramaniam and Youndt (2005)	The influence of intellectual capital on the types of innovative capabilities	Academy of Management Journal	1105	73.67
Han, Kim and Srivastava (1998)	Market orientation and organizational performance: is innovation a missing link?	Journal of Marketing	1075	44.86
Busenitz and Barney (1997)	Differences between entrepreneurs and managers in large organizations: Biases and heuristics in strategic decision-making	Journal of Business Venturing	927	40.30
Calantone, Cavusgil and Zhao (2002)	Learning orientation, firm innovation capability, and firm performance	Industrial Marketing Management	905	50.28
Agarwal, and Prasad (1998)	A conceptual and operational definition of personal innovativeness in the domain of information technology	Information Systems Research	900	40.91
Luo and Bhattacharya (2006)	Corporate social responsibility, customer satisfaction, and market value	Journal of Marketing	863	61.64
Lumpkin and Dess (2001)	Linking two dimensions of entrepreneurial orientation to firm performance: The moderating role of environment and industry life cycle	Journal of Business Venturing	816	42.95
Chesbrough (2010)	Business Model Innovation: Opportunities and Barriers	Long Range Planning	751	75.10
Furman, Porter and Stern (2002)	The determinants of national innovative capacity	Research Policy	712	39.56
Hult, Hurley and Knight (2004)	Innovativeness: Its antecedents and impact on business performance.	Industrial Marketing Management	653	40.81

Arnold and Reynolds (2003)	Hedonic shopping motivations.	Journal of Retailing	653	38.41
Dabholkar and Bagozzi (2002)	An attitudinal model of technology-based self-service: moderating effects of consumer traits and situational factors.	Journal of The Academy of Marketing Science	625	34.72
Lorenzoni and Lipparini (1999)	The leveraging of interfirm relationships as a distinctive organizational capability: a longitudinal study.	Strategic Management Journal	594	28.29
Zhou, Yim and Tse (2005)	The effects of strategic orientations on technology-and market-based breakthrough innovations.	Journal of Marketing	580	38.67

Source: Own

Figure 2.3 sets out the international panorama of scientific production for countries with a minimum of five articles published by its researchers. To this end, we applied the VOS Viewer software program that displays the area of each circle in keeping with the number of articles published by the researchers in each country (minimum of 5 publications). In turn, the proximity reflects the level of collaboration ongoing among the nations and is highlighted by the lines that represent more intense levels of cooperation. Finally, the circle colors indicate the impact of the scientific production of each country obtained by the number of article citations attributed. Thus, the United States dominates scientific production on the theme of innovativeness concerning the volume (32.1% of the works) and the impact of these outputs. The United Kingdom, China, and the Netherlands trail in its wake and account for 8.9%, 8.4%, and 8.2% of the studies published. This also duly emphasized the impact of the research produced in countries including the Netherlands, Belgium, Norway, and Greece. Despite publishing fewer works, these countries all had research studies that registered high citation averages.

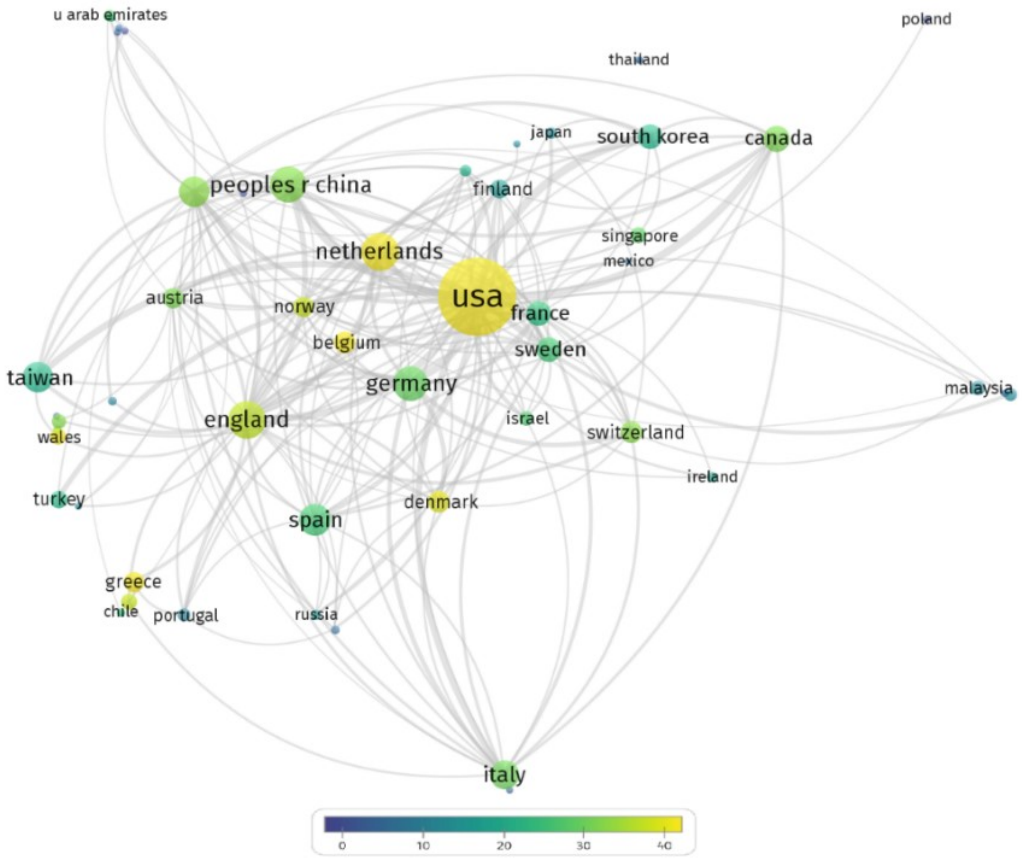

Figure 2.3 - Global scientific production and impact of (citation average per article).
Source: Own (VOS viewer)

To establish the journals recording the most significant impact on innovativeness in the business field, thus those responsible for the most important number of articles, we applied the Bradford Law (Bradford 1934), with support from Bibliometrix. According to this bibliometric law, a small number of scientific journals is responsible for the great majority of publications on specific different themes and thus correspond to the core of scientific production. Figure 2.4 sets out the journals with the most significant importance to innovativeness; among the 255 journals that published studies on this theme, just ten accounts for the bulk of the literature on this field. Hence, this suggests that researchers interested in the innovativeness theme need to pay particular attention to the last journals.

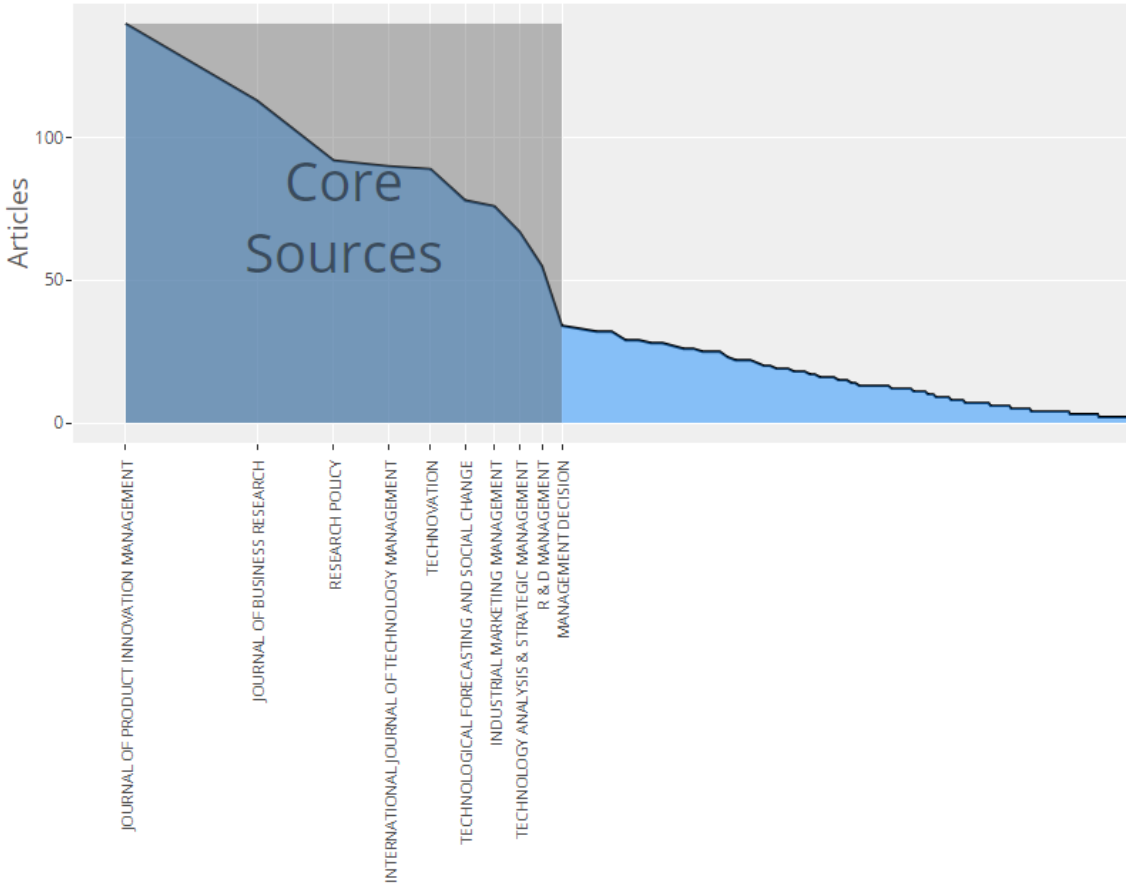

Figure 2.4 - Core of journals publishing on the innovativeness theme.
Source: Own (Bibliometrix)

2.4.2 Conceptual structure

2.4.2.1 Thematic mapping

The studies approaching the theme of innovativeness are susceptible to the grouping into thematic clusters that each display dynamics and varying levels of importance with the scientific field. We applied the strategic theme mapping approach to locate the main groups and identify

their relative roles within the literature (Cobo et al. 2011a). This correspondingly enables the positioning of the clusters across bi-dimensional access establishing quadrants that represent: (1) driver themes, thus already well-developed, important to structuring the field and holding solid relationships with external themes; (2) themes of marginal importance, hence, internally well-developed but with weak relationships beyond the scope of the field; (3) poorly developed themes, whether emerging or fading; (4) essential themes to the field but with low levels of development, grouping transversal and basic themes.

We obtained the themes through means of applying the keyword co-occurrence analytical technique. Hence, this used the keywords selected by the authors and those extracted from the WoS database (ISI Keyword Plus). To enable a longitudinal vision of scientific production on the theme of innovativeness, we selected the six periods detailed in Fig. 1. Each period incorporates five years of the scientific output (except for the first), which guaranteed the portrayal of the production growth and more closely accompanied the evolution of this theme. Considering the surge in scientific outputs on the innovativeness theme over the years, we opted to establish rising totals for the minimum number of keywords occurrences and the network reduction parameters (Cobo et al., 2012). For example, this stipulated that a keyword would have to be registered by at least two articles in the first period (through to 1993). In turn, this same parameter was set at ten occurrences for the final period (2014–2018).

Despite SciMAT providing a wide variety of methods for the normalization of the network, we opted to apply the Inclusion Index as this bestows advantages in terms of measuring similar sets given that this is not subject to any influence by the number of items in each group (Cobo et al. 2011a). We chose the Simple Centers Algorithm as the grouping algorithm, following Cobo et al. (2012). Figure 2.5 provides the general strategic diagram for the literature on innovativeness. Therefore, we can observe how the driver themes interrelated with innovativeness are strategic management, organizational performance, knowledge management, market orientation, and innovativeness in terms of product.

Among the five driver themes underlying research on innovativeness, the cluster containing the most central theme is strategic management and, as reflected by generating the most significant impact in terms of citations and the highest number of published works (175). This group incorporates a series of associated studies on various correlated themes such as, for example, competitive advantage (Kyrgidou and Spyropoulou 2013), strategic alliances (Kalaignanam et al. 2007), strategic orientation (Cheng and Huizingh 2014) as well as the application of theories from this field (Knight and Kim 2009). Secondly, the studies grouped under the theme of organizational performance collated 156 works. This cluster also gathers works associating innovativeness and organizational performance, approached jointly, to other central management themes, such as profitability (Cho and Pucik 2005), learning orientation (Calantone et al. 2002), entrepreneurial orientation (Lumpkin and Dess 2001), and corporate entrepreneurship (Antoncic and Hisrich 2001). In turn, the cluster of works focusing on

knowledge management included 79 studies. Furthermore, in addition to specific approaches to the management of knowledge, the studies featuring in this cluster also deal with themes such as structural shortcomings (Gray et al. 2011), creating knowledge (Hsu and Sabherwal 2012), organizational learning (Santos-Vijande et al. 2012) and social networks (Tortoriello 2015). The market orientation theme displays a significant input from studies interrelated with innovativeness. The 111 works collected in this cluster also incorporate other key themes, such as organizational innovativeness (Han et al. 1998; Hult et al. 2004), consumer orientation (Brown et al.2003), and culture (Deshpandé and Farley 2004). Finally, the last cluster positioned among the drivers is product-related innovativeness, with 127 studies identified. Grouped into this cluster are reflections on the supply chain (Pero et al. 2010), radical innovations (Pérez-Luño et al. 2011), and dynamic capacities (Akgün et al. 2012). Thus, we understand that innovativeness is a prolific theme based on identifying the driver themes alongside their sub-themes. It runs transversally to the literature on the management field and establishes a connecting line between the different approaches and lines of research.

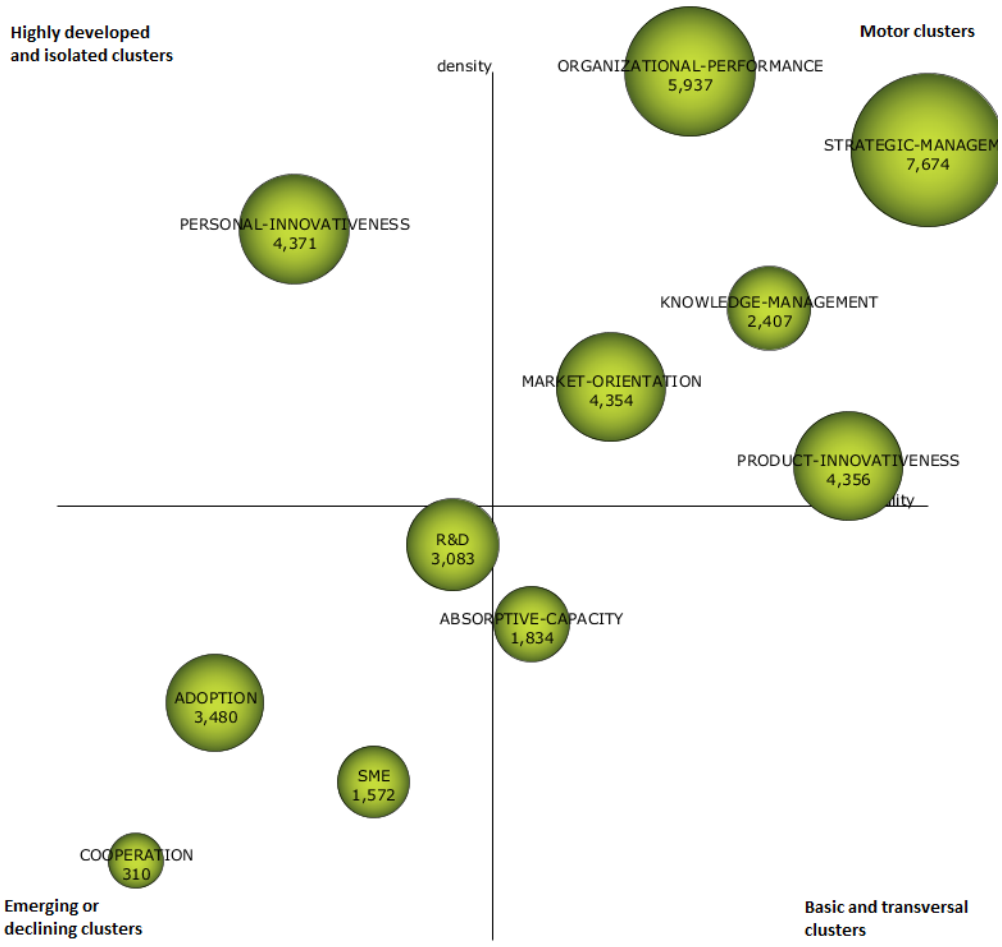

Figure 2.5 - Strategic diagram on the innovativeness theme and the number of citations.
Source: Own (SciMAT)

The theme of personal innovativeness also deserves attention as the only theme identified as highly developed even while displaying a lower level of interrelationship with other themes in the management field. The literature primarily refers to this concept in two different fashions: (1) personal innovativeness, more commonly applied in the literature related to information technology (Agarwal and Prasad 1998); (2) consumer innovativeness, frequently occurring in the marketing literature (Hauser et al. 2007). With a total of 68 publications composing its research core, this cluster also features works interrelated with other sub-topics, such as the optimum stimulation level—OSL) (Roehrich 2004), social influence (Corrocher 2011), perceptions of utility (Lu et al. 2005), as well as the application of technology acceptance theories (McKnight et al. 2002).

2.4.2.2 Thematic evolution

Over time, the keywords in any research field adapt and change (Cobo et al. 2011a). Similarly, the literature on innovativeness has evolved and applied different keywords to describe the contents of their studies, with new topics emerging just as others have disappeared. Furthermore, a subset of keywords remained unchanged over consecutive sub-periods. Figure 2.6 displays this evolution in the keywords related to studies on innovativeness. As Cobo et al. (2011a) detail, these circles indicate each period. The number of keywords featuring within each circle with the arrows between the consecutive periods depicts the number of keywords they mutually share. Furthermore, the similarity index, which portrays the overlap among the keywords between periods, appears between the parentheses. The arrows entering from above represent the number of new keywords emerging in each period. Finally, the upwards arrows depict the number of keywords carried over into the following period.

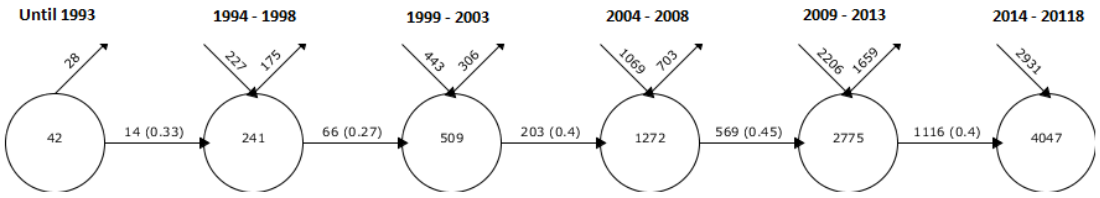

Figure 2.6 - Dynamics in the renewal of keywords.
Source: Own (SciMAT)

For example, the fourth period (2004–2008) registered 1272 keywords, of which 569 keywords carried over into the following period (2009–2013), and 703 were thus subject to discontinuation. Hence, the similarity index between these periods stood at 0.45 (45%). A similar dynamic emerges among each of the other periods reflecting a high rate of new and transitory keywords. Hence, we may note many transversal keywords are applied only in one sub-period and not subject to any repetition (Cobo et al. 2011a). These indicators convey a high level of renewal in the themes interrelated with scientific outputs on innovativeness. Because of this renewal, the research fronts have also evolved. Figure 2.7, therefore, presents the mapping of this same evolution.

This enables a graphical depiction of the longitudinal evolution of the research fronts. The solid lines indicate the existence of a relevant connection between the thematic areas present in different periods. In turn, the broken lines indicate that the association, despite existing, holds less relevance. The thickness of the lines also conveys the intensity of the respective connections. Finally, the scale of the spheres indicates the number of published studies (Cobo et al. 2011a). Hence, we can identify the contributions and interrelationships between the themes over time. For example, in terms of the studies on personal innovativeness, they took on the relevance between 1999 and 2003 (Agarwal and Karahanna 2000; McKnight et al. 2002). In the following period (2004 to 2008), they received contributions from studies approaching the adoption of information technologies (Lu et al. 2005), which then intensified over the following period due to the deepening of studies that adopted and applied the Technology Acceptance Model—TAM (Kuo and Yen 2009).

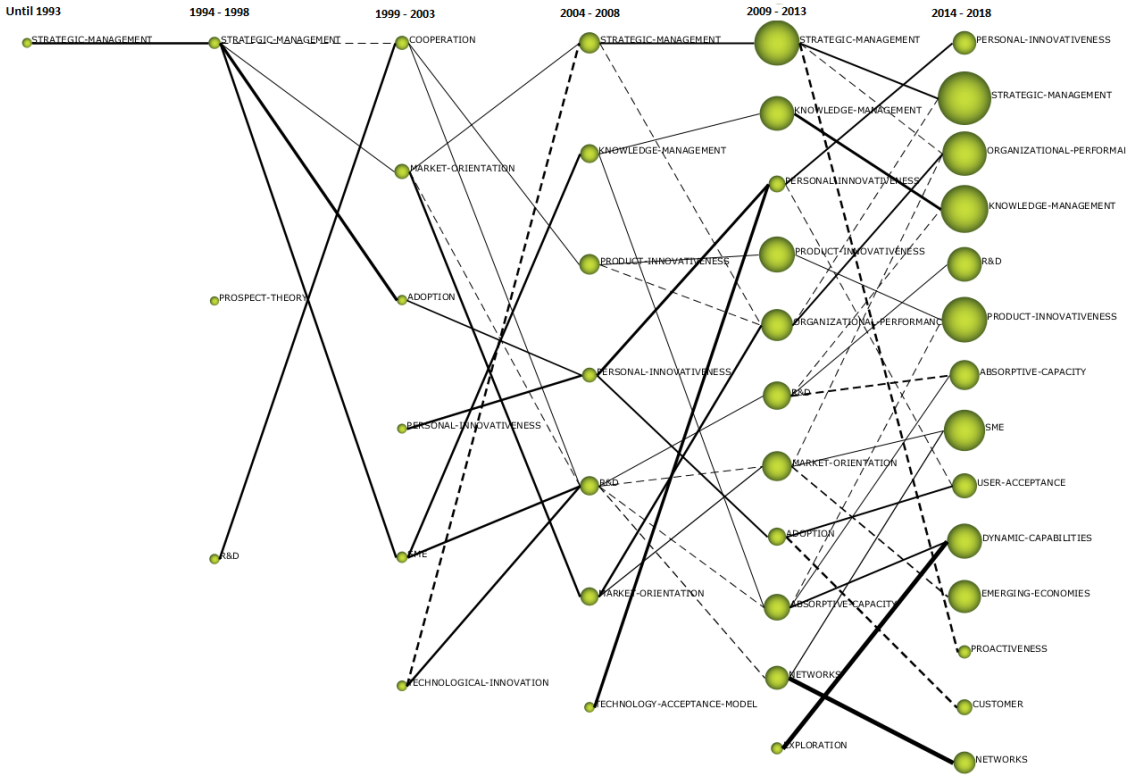

Figure 2.7 - Longitudinal thematic analysis.
Source: Own (SciMAT)

2.4.3 Intellectual structure

We applied co-citation document analysis to identify the most important documents that have originated or influenced the current literature on innovativeness (Small 1973). Considering many works, we thus established a minimum criterion of 20 citations per reference for its eligibility for analysis and correspondingly focusing on works with the most significant impact on the development of the literature. Furthermore, we manually excluded studies specifically on

research methodologies to avoid distortions in the relationships established by the co-citations. At the end of this phase, we had 593 documents selected for analysis. This involved co-citation analysis in conjunction with qualitative research carried out based on reading the titles and abstracts of the papers that revealed the presence of six clusters that correspondingly reflect the main intellectual structures of the literature on innovativeness. Figure 8 enables the visualization of the cluster densities while also indicating the works generating the respective most significant impacts. The articles and studies highlighted correspondingly received the highest number of citations in their separate areas.

The first and largest cluster, identified in red, gathers 183 publications (30.86%) with knowledge management as their dominant theme. Furthermore, the seminal studies in this area, such as Cohen and Levinthal (2006), accompanied by a broad swathe of the associated literature, make up the main intellectual structure providing the foundations for research into innovativeness. The second cluster identified in green accounts for 125 works (21.08%). The focus of works in this cluster spans the applications of innovativeness, such as product development (Kleinschmidt and Cooper 1991) and the organizational capacity for innovation (Damanpour 2018). The map of scientific production (Figure 2.8) indicates that the studies in this cluster depict a core study field for innovativeness, displaying a strong connection with the other collections. This may explain how these studies apply the concepts, theories, and themes present in the different groups to develop specific literature focused on innovativeness. The third cluster, portrayed in blue, incorporates 97 studies (16.36%). The focuses of the works in this cluster range across diverse aspects, such as consumer behavior (Goldsmith and Hofacker 1991) and the acceptance of technology (Davis 2006), among others. The fourth cluster, identified in yellow, collates 83 works (13.99%). The driving theme of this cluster is marketing while also incorporating diverse innovation-related sub-topics, including, for example, market orientation (Jaworski and Kohli 2012; Narver and Slater 2012). The fifth cluster, set out in purple, accounts for 79 studies (13.32%) with entrepreneurship as their core theme. This framework clearly defines the relationship between the themes of innovation, entrepreneurship, and organizational performance (Lumpkin and Dess 1996). The sixth and final cluster, identified in light blue, hosts 26 documents (4.39%). This cluster, positioned centrally within the innovativeness literature map, focuses on strategy (Barney 1991; Teece et al. 1997). Table 2.2 presents the five most cited works in each cluster that make up the six intellectual structures in the innovativeness literature.

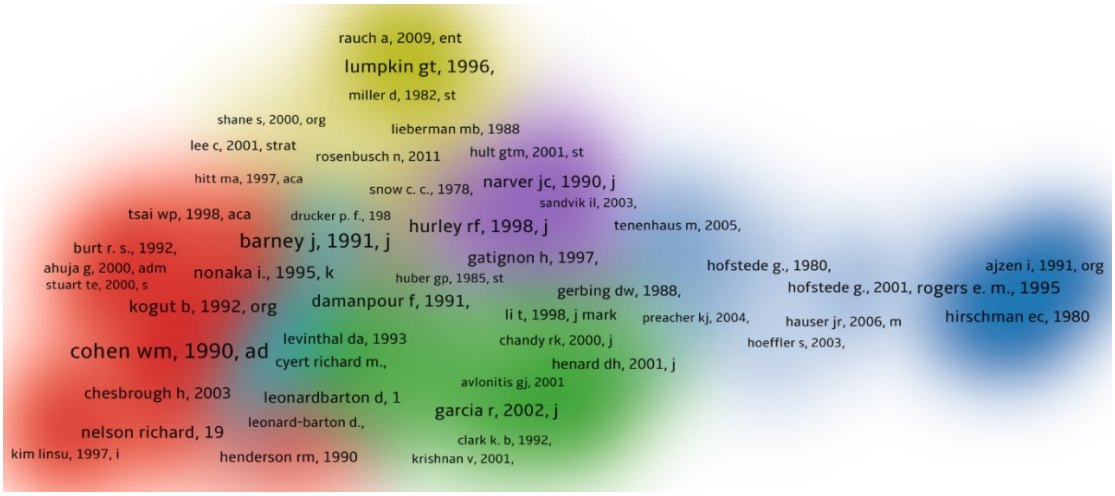

Figure 2.8: Map of the document co-citations.
Source: Own (VOS viewer)

Table 2.2 - Intellectual structures and key works (by number of citations in the studies subject to analysis)

Cluster	Driving theme	Reference	Title	Source
1	Knowledge management	Cohen and Levinthal (1990)	Absorptive capacity: A new perspective on learning and innovation	Administrative Science Quarterly
		Nelson and Winter (1982)	An Evolutionary Theory of Economic Change	Harvard University Press (book)
		Kogut and Zander (1992)	Knowledge of the firm, combinative capabilities, and the replication of technology	Organization science
		Nonaka and Takeuchi (1995)	The knowledge-creating company: How Japanese companies create the dynamics of innovation	Oxford University Press (book)
		Grant (1996)	Toward a knowledge-based theory of the firm	Strategic Management Journal
2	Applied innovativeness	Garcia and Calantone (2002)	A critical look at technological innovation typology and innovativeness terminology: a literature review	Journal of Product Innovation Management
		March (1991)	Exploration and exploitation in organizational learning	Organization Science
		Damanpour (1991)	Organizational innovation: A meta-analysis of effects of determinants and moderators	Academy of Management Journal
		Leonard-Barton (1992)	Core capabilities and core rigidities: A paradox in managing new product development	Strategic Management Journal
		Kleinschmidt and Cooper (1991)	The impact of product innovativeness on performance	Journal of Product Innovation Management
3	Individual	Rogers (1995)	Diffusion of innovations	Free Press (book)
		Midgley and Dowling (1978)	Innovativeness: The concept and its measurement	Journal of Consumer Research
		Goldsmith and Hofacker (1991)	Measuring consumer innovativeness	Journal of the Academy of Marketing Science

		Hirschman (1980)	Innovativeness, novelty seeking, and consumer creativity	Journal of Consumer Research
		Davis (1989)	Perceived usefulness, perceived ease of use, and user acceptance of information technology	MIS Quarterly
4	Entrepreneurship	Lumpkin and Dess (1996)	Clarifying the entrepreneurial orientation construct and linking it to performance	Academy of Management Review
		Shumpeter (1934)	Theory of economic development	Harvard University Press (book)
		Covin and Slevin (1989)	Strategic management of small firms in hostile and benign environments	Strategic Management Journal
		Miller (1983)	The correlates of entrepreneurship in three types of firms	Management Science
		Lumpkin and Dess (2001)	Linking two dimensions of entrepreneurial orientation to firm performance: The moderating role of environment and industry life cycle.	Journal of Business Venturing
5	Marketing	Hurley and Hult (1998)	Innovation, market orientation, and organizational learning: an integration and empirical examination	Journal of Marketing
		Narver and Slater (1990)	The effect of a market orientation on business profitability	Journal of Marketing
		Jaworski and Kohli (1993)	Market orientation: antecedents and consequences	Journal of Marketing
		Deshpandé, Farley and Webster Jr (1993)	Corporate culture, customer orientation, and innovativeness in Japanese firms: a quadrad analysis	Journal of Marketing
		Hult, Hurley and Knight (2004)	Innovativeness: Its antecedents and impact on business performance	Industrial Marketing Management
6	Strategy	Barney (1991)	Firm resources and sustained competitive advantage	Journal of Management
		Teece, Pisano and Shuen (1997)	Dynamic capabilities and strategic management	Strategic Management Journal
		Eisenhardt and Martin (2000)	Dynamic capabilities: what are they?	Strategic Management Journal
		Wernerfelt (1984)	A resource-based view of the firm	Strategic Management Journal
		Teece (2007)	Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance	Strategic Management Journal

Source: Own

2.4.4 Research fronts

To identify the most recent research fronts to the theme of innovativeness, we deployed the bibliographic coupling technique to articles on this field published between 2015 and 2019 (up to 16 March 2019, our search date) in keeping with guidelines set down in the specialist literature (Zupic and Čater 2015). Hence, we collected 645 articles from which we selected the 500 with the highest degree of convergence in their references. We did not apply any criteria in terms of the number of citations to detect the most recent scientific outputs. However, to ensure the selection of the articles with the most significant relevance, we selected only periodicals with

an impact factor of greater than one and at least three essays on the theme in this period. Hence, we were able to identify a total of ten active research fronts.

2.4.4.1 Family-owned companies

The first front identified approaches innovativeness in family-owned firm context. For example, based on the literature about family functionality, family-owned companies, and socio-emotional wealth (SEW), Filser et al. (2018) presented a theoretical model to explain how family functionality and the SEW dimensions influence company innovation. These authors maintained that family functionality positively connects with SEW. However, divergences then appear when analyzing the different dimensions to SEW concerning innovation. In turn, Kraus et al. (2018) reported that family company performance depends on a configuration of diverse factors, among them innovativeness. According to Kallmuenzer et al.2018), studying the effects of entrepreneurial attitudes on organizational performance within family-owned firms identified how the control mechanisms applied to avoid agency problems moderate the impact of innovativeness on organizational performance. Furthermore, Pittino et al. (2018), who studied the moderating role of heterogeneity on governance about psychological ownership (PO), knowledge sharing (KS), and entrepreneurial orientation (EO), proposed the PO of family members as one of the critical determinants to EO factors of proactivity and innovation in family-owned companies.

2.4.4.2 Self-attendance services

Based on the integration of innovativeness at the individual level, with theoretical references including the acceptance of technology (TAM) and planned behavior (TPB), Ghazali et al. (2018) identified how innovativeness influences intentions towards adopting M-Shopping. In another study, Madan and Yadav (2018) posited a significant relationship between the intention to use M-Shopping and individual innovativeness. In turn, Ramos-de-Luna et al. (2016) studied the acceptance of mobile payments systems and identified how innovativeness is determinant to intensions over recourse to technology. Finally, Kaushik et al. (2015) evaluated the preferences of tourists as regards self-attendance services from the TAM analytical perspective. The authors correspondingly detailed how trust and subjective norms have a substantial impact on tourists' behavioral intentions towards adopting new technologies, with a particular emphasis on the former factor.

2.4.4.3 Export markets

Exploring the context of export companies and adopting the resource-based vision as their theoretical framework, Vicente et al. (2015) set out the interrelated dimensions before proposing a new scale for measuring the innovativeness of export companies (INNOVSCALE) based upon a set of Portuguese companies. The scale operationalizes innovativeness in a broad sense and as a second-order construct. In turn, Nemkova et al. (2017), based on the dynamic capacities approach, included innovativeness among the capacities necessary to be able to export more and achieve competitive advantages in external markets. Another study on this front comes from Miocevic and Morgan (2018) who studied interactions among organizational capacities and entrepreneurial opportunities as well as their impacts on the exports of small-scale companies. Among their results, the authors identify how companies displaying more developed levels of innovativeness better take advantage of international export opportunities. Makri et al. (2017) detailed how innovativeness positively interrelates with the decentralization of structures and decisions taken by export companies and that generate a positive effect on export performance levels.

2.4.4.4 Coopetition

Coopetition strategies (collaboration among competitors) increasingly serve as the means adopted to drive innovation (Fernandez et al. 2018). This represents the most prolific research front in the field of innovativeness. Within this scope, Bouncken et al. (2016) described how the application of various types of alliance governance (relational, transactional, or plural) results in different impacts on the innovation of products produced under coopetitive terms. Furthermore, Fernandez et al. (2018) studied the structures of projects undertaken by coopetitors to manage their shared innovation projects in the space satellite market, identifying how coopetitive project teams (CPT) represent a more commonly adopted solution for expensive, risky, and highly innovative projects. Meanwhile, in low-cost projects that require low levels of knowledge sharing, separate project teams (SPT) tend to prevail. Vanyushyn et al. (2018) approached questions around the international coopetition associated with innovation and reported that companies that cooperate with their international competitors also display a greater propensity to introduce radical innovations but that this effect remains conditioned by organizational adjustments. Hora et al. (2017) researched coopetition among start-ups and established companies in a qualitative approach exploring just which factors drove recourse to cooperation such as the management of the coopetitive relationships as well as the main implications of this strategy, including the potential benefits and risks. Finally, Klimas and Czakon (2018) also approached the relationship between coopetition and innovation based on research into Polish games developers and concluded that the organizational capacity to innovate, as well as its respective dimensions, positively interrelates with coopetition, both directly and indirectly.

2.4.4.5 Organizational networks

The association between studies on innovativeness and organizational networks emerges as an essential front of ongoing research. For example, Rodrigo-Alarcón et al. (2017) approached the density of the networks in which companies participate and how these impact the relationships between the environment, dynamism, and innovation. According to these authors, technological dynamism shapes innovation, but the same does not hold for the relationship with market dynamism. In turn, Doblinger et al. (2016) studied the mechanisms by which public policies, regulatory uncertainties, and the bonds established by industrial networks impact the business decision-making processes and their innovativeness based on an institutional perspective applied to the power generation sector. Their results demonstrate how public policies may restrict innovation and the risk incurring behaviors of companies as they encourage companies to take more conservative attitudes and dissuade them from seeking out high-risk innovation projects. More recently, García-Villaverde et al. (2018) looked at the effects of cognitive, social capital (CSC) on the entrepreneurial orientations (EO) of companies and how their capacity to absorb knowledge moderates this relationship. They correspondingly reported that CSC returns a curvilinear influence on EO and how this relationship becomes deeper following higher levels of absorption capacities.

2.4.4.6 Entrepreneurial orientation and its dimensions

Another active research front focuses on the detailed study of the dimensions to entrepreneurial orientation (EO), including innovativeness. For example, based upon a configurational approach and assuming EO as a formative construct, Linton and Kask (2017) propose three different combinations (ideal types) for EO and strategy, thereby identifying diverse impacts in terms of performance. Also applying a configurational approach, McKenny et al. (2018) analyzed different EO and organizational performance patterns based on the longitudinal data of technology companies. In turn, in seeking to better grasp the EO dimensions' role in organizational performance in different contexts, Lomberg, Urbig, Stöckmann, Marino & Dickson (2017) isolated the unique and shared effects of the EO dimensions of performance-based upon commonality analysis.

2.4.4.7 Interactions with the market

The association between innovativeness and market interactions emerges as another active research front. Within this scope, Stock et al. (2017) proposed that strategies targeting innovation, combined with transactional and transformational leadership, constitute drivers for a general openness and the strategic directions that emphasize innovation and are based on co-developed activities involving both companies and their clients. In turn, based upon the resource-based theoretical perspective, Chen et al. (2017) evaluated the extent to which company capacities to interact with their clients impacts performance in terms of new product development, with a particular emphasis on the mediating role of the ability to relate with markets. Zhang et al. (2015) published another critical study on this front after examining the

different ways of balancing market exploration and market exploitation within the product innovation context. These correspondingly identified how to market exploration drives innovativeness interrelated with new products while market exploitation more closely relates with the speed rate of new product launches.

2.4.4.8 Open innovation and the absorption capacity

The combination of the open innovation absorption capacity themes has also attracted particular levels of research interest in recent years. For example, Ghisetti, Marzucchi & Montresor (2015) studied the effect of supplying knowledge and absorption capacities to company innovation environments by applying the open innovation paradigm to research the surrounding environment. In turn, Rubera et al. (2016), in studying the relations existing between open innovation (OI), innovativeness and the new product portfolio (NPD) and the performance of companies to report the need for differentiation between the different types of OI practices while simultaneously identifying the influence of NPD capacities on OI practices. More recently, Xie et al. (2018) approached the underlying mediating mechanisms and the contextual conditions in the relationship between the acquisition of inter-organizational knowledge and the radical innovation of companies. In turn, Criscuolo et al. (2018) analyzed the effectiveness of different combinations of sources of knowledge in terms of the performance in innovation and thereby identified the utility of cognitively distant sources of expertise to innovation but only when applied in conjunction with sources of knowledge more proximate to the company.

2.4.4.9 Resistance to innovation

Another active research front on innovativeness deals with resistance to innovation. Thus, recognizing that resistance to innovation constitutes a barrier to consumers' adoption of new products, Heidenreich and Kraemer (2016) evaluated the efficiency of marketing instruments to reduce the adverse effects of passive resistance to innovation, thereby confirming the effectiveness of mental simulation and the comparison of benefits. Furthermore, within this same scope, Heidenreich et al. (2016) identified how consumers with high levels of passive resistance in one dimension (whether cognitive or situational) display similar adverse effects while consumers with high levels in both dimensions record greater resistance to innovation. In turn, based upon a qualitative approach, Reinhardt et al. (2017) innovated through analyzing the transition stage between the state of non-adoption and the state of adoption to research the triggers able to overcome the initial resistance of consumers. The authors concluded that the adoption triggers fell into three major categories, more specifically: boosting the attraction to innovation, the reduction of barriers, and the inclination of the system.

2.4.4.10 Entrepreneurial orientation and culture

Combining entrepreneurial orientation (EO) and cultural aspects has emerged as a promising front of research in the innovativeness field. This front includes Engelen et al. (2015), who studied the simultaneous influence of national culture and market turbulence on entrepreneurial orientations to report results that maintain a direct relationship between the phenomena subject to analysis. Furthermore, Brettel et al. (2015) put forward the core dimensions to organizational culture (group, hierarchy, development, and. rationale) that exercise a strong influence over EO and demonstrate how EO is subject to impacts from external orientations.

2.4.5 Opportunities for new research projects on innovativeness

Based on these active research fronts, we were able to identify a diverse range of unexplored opportunities that were susceptible to generating insights for new research projects on the innovativeness theme. Hence, to complement the bibliographic coupling analysis and the mapping of the scientific literature, we carried out a qualitative analysis of the theoretical basis of the studies associated with each front. Table 2.3 sets out the summary of these opportunities.

Table 2.3 - Research opportunities on each research front

Research front	Source	Opportunities
Family companies	Filser *et al.* (2018)	Context of medium and large scale family companies Effects of the different SEW dimensions (Gast et al. 2018) Different types of innovation (radical-incremental, disruptive-sustainable, and exploratory exploring)
	Kraus *et al.* (2018)	Validating the configurational approach to performance Integration of new aspects of family dynamics (succession management, diversity of risk dimensions)
	Kallmuenzer *et al.* (2018)	Role of control mechanisms and their interrelationship with innovation processes
	Pittino *et al.* (2018)	Effects of the various dimensions to family involvement in the relationships ongoing between PO, KS, and EO Application of other theoretical perspectives (agency, dynamic capacities)
Self-attendance services	Ghazali *et al.* (2018)	M-Shopping behaviors Moderating effects of age, gender, and experience (Madan and Yadav 2018) Criteria for classifying consumers
	Ramos-de-Luna *et al.* (2016)	Comparative study of different mobile payment systems Measuring the real usage of payment systems Effects of the influences of external factors (labels, brands, etc.) on the perceptions of security
	Kaushik *et al.* (2015)	Utilization of other approaches related to the adoption of IT (diffusion of innovation, rational actio,n and planned behaviors) Difference between users and non-users of self-attendance services
	Liébana-Cabanillas *et al.* (2016)	Incorporation of innovativeness into research on consumer behaviors towards mobile payment applications
Export markets	Vicente et al., (2015)	Testing of a scale across different contexts (countries, company transactions, different levels of IT utilization, import companies) Possible formative nature of innovativeness Antecedents and consequences of innovativeness in export markets Export performance as an independent variable
	Nemkova *et al.* (2017)	Role of strategic drivers in export capacities (orientation towards export markets, orientation towards learning, orientation towards decision making, entrepreneurial orientation) Conditions influencing drivers of competitive advantages

		Interrelationships among factors
	Makri *et al.* (2017)	Other key dimensions in the literature on export entrepreneurship
Coopetition	Bouncken *et al.* (2016)	Effects of governance mechanisms on projects involving varying levels of coopetition Dynamic interactions between competitive and collaborative intensity in relation to innovation Governance of international coopetition alliances
	Fernandez *et al.* (2018)	Coopetition and innovation in low technology markets Project governance and innovation
	Vanyushyn *et al.* (2018)	Organizational demands and capacities necessary to engage in coopetition-innovation
	Hora *et al.* (2017)	Exploratory and quantitative studies on the general importance of coopetition and their role in different company types Motives and expectations from coopetition Diverse phases in the development of startups (longitudinal studies)
	Klimas e Czakon (2018)	Coopetition-innovation relationships in the creative and cultural industries and services
Organizational networks	Rodrigo-Alarcón *et al.* (2017)	Replication of research on emerging industries Environmental characteristics as possible antecedents of innovation (hostility, heterogeneity, complexity, or level of imitation) Internal capacities as feasible determinants and moderators of innovativeness in dynamic environments Role of the absorption capacity for assimilating, integrating, and exploring knowledge within the context of innovation
	Doblinger *et al.* (2016)	Sectors with high levels of governmental participation (transmission of energy, telecommunications) Effects of entrepreneurial companies on policy formulation processes and networks
	García-Villaverde *et al.* (2018)	Inclusion of analysis of the social capital dimensions (structural and relational) Possible moderation by internal and external factors Specific effects that the antecedents might have on the different EO dimensions (innovativeness, proactivity, and risk-taking) Addition of other dimensions (aggressivity, autonomy)
Entrepreneurial orientation and dimensions	Linton e Kask (2017)	Possible formative dimensions of EO Different configurational models
	McKenny *et al.* (2018)	Possible causal effects of autonomy on the success of the strategic configurations of EO (including internal and external aspects) Role of economic cycles and other temporally based factors to the success of strategic EO
	Lomberg *et al.* (2017)	Considering the unique and shared effects of the EO dimensions, incorporating the bilaterally shared effects
Market interaction	Stock *et al.* (2017)	Real behaviors spanning the limitations of suppliers and clients during co-development processes Explicit measures for organizational openness in accordance with aspects such as open communication, openness to experiences, and openness to organizational change Frequency of new product launches based on the number of recently introduced products Results of innovation (newness, significance) Other contingency variables (characteristics related to the client or the product)
	Chen *et al.* (2017)	Potential effects of orienting interactions around other capacities (R&D, technology, manufacturing capacity) Moderating effects of other capacities (energy dependence, balance of power between companies and clients)
	Zhang *et al.* (2015)	Usage of objective measures for new product development Other contingency factors (information on competitors, different organizational structures) Effect of interactions between learning about the market and technological learning about developing innovation
Open innovation and absorption capacity	Ghisetti *et al.* (2015)	Effects of interactions with different types of suppliers of knowledge in environmentally innovative contexts
	Rubera *et al.* (2016)	Analysis of the output flows (alternative paths to commercialization) Complementary studies on industries with high levels of technology

		Effect of the capacities of partner companies for managing successful co-development relationships
	Xie *et al.* (2018)	Analysis of industries with varied technological levels and other economic environments Potential mediating effects of other factors (internal R&D, institutional distance)
	Criscuolo *et al.* (2018)	How different combination of research strategies influence the level of radical innovation
Resistance to innovation	Heidenreich e Kraemer (2016)	Different product and service categories and older populations Analysis of other marketing instruments (knowledge induction, product aggregation, Categorisation, suggestions or product demonstrations, combined application of various instruments)
	Heidenreich *et al.* (2016)	Moderating effect of individual differences in the relationship between different types of resistance to passive innovation and the adoption of new products
	Reinhardt *et al.* (2017)	Underlying mechanisms that trigger adoption Utilization of quantitative methods to validate results Comparison of results (attitudinal and behavioral) of triggers that directly and indirectly impact on adopting innovations
Entrepreneurial orientation and culture	Engelen *et al.* (2015)	Utilization of secondary data Specifications of national cultures across multiple levels Role of factors such as orientation towards actions (proactivity), the creative usage of Assets, and the capacity to leverage relationships with a focus on results, especially in Turbulent environments
	Brettel *et al.* (2015)	The potential moderating effect of national culture on the relationships ongoing across the diverse dimensions of organizational culture and EO Impact of the external business environment (dynamism and hostility) on facets of organizational culture Effect of environmental changes

Source: Own

2.5 Conclusions

The present study set out to identify, analyze, and map the high impact literature on innovativeness, thereby revealing its conceptual and intellectual structures and reviewing and detailing the state-of-the-art research in this field while also surveying the indications for future research opportunities. To this end, we analyzed 2523 scientific works based on quantitative and qualitative approaches. This then identified how the literature on innovativeness is broad, fragmented, and transversal to various scientific fields in a context favoring the application of quantitative methods for analyzing the literature as this study duly carried out. Therefore, these results stem from a combination of techniques. We were able to present future researchers with a consistent and balanced narrative over the origins and trends of this field and the most recent research developments in this scientific field. Hence, we correspondingly consider that we obtained our study objectives.

This identified how the literature on innovativeness, applied to business studies, traces its roots to different fields, such as knowledge management, the diffusion of innovation and acceptance of technology by individuals, entrepreneurship, marketing, and strategy. The thematic analysis strengthened the connectivity between the theme of innovativeness and other areas, especially those that served to leverage its scientific outputs, including strategic management, organizational performance, knowledge management, and market orientation. Furthermore,

analysis of the co-citations revealed that the connections between these areas are in no way uniform. For example, the knowledge management cluster displayed strong connections with strategy and marketing. However, there was no relationship between knowledge management and marketing and entrepreneurship, which underpins the inference that the relations between these themes may be subject to exploration by future studies on innovativeness. Within the same scope, works on the diffusion of innovation and acceptance of technology emerge as relatively isolated and with weak connections with other fields, opening up another path for new approaches. For example, future researchers might analyze the effects of utility and facility of perceived usage of technological resources on organizational results based upon the mediating effects of innovativeness and from the dynamic capacities theoretical perspective.

The most active channel for disseminating knowledge on the theme of innovativeness applied to the business studies field is the Journal of Product Innovation Management. The United States, the United Kingdom, China, and the Netherlands are the leading producers of knowledge on the field. We also identified ten active fronts in the recent research literature. They are family companies; self-attendance services, export markets, coopetition, organizational networks, entrepreneurial orientation, and its dimensions; market interactions, open innovation, absorption capacities, resistance to innovation; entrepreneurial orientation, and culture. These fronts represent the research state-of-the-art on innovativeness, driving the development of research and providing a wide range of opportunities for future researchers that we duly summarized in this study.

As a theoretical contribution, this study identifies and interprets the main research questions investigated about innovativeness and the evolutionary pattern of the debate on the topic. In addition, it provides insights into new or under-explored issues that may be the subject of future research. It offers additional paths to promote a greater understanding of the topic. In this regard, in comparison with previous literature reviews, this article focuses on the intellectual structure of research on innovativeness, demonstrating the development of the subject under investigation over time, providing a comprehensive view of the historical origin and research trends, reconstructing the debate in terms of academic journals, topics, theoretical frameworks, and contexts. As for the practical contribution, the elements presented in this work can serve as a basis for professionals interested in knowing the field of research, pointing out directions for practical applications of knowledge about the innovativeness phenomenon. In addition, the result of the work can serve as support for researchers, academics, and professionals interested in making new advances in this field of research, from the moment the work updates them on the evolution of the knowledge framework, as well as pointing to paths promising for their research efforts, taking scientific knowledge about the field of innovativeness to a new level. Finally, as a methodological contribution, the study is an example of combining several techniques and tools for quantitative analysis in a field of knowledge. In addition, the work also shows how to combine quantitative and qualitative research to purify and better understand and in greater depth the different faces of a scientific field.

However, as with all research, this study has limitations, including those stemming from the choice of keywords and recourse to only one database. Therefore, future studies might expand the research base to include works published in the Scopus database, generally deemed wider reaching than the WoS database, that would be especially relevant for mapping lesser areas of research that fall beyond the WoS scope (Zupic and Čater 2015). However, during the pre-processing phase and dealing with duplications, researchers need to be aware of the differences between these databases. For example, Scopus contains data on every author in the references cited to the contrary of WoS that only details information on the lead author in a factor that may cause distortions to the citation and co-citation analytical procedures. In addition, future research may seek to expand the present work results and compare the results found, using other promising research techniques that emerge in the literature, such as bidirectional citation analysis (Galgani et al., 2015). Finally, another opportunity for advancing the application of bibliometric approaches to the literature would involve the development of software dedicated to combining data from different origins (Scopus, WoS, etc.) and applying pre-processing procedures. This would enable the already processed data to be exported to other bibliometric software tools in an intuitive and accessible fashion for researchers otherwise lacking in the database or coding language skills.

Chapter 3

Information Technology Capabilities: a bibliometric vision of the conceptual and intellectual structures and the past and future research directions

Abstract

Scientific production on the topic of information technology (IT) capabilities grows each year, leading researchers working in the field into difficulties to keep abreast of the new research flows and know the intellectual and conceptual structures that sustain the area. Thus, the present study is the result of applying a quantitative approach to the international scientific production on the subject. Several complementary bibliometric techniques, such as keywords co-occurrence, bibliographic coupling, and cocitation analysis, were combined. Considering that the bibliometric research support software currently available to the academic community has strengths and weaknesses, the present study uses three recent analysis tools (VOS viewer, SciMAT, and Bibliometrix) to explore the best that each can offer. We analyzed 219 scientific papers available on the Web of Science. We identify the origins of the current literature on IT capabilities and their foundations and main intellectual and conceptual structures, including a longitudinal view of the development of the theme. The paper also presents the main research fronts in the field and several opportunities that can contribute to the advancement of research involving IT capabilities.

Keywords: IT Capabilities; Co-citations; Bibliographic coupling; Co-occurrence; State-of-the-art.

3.1 Introduction

The IT Capabilities theme has attracted more and more the attention of researchers from around the world, including those who work in the business area. This generates a strong growth in related scientific production, which has gained momentum since 2005. This causes a substantial increase in the connected world scientific production, which has gained momentum since 2005, making it increasingly difficult for researchers to maintain adequate levels of update and the identification and monitoring of the various research fronts. For the same reason, it is not trivial to researchers dedicated to the field to identify and understand the intellectual and conceptual structures of the area, fundamental knowledge for the conduct of consistent research projects, and the training of new researchers.

On the other hand, literature reviews based on traditional methods, despite their undisputed potential to shed light on a field, are not free of several limitations, such as researchers' bias, lack of objectivity, and difficulty in reproducibility (Aria & Cuccurullo, 2017; Tranfield, Denyer, & Smart, 2003; Zupic & Čater, 2015). To minimize these difficulties, a third approach to dealing with literature, including in management and organizations, is increasingly gaining space: scientific mapping. This strategy is based on several bibliometric methods and is supported by powerful new software. With this, we seek to carry out transparent, reproducible, and less biased investigations (Zupic & Čater, 2015). According to Aria & Cuccurullo (2017), the use of bibliometric methods is expanding for all disciplines, and its application is recommended, especially in the face of large and growing research flows.

However, the literature on IT capabilities is still lacking in studies of this nature. Thus, the purpose of this study is to help fill this gap by seeking to answer the following research questions: i) what are the conceptual and intellectual structures of literature that involves IT capabilities; ii) what are the main research fronts and the opportunities for the evolution of related scientific production? In this line, the work aims to identify, analyze and map the literature of high impact on IT capabilities, reveal their conceptual and intellectual structures, and review and present the state of the art of research on the field, accompanied by indications of opportunities for future researchers.

The intellectual structure refers to the research tradition of the examined scientific domain, its disciplinary composition, influence on research topics, and the pattern of its interrelationships (Shafique 2013). The publications that constitute the intellectual structure are the foundations on which the current research is being carried out and contain fundamental theories, pioneering works, and methodological canons applied to the area (Zupic and Čater 2015). On the other hand, the unit of analysis of the conceptual structure of a field is a concept, not a document, author, or periodical.

The information presented in this study contributed to the advancement of scientific production on IT capabilities by providing an overview of the high-impact scientific production in the area. Thus, future researchers will have relevant information that can offer insights into the development of the field. In addition, the present study, by demonstrating the simultaneous and complimentary use of three software for bibliometric analysis, aims to contribute to the quality of the results of literature reviews to be conducted by future researchers, revisions that are basic to any research project, whether theoretical, empirical or summaries of previous contributions.

3.2 Literature Review

Organizations should apply IT effectively to achieve practical organizational benefits (Yoon, 2011). In this context, IT capabilities can be identified with organizations' capabilities to assemble, integrate, and implement IT resources to meet their business process needs (Liu,

Huang, Wei, & Huang, 2015). As for Stoel & Muhanna (2009), IT capabilities are a complex set of IT-related resources, skills, and knowledge, but exercised through the business processes. Thus, IT can help organizations coordinate their activities for better results. In this context, the seminal work by Bharadwaj (2000) is highlighted, for whom the specific organizational resource of IT is the IT infrastructure (communication technologies and computers, shareable technical platforms, and databases), the human resources of IT (technical and managerial skills of the IT staff) and the intangible resources of IT (knowledge assets of the organization, as well as its customer orientation and organizational synergy, made possible by technological resources).

Empirical evidence is analyzed under the theoretical lens of the resource-based view (RBV) and the competition theory has indicated that organizations' performance effectively depends on their IT capabilities and not directly from technology spending (Mata, Fuerst, & Barney, 1995; Powell & Dent-Micallef, 1997; Ray, Muhanna, & Barney, 2005; Stoel & Muhanna, 2009; Stratopoulos & Dehning, 2000). Several studies have indicated that IT capabilities are related to the improvement of business processes, the increase of the organizational performance of the capacity of innovation, as well as the generation of competitive advantage (Bharadwaj, 2000; J.-S. S. Chen & Tsou, 2012; G. Kim, Shin, Kim, & Lee, 2011; Kmieciak, Michna, & Meczynska, 2012; Liu et al., 2015; Lu & Ramamurthy, 2011; Oliveira & Maçada, 2013; Rai, Pavlou, & Du, 2012). Associating a contingency perspective with RBV, Stoel and Muhanna (2009) found evidence that the impact of IT capabilities on firms depends on the adjustment between the type of capability and the demands of the market. According to the authors, externally focused IT capabilities and resources help build trust and respond to changing customer and vendor needs. On the other hand, the internally focused resource and capabilities allow the company to deliver reliable products and services while minimizing costs. Later, highlighting the importance of IT capabilities for managing organizations and improving business processes, Yoon (2011) proposed a new instrument, the perceived enterprise IT capability, which operates four dimensions of IT capabilities, i.e., IT strategy, IT knowledge, IT operations, and IT infrastructure. Lu and Ramamurthy (1989) empirically evaluated the effect of IT capabilities on organizational agility, motivated by contradictory results from previous research. On the one hand, IT was pointed out as an agility enabler, allowing faster decisions, facilitating organizational communication, and creating digital options for companies (Lucas Jr. & Olson, 1994; Sambamurthy, Bharadwaj, & Grover, 2003). On the other hand, IT was pointed out as an obstacle to organizational agility, considering, for example, the possibility of relatively fixed physical and technological artifacts, legacy information systems, and rigid and complex IT architectures (Galliers, 2007; van Oosterhout, Waarts, & van Hillegersberg, 2006). Lu and Ramamurthy (2011) revisited the theme and understood IT capabilities as a latent construct composed of three dimensions: i) IT infrastructure capacity; ii) IT business capability; iii) proactive IT capability. Thus, the authors detected a positive relationship between IT capabilities and organizational agility.

IT capabilities have been related to several organizational phenomena. For example, from the Dynamic Capabilities approach, Kim et al. (2011) examined the relationships between IT capabilities, dynamic capabilities oriented to processes, and enterprises' financial performance. For the authors, IT capabilities are divided into i) IT expertise (the level of professional skills or knowledge of the IT staff); ii) IT Infrastructure Flexibility (the capability of a company's IT infrastructure to enable the rapid development and support of multiple system components); iii) IT management capability (the ability of a company to manage IT resources to deliver business value). Kim et al. (2011) found a significant causal relationship between IT expertise, IT management capability, IT infrastructure flexibility, dynamics oriented to processes, and companies' financial performance. Chen and Tsou (2012) proposed that customer service would be a significant mediator through which IT capability and service process innovation would influence organizational performance. The IT capability would be a critical factor that would facilitate the innovation of the service process. For this purpose, the authors identified IT capabilities as a second-order factor, composed of: i) IT infrastructure (provides the foundation for companies to offer applications and services to business areas, share information across different industries, and respond to changes in business strategy); ii) IT business expertise (organizational capacity to integrate business and IT strategy); iii) IT relationship resources (the ability of the company to integrate the IT department with the business units); iv) IT human resources (technical and managerial skills of IT staff). When they found empirical support for their hypotheses, Chen and Tsou (2012) suggested that management initiatives should be directed towards developing IT capability and the innovation of service processes to improve customer service to achieve superior performance.

Kmieciak et al. (2012) devoted themselves to studying the effects of IT capabilities and employee empowerment on innovation and performance of micro and small enterprises. The authors have operationalized IT capabilities in three dimensions, related to IT knowledge and its use to support business areas: i) IT knowledge (technical skills of IT staff); ii) IT integration with business strategy; iii) internal communication with IT. The authors identified that innovation in small and medium-sized enterprises is positively related to technological turbulence, the climate for innovation, investments in innovation, and the use of IT in internal communications. In addition, innovation activity and IT knowledge positively affect subjective company performance measures. From the Hierachy Theory, Lim, Stratopoulos, and Wirjanto (2012) proposed a positive relationship between the structural power of IT executives and the likelihood of a company developing higher levels of IT capabilities. The authors also suggested that the contribution of IT capabilities to the achievement of competitive advantage by companies is more significant in organizations in which the IT executive exercises greater power. The authors found evidence to support the hypotheses. In turn, Liu, Ke, Wei, and Hua (2013) used the dynamic capabilities perspective to study the mechanisms of influence of IT capabilities. More precisely, the authors proposed that two specific IT capabilities (IT flexibility and IT assimilation) support the development of absorption capacity and the supply chain's

agility, influencing the company's performance. The evidence gathered from IT executives supported the assumptions made.

3.3 Methodology

We conducted the study according to Zupic and Čater (2015) proposed. Initially, we designed the research and defined the research question and the methods necessary for its response. We then select the database, as well as the search filters. Following, we determined the software appropriate to the described procedures and performed the pre-processing of the data (Cobo, López-Herrera, Herrera-Viedma, & Herrera, 2011a). The fourth step was the selection of the most appropriate methods and software to visualize the results, focusing on their interpretation. Figure 3.1 graphically presents a summary of the steps followed.

Step 1: Research project

c. Definition of research questions
d. Selection of analysis methods
    - Keyword co-occurrence (conceptual structures).
    - Cocitation analysis -> (intellectual structures).
    - Bibliographic coupling (Research fronts).

Step 2: Compilation of bibliometric data

d. Choice of database:
    - Main collection of Web of Science.
e. Identification of search terms.
    - Exploratory research.
f. Conducting the research
    - Titles, abstracts, and keywords.
    - SCI-Expanded, SSCI and A&HCI.
    - Articles and literature reviews.
    - Writings in English.
    - Management and Business.
    - Published until 2018.

Step 3: Analysis

d. Choice of bibliometric software
    - SciMAT, VOS viewer and Bibliometrix.
e. Data cleaning
    - Pre-processing with SciMAT.
    - Importing of the “clean base” (SQL and Python).
f. Data analysis
    - Clustering.
    - Network analysis.
    - Strategic mapping.

Step 4: Visualization

c. Visualization methods
    - clusters (keywords, documents, and authors).
    - maps (co-occurrence of words, strategic, cocitation, evolution of publications, worldwide scientific production, interest of journals).
d. Simultaneous use of tools (SciMAT, VOS viewer and Bibliometrix).

Step 5: Interpretation

b. Qualitative approach
    - Higher impact jobs (clusters)
    - Full reading (research fronts)

Figure 3.1 - Summary of the applied steps
Source: Own

Considering the amplitude of the research question, we used different units of analysis and bibliometric methods (Aria & Cuccurullo, 2017; Zupic & Čater, 2015). To identify the conceptual frameworks of the field, we chose the use of the keyword as the unit of analysis and used the word co-occurrence method. To identify the intellectual structures of the field, the choice of the unit of analysis was cited references, and we applied the analysis of cocitation as the method of analysis. In turn, the research fronts were scanned through the technique of bibliographical coupling of documents, published in the last five years exclusively in high-impact journals (Zupic & Čater, 2015). This group of recent publications, representing the state-of-the-art literature, allowed us to identify research opportunities not yet explored.

The works were extracted from the main collection of the Web of Science (WoS), the world's most traditional scientific indexing base (Zupic & Čater, 2015). The search terms were "INFORMATION* TECHNOLOG* CAPABILIT*", "IT CAPABILIT*", "INFORMATION* TECHNOLOG* CAPACIT*", "IT CAPACIT*", associated with the Boolean operator "OR". We searched the titles, abstracts, and keywords of publications indexed to the indices: Science Citation Index Expanded (SCI-Expanded), Social Sciences Citation Index (SSCI), and Arts & Humanities Citation Index (A&HCI). We retrieved 219 studies published in English until April 5, 2019, in the categories Management and Business, considering that the present study's focus is the business area.

The academic community now has a variety of bibliometric tools with complementary features. Some software have efficient functions for data pre-processing, while others are suitable for map visualization (Cobo, López-Herrera, Herrera-Viedma, & Herrera, 2011b). Thus, the present study was based on the associated use of three tools, exploring the most robust characteristics of each software. SciMAT broadly covers the flow of scientific mapping, emphasizing the resources of pre-processing and various measures of similarity and techniques for building networks. The tool also allows the production of a longitudinal view of scientific topics. The VOS viewer (van Eck & Waltman, 2010) features the ability to represent large maps, various bibliometric techniques available, and ease of operation. However, it has limited capabilities for pre-processing. Finally, the Bibliometrix (Aria & Cuccurullo, 2017) offers a variety of analysis and visualization features, some of which are not available in SciMAT and VOS viewer. However, the package also does not have efficient mechanisms for pre-processing. Thus, the combined use of the three tools allowed the literature on the subject to be scrutinized in several aspects.

The pre-processing was fully realized with the support of SciMAT, from the creation of groups of authors, documents, and references. Several types of problems were identified and corrected. For example, during the pre-processing of the authors, names with small spelling differences were grouped (e.g., Coltman, T, and Coltman, TR), but it was avoided to different group authors identified in the same way (e.g., Liu, Yan, and Liu, Yu). In the same way, applying the technique of analysis of co-occurrence of keywords, basis for thematic mapping, would be compromised if the pre-processing step. For example, the term "Total Quality Management" appears in some

works as “TQM”. It was also possible to standardize the identification of authors in the primary references (e.g., Bharadwaj, AS and BHARADWAJ, A). Because of many references (10.971), we chose to carry out this intervention in the works with 30 citations or more. We also used the pre-processing of references to standardize the various editions of books. As Cobo et al. (2012) highlighted, the pre-processing step is one of the most important in the flow of scientific mapping.

Further, the “clean” base was then exported from SciMAT and loaded into VOS viewer and Bibliometrix. For this purpose, a script was produced based on Structured Query Language (SQL) and in the Python programming language. Thus, the three tools’ analyses were based on the same data set, which ensured the consistency of the information and the possibility of comparing the results generated by the different software.

To visualize the results, bibliometric maps were constructed for each unit of analysis. To identify the conceptual frameworks of the field, we used the keyword co-occurrence technique (He, 1999). With the support of SciMAT, it was possible to construct strategic maps, including longitudinal cuts, according to the proposed by Cobo et al. (2011a). On the other hand, in order to identify the intellectual structures underlying the literature on IT capabilities, we applied a cocitation analysis (Small, 1973), from the assumption that the bond strength between two articles grows in the measure more often are cited together (Marchiori & Franco, 2020). From the reference lists of articles and using the VOS viewer, we elaborated a map in which we identified the main clusters present in the literature, defined on conceptual bases. Other display artifacts were also produced, as the graph with the evolution of publications (SciMAT), the map of world scientific production (VOS viewer), and the graph with the dynamics of interest of the prominent journals by the theme (Bibliometrix).

Considering that the bibliographical references of scientific work are the reflection of the intellectual environment in which the authors acted and that the link strength between two articles increases according to the level of sharing of references (Marchiori, Popadiuk, Mainardes & Rodrigues, 2020), we applied the technique of bibliographic coupling (Kessler, 1963) on the most recent literature (2014-2019), as recommended by Zupic & Čater (2015). To allow the comparison of results and enable more precise identification of the research fronts, we used the three tools applied in the present study (VOS viewer, SciMAT, and Bibliometrix). The conceptual and intellectual structures of the literature on IT capacities were identified and analyzed, as well as a longitudinal analysis of the themes that guided the development of the field. A quantitative approach of a scientific field does not replace the reading of the works but can reveal its structures and provide an objective guide for more analytical examination (Zupic & Čater, 2015). Thus, the research opportunities present in the most recent literature were selected from reading and from a qualitative approach of the studies.

3.4 Results and Discussion

3.4.1 Description of the field

Scientific output on IT capabilities remained relatively small by 2005, the year in which 8 papers on the subject were published. Since then, the scientific production has grown considerably, as can be observed in Figure 3.2, in which it is possible to observe a strong increase of the interest in the subject in the last years. In this sense, the literature produced only in the last period (2015-2019) represents 42% of the total.

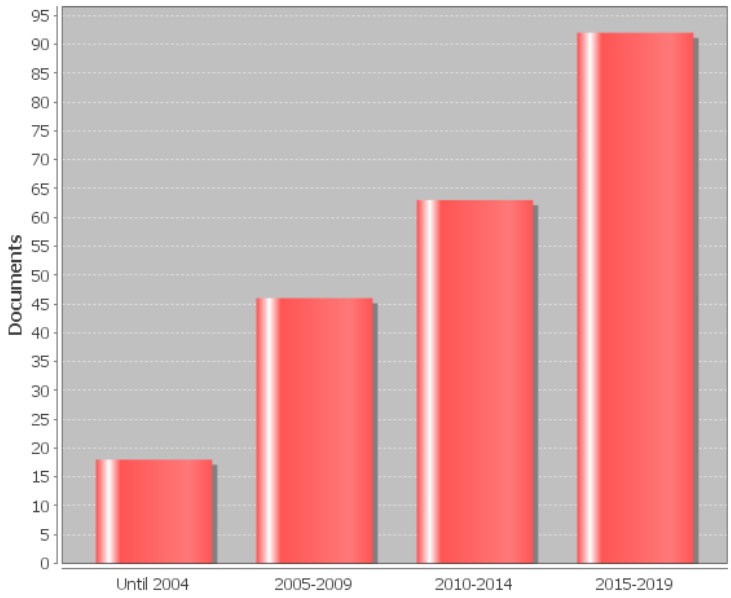

Figure 3.2 - Evolution of publications.
Source: Own (SciMAT)

The work with the gmost significantimpact, with the highest total number of citations (1,477) and the highest annual average (73.85), in the WoS database, is "A resource-based perspective on information technology capability and firm performance: An empirical investigation" (Bharadwaj, 2000). The list of the ten works of greatest impact in the area can be seen in Table 3.1.

Table 3.1 - Studies with greater impact

Article	Title	Source	Total of citations (WoS)	Annual average
Bharadwaj (2000)	A resource-based perspective on information technology capability and firm performance: An empirical investigation	MIS Quarterly	1477	73.85
Newbert (2007)	Empirical research on the resource-based view of the firm: An assessment and suggestions for future research	Strategic Management Journal	684	52.62
Santhanam & Hartono (2003)	Issues in linking information technology capability to firm performance	MIS Quarterly	383	22.53
Ray, Muhanna & Barney	Information technology and the performance of the customer service process: A resource-based analysis	MIS Quarterly	370	24.67

(2005)				
Bhatt & Grover (2005)	Types of information technology capabilities and their role in competitive advantage: An empirical study	Journal of Management Information Systems	345	23.00
Mithas, Krishnan & Fornell (2005)	Why do customer relationship management applications affect customer satisfaction?	Journal of Marketing	268	17.87
Piccoli & Ives (2005)	Review: It-dependent strategic initiatives and sustained competitive advantage: A review and synthesis of the literature	MIS Quarterly	256	17.07
Aral & Weill (2007)	IT assets, organizational capabilities, and firm performance: How resource allocations and organizational differences explain performance variation	Organization Science	227	17.46
Lu & Ramamurthy (2011)	Understanding the link between information technology capability and organizational agility: an empirical examination	MIS Quarterly	181	20.11
Mithas, Ramasubbu & Sambamurthy (2011)	How information management capability influences firm performance	MIS Quarterly	180	20.00

Source: Own

Moving towards the scientific production of countries, in Figure 3.3 a map with the works in each country is presented, considering the minimum of 2 articles published by its researchers. The area of the circles represents the number of articles published by the researchers of the countries. The proximity between countries indicates their level of collaboration, which is reinforced by the thickness of the lines connecting them. Finally, the color of the circles indicates the impact of the scientific production of each country, obtained through the average number of citations of the respective articles.

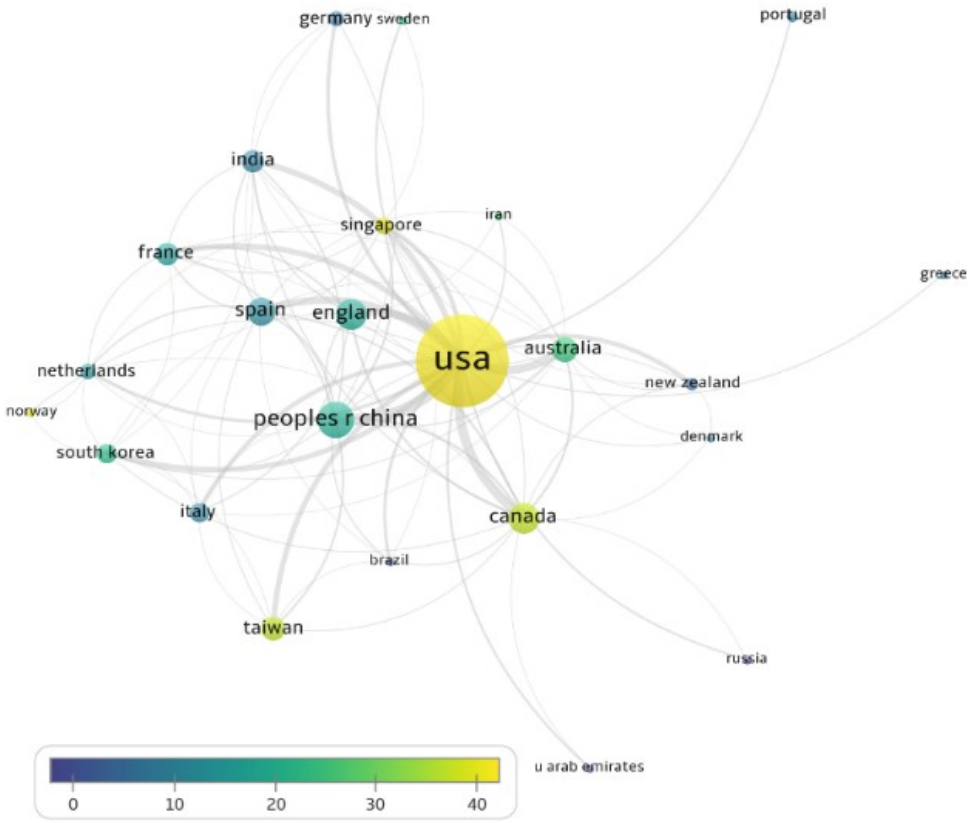

Figure 3.3 - International scientific production and relative impact
Source: Own (VOS viewer)

Dominating the scientific production on IT capabilities are the United States, with 55% of production and an average of 68.1 citations per article). Then there is China, with 10.9% of production and its articles having been cited 18.7 times on average. However, the results showed that, although smaller in terms of quantity, the literature produced in Canada, Taiwan, and Singapore has a high impact in terms of citations.

Finally, in order to establish the journals with the greatest impact on the topic of IT capabilities in the business area, that is, those who were responsible for the largest number of articles, we applied Bradford's (1934) law. Along these lines, a small number of journals are responsible for most publications. Figure 3.4 presents the most productive journals on the topic of IT capabilities. Among the sixty-nine journals that published studies on the subject, ten of them can be considered as the nucleus of scientific production.

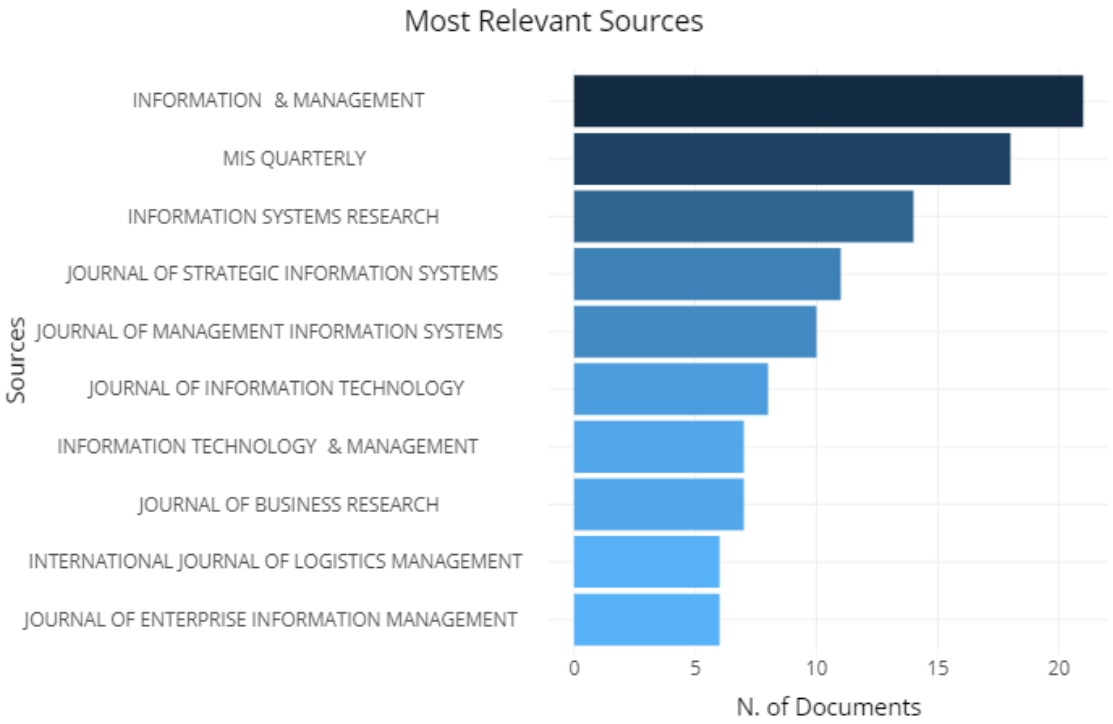

Figure 3.4 - Core of journals on the subject of IT
Source: Own (Bibliometrix)

3.4.2 Conceptual structure

3.4.2.1Thematic mapping

Studies involving the topic of IT capabilities can be grouped into thematic clusters, which have varying dynamics and importance in scientific production. In order to locate the main clusters and how to identify their relative roles in the set of works, we use the strategic thematic mapping approach (Cobo et al., 2011a). The clusters were positioned in a two-dimensional plane, distributed in quadrants that represent the driving-themes (well developed and important for the structuring of the field, having strong relations with external themes), themes of marginal importance (well-developed internally but with weak external relations), weakly developed themes (emerging or disappearing) and cross-sectional themes (important for the field, but with a low level of development).

We analyzed the keywords chosen by the authors and those extracted from the WoS database (ISI Keyword Plus). In view of a large number of identified keywords, it was necessary to reduce the network. For this purpose, we established as a parameter that the keywords should have four occurrences or more. The method option for network normalization in SciMAT was by the Inclusion Index, considering its suitability to measure similar sets, without being influenced by the numbers of items of each set (Cobo et al., 2011a). For the clustering algorithm, we chose the Simple Centers Algorithm, also in line with Cobo et al., (2012a). Figure 3.5 presents the general strategic diagram of the literature on IT capabilities.

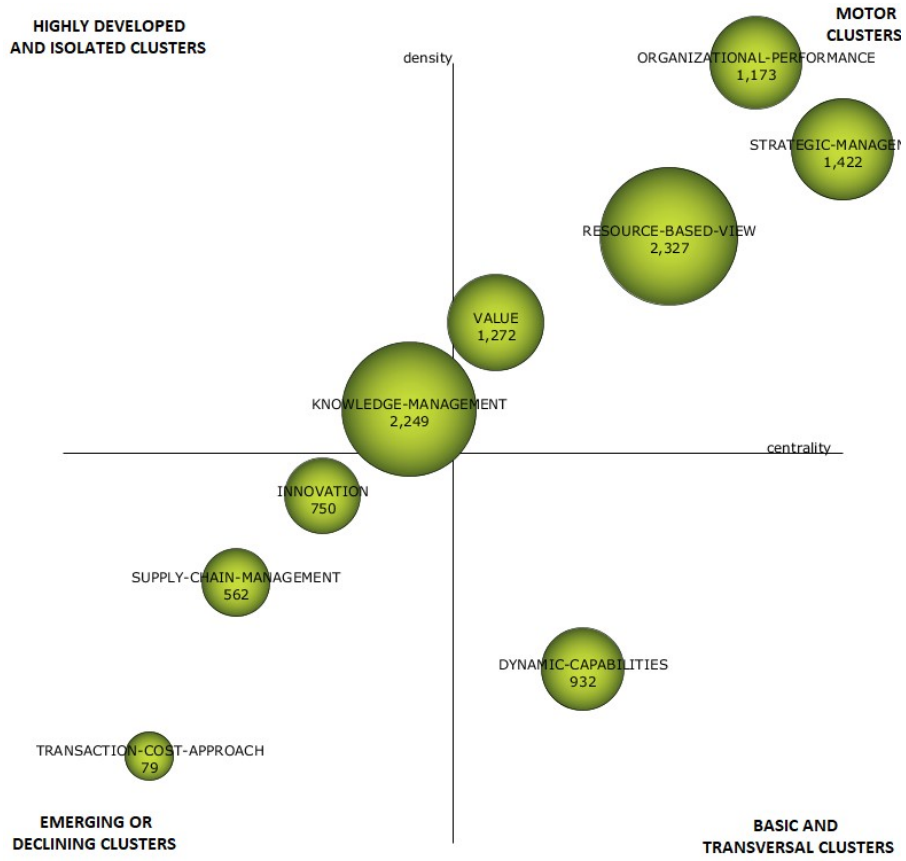

Figure 3.5 - Strategic diagram of IT skills theme.
Source: Own (SciMAT)

The driving themes of the area are organizational performance, strategic management, resource-based view, and value. More precisely, the resource-based view (RBV) is the connecting factor between the works that form the driving theme with the greatest impact in the field of IT capabilities, with 18 papers published and with 2,327 citations in the WoS database (Lioukas, Reuer, & Zollo, 2016). The cluster also covers topics such as environmental dynamism (Soto-Acosta, Popa, & Martinez-Conesa, 2018), service quality (Choy et al., 2014), and quality management (Benitez-Amado, Llorens-Montes, & Fernandez-Perez, 2015), as well as presenting areas in which research on IT capacities develops from RBV, such as health (Mandal, 2018) and customer relationship management (Keramati, Mehrabi, & Mojir, 2010). In turn, the cluster that brings together the 18 papers that focus on organizational performance accumulates 1,173 citations (Miao, Wang, & Jiraporn, 2018). The work of this cluster includes the themes of entrepreneurship (Y. Chen, Wang, Nevo, Benitez-Amado, & Kou, 2015), advertising (Dong & Wu, 2015), and financial performance (Popa, Soto-Acosta, & Perez-Gonzalez, 2018). Another driving theme of research involving IT capabilities is strategic management, which brings together 16 papers, cited 1,422 times (Côrte-Real, Oliveira, & Ruivo, 2017). Among the main topics associated are marketing (Zhao & Priporas, 2017), relationships between buyers and sellers (Rai, Pavlou, Im, & Du, 2012), orchestration of IT resources (Queiroz, Tallon, Sharma, & Coltman, 2018), and multiple business enterprises. In turn, the 26 papers that deal with the

value theme were cited 1,272 times (Krishnamoorthi & Mathew, 2018). Among the main topics associated are IT investments (K. Kim, Mithas, & Kimbrough, 2017), productivity (Han, Kauffman, & Nault, 2011), business intelligence (Ghasemaghaei, Ebrahimi, & Hassanein, 2018), IT-enabled resources (Nevo & Wade, 2010) and management capacity (Braojos, Benitez, & Llorens, 2019).

Despite not being located in the driving theme quadrant, the theme of knowledge management presented the greatest impact in the literature on IT capabilities, with its 21 papers having been cited 2,249 times (Bamel & Bamel, 2018). The cluster involves work on organizational learning (Koo, Lee, Heng, & Park, 2017), absorption capacity (Wang & Byrd, 2017), and business process management (Giacosa, Mazzoleni, & Usai, 2018). Finally, although they are not among the most developed, other themes have also proved important for research on IT capacity, especially innovation (Zhang & Hartley, 2018) and management of supply chains (Cai, Huang, Liu, & Liang, 2016), as well as the application of the theoretical lenses of dynamic capabilities (Wamba, Gunasekaran, Akter, Ren, Dubey & Childe, 2017) and transaction costs (Tebboune & Urquhart, 2016).

3.4.2.2 Thematic evolution

However, over time, the keywords in a research field do not remain the same (Cobo et al., 2011a). Thus, the literature on IT capabilities evolved over the period using different keywords to describe the content of the work, with new topics and others disappearing, but a subset of keywords that remained unchanged during consecutive subperiods. Figure 3.6 shows the evolution of the keywords used in the studies on IT capabilities. As explained in Cobo et al., (2011a), the circles indicate each period. The number of keywords of the period is represented inside. The arrows between consecutive periods represent the number of keywords shared between them. In addition, the index of similarity (or overlapping) of keywords between periods is shown in parentheses. The top input arrows represent the number of new keywords in each period. Finally, the top exit arrows represent the number of keywords that were discontinued in the next period.

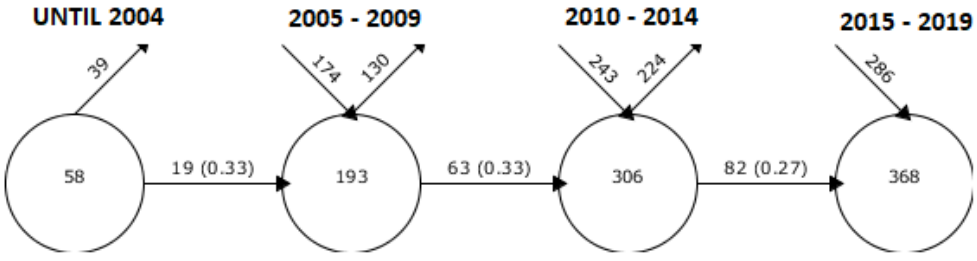

Figure 3.6 - Keywords renewal dynamics
Source: Own (SciMAT)

For example, in the third period (2010 - 2014), 306 keywords were registered, of which 82 remained for the following period (2015 - 2019), and 224 were no longer used. That is, the index of similarity between periods was 0.27 (27%). Similar dynamics are observed between the other

periods. Thus, the number of new and transient keywords is high, revealing a high level of thematic renewal in IT capability research. Therefore, the research fronts evolved over time, with Figure 3.7 showing the mapping of this evolution.

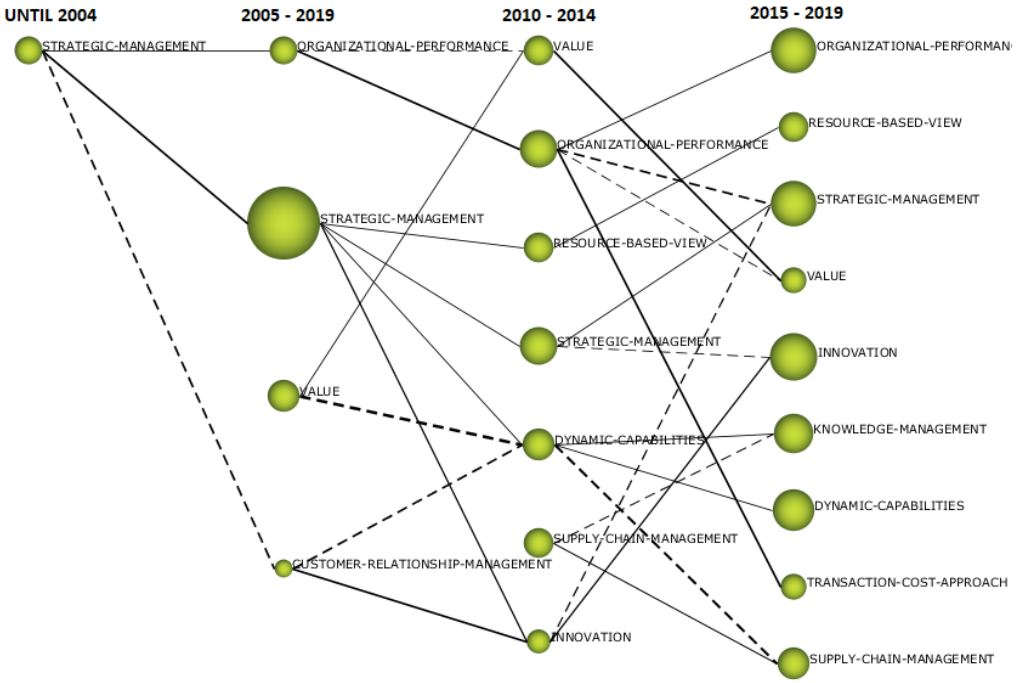

Figure 3.7 - Thematic longitudinal analysis (Source: SciMAT)

It is possible to visualize the longitudinal evolution of the research fronts graphically. The solid lines indicate that the existence of a relevant connection between thematic areas present in distinct periods. The dotted lines indicate that the link, although present, is less relevant. The strength of the relationship is also reinforced by the thickness of the lines. Finally, the volume of the spheres indicates the number of published studies (Cobo et al., 2011a). Thus, it is possible to identify the contributions and interrelations between the fronts over time. For example, studies associating IT capabilities and supply chain management have gained relevance between 2010 and 2014 (Liu et al., 2013). In the following period (2015 to 2019), the supply chain theme, in addition to forming a front, also contributes with research on IT capabilities and knowledge management (Leal-Millán, Roldán, Leal-Rodríguez, & Ortega-Gutiérrez, 2016).

3.4.3 Intellectual Structures

To identify the most important documents that gave rise to or influenced the current literature on IT capabilities, we applied the cocitation document analysis (Small, 1973). Given the large number of articles, we established that references would be analyzed with at least five citations, those most significant greatest impact on the development of literature. In addition, we manually excluded specific research methodology assignments to avoid distortions in the relations established by the citations. In the end, we selected 356 references for analysis. Considering the large number of references cited (10,967), we chose the fractional counting

method, as recommended by Perianes-Rodriguez, Waltman & van Eck (2016). The parameters for attraction and repulsion were set at 1 and 0, respectively.

Figure 3.8 shows a density map in which it is possible to observe the relations between the references. The works located in the red areas present the most significant weight in terms of the total binding force of the references in the analyzed set. That is, they are those that are linked to several other references, forming pairs that are more frequently cited in the analyzed sample. This indicates that these are fundamental works representing the main intellectual structures of the literature on IT capabilities.

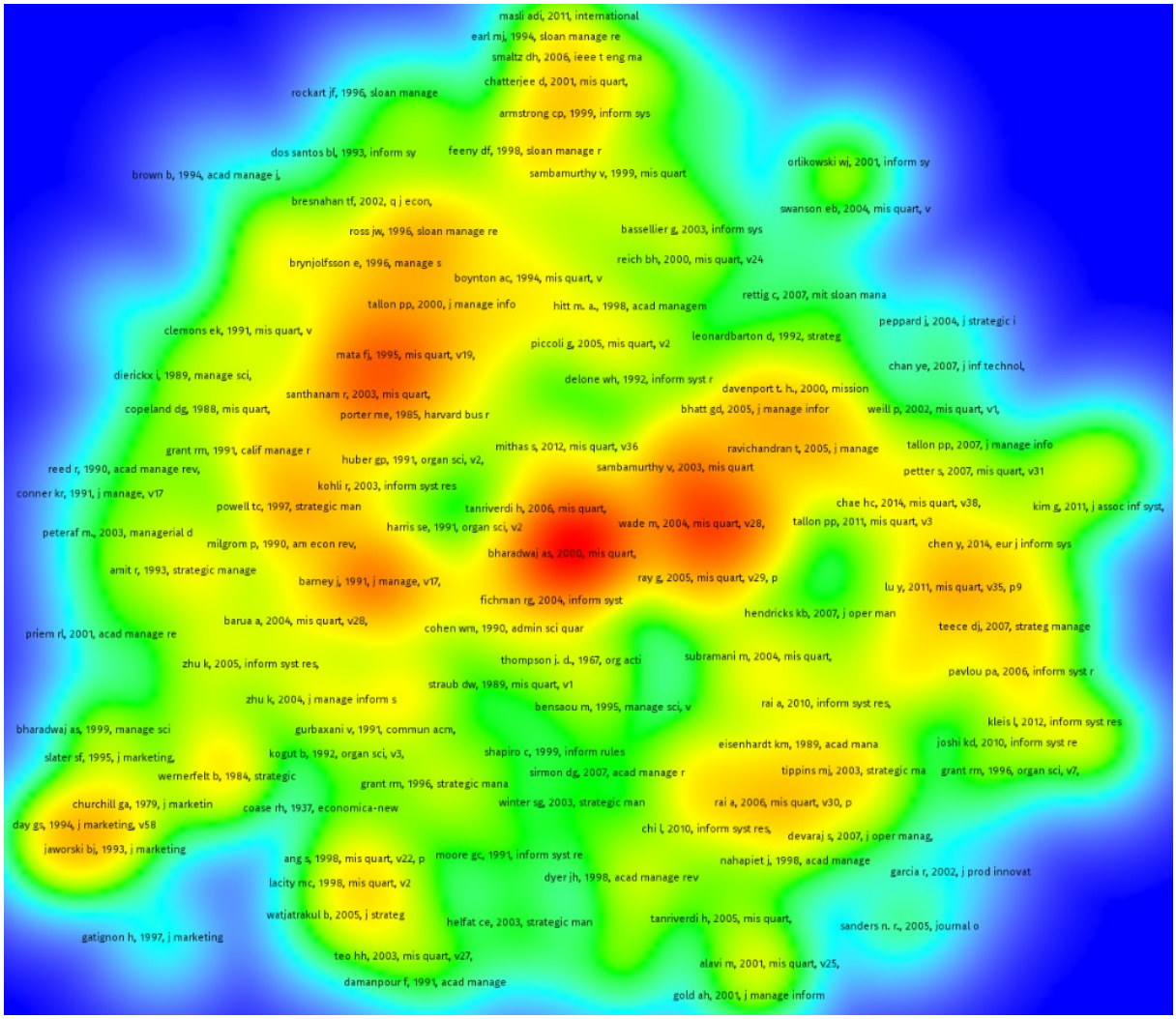

Figure 3.8 - Intellectual structures of the IT capabilities field
Source: Own (VOS viewer)

Among the main themes addressed by this central set of references, we highlight organizational performance (Bharadwaj, 2000; Ravichandran & Lertwongsatien, 2005), competitive advantage (Bhatt & Grover, 2005; Mata et al., 1995; Piccoli & Ives, 2017), organizational agility (Lu & Ramamurthy, 2011; Sambamurthy et al., 2003), leadership (Sambamurthy et al., 2003), IT and value (Melville, Kraemer, & Gurbaxani, 2017), organizational learning and knowledge management (Tippins & Sohi, 2003), supply chain management (Rai, Patnayakuni, & Seth,

2017; Subramani, 2017). The results also revealed that core works in various fields of the business area are fundamental for studies on IT capabilities, such as resource-based view (Barney, Wright, & Ketchen, 2001; Wernerfelt, 1984), dynamic capabilities (Eisenhardt & Martin, 2000; Teece, Pisano, & Shuen, 1997), absorption capacity (Cohen & Levinthal, 2006), as well as the literature on competitive advantage (Powell & Dent-Micallef, 1997; Ray, Barney, & Muhanna, 2004).

3.4.4 Research fronts

To identify the latest research fronts involving IT capabilities, we applied the technique of the bibliographic coupling of articles on the scientific production published between the years of 2015 and 2019 (until April 5, 2019, date of the survey), as directed by the specialized literature (Zupic & Čater, 2015). We collected 92 studies without applying criteria of a number of citations. Thus, it was possible to identify the five fronts of research that presented themselves more clearly in the mapping process and being very active, both in terms of production and quotations.

3.4.4.1 Business analytics

In the set of studies on IT capabilities, we identified an important research front whose studies involve using Big Data Analytics (BDA) in organizations. For example, Gupta and George (2016) identified several organizational levels of resources that, in combination, build the capacity of analysis with DBA and empirically validate the relationship between DBA and organizational performance. Jeble et al. (2018) analyzed the impact of the BDA and predictive analytical capacity on the sustainability of the supply chain from the theoretical lenses of the resource-based view (RBV) and contingency theory. Wang and Byrd (2017), from the theories of dynamic capabilities and RBV, conceptualized the ability of business analysis as a multidimensional construct and have suggested that the effective use of data analysis and interpretation tools in health units indirectly influences the effectiveness of decision making, this impact is mediated by the absorption capacity. Still, in the health field, Wang and Hajli (2017) used the RBV and the capacity development vision to explain how BDA resources can be developed and what potential benefits can be derived from these resources. Wamba et al. (2017) associated the RBV theoretical lens with the literature on the success of information systems and the commercial value of IT to examine the effects of the BDA on organizational performance. Other relevant works were on this front of research (Côrte-Real et al., 2017; Ghasemaghaei et al., 2018).

3.4.4.2 Ambidexterity

The results indicated that another recent and promising research front underlying the literature on IT capabilities of organizations involves ambidexterity. For example, Heckmann & Maedche (2018) emphasize, from a qualitative approach, the importance of balancing the exploitation and exploration capacities of IT-based business processes. Ferraris, Monge, and Mueller (2018) empirically addressed the relationship between the ambitious IT capabilities and the

performance of business processes. Soto-Acosta et al. (2018) studied how IT, knowledge management, and environmental dynamism influence the ambitious characteristics of innovation in small enterprises based on the theory of Technology-Organization-Environment and the Knowledge-Based Vision. For example, Lee, Sambamurthy, Lim, Wei, and Lee (2015) empirically identified that IT ambidexterity increases organizational agility. On the same line, Mao and Quan (2015) studied the conditions under which IT capabilities enable agility, paying particular attention to IT exploitation and exploration capabilities. Organizational agility, in turn, revealed the third research front identified in the present study.

3.4.4.3 Organizational agility

A central work for the research front that studies the subtopic organizational agility in the context of IT capabilities is Felipe, Roldán, & Leal-Rodríguez (2016), in which the authors proposed an explanatory and predictive model of organizational agility from the theory of dynamic capabilities. On the other hand, Queiroz et al. (2018) empirically studied the role of the orchestration capability of IT applications to improve agility and organizational performance. Panda and Rath (2016) investigated the apparently contradictory effect of IT ability on organizational agility. The authors identified that IT capacity acts as a facilitator for the business process and organizational agility. However, if IT investments are not adequately directed towards building higher capacity, it can negatively affect organizational agility. Other important jobs that link IT capabilities and organizational agility have also been identified (Liang, Wang, Xue, & Ge, 2017; Tan, Tan, Wang, & Sedera, 2017).

3.4.4.4 New products development

Another important focus of recent research involving IT capabilities is the new products development (NPD). For example, Kawakami, Barczak and Durmusoglu (2015), based on RBV, analyze whether there are three conditions (an IT executive advocate, global engagement, and organizational innovation that influence IT capabilities in turn affect the NPD results. Shortly after, Reid, Hultink, Marion, and Barczak (2016) empirically identified the impact of IT artifacts on pre-development performance in the NPD process. On the other hand, Addas and Pinsonneault (2016), based on the literature on knowledge management, conceptualize team knowledge processes as distinct channels of influence and examine their mediating role in the relationship between IT resources and NPD performance. Finally, based on IT value business literature, Mauerhoefer, Strese, and Brettel (2017) investigated empirically how the organizational antecedents, involving or not IT, translate into IT skills and competencies in the context of NPD, as well as its impact on NPD performance.

3.4.4.5 IT Supply

Finally, the last research front selected for the present work studies the various means, conditions, and strategies for IT supply. For example, Tebboune and Urquhart (2016) studied the phenomenon of netsourcing (rent or payment by consuming access to centrally managed

business applications and made available to third parties via the internet) from the RBV and the theory of transaction costs. On the other hand, Schneider & Sunyaev (2016) studied the determining factors for IT outsourcing decisions based on the cloud computing strategy through an extensive literature review. Tiwana and Kim (2016) are dedicated to exploring the growing trend of simultaneously internally structuring and hiring the same IT activity (concurrent IT sourcing). According to the authors, the results indicated that when an organization's internal resources complement the resources of its IT vendors, companies can internally maintain and simultaneously outsource the same IT activities, to improve the performance of internal and outsourced IT structures. Hanafizadeh and Zare Ravasan (2018) have also studied this theme.

3.4.5 Opportunities for new IT Capabilities research projects

Based on these active research fronts identified in section 3.4.4 of this paper, we were able to locate a diverse range of untapped opportunities that could generate insights for new research projects on the topic of IT Capabilities. Therefore, to complement the analysis of the bibliographic coupling and the mapping of scientific production, we carry out a qualitative analysis of the studies associated with each front. Thus, several research opportunities related to each front can provide valuable insights for researchers interested in the field. For example, about business analytics, given the growth in the number of data-driven companies, future research can compare the adoption and development of BDA between these companies and the traditional ones (Gupta & George, 2016). Future research may also operationalize the construct analysis capability from the actual impact of the use of BDA, and not just based on perceptions (Jeble et al., 2018). Another opportunity is to apply, in a sample with characteristics different from the original, confirmatory factor analysis on the new scale of analytical capacity proposed by Wang and Byrd (2017). Alternating to the front that studies ambidexterity, future research can take a quantitative approach to validate the recent IT business process capabilities model proposed by Heckmann and Maedche (2018). Future research may also direct the focus to strategies involving explorative change and analyze if different combination strategies have the same impact depending on the uncertainty characteristics of this business process, considering that exploitation is more valuable in dynamic environments (Ferraris et al., 2018). At the front on organizational agility, it is still necessary to identify the main antecedents of the orchestration capacity of IT applications, as well as investigate how the orchestration capability of IT applications and the characteristics of the resource allocation process jointly influence the agility and performance of the enterprise (Queiroz et al., 2018). Another possibility on this front involves investigating whether social alignment between IT and business executives can lead to cognitive inertia, negatively impacting organizational agility (Liang et al., 2017). About the front involving IT and NPD capabilities, future studies may consider the differences in country infrastructure when examining the impact of the frequency of use of IT artifacts on NPD performance, as well as reviewing the frequency and importance of IT artifacts at any stage of the NPD process, not just from the pre-development stage (Reid et al., 2016). Future studies can examine how NPD-related IT capabilities and competencies affect other organizational capabilities (marketing capability) or organizational results (such as product quality or degree of

innovation). Another gap is the need to explore tools or IT functionalities directed to NPD project management, not only those applicable at the operational level (Mauerhoefer et al., 2017). Finally, in the field of IT supply, future research can adopt a quantitative approach to empirically validate the propositions about netsourcing strategies presented by Tebboune and Urquhart (2016), as well as to extend the investigation through the use of other theoretical references, such as agency theory or resource dependency theory, in order to increase the consistency of results. Other examples of advancement opportunities can be the conceptualization of IT resources in a multidimensional way, including infrastructure assets and cultural elements of the organization. Further studies may also consider other delivery modalities related to IT outsourcing, such as multisourcing, conic integration, or parallel outsourcing (Tiwana & Kim, 2016). These and other opportunities fostered by the research fronts indicate that the topic of IT capabilities still has much to develop, making it a fertile and promising path for researchers in management and IT. Table 3.2 summarizes these, and other opportunities identified for advancing research in the context of IT capabilities.

Table 3.2 - Research opportunities on each research front

Research Front	Source	Opportunities
Business Analytics	Gupta and George (2016) Toward the development of a big data analytics capability	Extend the Big Data Analysis Capability model from tangible, human and intangible resources, specifically related to the context of "big data". Assess the differences between traditional companies and new generation companies, strongly based on Technology (such as UBER, AirBNB) in terms of adoption and development of Big Data Analyzes Capability. Validate the research tool presented by the authors, from data sources other than Linkedin, as well as validating the results achieved in other cultural and economic contexts, in addition to the United States.
	Jeble et al. (2018) Impact of big data and predictive analytics capability on supply chain sustainability.	Evaluate the causal relationships proposed by the study, involving Big Data & Predictive Analytics and supply chain performance, from a longitudinal perspective. Build and validate more comprehensive scales for BDPA capacity, as well as measuring its real (not just perceptual) impact on sustainable supply chain performance measures. Obtain and analyze data from a larger number of markets, countries and informants with different experiences to improve the generalization of the conclusions of the presented study.
	Wang and Byrd (2017) Business analytics-enabled decision-making effectiveness through knowledge absorptive capacity in health care.	Investigate possible facilitating, moderating and mediating effects of factors such as IT human resources, dynamic and improvisational capabilities, as well as specific organizational resources (such as data governance, synergy and culture) in the relationship between knowledge absorptive capacity and Business analytics-enabled decision-making effectiveness. Analyze the complexity of the interaction and possible interdependence between the factors described above, as well as examining how different organizational settings influence value creation.

	Wang and Hajli (2017) Exploring the path to big data analytics success in healthcare	Validate the model proposed by the authors from the use of academic data and information, in view of the evolution of research in the area studied by the authors, as well as assessing the role of additional variables, such as hospital size and type of institution (public or private). Apply the Big Data analysis model proposed by the authors to other sectors besides the health sector, in order to validate the general use capacity of the model. Apply quantitative approaches to validate the proposed model, in order to obtain empirical evidence that corroborates the results presented by the authors.
	Wamba et al. (2017) Big data analytics and firm performance: Effects of dynamic capabilities.	Apply the conceptual model presented in other market and cultural contexts. Apply a longitudinal approach to validate the results presented. Use objective performance measures (not perceptual) Adapt the research tool presented to other contexts (for example, customer analysis, supply chain analysis, etc), through rigorous statistical procedures. Analyze the effects of organizational culture and senior management commitment, possibly with a moderating effect on the relationships proposed by the authors.
	Côrte-Real et al. (2017) Assessing business value of Big Data Analytics in European firms.	Apply a longitudinal approach to validate the results found by the authors. Adapt and test the conceptual model, moving from the organizational level to the process level, in specific business areas. Use objective (non-perceptual) performance measures. Apply the model to countries that are not fully developed, to compare the results and identify any differences with the results achieved in the European context. Identification of possible differences between European regions.
	Ghasemaghaei et al. (2018) Data analytics competency for improving firm decision making performance	Analyze the influence of other organizational factors, such as, for example, the type of organizational structure or the specificity of the business processes, in the relationship between competence for data analysis and the performance of the decision-making process. Validate the results found in longitudinal surveys and in economic and cultural environments other than the North American. Include other 'big data' features in the model, such as Value, and Veracity. Include the decision type variable in future tests of the conceptual model, to identify the application of the model to specific decision-making contexts, such as marketing, recruitment, for example.
Ambidexterity	Heckmann & Maedche (2018) IT ambidexterity for business processes: the importance of	Continue the process of theoretical development initiated by the authors, based on the application of complementary approaches, such as configurational, for example, as well as the inclusion of contextual factors. Replicate the proposed model to other cultural,

	balance	organizational and economic contexts, besides the German electric sector, to increase the power of generalization of the model. Identify the impact of business process ambidexterity on the company's performance, based on a real process. Apply longitudinal approaches, considering that the organizational ambidexterity, by nature, evolves during the temple.
	Ferraris, Monge and Mueller (2018) Ambidextrous IT capabilities and business process performance: an empirical analysis	Investigate more focused exploratory change to the detriment of exploitative execution, especially at the business process level, as well as different if combination strategies have the same impact, depending on the uncertainty characteristics of each business process. Investigate the generalization potential of the results presented by the authors, from the replication of the study in other cultural and economic contexts, in addition to the Italian hospitality industry, as well as from the extension of the study with the application of longitudinal approaches.
	Soto-Acosta et al. (2018) Information technology, knowledge management and environmental dynamism as drivers of innovation ambidexterity: a study in SMEs	Expanding the base of companies to be studied in future research, from a sampling base that brings together companies from different countries could be used to provide a more international perspective on the subject, as well as the use of different informants in each organization, not being restricted to the key informant method used by the authors. Expansion of the number of factors whose relationships can be studied together with although the IT capacity, knowledge management capacity and environmental dynamism, such as organizational culture, leadership and open innovation. Use objective financial indicators to measure organizational performance, going beyond the application of perceptual measures.
	Lee, Sambamurthy, Lim, Wei and Lee (2015) How Does IT Ambidexterity Impact Organizational Agility?	Investigate possible changes in the relationship between ambidexterity and IT agility in different business environments and conditions (high and low dynamics, for example). Examine further how other potential capabilities and conditions can interact with the IT ambidexterity to enable organizational agility or other types of dynamic capabilities (for example, ability to develop new products), especially under the different environments conditions. Expand research on the emerging capacity of IT ambidexterity and its impact on companies. In particular, instead of examining IT ambidexterity as a combined capability, IT exploration and IT exploitation resources can be segregated and examined in terms of different values of their various combinations in different business conditions.
Organizational Agility	Queiroz et al. (2018) The role of IT application orchestration capability in improving agility and performance	Investigate whether the characteristics of the resource allocation process, as formalization and centralization incorporated into IT governance processes, structures and relationships, influence the orchestration capacity of IT applications. Analyze how the orchestration capacity of IT applications and the characteristics of the resource allocation process jointly influence the agility and performance of the company.

		Study how the orchestration capacity of IT applications relates to the ability to achieve and maintain the alignment between IT and business strategy. Investigate the main antecedents of IT application orchestration capacity, such as governance processes, outsourcing, supplier relationship management and change management. Explore the possible role of environmental factors in explaining the effects of IT application orchestration capacity, such as market turbulence and uncertainty.
	Panda and Rath (2016) Investigating the structural linkage between IT capability and organizational agility	Investigate the ability to generalize results from complementary research projects, such as longitudinal or experimental, to further explore the causal relationship between IT capacity and organizational agility. Analyze the potential of IT capabilities as a facilitator for superior agility and agile ability of companies to build greater IT capacity (enabler for superior agility and agile firms' ability to build greater IT capability). Investigate the company's effective use of IT to develop resources and increase agility at the business process level, as well as at the corporate level.
	Liang, Wang, Xue, & Ge (2017) Unraveling the alignment paradox: How does business-IT alignment shape organizational agility?	Extend the scope of the investigation to other cultural and economic contexts, beyond the Chinese shipbuilding industry, as well as applying longitudinal approaches, in order to test the power of generalization of the results found by the researchers. Deepen the conceptual model presented, including the analysis of the relationship between social alignment and cognitive inertia. Expand the conceptual model presented, making it more comprehensive. For example, examining how inertia is shaped under intellectual alignment is a promising line of research.
New Products Development	Kawakami, Barczak and Durmusoglu (2015) Information technology tools in new product development: The impact of complementary resources	Evaluate the ability to generalize the results, based on replication of the study in diverse cultural and economic environments in Japan, with emphasis on Latin America, as well as applying longitudinal research approaches. Expansion of the model proposed by the authors, testing contingent relationships. For example, asset specificity is a potential moderator. In addition, future research can capture several other constructs related to IT tools and investigate whether there is a second order construct that can be labeled "IT tool competence for NPD", which is a source of sustained competitive advantage. Examine whether different contexts (for example, product innovation, nature of global partners) can alter this relationship between global engagement and the frequency of IT tool replacement.
	Reid, Hultink, Marion and Barczak (2016) The impact of the frequency of usage of IT artifacts on predevelopment performance in the NPD process	Examine the conceptual structure in specific sectors to determine the importance of these relationships in the model proposed by the authors. Expansion of the scope of the research to other environments, cultural, economic and technological, in addition to the one used (Australian companies). Examine the frequency of use and the importance of specific IT artifacts and their influence at any stage of the NPD process, for example, how ideation software applications are used inter-organizationally to

		promote the co-creation of ideas in the pre-development stage.
	Addas and Pinsonneault (2016) IT capabilities and NPD performance: Examining the mediating role of team knowledge processes	Deepen research into the consequences of using IT to enable external knowledge processes, either vertically (for example, co-developing products with customers or suppliers) or horizontally (for example, product co-development with alliance members), and how it all influences the efficiency and effectiveness of the NPD Apply the conceptual framework to dynamic NPD environments, but with caution, as such environments may require other types of IT resources and KM processes, such as dynamic IT capabilities, absorption capacity and reconfiguration of knowledge. Investigate the role of NPD team leaders in the proposed conceptual model. Specifically, it can be suggested that the characteristics of the NPD team leader can influence the types of IT used in the NPD teams and also have a direct effect on the team's knowledge processes.
	Mauerhoefer, Strese and Brettel (2017) The Impact of Information Technology on New Product Development Performance	Include in the model the potential dynamic effects of IT resource development and IT leverage competency, for example, examining the time patterns of changes in NPD IT capabilities and competencies resulting from investments in new IT tools, from the introduction of a formal executive champion role or other non-IT background. Expand the conceptual model by examining contingencies and other antecedents and results of NPD's IT capabilities and competencies. For example, investigating IT spending (for example, on hardware, software or training) as a moderator of the relationships between company-level IT resources or executive champion and NPD IT resources can help identify the appropriate level of NPD IT investments. Extend the scope of the research to other cultural and economic environments, in addition to the German business. Explore the existence of certain IT tools or IT functionality that are important to NPD managers who conduct one or more NPD projects (that is, IT features that support management tasks), instead of members of the NPD team (i.e. IT features that facilitate operational tasks). Analyze how NPD IT capabilities and competencies affect other capabilities (for example, technological or marketing capabilities) or other performance metrics (for example, product quality, degree of innovation). In this sense, it is suggested to use the updated concept of IT leverage competence in NPD.
IT Supply	Tebboune and Urquhart (2016) Netsourcing strategies for vendors: A resource-based and transaction	Expand the sample size in future research, as well as the inclusion of other theoretical lenses, such as agency theory and resource dependency theory.

cost economics perspective	
Schneider & Sunyaev (2016) Determinant factors of cloud-sourcing decisions: Reflecting on the IT outsourcing literature in the era of cloud computing	Direct attention to factors other than technology characteristics, such as organizational, individual and environmental characteristics, in the context of cloud outsourcing decisions Distinguish environmental uncertainty from demand uncertainty and product uncertainty to clarify inconsistent findings in the context of cloud computing. Extend research on IT outsourcing by including technological aspects, such as security risks, availability risks, perceived complexity of innovation, reduced time to market and supplier service resources. Apply a micro-level perspective to investigate cloud outsourcing decisions, as well as combine factors from strategic and economic theories with factors from social or organizational theories, particularly determining factors of the categories individual characteristics and environmental characteristics.
Tiwana and Kim (2016) Concurrent IT Sourcing: Mechanisms and Contingent Advantages	Explore the possible effects of other factors that affect the simultaneous benefits of IT outsourcing, as well as other consequences, such as IT ambidexterity. Examples of factors include whether the client outsources primarily to access experience or to reduce costs, inter-firm asymmetries in the maturity of IT capacity, formal control mechanisms used and interfirm energy asymmetry. Conceptualize IT Capabilities at the company level in a multidimensional way that include IT infrastructure assets and cultural elements of the company's capabilities
Hanafizadeh & Zare Ravasan (2018) An empirical analysis on outsourcing decision: the case of e-banking services	Use user-centered theories to analyze the IT outsourcing process, especially the theory of planned behavior (TPB), focusing on user adoption and acceptance. Test the power of generalization of the results presented, based on longitudinal strategies and comparisons of results obtained in contexts of greater or lesser economic development. In addition, differences in context, client size or even selected outsourcing strategy can be analyzed. Analyze the effect of the outsourcing strategy, as well as the public or private type of the client organization, as well as studying the IT outsourcing process from the perspective of different stakeholders from IT executives, as business owners, CEOs and people whose careers are influenced and even threatened by outsourcing initiatives. Consider the concept of IT portfolio outsourcing, instead of outsourcing IT services and processes in isolation.

Source: Own

3.5 Conclusions

This study aimed to analyze the scientific literature on IT capabilities, in search of revealing its conceptual and intellectual strutures, and presenting the state of the art of research on the field. We analyzed 219 works using the innovative use of three complementary software and the application of several bibliometric techniques. As a result, we present a consistent and harmonious narrative about the origin, evolution, and future of IT capabilities research to the academic community. The fundamental themes for structuring the whole of the scientific production on IT capabilities, which had a higher level of development and connection with external research flows, are organizational performance, strategic management, resource, and value-based view. Thus, future researchers will find underlying literature on IT capabilities in the context of business a rich and varied literature involving these major themes, as well as various sub-themes associated with each driving theme, as presented in the course of the article. Another contribution of this work is the presentation to the academic community of the intellectual structural main field, i.e., those works with high levels of cocitation and grouped in relatively cohesive thematic blocks. These work clusters explore topics such as organizational performance, competitive advantage, organizational agility, leadership, organizational learning and knowledge management, IT use and value, and supply chain management. Another significant contribution of the work was the identification of the main paths that have been taken in recent years by researchers, that is, the state-of-the-art literature on IT capabilities. In this sense, we highlight the current research on business analytics, ambidexterity, organizational agility, the development of new products, and IT supply. These five themes represent the main working fronts in the field.

Like all scientific research, this study is not free of limitations, including those resulting from the choice of keywords and the use of only one database. In this sense, future studies can broaden the scope and include works published in the Scopus database, considered more comprehensive (Zupic & Čater, 2015). This would be especially useful for mapping more minor, non-WoS-covered search areas. However, during the pre-processing phase and addressing duplicities, researchers should be aware of the differences between the databases. For example, Scopus contains data for all authors of cited references, unlike WoS that contains only information from the first author, which can cause distortions in the analysis of quotation and cocitation. Another possibility of advancement for applying the bibliometric approach of the literature would be the development of software that would allow the junction of databases and the transfer of pre-processed data between the several bibliometric software in a more intuitive way. Thus, researchers who do not master databases and programming languages would expand their possibilities of performing bibliometric analyses of the literature, either to produce articles similar to this or to enrich the critical literature review of any scientific study.

Chapter 4

The role of information technology capabilities, IT reconfiguration capability and innovativeness on organizational performance: evidence from the Brazilian public sector

Abstract

In view of the growing volume of resources invested in information technology each year, public sector organizations must increasingly have the ability to gather, integrate and implement IT resources in order to meet the needs of organizational processes. In addition, public organizations are increasingly demanding to be more agile and flexible in order to meet the dynamic demands of societies. In this sense, public organizations must be able to properly manage and apply the IT resources available to them, as well as create organizational environments that allow and encourage the flourishing of innovation. That is, they must learn to cultivate IT capabilities and innovativeness, with the objective of better performing its mission and creating public value. Thus, this study aims to identify the existing relationships between innovativeness, IT capabilities, IT reconfiguration capability, and organizational performance in the context of the public sector. To this end, data from 254 Brazilian public organizations of the most diverse sizes and sectors were analyzed using a structural equation approach (SEM). The results indicated that the ability to reconfigure IT must be listed among the IT capabilities of public organizations, as well as that IT capabilities play a role in fostering organizations' innovativeness and that both (IT capabilities and the innovativeness) have a positive impact on the performance of organizations. When testing theoretical propositions identified in the context of the private sector but insufficiently evaluated in the public sector, the study adds a block in the building of knowledge about innovation capacity and IT capacities, as well as points out ways for public managers on how they can make their institutions better prepared to face constantly changing environments.

Keywords: Organizational performance; Innovativeness, IT capabilities; Public sector

4.1 Introduction

The innovativeness, that is, the ability that organizations have to generate and implement new processes, products, or ideas, is increasingly recognized as fundamental to improving organizational performance (Hult, Hurley, & Knight, 2004; Parida, Pesämaa, Wincent, &

Westerberg, 2017; Rosenbusch, Brinckmann, & Bausch, 2011; Subramanian & Nilakanta, 1996). Organizational innovativeness is part of the corporate culture, from which the conditions are created for different actors, inside and outside the organization, to get involved in all phases of the innovation process (Boso, Story, & Cadogan, 2013). In the same vein, more and more frequent, social changes put pressure on public organizations to be vigilant, understand the circumstances that lead to change, and capture the emerging needs and aspirations of citizens and institutions (Hartley, 2015). Thus, public sector organizations increasingly need to be flexible and agile and learn to deal with emerging challenges in an innovative way (Dunleavy, Margetts, Bastow, & Tinkler, 2006).

Thus, the literature points out a possible way to expand the organizational innovativeness in the public sector the appropriate application of information technology (IT) (Hartley, 2015; Pang, Lee, & Delone, 2014). More specifically, organizations must develop their skills to gather, integrate and implement IT resources, focusing on meeting the needs of their organizational processes, that is, their IT capabilities (Liu, Huang, Wei, & Huang, 2015). Thus, IT capabilities are a set of resources, skills, and knowledge related to IT, but exercised through business processes to improve organizational results (Stoel & Muhanna, 2009). In addition, recent advances in the literature point out that organizations that operate in turbulent and constantly changing environments also need to develop a specific aspect of their IT capabilities, i.e., the ability to reconfigure IT resources to deal with unplanned changes and situations (Oliveira, Maçada, & Oliveira, 2016; Pavlou & Sawy, 2010). Public organizations, in turn, are large consumers of IT and make even more significant investments, acquiring or contracting more and more software solutions, hardware, cloud storage, and processing services, IT management advice, team training, among others (Pang et al., 2014).

Despite this, the literature on the capacity to innovate and IT capabilities in the public sector is much less developed than its private-sector counterpart, with a significant lack of specific scientific knowledge on the subject (Hartley, 2015; Pang et al., 2014). To help fill this gap, the present study seeks to associate the phenomena innovativeness, IT capabilities, and IT reconfiguration capability, in the context of the Brazilian public sector, to study theoretical relationships based on the literature in the areas of information and innovation systems, as well as their impact on organizational performance. More specifically, the objective of the present study is to identify the existing relationships between innovativeness, IT capabilities, IT reconfiguration capabilities, and organizational performance in the context of the public sector. To this end, data were studied from 254 Brazilian public organizations of the most diverse sizes and sectors through a covariance-based structural equation approach (CB-SEM). In a complementary and exploratory manner, the study aimed to measure the effect of differences related to the size of organizations and their sphere of action concerning each of the factors that make up IT capabilities, as well as the innovativeness. This complementary analysis is justified with the alert of Rainey and Chun (2007) in the sense that organizations can present significant

variations depending on their size and sectors of activity, that is, organizational characteristics and sector of activity can affect innovation processes and their results.

The present study has theoretical and practical implications. Regarding the evolution of the scientific literature, the results presented can serve as a point of comparison with future studies carried out in other geographical, social, and economic contexts. In addition, when testing theoretical propositions already identified in the private sector but insufficiently evaluated in the public sector, the study adds a small block in building knowledge about innovativeness and IT capabilities. In the practical field, the results point out ways for public managers to make their institutions better prepared to face an ever-changing environment and improve organizational performance.

After this introduction, the study content was organized as follows: The following section presents a review of the literature on organizational IT capabilities and capabilities to innovate, accompanied by the hypotheses and conceptual model adopted by the study. The following section explains the methodological aspects used to collect and analyze the data. The results of the analysis for the hypotheses presented and the discussion of the results are carried out below. Finally, the final considerations of the study are presented, highlighting the implications of the results, the limitations of the research, and the presentation of suggestions for future research.

4.2 Literature review

4.2.1 IT Organizational Capabilities

The skills that organizations have to gather, integrate and implement IT resources in order to meet the needs of their organizational processes, are presented in the specialized literature as IT capabilities (Liu, Huang, Wei, & Huang, 2015a). That is, IT capabilities are a set of IT-related resources, skills, and knowledge, but exercised through business processes, to improve organizational results (Stoel & Muhanna, 2009). In this sense, from the theoretical basis of the Resource-Based View (RBV), the literature presents evidence that effectively IT capabilities, and not direct investments in technology, can improve organizational performance (Mata, Fuerst, & Barney, 1995; Powell & Dent-Micallef, 1997; Ray, Muhanna, & Barney, 2005; Stoel & Muhanna, 2009; Stratopoulos & Dehning, 2000). The literature points out that IT capabilities provide organizations with several benefits, such as improving business processes and organizational agility, increasing the capacity to innovate, as well as improving organizational performance and obtaining competitive advantages (Bharadwaj, 2000; Chen & Tsou, 2012; Kim, Shin, Kim, & Lee, 2011; Kmieciak, Michna, & Meczynska, 2012; Liu et al., 2015a; Lu & Ramamurthy, 2011; Oliveira et al., 2016; Rai, Pavlou, & Du, 2012).

In this sense, the literature records several proposals for the definition and operationalization of IT organizational capabilities. For example, Yoon (2011), that defined the concept of corporate IT capabilities as the total IT capability that a company must maintain to efficiently support its management activities and improve its business performance in an IT environment, operationalized the concept from four dimensions, that is, IT strategy, IT knowledge, IT operations and IT infrastructure. In turn, Lu and Ramamurthy (2011) focused on the theme and operationalized IT capabilities as a latent construct composed of three dimensions: i) IT infrastructure capacity; ii) IT business capability; iii) proactive IT capability. As for Kim et al. (2011), from a Dynamic Capabilities perspective, the dimensions of organizational IT capabilities should be: i) IT expertise; ii) IT infrastructure flexibility; iii) IT management capability. Posteriorly, Chen and Tsou (2012) proposed that IT capabilities should be understood as a second-order latent construct, composed of the factors: i) IT infrastructure, ii) IT business expertise; iii) IT relationship resources; iv) IT human resources. Kmieciak et al. (2012) operationalized IT capabilities in three dimensions, related to the use of IT to support business areas: i) IT knowledge; ii) integration of IT with business strategy; iii) internal communication from IT.

Chen, Wang, Nevo, Benitez-Amado, and Kou (2015) revisited the theme, associating it with other organizational capabilities, including innovativeness. The authors proposed that organizational IT capabilities should be operationalized as a second-order construct, composed of four dimensions: IT infrastructure flexibility, IT integration, IT and business alignment, and IT management. According to the authors, the flexibility of the IT infrastructure refers to the extent to which an organization's IT infrastructure is scalable, modular, compatible with legacy systems, and capable of serving various business applications. IT integration refers to how a company links its IT to that of its business partners. IT management refers to the company's ability to implement IT-related activities effectively. IT business alignment refers to the extent to which IT and business operations share congruent goals and maintain a harmonious relationship. According to the authors, comparing it with the other models for operationalizing IT capability present in the literature, the form proposed by the authors is the most appropriate, considering that it enables its association, systemically, the dynamics of corporate entrepreneurship, as well as the capability for organizational innovation. In this sense, considering the present work we propose to study the relationship between IT capabilities and innovativeness, we used the instrument offered by Chen et al. (2015) as a basis for operationalizing IT organizational capabilities.

On the other hand, based on the theoretical approach of Dynamic Capabilities, more specifically from the notion that an organization must have sufficient ability to purposely create, extend or modify its resource base (Helfat, Finkelstein, Mitchell, Peteraf, Singh, Teece & Winter, 2007), the IT literature has recognized the importance of organizational ability to improvise and reconfigure IT resources (Pavlou & Sawy, 2010; Pavlou & Gefen, 2006). Thus, the present work is associated with Oliveira et al. (2016) and adds the ability to reconfigure IT as one of the

dimensions of IT capabilities. According to Pavlou and Sawy (2010), the ability to improvise is to act in an unplanned way from the reconfiguration of IT resources. It is a very important skill for situations involving new technological applications, which can be especially useful for fostering organizational innovation.

Considering that the focus of this study is aimed at the public sector, it is necessary to present a current overview of studies on IT capabilities in this context. Firstly, it should be noted that there is a lack of scientific literature in this area, including theoretical bases to study the value of IT in the public sector (Pang et al., 2014). For example, studies that apply the IT reconfiguration dimension within the public sector, as opposed to the private sector, have not been found in the specialized literature, as seen in Oliveira et al. (2016). A notable exception to the scarcity of literature on IT capabilities and the public sector is the conceptual study by Pang et al. (2014). Possible theoretical paths for converting IT investments into the performance of public organizations are indicated, with a focus on generating value for citizens. Among other possibilities, the authors suggest that the innovative capacity of public organizations can be a way to improve organizational performance. The authors also highlight the potential for the positive influence of IT capabilities and resources on organizational innovativeness.

4.2.2 Organizational innovativeness

Organizational innovativeness is classically defined as the skill set of an organization that allows it to create new processes, products, or ideas (Hult, Hurley, & Knight, 2004). According to Tsai (2001), innovativeness is the organizational ability to obtain new knowledge with the encouragement of learning and the exploitation of relevant external knowledge. Innovativeness is also recognized as an organization's propensity to innovate or develop new products and the level at which the organization encourages and supports new processes or services (Garcia & Calantone, 2002; Pesämaa, Shoham, Wincent, & Ruvio, 2013). Innovativeness is a concept applied in a multidisciplinary way by the literature of the management area, with deep connections with other themes such as strategic management, organizational performance, knowledge management, and market orientation (Marchiori, Popadiuk, Mainardes, & Rodrigues, 2020). Despite the existence of a tension between understanding the innovativeness as a culture or as an effective behavior, the prevailing opinion understands the concept as a cultural aspect of organizations (Story, Boso, & Cadogan, 2015).

Several studies have investigated the relationship between innovativeness and organizational results. For example, Hyytinen, Pajarinen, and Rouvinen (2015) highlight the positive relationship between innovation and the survival of organizations. The literature explores, in-depth, the positive impacts of innovation on organizational performance (Boso, Story, & Cadogan, 2013; Hult et al., 2004; Kyrgidou & Spyropoulou, 2013; Panayides & Lun, 2009; Parida, Pesämaa, Wincent, & Westerberg, 2017; Rhee, Park, & Lee, 2010; Rosenbusch, Brinckmann, & Bausch, 2011; Salge & Vera, 2009). Following this line of reasoning, one of the

pioneering studies relating to performance and innovativeness was conducted by Subramanian and Nilakanta (1996). Deshpandé, Farley, and Webster (1993) identified that the ability to innovate, especially when related to market innovations, positively impacts organizational performance. In addition, even if considered at the level of work teams, the innovativeness can positively impact the organization's performance in general terms (Akhavan & Mahdi Hosseini, 2016; Kim & Lee, 2012).

In the field of entrepreneurship, innovativeness represents one of the dimensions of entrepreneurial orientation (alongside proactivity and the propensity to accept risks), and that is reflected in the tendency of organizations to support new ideas, experimentation, and creative processes that can result in new products, services, or technological processes (Lumpkin & Dess, 1996; Rodrigues & Raposo, 2011). Szymanski, Kroff & Troy (2007) identified that innovativeness could be a source of competitive advantage, especially when focusing on new solutions for the market and not for the company. Regarding the antecedents, recent evidence indicates that organizational innovativeness can be boosted by intra-organizational collaboration (Alexiev, Volberda, & Van den Bosch, 2016). Para Hult et al. (2004), innovativeness can benefit from other organizational characteristics, such as market orientation, entrepreneurial orientation, and learning orientation. But the literature recognizes that it is necessary to understand better the factors that drive innovation in organizations, as well as how they exert their influence on organizational results (Hult et al., 2004).

In turn, research on innovativeness in the public sector is scarce as part of this study. For example, Hartley (2015) explains that the innovation literature is primarily dominated by the analysis of private sector institutions, with insufficient attention to the distinctive characteristics of public organizations and democratic contexts. On the one hand, there is a strand in the literature that understands that the private sector is more successful in innovating when compared to the public sector, thus stimulating the public sector to emulate the private sector in its organizational forms and management processes (Hartley, Sørensen, & Torfing, 2013). On the other hand, for Hartley (2015), the analysis of innovation through the lens of public value reveals some substantial differences between the public and private sectors that cannot be disregarded, related to the fact that public managers carry out their work in a political and democratic context. In this line, Hartley and Skelcher (2008) argue that one of the specific elements of public sector organizations is that they operate in a democratic and political context, often under the management of elected officials and who are accountable to their voters. Bozeman (1987) also describes two key dimensions that help to differentiate organizations from the public and private sectors: economic authority and political authority. While economic authority is related to the degree to which the organization has control over its revenues and assets, political authority stems from the legitimacy conferred by citizens, legislative and governmental bodies, both dimensions of which must be considered about innovation in public service organizations (Hartley, 2015). In addition, under certain circumstances and within certain legal limits, public organizations can use state authority to compel citizens to engage in

certain actions (Hartley, 2015; O'Flynn, 2007). Finally, recent evidence indicates that interorganizational collaboration and political processes may play a central role in the innovation culture of public organizations, rather than competition, a hallmark of the private sector. (Tõnurist, Kattel, & Lember, 2017). In this sense, recent literature highlights the flourishing of public innovation laboratories as essential catalysts for the culture of innovation in public organizations (McGann, Blomkamp, & Lewis, 2018; McGann, Wells, & Blomkamp, 2021; Tõnurist et al., 2017). On the other hand, part of the reasons that lead organizations to innovate are not present in the public sector, as the absence of competitive pressures and the need to obtain profits. In addition, the presence of overly bureaucratic public managers and an often-outdated administrative structure can be an obstacle for public organizations to innovate (Hartley, 2015).

4.2.3 Hypotheses and conceptual model

From the literature review carried out for the present study, four hypotheses were outlined to be submitted to scrutinize the data. So, first, the literature recognizes that organizations must have the capability to improvise and reconfigure their IT resources (Pavlou & Sawy, 2010; Pavlou & Gefen, 2006) from the creation, expansion, and modification of organizational resources (Helfat, Finkelstein, Mitchell, Peteraf, Singh, Teece & Winter, 2007). In this sense, Oliveira et al. (2016) proposed and found evidence, within the private sector, that the IT reconfiguration capability must be one of the factors of organizational IT capabilities. Thus, finally considering that the appointment of Pavlou and Sawy (2010) in the sense that the ability to improvise and reconfigure IT resources is fundamental for situations involving new technological applications, with a potentially positive result in the organizational innovation process, as well as given the lack of empirical evidence on this relationship in the public sector, we present the following hypothesis:

H_1: The IT reconfiguration capability is a factor underlying the organizational IT capability within the scope of the public sector.

According to Hartley (2015), the organizational innovativeness of the public sector must be based on the ability of organizations to analyze and disseminate information to generate public value. Thus, without innovativeness, public organizations are unable to become agile and flexible enough to meet the dynamic demands of the public and deal with increasingly uncertain and changing social and economic environments. However, by using IT resources, public sector organizations can overcome their knowledge, resources, and agility limitations. In this line, Hartley (2011) proposes that IT resources have a positive effect on public sector innovativeness in such a way as to allow public sector organizations to create new services that they would not be able to offer without IT. Furthermore, considering the proposition by Pang et al. (2014) that there would be a positive influence of IT capabilities and resources on the innovativeness of public organizations, we present the following hypothesis:

H_2: IT capabilities are positively associated with the innovativeness of public organizations.

The literature is abundant with evidence on the positive effect of innovativeness on organizational performance in the context of the private sector (Boso, Story, & Cadogan, 2013; G. T. M. Hult et al., 2004; Kyrgidou & Spyropoulou, 2013; Panayides & Lun, 2009; Parida, Pesämaa, Wincent, & Westerberg, 2017; Rhee, Park, & Lee, 2010; Rosenbusch, Brinckmann, & Bausch, 2011; Salge & Vera, 2009). In this sense, considering that the private burden of creating public value through innovation weighs on public organizations (Hartley, 2015), as well as considering the lack of studies in the scope of the public sector, we present the following hypothesis:

H_3: Innovativeness is positively associated with the performance of public organizations.

Several studies, whose bases are based mainly on the theoretical strand of Resource-Based View (RBV), present evidence, within the private sector that IT capabilities can improve organizational performance (Mata, Fuerst, & Barney, 1995; Powell & Dent-Micallef, 1997; Ray, Muhanna, & Barney, 2005; Stoel & Muhanna, 2009; Stratopoulos & Dehning, 2000). More recently, Pang et al. (2014) theoretically proposed that public organizations could convert IT capabilities into performance. Thus, considering the lack of similar studies in the public sector, the fourth and last hypothesis of the present study is presented:

H_4: IT capabilities are positively associated with the performance of public organizations.

In this sense, figure 4.1 presents a synthesis of the above hypotheses in a conceptual model.

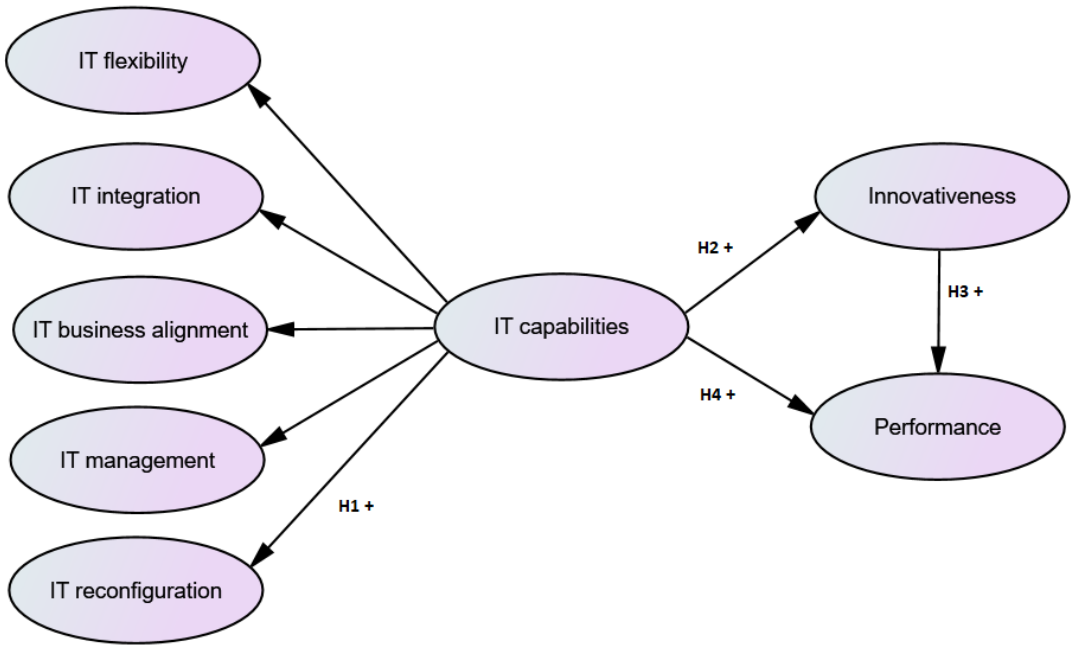

Figure 4.1 - Conceptual model
Source: Own

4.3 Methodology

The study is based on a quantitative, descriptive approach and derived from a transversal cut in the primary data, which were collected through a Survey applied in the month of August 2019. We invited 798 Brazilian public bodies to participate, linked to the three powers constituted in Brazil (Executive, Legislative, and Judiciary), as well as the three spheres of the Brazilian public sector (Federal, State, and Municipal). Considering the objective of the study, we defined the organization as the unit of analysis and as the key informant the main IT manager of the organization (CIO or correspondent), in line with the previous literature (Chen, Wang, Nevo, Benitez-Amado, & Kou, 2015; Kim et al., 2011). Individual contacts were made with each IT manager, either by phone or email address, the latter being the form selected for the distribution of the access link to the electronic questionnaire, which was divided into two parts. The first was dedicated to obtaining the necessary data for the characterization of the sample and the second was focused on measuring the constructs used in the research. More precisely, the IT capabilities construct was operationalized by adapting the scales used by Chen et al. (2015) and Oliveira, Maçada, & Oliveira (2016). Innovativeness was measured using the scale proposed by Hult, Hurley, & Knight, (2004) and Tajeddini, (2011). Finally, considering that the IT literature indicates that the perception of IT managers and users adequately reflects the effective performance of the organization (Oliveira et al., 2016; Tallon, 2010; Tallon & Kraemer, 2006), the performance construct was operationalized by adapting the perception scale used by Gould-Williams (2003). We used a five-point Likert scale for all cases, ranging from strongly disagree to totally agree.

Before applying the questionnaire, the instrument was submitted to the content evaluation process, attended by three experienced researchers specializing in Information Systems and five IT managers from public agencies that adequately represented the target audience of the research. After removing and adapting some items from the questionnaire, we move on to the pre-test phase. To this end, the questionnaire was applied to twenty-one other public IT managers, who did not report problems in understanding the issues or of any other nature. In addition, a preliminary analysis of the data did not present any issues with specifying the model. Thus, the questionnaire was applied using the Google Forms platform. After three weeks of collection, 278 completed questionnaires were received, resulting in a response rate of 34.8%. The final version of the applied questionnaire is presented in Appendix 1.

Data analysis was performed with the help of IBM SPSS and IBM AMOS software, both in version 27. The analysis approach selected to achieve the objective of the study was the modeling of structural equations based on covariance (CB-SEM), from a confirmatory factor analysis (CFA), following a two-step strategy (Anderson & Gerbing, 1988). Thus, after specifying the measurement model, we check for the possible existence of multivariate outliers, identified

using the square distance by Mahalanobis (D^2) of all observations. We performed the calculation from the specification of a submodel containing all items in the questionnaire and before any adjustments were made (Marôco, 2014). By adopting a conservative approach, 24 responses were excluded, with p1 and p2 values greater than 0.001. Thus, the final sample used in the analyzes was reduced to 254 observations. Then, the normality of the variables was assessed by analyzing the skewness coefficients (Sk) and kurtosis (Ku), and no results were found to suggest violations of the normal distribution (|Sk|<2 and |Ku|<7) (Marôco, 2014).

The CFA measurement model was adjusted after the data processing phase was completed. The first step was the assessment of factor loadings, which resulted in the elimination of two items that had factor loadings much less than the minimum of 0.7 (Hair, Black, Babin, Anderson, & Tatham, 2009). More specifically, items CI4 (0.02) and CI7 (0.23). However, considering that the model is reflective, removing the items does not represent a problem for the analyzes (Hair et al., 2009).

Subsequently, the Modification Indices indicated by AMOS were evaluated, considering that values higher than 11 indicated problems of local adjustment, as well as the measurement errors that were theoretically justified were correlated (Marôco, 2014). Thus, the adjustment indicators for the measurement model were calculated, whose indicators obtained were: χ^2 = 636.256; χ^2/gl = 1.670; CFI = 0.954; TLI = 0.948; GFI = 0.859; RMSEA = 0.051; SRMR = 0.0624. The GFI was the only indicator that presented a value lower than the expected minimum (0.90). However, the literature explains that this indicator is affected by a large number of variables in the model (Marôco, 2014), exactly the case in the present study. Thus, the quality of the indicators can be considered adequate for the present study.

Then, to evaluate the model specification broadly, the convergent validity of the constructs was calculated through the analysis of factor loadings, the average variance extracted (AVE), and the level of reliability of the constructs (CR). The discriminant validity was also verified by comparing the percentages of AVE for any two constructs with the square of the estimate of their correlation (r^2) (Hair et al., 2009). Table 4.1 presents the results in detail, accompanied by the acceptance criteria for each test, in the light of Hair Jr et al. (2009), indicating that the model used in the present study did not current problems related to the convergent and discriminant validities.

Table 4.1 - Reliability and validity of the structural model

CONSTRUCT	RELIABILITY	CONVERGENT VALIDITY	DISCRIMINANT VALIDITY						
	CR >=0.7	AVE >= 0.5	AVE > r^2						
	CR	AVE	r^2						
			FLE	INT	ALI	MAN	REC	INN	PER
Flexibility (FLE)	0.877	0.643							
Integration (INT)	0.844	0.646	0.257						
Alignment (ALI)	0.868	0.576	0.197	0.051					
Management (MAN)	0.928	0.721	0.319	0.220	0.298				
Reconfiguration (REC)	0.890	0.674	0.207	0.043	0.162	0.268			

Innovativeness (INN)	0.924	0.711	0.199	0.108	0.130	0.253	0.254	
Performance (PER)	0.882	0.653	0.184	0.076	0.155	0.209	0.249	0.364

Source: Own

In the sequence, given the possibility of specifying a structural model with good goodness of fit indicators, but with incorrectly specified causal relationships (Mulaik et al., 1989), we also calculated the RNFI (Relative Normed Fit Index), that considered in an identical way the contribution of the measurement and structural models (Marôco, 2014), no problems have been detected in this regard.

Finally, we investigated the existence of differences between groups based on the characteristics of the sample through the specification of MIMIC models (Multiple Imputation and Multiple Causes), with the use of SEM, as proposed by Joreskog & Goldberger (1975). According to Marôco (2014), it is an agile and robust way to identify differences between groups based on a structural model (Marôco, 2014). The first analysis focused on two groups formed from the size of the organizations. Organizations with up to 1,500 public servants were grouped (N = 153) and organizations with several workers above this limit (N = 105). Thus, bearing in mind that the size of organizations has been presented in the literature as having a significant role in research involving the role of organizations' IT capabilities (Damanpour, 2010; J. K. Kim, Xiang, & Lee, 2009; Oliveira et al., 2016), a dummy variable was specified to represent the largest organizations. The second front of analysis was dedicated to comparing the organizations that are part of the federal sphere of the Brazilian public power with those linked to local administrations. The choice of these groups was inspired by the literature that indicates that the sector in which organizations operate can influence the IT capabilities of organizations (Kim et al., 2011; Oliveira et al., 2016; Stoel & Muhanna, 2009). In addition, the fact that federal organizations generally follow central guidelines for structuring and managing IT areas and applying IT resources justifies the definition of these groups. Thus, a dummy variable was specified to represent organizations at the federal level (N = 185), compared to state and municipal organizations (N = 73).

4.4 Results and discussion

Data analysis started with the characterization of the sample, the summary of which is shown in Table 4.2 (participating organizations) and Table 4.3 (key respondents), as follows:

Table 4.2 - Characterization of participating organizations

	Frequency	Percentage	Accumulated percentage
Size			
up to 100 workers	29	11.2	11.2
between 101 and 500 workers	49	19.0	30.2
between 501 and 1,500 workers	75	29.1	59.3
between 1,501 and 5,000 workers	69	26.7	86.0
between 5,001 a 10,000	21	8.1	94.2

workers			
over 10,000 workers	15	5.8	100
level			
municipal organizations	23	8.9	8.9
state organizations	50	19.4	28.3
federal organizations	185	71.7	100
Field			
justice	54	20.9	20.9
education	57	22.1	43.0
health	27	10.5	53.5
research and education	15	5.8	59.3
public security	6	2.3	61.6
banking and economic	7	2.7	64.3
military	5	1.9	66.3
transportation	11	4.3	70.5
municipal government	23	8.9	79.5
others	53	20.5	100

Source: Own

In other words, the characterization of the sample indicated that most of the 254 organizations participating in the research are small and medium-sized, with up to 1,500 servers (59.3%) and belonging to the federal sphere (71.7%). The most representative sectors were Justice (20.9%), Education (22.1%), and Health (10.5%).

Table 2.3 - Characterization of key respondents

	Frequency	Percentage	Accumulated percentage
Formal Education			
high School/Technical/Other	7	2.7	2.7
university level	45	17.4	20.2
specialization course	112	43.4	63.6
master's or Doctorate	94	36.4	100
Gender			
women	24	9.3	9.3
men	234	90.7	100
Professional experience			
up to 2 years	10	3.9	3.9
between 2 and 5 years	32	12.6	16.5
between 6 and 10 years	48	18.9	35.4
between 11 and 15 years	50	19.7	55.1
between 16 and 20 years	27	10.6	65.7
21 years or older	87	34.3	100
Age			
up to 29 years	7	2.7	2.7
between 30 and 39 years	85	32.9	35.7
between 40 and 49 years	103	39.9	75.6
between 50 and 59 years	55	21.3	96.9
60 years or older	8	3.1	100

Source: Own

In turn, the analysis of key respondents, that is, the main IT executives of each organization identified that most of the participants are male (90.7%), with complete higher education and a completed specialization course (43.4%), aged between 40 and 49 years (39.9%) and more than

20 years of professional experience (34.3%). In other words, despite the relative concentration of organizations at the federal level, the sample did not present biases or trends that could compromise its representativeness, having been considered adequate to the objectives of the study.

Moving forward with the analysis, possible differences between groups of organizations were preliminarily assessed in terms of "size" and "sphere of action" to identify potential differences between groups of organizations about each of the seven latent variables studied. Figure 4.2 and Table 4.4 show the results identified when comparing the group of large organizations with the group of small and medium-sized organizations.

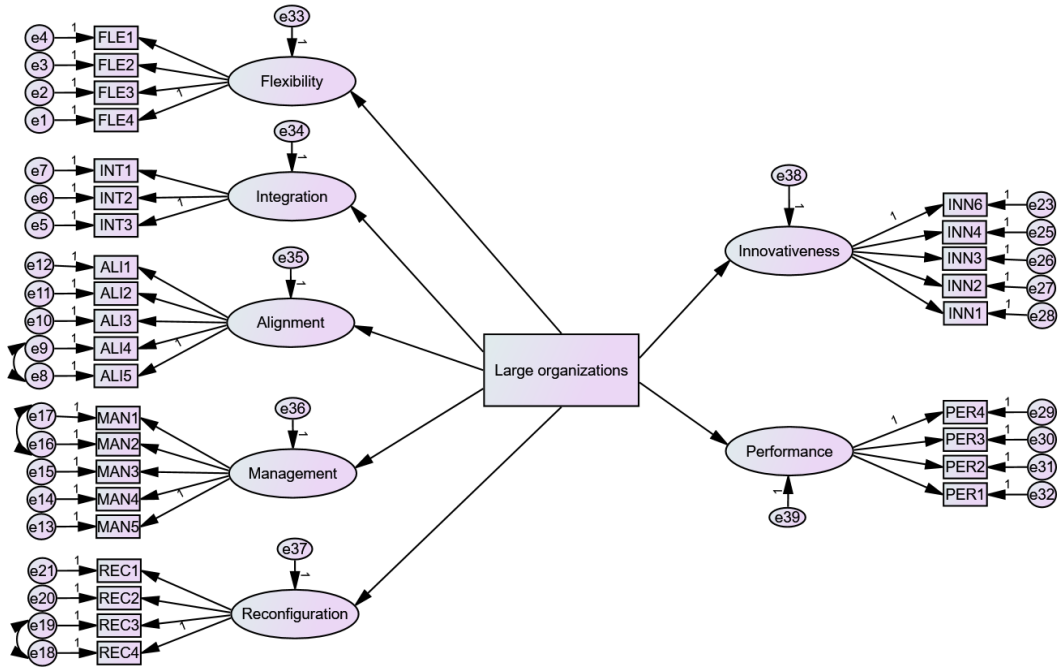

Figure 4.2 - MIMIC model for large organizations
Source: Own

Table 4.4 - Statistical significance of the effects for large organizations

Relations between constructs			Estimates	S.E.	C.R.	P
Innovativeness	<---	Large organizations	0.126	0.155	0.814	0.415
Flexibility	<---	Large organizations	0.116	0.109	1.067	0.286
Management	<---	Large organizations	0.250	0.154	1.617	0.106
Integration	<---	Large organizations	-0.125	0.195	-0.640	0.522
Alignment	<---	Large organizations	0.213	0.113	1.874	0.061
Reconfiguration	<---	Large organizations	-0.039	0.081	-0.485	0.628
Performance	<---	Large organizations	0.097	0.146	0.662	0.508

*** P<0.001
Source: Own

In other words, no statistically significant differences were detected between the group of large organizations and the others in any of the five dimensions of IT capabilities (flexibility, management, integration, alignment, and reconfiguration). Likewise, no differences were

detected between groups for the innovativeness and perceived organizational performance constructs.

In turn, Figure 4.3 and Table 4.5 present the results identified when comparing the group of organizations linked to the federal public administration of Brazil, that is, that has national coverage, compared to those that have local coverage, whether state or municipal.

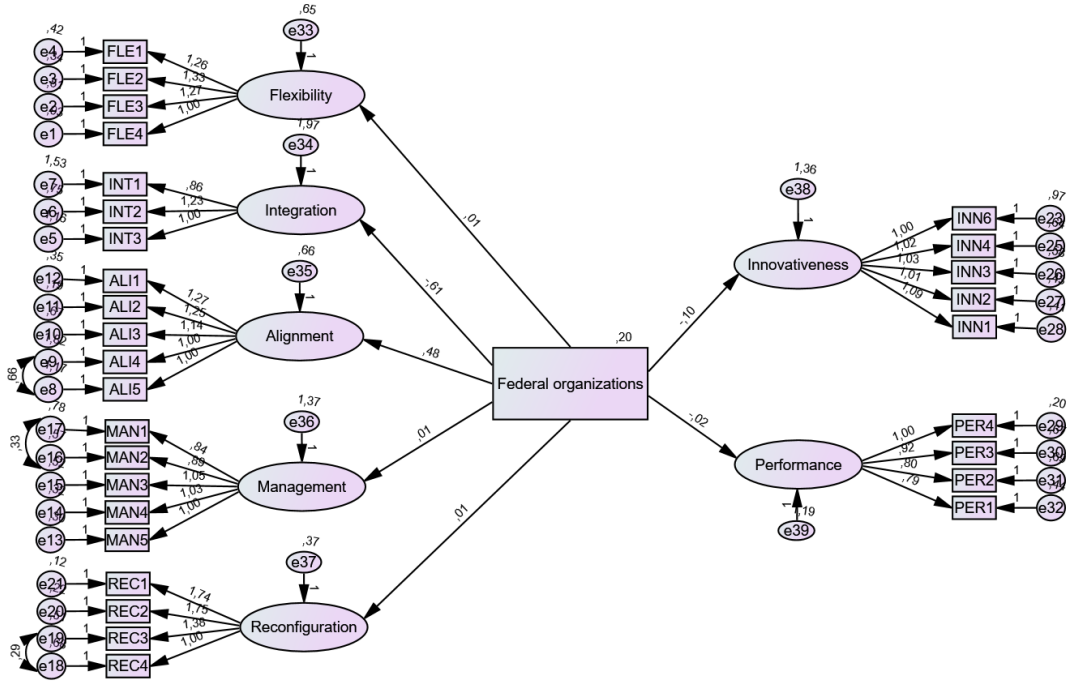

Figure 4.3 - MIMIC model for federal organizations
Source: Own

Table 4.5 - Statistical significance of the effects for Federal organizations

Relations between constructs			Estimates	S.E.	C.R.	P
Innovativeness	<---	Federal organizations	-0.096	0.169	-0.569	0.569
Flexibility	<---	Federal organizations	0.007	0.118	0.056	0.955
Management	<---	Federal organizations	0.014	0.169	0.082	0.935
Integration	<---	Federal organizations	-0.615	0.213	-2.892	0.004
Alignment	<---	Federal organizations	0.484	0.125	3.854	***
Reconfiguration	<---	Federal organizations	0.014	0.088	0.160	0.873
Performance	<---	Federal organizations	-0.023	0.160	-0.145	0.885

*** P<0.001
Source: Own

In this case, differences were detected between the group of organizations at the federal level about the others (state and municipal) in the “integration” and “alignment” factors. In the first case, we identified that federal organizations have a lower degree of IT integration; that is, less capacity was detected to perceive and respond to changes and opportunities in the context external to the organization, as well as integrating them into internal processes. On the other hand, federal organizations had a more remarkable ability to devise an IT strategy that is consistent with the overall strategy of the organization, as well as to support it in formulating and realizing its innovation objectives. No significant differences were detected for the other factors of IT capabilities and the perception of performance or organizational innovativeness.

Subsequently, advancing on the four hypotheses of the present study, the causal structural model was specified. The result can be seen in detail in Figure 4.4.

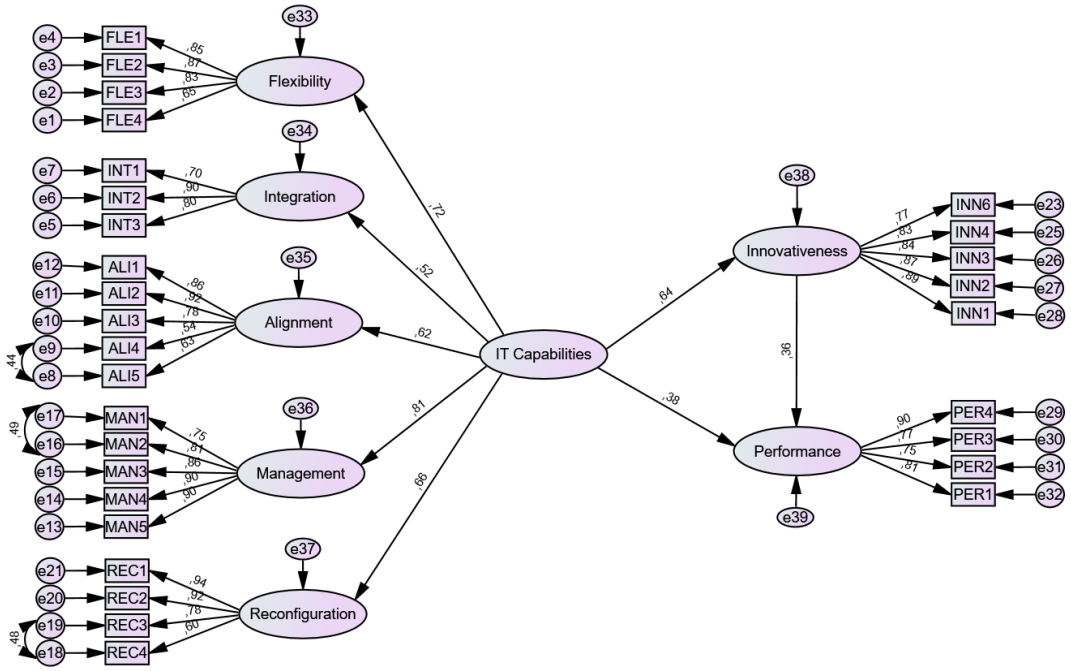

Figure 4.4 - Structural Model
Source: Own

The specified model explained 41% and 45%, respectively, of the variability of the innovativeness and perceived performance constructs. In addition, all the effects analyzed in the model were statically significant, the details of which can be seen in Table 4.6.

Table 4.6: Statistical significance of effects

Relations between constructs			Estimates	S.E.	**C.R.**	**P**
Innovativeness	<---	IT capabilities	0.751	0.085	8.834	***
Flexibility	<---	IT capabilities	0.589	0.068	8.627	***
Management	<---	IT capabilities	0.751	0.106	7.057	***
Integration	<---	IT capabilities	0.540	0.071	7.623	***
Alignment	<---	IT capabilities	0.942	0.074	12.652	***
Reconfiguration	<---	IT capabilities	0.406	0.052	7.77	***
Performance	<---	IT capabilities	0.406	0.091	4.453	***
Innovativeness	<---	Innovativeness	0.326	0.075	4.367	***

*** P<0.001
Source: Own

These results made it possible to rescue and test the hypotheses assumed for the present study. The first hypothesis of the study (H_1) had indicated that the IT reconfiguration capability should be listed among the factors that make up the IT capabilities of public organizations, as seen in private organizations (Oliveira et al., 2016). The results obtained indicated that 66% of the variability of the reconfiguration capacity construct was based on the superior hierarchical factor (2nd order) IT capabilities. In addition, the relationship observed between the second-

order IT capabilities construct and the IT reconfiguration factor was significant, a result that supports hypothesis 1.

This result is an indication that the managers of public organizations must plan and organize their respective IT areas to provide them with the capacity to improvise, that is, to adapt to unexpected changes, which do not necessarily occur in a planned way. In this sense, the ability to improvise, based on the reconfiguration of IT resources, is an alternative way to manage turbulent environments and can be understood as the ability to spontaneously reconfigure existing resources to build new operational capabilities to deal with new, unpredictable, and urgent environmental situations (Pavlou & Sawy, 2010). For example, the recent changes caused by the COVID-19 pandemic have forced many public organizations to make remote work possible for their workers, which was based mainly on information technology solutions. In this sense, a possible path pointed out by the literature as having the potential to expand the IT reconfiguration capacity in organizations involves implementing project and resource management systems, organizational memory systems, and cooperative work systems, as indicated by Pavlou and Sawy (2010).

The second hypothesis of the study (H_2) indicated that public organizations' IT capabilities are positively associated with innovativeness. In this sense, we identified that 41% of the variation found in the innovativeness of the organizations studied was explained by their IT capabilities, a result that supports hypothesis 2 of the present study, in line with the propositions by Hartley (2011) and Pang et al. (2014). In this sense, public managers must effectively apply the potential of data capture and processing that IT provides to discover needs and opportunities for new public services, as the creation of systems to monitor risks to collective health (Pang et al., 2014). In this sense, the tragic COVID-19 pandemic left several lessons on the importance of treating this type of information quickly and accurately, with a focus on decision making. The study results represent a call for public organizations to increase their investments in e-government projects, initiatives that combine the application of IT resources innovatively, with a focus on creating public value (Hartley, 2015). Another possibility of action by organizations with potentially positive results for society as a whole is the collection and dissemination of data and public information in an open data model, bearing in mind that the literature points out that the opening of public data can be an essential stimulus to innovation (Pang et al., 2014).

The third hypothesis of the study (H_3) proposed that the innovativeness of public organizations positively affects their organizational performance. The results supported this hypothesis, in line with Hartley (2015) and corroborated several studies that detected a similar relationship in the private sector (Boso, Story, & Cadogan, 2013; Hult et al., 2004; Kyrgidou & Spyropoulou, 2013; Panayides & Lun, 2009; Parida, Pesämaa, Wincent, & Westerberg, 2017; Rhee, Park, & Lee, 2010; Rosenbusch, Brinckmann, & Bausch, 2011; Salge & Vera, 2009). Thus, public managers must promote a culture of innovation within their respective organizations.

One possible path is the establishment of innovation laboratories (I-Labs), since the evidence that these structures, in general, have particular and unique missions and can act as agents of change within the public sector, as long as they have the autonomy to define their goals and working methods (Tõnurist et al., 2017). According to McGann, Blomkamp, and Lewis (2018), public organizations increasingly turn to innovation laboratories to create new approaches and formulate innovative policies and services. In this sense, public managers should adopt participatory approaches and centered on users of public services, like "design thinking," for example, focusing on the collaborative generation of ideas and effective involvement of stakeholders (McGann et al., 2018). However, public managers should not shy away from guaranteeing the necessary political and administrative support for innovation laboratories, under penalty of watching the early death of initiatives (Tõnurist et al., 2017).

Finally, the fourth hypothesis of this study (H4) assumed that organizational IT capabilities are positively associated with performance. Again, the results supported the hypothesis, which is in line with several similar studies carried out in the private sector (Mata, Fuerst, & Barney, 1995; Powell & Dent-Micallef, 1997; Ray, Muhanna, & Barney, 2005; Stoel & Muhanna, 2009; Stratopoulos & Dehning, 2000). In this sense, public managers can encourage a series of actions, projects, and programs to convert IT capabilities into the performance of public organizations. Pang et al. (2014) indicate that public organizations must properly use their IT resources and capabilities to achieve the following objectives: i) provide public services with fewer resources, given the growing budget limitation; ii) increase the engagement of a broader range of stakeholders; iii) coordinate and obtain co-production of public value, based on inter-organizational collaboration; iv) support fundraising initiatives; v) stimulate innovation, intra and inter-organizational. Thus, it is the role of public managers, especially IT managers of public organizations, to ensure investments and the use of IT resources and ensure that IT management is fully aligned with the organization's strategic direction (Pang et al., 2014).

4.5 Conclusions

This study analyzed the relationships between IT capabilities, innovativeness, and organizational performance, based on data obtained from IT managers in the Brazilian public sector, adopting as a basis the literature in the areas of information and innovation systems and based on the theoretical framework of the Resource-Based View and Dynamic Capabilities. More specifically, the study measured the impact of IT capabilities on organizational innovativeness and the effect of these two sets of organizational skills on overall performance, as perceived by managers. In addition, the study analyzed the theoretical foundations and empirical data that justify including the IT reconfiguration capability among the factors that make up the IT capabilities of organizations. The results supported the four hypotheses formulated. We identified that the IT reconfiguration capability must be listed among the IT capabilities of public organizations. The data also indicated that IT capabilities play a role in fostering the innovativeness of public organizations and that both (IT capabilities and innovativeness) positively impact organizations' performance.

Given this, the first implication of this research for the public service refers to the recognition that the IT areas of organizations must reorganize IT resources and processing capability in an agile and efficient way to allow organizations to adapt and offer increasingly better public services to generate value for society as a whole. In addition, the results show that the greater the ability of public organizations to gather, integrate and implement IT resources to meet the needs of their business processes, the greater the propensity of these organizations to create new processes, products, or ideas, that is, to innovate (Hult et al., 2004; Liu, Huang, Wei, & Huang, 2015). Furthermore, despite the absence of competitive pressures and, often, the presence of an overly bureaucratic environment, the study highlights the need for public managers to create conditions for innovation to be allowed and encouraged - unpunished - conditions contrary to those commonly found in the public sector (Hartley, 2015).

However, the present study results should not be generalized given the existence of limitations. First, the choice of research participants (IT managers) was not random, which may have introduced some bias in the answers. In addition, data were obtained only from Brazilian public organizations, being highly recommended that the present study be replicated in other economic, demographic, and social contexts in such a way as to allow comparison of results. Moving forward with suggestions for future research, considering the emphasis made by the literature on the importance of technical knowledge, managerial capability, and interpersonal skills of IT professionals (Kim et al., 2011; Sambamurthy, Bharadwaj, & Grover, 2003), researchers dedicated to the areas of IT capabilities could study the role of IT human capital over the IT capabilities of public organizations. In addition, future research could expand the present study and add an analysis of the mediating effect of innovativeness on the relationship between IT capabilities and organizational performance, in line with Pang et al. (2014).

Chapter 5

The relationship between human capital and information technology capabilities: an alternative approach

Abstract

In a constantly changing world, organizations' skills to assemble, integrate, and implement information technology resources (IT), that is, their organizational IT capabilities, are increasingly recognized as fundamental to achieving superior organizational performance. In this context, the role of IT human resources is often stressed, but its nature and its relationship to IT capabilities are unclear. Thus, from the literature on human capital and theories of vision based on dynamic resources and capabilities, the present work discusses the particularities of IT human capital and its role in IT capabilities. For this purpose, responses from senior IT managers from 246 Brazilian public organizations were analyzed based on structural equation modeling. The results indicated that the IT human capital is a multidimensional phenomenon composed of the factors technical skills, interpersonal skills, and the staff's relationship with technology, as well as IT human capital is an antecedent of IT capabilities, not an intrinsic factor, as it is commonly presented in the literature of the area. The study shows an objective and empirically tested way to measure and assess the impact of IT human resources. Paths are also pointed out to recruit and develop IT human capital prepared to face constantly changing environments.

Keywords: IT human capital; IT capabilities; structural equation modeling; Public sector; Brazil

5.1 Introduction

The IT literature increasingly recognizes that the performance of organizations is more positively affected by the increase in their IT capabilities than by direct spending on information technology (Mata, Fuerst, & Barney, 1995; Powell & Dent-Micallef, 1997; Ray, Muhanna, & Barney, 2005; Stoel & Muhanna, 2009; Stratopoulos & Dehning, 2000). IT capabilities can be understood as the skills that organizations have to assemble, integrate, and implement IT resources to meet their business processes' needs (Liu, Huang, Wei, & Huang, 2015). In other words, IT capabilities are a complex set of resources, skills, and knowledge related to IT, exercised through business processes (Stoel & Muhanna, 2009).

Several types of research highlight the importance of IT human resources in the context of organizations' IT capabilities, based on aspects such as the technical and managerial skills of the IT team. Often, IT human resources, expressed by their skills and knowledge, are listed as factors in IT organizational capabilities (Bharadwaj, 2000; Chen & Tsou, 2012; Park, Im, & Kim, 2011). However, in light of human capital theories and dynamic capabilities, the present paper presents and tests an alternative way to operationalize the IT human capital and identify their relationship with the organizations' IT capabilities.

The present study proposes that IT human capital, as an organizational resource, should be studied independently of the IT capabilities construct, not as a factor of these capabilities. Thus, it is possible to identify the role of human capital more accurately on the IT capabilities of organizations. Despite the large volume of scientific work that links IT capabilities to IT human resources, the approach proposed in the present study is rare in the literature, representing a gap in scientific knowledge, which the present study aims to help fill.

Thus, the study's objective is to propose and test a theoretical model for the operationalization of IT human capital of organizations and analyze the role of human capital on the IT capabilities of organizations. For this purpose, we analyzed data provided by the main IT managers of 246 Brazilian public organizations of the most diverse sizes and sectors, using structural equations based on covariance (CB-SEM), with the application of confirmatory factor analysis. In a complementary and exploratory manner, the study aimed to measure the effect of differences related to the size of organizations, as well as its sphere of action, about each one of the factors that compose the IT capabilities, as well as the IT human capital, considering that organizations can present significant variations, depending on their size and sectors of operation (Rainey & Chun, 2007).

The study has theoretical and practical implications. Regarding the evolution of the scientific literature, the results presented can serve as a point of comparison with future studies carried out in other geographical, social, structural, and economic contexts. In addition, by presenting and validating an alternative approach to operationalize the IT human capital construct, the article provides future researchers with a more objective and empirically tested means of measuring and evaluating the impact of this concept on various aspects addressed by IT research in organizations. In the practical field, the results show ways for organizations to select IT human resources better prepared to face constantly changing environments, from creating IT organizational capabilities.

After this introduction, the study content was organized as follows: The following section reviews the literature on IT human capital and IT organizational capabilities, accompanied by research hypotheses. The following section explains the methodological aspects used to collect and analyze the data. The results of the analyses for the hypotheses presented and the discussion of the results are carried out in sequence. Finally, the final considerations of the

study are presented, highlighting the implications of the results, the limitations of the study, and the presentation of suggestions for future research.

5.2 Literature review

5.2.1 IT human capital

Human capital applies to the set of productive capacities of human beings, related to the knowledge, attitudes, and skills that generate superior results (Baptiste, 2001; Becker, 1962; Blaug, 1976). Its origins go back to the precursor studies by Schultz and Becker in the 60s (Becker, 1962; Schultz, 1960; Schultz, 1961) that gave rise to the theory of human capital. The assumptions of human capital theory establish that people are educated. The main effect of education is the improvement of skills and knowledge, in a logic of investment in the human being, of building human capital (Cunha, Cornachione Junior, & Martins, 2010). From the development of the human capital theory, the organizational level began to attribute value to the human factor due to its capacity to generate services (Blaug, 1976; Cunha et al., 2010).

Kucharčíková (2011) explained that human capital could be understood as the combination of intelligence, human skills, and experience that gives the organization its distinctive character, that is, they are the human elements of the organization, with the capacity to learn, change, innovate and provide the creative impulse, that can guarantee superior results and the long-term survival of organizations. The literature recognizes the importance of human capital for organizations (Liu, 2014). For example, as a driver of innovativeness (Subramaniam & Youndt, 2005), organizational performance (Hitt, Bierman, Shimizu, & Kochhar, 2001; Reed, Lubatkin, & Srinivasan, 2006), and as a source of competitive advantage (Barney & Wright, 1998; Coff & Kryscynski, 2011; Ployhart & Moliterno, 2011).

A frequent approach in the literature classifies human capital as general and specific (van Teeffelen & Uhlaner, 2013). General human capital, like broad professional experience, is transferable between organizations. In contrast, specific human capital, such as professional experience in the organization, is useful only in the organization in question and is not easily transferable between organizations (Becker, 1962; Wang, Chou, Lee, & Lai, 2014). For Hatch and Dyer (2004), human capital is intangible and socially complex. Along this same line, Ployhart and Moliterno (2011) explain that human capital should be considered a collective resource, given that workers usually collaborate in the organizational environment. However, Cunha et al. (2010) warn that a characteristic that differentiates human capital from the physical capital of an organization is that human capital essentially belongs to the individual, with the source of financing for their development being less critical. On the other hand, human capital can suffer from obsolescence and must undergo constant maintenance just like physical capital.

Along this same line, the literature highlights the specific importance of the human capital of organizations' information technology teams (Wang, Chou, Lee, & Lai, 2014). For example, Ravichandran and Lertwongsatien (2005) explain that the human capital of the IT areas is an essential input for the development of organizational capacities. For the authors, the IT human capital is composed of the technical and business skills of the IT staff, in addition to their specific knowledge of the organization, including its culture and routines. According to Park, Im, and Kim (2011), human IT capabilities, that is, the skills needed to manage organizations' IT resources, involve the skills of technology management, business, interpersonal, and management, in addition to the technical skill itself. For the authors, in the light of the theoretical lens of resource-based vision, IT human capital can be considered a rare, valuable, and difficult to imitate resource.

In turn, Hulland, Wade, and Antia (2007) point out that the technical skills of IT personnel do include not only technical knowledge but also the ability to deploy, use and manage that knowledge. For the authors, although the relative mobility of IT staff tends to be high, some intangible IT skills, as corporate-level knowledge assets and technology integration skills, are incorporated into the organization, making it more difficult to obtain, commercialize, imitate, or replace.

5.2.2 IT organizational capabilities

Organizational capabilities refer to the skills from which an organization assembles, integrates, and implements its valuable, rare, and difficult to imitate resources, to build unique skills (Teece, Pisano, & Shuen, 1997). Organizational capabilities and resources provide the basic direction for the strategy and are the primary source of results for organizations (Grant, 1991). However, there is a fundamental difference between a resource and an organizational capability. Makadok (2001) explains that a resource is an observable asset, but not necessarily tangible, that can be assessed and negotiated independently, while a capability is unobservable and therefore necessarily intangible.

For Grant (1991), resources are inputs into organizational processes; that is, they are the basic units of analysis. The author explains that resources can include equipment, capital, employee skills, patents, brands, among others. However, the functioning of an organization requires the cooperation and coordination of the set of resources. Thus, a capacity is the ability of a group of resources to perform some task or activity, with resources fueling these capabilities.

Makadok (2001) also explains that two important theoretical strands in the strategy area address the relationship between resources and organizational capabilities. On the one hand, there is the theoretical perspective of the resource-based view of Ricardian inspiration (Ricardo, 1917). The choice and selection of resources are the primary mechanisms for creating value for organizations. Based on this logic, the heterogeneity in performance between organizations is due to the access and use of differentiated resources. On the other hand, the theoretical

perspective of dynamic capabilities, of Shumpterian inspiration (Schumpeter, 1950), highlights the central importance of building organizational capabilities based on available resources. In this sense, capabilities are built on managers and workers' ability to deploy resources, usually in combination, from complex organizational processes and developed over time, to achieve specific goals (Amit & Schoemaker, 1993).

In the IT literature, IT capabilities are identified with the skills of organizations to assemble, integrate, and implement IT resources to meet the needs of business processes (Liu et al., 2015). Stoel and Muhanna (2009) explain that IT capabilities are a complex set of IT-related resources, skills, and knowledge exercised through organizational processes. In this context, previous work operationalized the IT capability construct, following diverse strategies and perspectives. For example, in a seminal study, Bharadwaj (2000) explained that IT capabilities are divided into i) IT infrastructure (communication technologies and computers, shareable technical platforms and databases); ii) IT human resources (technical and managerial skills of the IT team); iii) intangible IT resources (knowledge assets of the organization, as well as its customer orientation and organizational synergy enabled by technological resources). As for Kim, Shin, Kim, and Lee (2011), IT capabilities are divided into i) IT specialization (the level of professional skills or knowledge of the IT staff); ii) IT infrastructure flexibility (the ability of the IT infrastructure to enable rapid development and support of various technological components); iii) IT management capability (an organization's ability to manage IT resources to add value to the business).

In turn, Chen and Tsou (2012) identified IT capabilities as a second-order factor, composed of: i) IT infrastructure (set of applications and services provided to business areas, as well as to share information between different sectors and respond to changes in business strategy); ii) IT business expertise (organizational capability to integrate business and IT strategy); iii) IT relationship resources (the company's ability to integrate the IT department with the business units); iv) IT human resources (technical and managerial skills of IT staff). In turn, Kmieciak, Michna, and Meczynska (2012) operationalized IT capabilities in three dimensions, related to the use of IT to support business areas: i) IT knowledge; ii) integration of IT with business strategy; iii) internal communication from IT.

More recently, Chen, Wang, Nevo, Benitez-Amado, and Kou (2015) proposed that organizational IT capabilities should be operationalized as a second-order construct, composed of four dimensions: IT infrastructure flexibility, IT integration, IT and business alignment, and IT management. According to the authors, the flexibility of the IT infrastructure refers to the extent to which an organization's IT infrastructure is scalable, modular, compatible with legacy systems, and capable of serving various business applications. IT integration refers to how an organization links its IT to that of its business partners. IT management refers to the company's ability to implement IT-related activities effectively. IT business alignment refers to the extent

to which IT and business operations share common goals and maintain a harmonious relationship.

5.2.3 Relationship between IT human capital and IT capabilities

Despite the theme's relevance and a large number of studies in the area, the literature review for the present study identified that there is no consensus on how to operationalize the IT capabilities phenomenon. More specifically, by directing attention to the IT human capital issue, it is observed that some researchers choose to directly include the technical and managerial skills of IT staff as a factor in IT organizational capabilities (Chen & Tsou, 2012; Kim et al., 2011; Kmieciak et al., 2012). On the other hand, some jobs do not directly include IT human resources as an element of IT capabilities (Lu & Ramamurthy, 2011; Wang et al., 2014). The present study is associated with the second group; that is, it does not directly list the human capital of IT as a factor in the IT capabilities of organizations.

Bearing in mind that, from the theoretical perspective of dynamic capabilities, the human resources of the IT areas must be understood as such, that is, as resources. Thus, in conjunction with other organizational resources, such as equipment, capital, patents, brands, among others, organized in a coordinated and synergistic manner, IT human capital is one of the elements available for building organizational IT capabilities (Amit & Schoemaker, 1993; Grant, 1991; Makadok, 2001). In addition, from the lens of the analysis of the theory of human capital, human capital in IT areas is an essential input (or resource) for the development of organizational capabilities, as explained by Ravichandran and Lertwongsatien (2005).

In this sense, the present study is based on the strategy used by Wang et al. (2014) for measuring IT human capital, dividing it into technical skills (hard skills), interpersonal skills (soft skills), and the relationship of the IT team with the technology. Hard skills are related to program, analyze and designing systems, networks, and data storage. Soft skills are associated with the expertise of IT personnel to manage information systems functions, as well as interact with users and carry out project management and leadership. Finally, the team's relationship with IT reflects how well IT staff manages IT functions and engages in IT-related self-learning processes (Byrd & Turner, 2001; Lee, Trauth, & Farwell, 1995).

Along this line, this paper presents the relationship between IT human capital and IT capabilities from a new perspective. Firstly, considering the nature of IT human capital as an organizational resource, not as part of IT capabilities per se, IT human capital must be operationalized and measured independently. Thus, based on the propositions of Wang et al. (2014), the three hypotheses associated with the human capital of IT are presented:

H_1. The interpersonal ability of the IT team is a factor underlying the organization's IT human capital.

H_2. The technical skill of the IT team is a factor underlying the organization's IT human capital.

H_3. The relationship of IT professionals with technology is a factor underlying the organization's IT human capital.

In addition, the literature recognizes the importance of IT human resources over organizations' ability to manage and use information technology despite the different approaches adopted by previous research. Thus, from the notion that the human capital of the IT areas is an essential input for the development of organizational capabilities (Ravichandran & Lertwongsatien, 2005), we present an alternative model of the relationship between IT capabilities and IT human capital, expressed in the hypothesis below:

H_4. The IT human capital is positively associated with the IT capability of organizations.

5.3 Methodology

The present study can be classified as quantitative, descriptive, whose primary data we obtained in a transversal way through an applied Survey in August 2019. We sent invites to 798 senior public-sector IT managers to participate (CIO or equivalent), linked to the three powers constituted in Brazil (Executive, Legislative, and Judiciary) and related to the three spheres of the Brazilian public sector (Federal, State, and Municipal). The definition of the key respondent for the research follows the practice of the IT literature (Chen, Wang, Nevo, Benitez-Amado, & Kou, 2015; Kim et al., 2011; Liang, Wang, Xue, & Ge, 2017; Wang et al., 2014). Each manager was contacted personally, by email, or phone, and the link to access the questionnaire was sent by email.

The research form was divided into two parts, the first of which was to capture the data necessary for the characterization of the sample. On the other hand, the second part contained the items selected for measuring the observed variables that formed the constructs of the study. IT capacities were operationalized in five factors based on the adaptation of the scale used by Chen et al. (2015), that is, IT flexibility, IT integration, alignment between IT and business and IT management, with the addition of the reconfiguration capability dimension, as proposed by Oliveira, Maçada and Oliveira (2016). For IT human capital, we follow the strategy used by Wang et al. (2014), using a three-factor solution: hard skills, soft skills, and the relationship of the IT team with technology.

Before applying the questionnaire, the instrument was submitted to the content evaluation process, attended by three experienced researchers specialized in information systems and five IT managers from public agencies that adequately represented the target audience of the research. After removing and adapting some items from the questionnaire, we proceeded to the pre-test phase. To this end, the questionnaire was applied to twenty-one other public IT

managers, who did not report problems in understanding the issues or of any different nature. In addition, a preliminary analysis of the data did not present any problems with specifying the model. Thus, we applied the questionnaire using the Google Forms platform. After three weeks of collection, we received 278 completed questionnaires, resulting in a response rate of 34.8%. The final versions of the applied scales are presented in Appendix 2.

Data analysis was performed with the help of IBM SPSS and IBM AMOS software, both in version 27. The selected analysis approach was the modeling of structural equations based on covariance (CB-SEM), from a confirmatory factor analysis (CFA), following a two-step strategy (Anderson & Gerbing, 1988). After specifying the measurement model, the possible existence of multivariate outliers was verified, identified utilizing the observations' Mahalanobis squared distance (D^2). The calculation was performed from the specification of a submodel containing all items in the questionnaire and before any adjustments were made (Marôco, 2014). In adopting a conservative approach, we excluded 32 responses that presented values of p1 and p2 greater than 0.001. Thus, the final sample used in the analyzes was reduced to 246 observations. In the sequence, the normality of the variables is evaluated using the analysis of skewness coefficients (Sk) and kurtosis (Ku), is that we did not detect results that suggested violations to the normal distribution ($|Sk|<2$ and $|Ku|<7$) (Marôco, 2014).

Once the data processing phase was completed, the CFA measurement model was adjusted. The first step was the assessment of the factor loadings without detecting problems (Hair, Black, Babin, Anderson, & Tatham, 2009). Subsequently, the Modification Indices indicated by AMOS were evaluated, considering that values higher than 11 indicated problems of local adjustment, as well as the measurement errors that were theoretically justified were correlated (Marôco, 2014). Then, the structural model was specified, according to the research hypotheses.

Finally, the existence of differences between groups based on the characteristics of the sample (size of the organization and sphere of action) was investigated through the specification of MIMIC models (Multiple Imputation and Multiple Causes), with the use of SEM, as proposed by Joreskog & Goldberger (1975). According to Marôco, this is an agile and robust way to identify differences between groups from a structural model (Marôco, 2014).

5.4 Results and discussion

Data analysis started with the characterization of the sample, the summary of which is shown in Tables 5.1 e 5.2.

Table 3.1 - Characterization of organizations

	Frequency	Percentage	Accumulated percentage
Size			
up to 100 workers	26	10.6	10,6
between 101 and 500 workers	48	19.5	30,1

between 501 and 1,500 workers	73	29.7	59.8
between 1,501 and 5,000 workers	66	26.8	86.6
between 5,001 a 10,000 workers	19	7.7	94.3
over 10,000 workers	14	5.7	100
Level			
municipal organizations	20	8.1	8.1
state organizations	48	19.5	27.6
federal organizations	178	72.4	100
Field			
justice	51	20.7	20.7
education	54	22.0	42.7
health	24	9.8	52.4
research and education	15	6.1	58.5
public security	6	2.4	61.0
banking and economic	7	2.8	63.8
military	5	2.0	65.9
transportation	11	4.5	70.3
municipal government	20	8.1	78.5
others	53	21.5	100

Source: Own

Table 5.2: Characterization of key respondents

	Frequency	Percentage	Accumulated percentage
Formal Education			
high School/Technical/Other	7	2.8	2.8
university level	41	16.7	19.5
specialization course	106	43.1	62.6
master's or Doctorate	92	37.4	100
Gender			
women	24	9.8	9.8
men	222	90.2	100
Professional experience			
up to 2 years	9	3.7	3.7
between 2 and 5 years	33	13.4	17.1
between 6 and 10 years	46	18.7	35.8
between 11 and 15 years	46	18.7	54.5
between 16 and 20 years	27	11.0	65.4
21 years or older	85	34.6	100
Age			
up to 29 years	6	2.4	2.4
between 30 and 39 years	80	32.5	35.0
between 40 and 49 years	98	39.8	74.8
between 50 and 59 years	54	22.0	96.7
60 years or older	8	3.3	100

Source: Own

A sample can be briefly characterized as follows: most of the 246 IT managers who responded are male (90.2%), has between 40 and 49 years of age (39.8%), and more than 20 years of professional experience (34.6%), as well as specialization courses (post-graduation *lato sensu*) (43.1%). In terms of organization, the most frequent responses came from medium-sized institutions, where 500 to 1,500 people work (29.7%) and are linked to the federal sphere of the

Brazilian public sector (72.4%). In addition, most organizations operate in education (22%) and justice (20.7%). Thus, although the sample contains a disproportionate number of federal organizations, with national operations, compared to organizations with local or regional operations, the data showed no bias or trends that could compromise its representativeness. The sample was considered adequate to the research objectives.

In the sequence, we made the specification of the structural measurement model, the first stage of confirmatory factor analysis (Anderson & Gerbing, 1988), which presented the following indicators: χ^2 = 1687.356; χ^2/df = 2.649; CFI = 0.858; TLI = 0.844; GFI = 0.747; RMSEA = 0.079; SRMR = 0.0684. Considering Hair et al. (2009), these values were insufficient to continue the analysis. However, based on the guidelines by Morôco (2014), errors of observed variables belonging to the same construct were correlated, a process guided by the Modification Indices generated by AMOS (MI > 11). More specifically, we correlated the errors of the variables ALI4 with ALI5, GES1 with GES2, REC3 with REC4, HIE1 with HIE2, HIE2 with HIE3, and, finally, RET2 with RET3. Therefore, we observed a considerable improvement in the goodness of fit indicators, thus considering them suitable: χ^2 = 1211.33; P-value = 0.000; χ^2/df = 1.923; CFI = 0.918; TLI = 0.909; GFI = 0.802; RMSEA = 0061; SRMR = 0.0750. It should be noted that the observed results of P-value (not significant) and the GFI indicator (below 0.9) can be justified by the number of variables observed in the model and by the sample size (Marôco, 2014), not necessarily representing a fit problem in the model.

Thus, given the goodness of fit results of the indicators, the analysis continued with the assessment of the convergent and discriminant validity of the constructs. For this purpose, the reliability values of the constructs were calculated (CR) and the average variance extracted (AVE). The results were considered satisfactory. Table 5.3 presents the results in detail, accompanied by the acceptance criteria for each test, according to Hair et al. (2009).

Table 5.3 - Statistical significance of effects

CONSTRUCT	RELIABILITY	CONVERGENT VALIDITY	DISCRIMINANT VALIDITY							
	CR >=0.7	AVE >= 0.5	AVE > r^2							
	CR	AVE	r^2							
			FLE	INT	ALI	MAN	REC	SSK	RWT	HSK
Flexibility (FLE)	0.884	0.657								
Integration (INT)	0.843	0.643	0.285							
Alignment (ALI)	0.870	0.582	0.199	0.049						
Managem. (MAN)	0.926	0.716	0.339	0.222	0.286					
Reconfigur.(REC)	0.879	0.651	0.228	0.052	0.186	0.262				
Soft skills (SSK)	0.933	0.640	0.147	0.045	0.176	0.158	0.308			
Relat. Tech. (RWT)	0.847	0.584	0.160	0.020	0.276	0.180	0.267	0.540		
Hard skills (HSK)	0.872	0.578	0.319	0.073	0.215	0.264	0.307	0.501	0.398	

Source: Own

Moving forward with the analysis, possible differences between groups of organizations were preliminarily assessed, in terms of “size” and “sphere of action,” about each of the seven latent variables measured in the study. Figure 5.1 and Table 5.4 show the results identified when comparing the group formed by large organizations with small and medium-sized organizations.

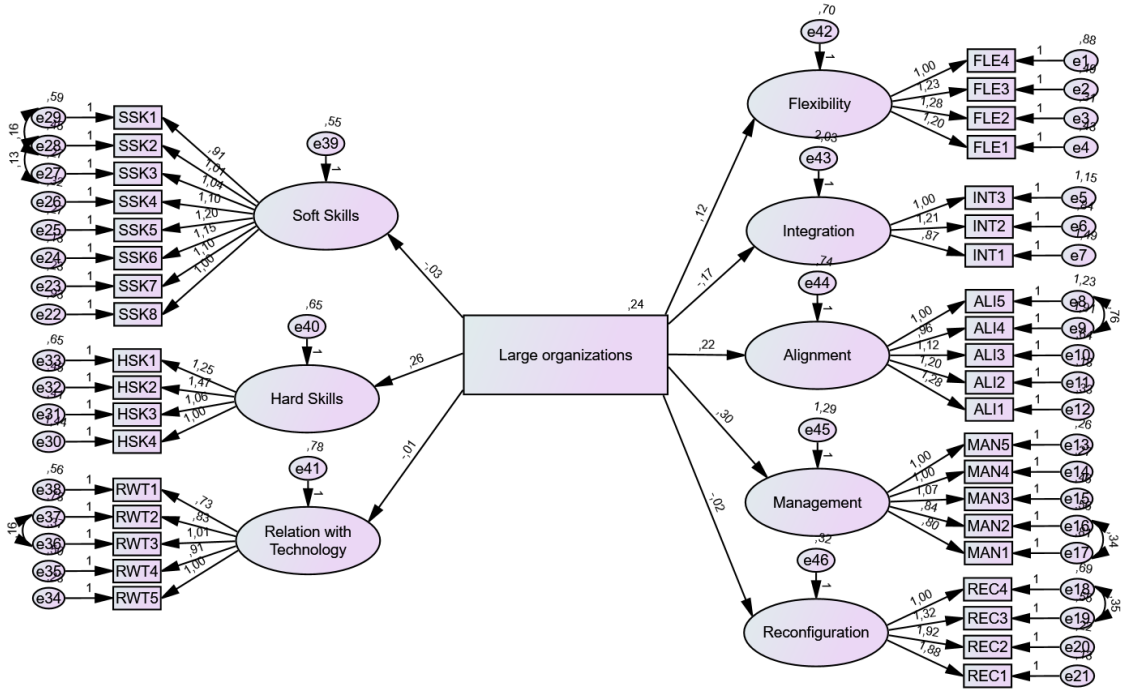

Figure 5.1 - MIMIC model for large organizations
Source: Own

Table 5.4 - Statistical significance of the effects for the large organizations group

Relations between constructs			Estimates	S.E.	C.R.	P
Soft Skills	<---	Large organizations	-0.026	0.100	-0.260	0.795
Hard Skills	<---	Large organizations	0.259	0.115	2.246	0.025
Relation with Technology	<---	Large organizations	-0.015	0.123	-0.121	0.904
Flexibility	<---	Large organizations	0.123	0.115	1.062	0.288
Integration	<---	Large organizations	-0.171	0.201	-0.851	0.395
Alignment	<---	Large organizations	0.222	0.118	1.877	0.060
Management	<---	Large organizations	0.304	0.153	1.980	0.048
Reconfiguration	<---	Large organizations	-0.021	0.076	-0.269	0.788

Source: Own

There were no statistically significant differences between groups for four of the five dimensions of IT capabilities (flexibility, integration, alignment, and reconfiguration). However, at the limit, it was identified that larger organizations had a greater capacity for IT management. Likewise, the results indicated that workers in larger organizations had greater technical skills. On the other hand, no relevant differences were identified for the dimensions of interpersonal skills and relationship with technology. One possible explanation is that larger organizations tend to invest more in IT, including technical training. In addition, the remuneration of IT managers in larger organizations tends to be higher, which attracts candidates with a higher level of education and experience.

In turn, Figure 5.2 and Table 5.5 present the results identified when comparing the group of organizations linked to the federal public administration of Brazil, that is, that has national coverage, compared to those that have local coverage, whether state or municipal.

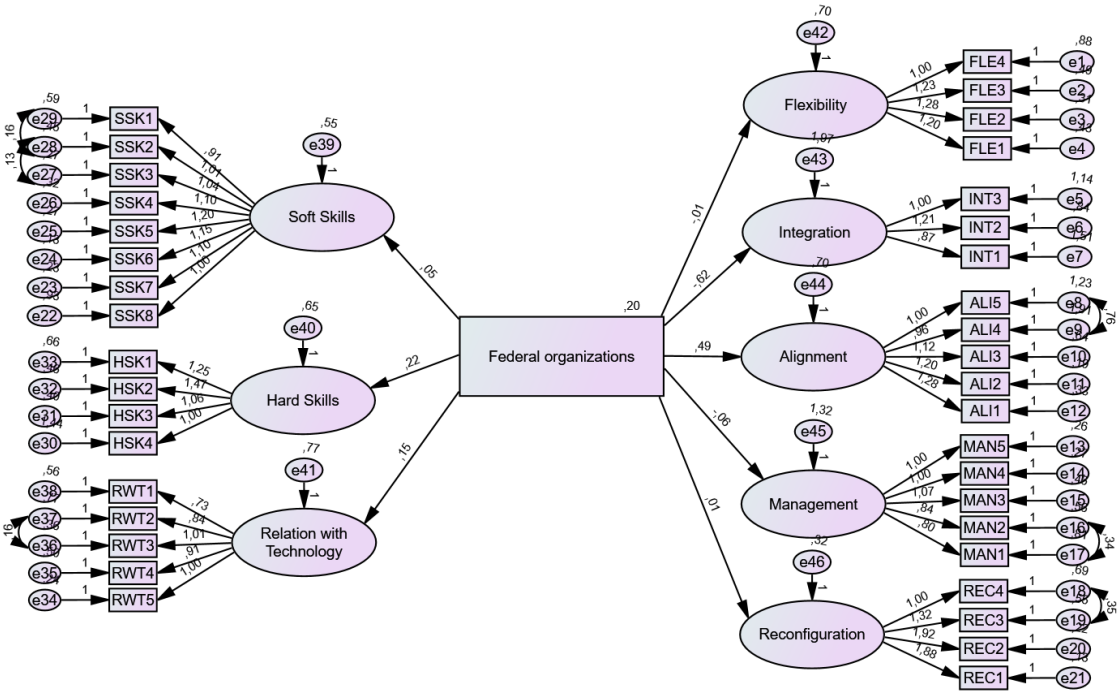

Figure 5.2 - Statistical significance of the effects for the federal organizations group
Source: Own

Table 5.5 - Statistical significance of the effects for the federal organizations group

Relations between constructs			Estimates	S.E.	C.R.	P
Soft Skills	<---	Federal organizations	-0.026	0.100	-0.260	0.795
Hard Skills	<---	Federal organizations	0.259	0.115	2.246	0.025
Relation with Technology	<---	Federal organizations	-0.015	0.123	-0.121	0.904
Flexibility	<---	Federal organizations	0.123	0.115	1.062	0.288
Integration	<---	Federal organizations	-0.171	0.201	-0.851	0.395
Alignment	<---	Federal organizations	0.222	0.118	1.877	0.060
Management	<---	Federal organizations	0.304	0.153	1.980	0.048
Reconfiguration	<---	Federal organizations	-0.021	0.076	-0.269	0.788

Source: Own

In this case, differences between the groups were detected in the integration and alignment factors. In the first case, we identified that federal organizations have a lower degree of IT integration; that is, less capacity was detected to perceive and respond to changes and opportunities in the context external to the organization and integrate them into internal processes. On the other hand, federal organizations had a greater ability to devise an IT strategy that is consistent with the overall strategy of the organization, as well as to support it in formulating and realizing its innovativeness objectives. No significant differences were detected for the other factors of IT capabilities. In addition, no significant differences were identified about the factors of IT human capital.

In the sequence, advancing on the hypotheses of the present study, the specification of the structural model was made. The result can be seen in detail in Figure 5.3.

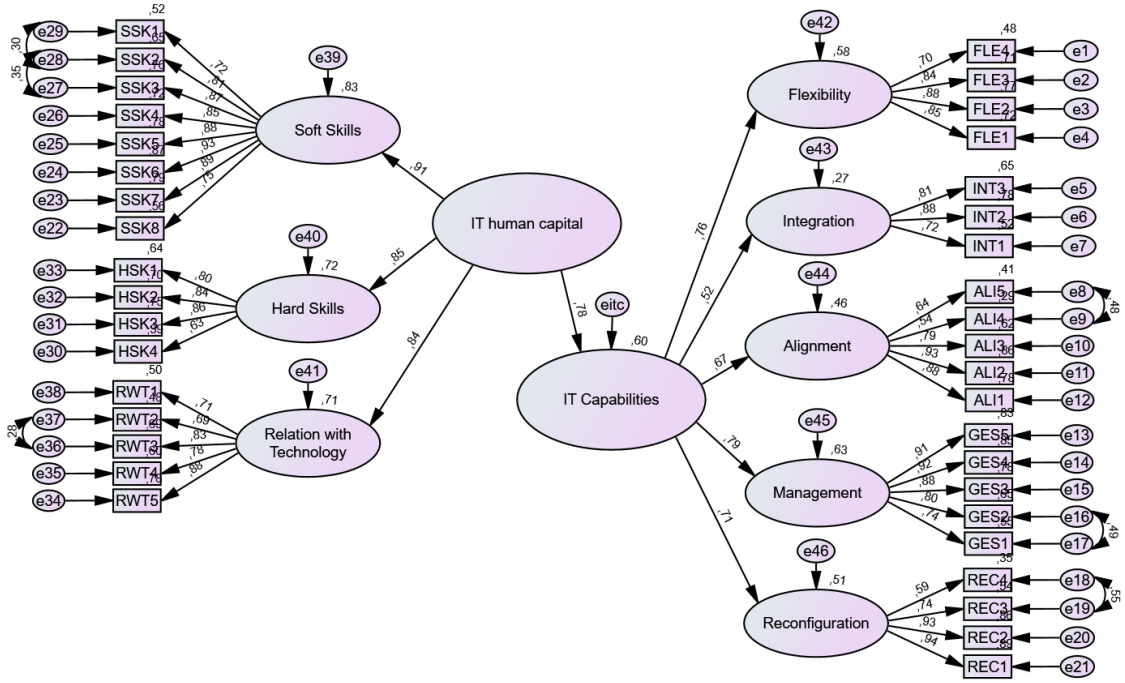

Figure 5.1 - Structural model
Source: Own

Thus, it was possible to rescue and test the hypotheses assumed for the present study. The study proposed that IT human capital could be operationalized as a 2nd order construct, composed of the soft skills factors of the IT team (H_1), the hard skill of the IT staff (H_2), and the relationship of IT professionals with technology (H_3). The results were shown to be in line with that observed by Wang et al. (2014). They supported the three initial propositions of the present study, as all the analyzed effects were statistically significant. Details of the results can be seen in table 5.6.

Table 5.6 - Statistical significance of the effects on IT human capital

Relations between constructs			Estimates	S.E.	C.R.	P
Soft Skills	<---	IT Human Capital	0.642	0.069	9.301	***
Hard Skills	<---	IT Human Capital	0.722	0.086	8.42	***
Relation with Technology	<---	IT Human Capital	0.713	0.059	12.172	***

*** p<0.001
Source: Own

The results validate the alternative model strategy for operationalizing IT capital in organizations proposed in the present study. The IT human capital can be structured appropriately and measured as a latent construct of a higher order from three complementary underlying factors that can be identified in IT teams hard skills, soft skills, and relationship with IT). From this scenario, it is convenient to rescue the guideline presented by Wang et al. (2014) in the sense that, although IT professionals are expected to be more familiar with structured approaches and specific IT knowledge (technical skills), organizations must increasingly form IT teams that can interact appropriately with businesspeople. Hard skills are not enough for IT professionals to deal with real-world complexity, constantly changing. In addition, soft skills

allow IT people to work more effectively with businesspeople and better translate IT solutions into business solutions.

In parallel, in addition to the role of managers in this process, IT professionals themselves must adopt a proactive attitude in search of updating the technical knowledge they need to perform their tasks. This alert becomes more critical as the threat of professional obsolescence remains a permanent challenge for IT professionals since the half-life of IT professionals' technical knowledge is estimated to be less than two years (Joseph, Koh, & Foo, 2010). Thus, the risk of technical obsolescence for IT professionals is very high, as their specific human capital is rapidly wearing out (Tsai, Compeau, & Haggerty, 2007). In this context and based on the assumptions of the resource-based view, it is recommended that organizations, in general, and IT managers adopt strategies to select and hire IT professionals who, in addition to the evident technical skills, also demonstrate soft skills and a proactive stance in constant search of updating and obtaining new technological knowledge. Therefore, recruitment processes should include these criteria for selecting professionals.

In turn, the fourth hypothesis of the study (H4) proposed that IT human capital is positively associated with the IT capabilities of organizations. The specified model explained 78% of the variability of the IT capability construct from the IT human capital, which supports the hypothesis launched. Details can be seen in Table 5.7. The result is in line with Ravichandran and Lertwongsatien (2005) observations, which explain that the human capital of the IT areas is an essential input for the development of organizational capabilities.

Table 5.7 - Statistical significance of the effects of IT human capital on IT capabilities

Relations between constructs			Estimates	S.E.	C.R.	P
IT Capabilities	<---	IT Human Capital	0.524	0.070	7.475	***

*** p<0.001
Source: Own

Thus, the alert for organizations to ensure that their staff has adequate human capital is reinforced, composed of a set of technical (hard) skills and problem-solving skills to achieve superior performance (Youndt, Snell, Dean, & Lepak, 1996). Wang et al. (2014) explain that intangible works, such as problem-solving, coordination, and judgment, occupy a large part of the daily operations of organizations, especially in a context of uncertainties. Thus, technological and strategic changes can increase organizational productivity but require a broader range of skills and higher average workforce skills. Under such circumstances, organizations need their IT staff to be equipped with adequate skills broadly. In this context, it is recommended that organizations adopt continuous training programs for IT professionals, involving technical aspects, interpersonal relationships, and encouraging self-learning behaviors.

Based on the assumptions of dynamic capabilities, no less important is the recommendation for organizations and IT managers to seek to develop the skills of IT human resources in favor of

building organizational IT capabilities. Ultimately, organizations and managers must be aware that it is IT capabilities that must be made internally, and not just direct investments in IT resources, the ultimately responsibility for superior organizational performance (Mata, Fuerst, & Barney, 1995; Powell & Dent-Micallef, 1997; Ray, Muhanna, & Barney, 2005; Stoel & Muhanna, 2009; Stratopoulos & Dehning, 2000).

5.5 Conclusions

The study presented an alternative proposal for the operationalization of IT human capital and analyzed the relationship between human capital and IT capabilities in organizations. Data obtained from IT managers in the Brazilian public sector were used, adopting the literature in the areas of information systems and human capital, based on the theoretical framework of the vision based on resources and dynamic capabilities. More specifically, the study proposed and tested a new theoretical model for operationalizing the IT human capital of organizations, formed by the factors of hard skills, soft skills, and the team's relationship with technology, as well as measuring the impact of human capital on the IT capabilities of organizations. The results supported the hypotheses formulated. In other words, the proposed model proved to be theoretically grounded, and statistically reliable, as well as evidence were found that support the importance of human capital for the formation of IT capabilities of organizations. Thus, it is considered that the objectives of the study were achieved.

However, as in all studies, the generalization of results should be avoided given the existence of limitations. First, the choice of survey participants (IT managers) was not random, which may have introduced some bias in the responses. In addition, data were obtained only from Brazilian public organizations, and it is highly recommended that the present study be replicated in other economic contexts, structural and social demographics in such a way as to allow comparison of the results.

The study has implications for theory and practice. First, researchers and managers are presented with a theoretically grounded and statistically reliable instrument for measuring the IT human capital of organizations. With this, future researchers can reliably and comprehensively measure the human capital of IT. In addition, the study sheds light on the uniqueness of IT human capital about IT capabilities, which opens avenues for future research. That is, to the extent that IT human capital is no longer taken as an integral part of IT capabilities. Still, as an antecedent phenomenon, future researchers can proceed with the research and explore other possibilities of relationships, including direct and indirect effects, as well as relations of mediation and moderation towards various organizational aspects.

In parallel, IT managers have an instrument that allows them to measure the IT human capital more accurately. In addition, IT and HR managers are instructed to select future members of the IT teams considering the importance of the candidate’s potential interpersonal relationship, as well as their inclination towards self-learning. Finally, the work emphasizes the extent that

the attention of researchers and managers is directed towards the construction of organizational IT capabilities, which are, compared to direct investments in IT resources, significantly more effective to obtain superior results (Mata et al., 1995; Powell & Dent-Micallef, 1997; Ray et al., 2005; Stoel & Muhanna, 2009; Stratopoulos & Dehning, 2000).

Chapter 6

The relationship between human capital, information technology capability, innovativeness, and organizational performance: an integrated approach

Abstract

The objective of the present study is to identify the existing relationships between the information technology (IT) human capital, IT capabilities, innovativeness, and organizational performance, based on an integrated analysis approach. A literature review indicated that there is space to be filled in the meeting of IT literature, human capital, and innovativeness, insofar as the particularities of these relationships are not clear and their joint role in the performance of organizations. For this purpose, a structural equation model was developed that analyzed the primary data provided by senior IT managers from 258 Brazilian public organizations. The results indicated that IT human capital is a unique construct and independent of IT capabilities, formed by the hard and soft skills of the IT staff, as well as their attitude towards technology. We identified that IT human capital positively impacts IT capabilities, which positively affects organizational innovativeness. Finally, we determined that innovativeness is, at the same time, a driver for performance and a means that leverages the effect of IT capabilities on performance.

Keywords: human capital; IT capabilities; ability to innovate; organizational performance; structural equation modeling

6.1 Introduction

In the scientific literature, there is a growing understanding that the expertise of organizations to coordinate their IT resources, skills, and knowledge, synergistically, has a relevant role in achieving superior performance (Mata, Fuerst, & Barney, 1995; Powell & Dent-Micallef, 1997; Ray, Muhanna, & Barney, 2005; Stoel & Muhanna, 2009; Stratopoulos & Dehning, 2000). This organizational aptitude is called IT capabilities (Liu, Huang, Wei, & Huang, 2015; Stoel & Muhanna, 2009). Along these lines, several surveys show that superior performance is obtained by building and developing IT capabilities, and not simply by investing in IT resources (Mata et al., 1995; Powell & Dent-Micallef, 1997; Ray et al., 2005; Stoel & Muhanna, 2009; Stratopoulos & Dehning, 2000). In addition to having a conceptual distinction between IT resources and capabilities (Grant, 1991; Makadok, 2001), organizations must have the right expectations about what they can expect to get from each.

Along this line, it is possible to identify that the set of human resources, composed of their technical (hard) skills, interpersonal (soft) skills, and postures of team members in the face of technology, can be identified as the IT human capital of organizations (Chen, Wang, Nevo, Benitez-Amado, & Kou, 2015). However, the IT literature is not homogeneous in relating IT human capital to IT capabilities. While some research strands incorporate human aspects into IT capabilities, as an intrinsic part of their training (Chen & Tsou, 2012; Kim et al., 2011; Kmieciak et al., 2012), other research does not directly address these aspects (Lu & Ramamurthy, 2011; Wang, Chou, Lee, & Lai, 2014). In this sense, a contradiction must be better understood, especially given the conceptual difference between resources and capabilities (Grant, 1991; Makadok, 2001).

Similarly, the literature recognizes the influence that an organizational culture of encouraging innovativeness has on the performance of organizations (Boso, Story, & Cadogan, 2013; Hult, Hurley, & Knight, 2004; Kyrgidou & Spyropoulou, 2013; Panayides & Lun, 2009; Parida, Pesämaa, Wincent, & Westerberg, 2017; Rhee, Park, & Lee, 2010; Rosenbusch, Brinckmann, & Bausch, 2011; Salge & Vera, 2009). This cultural propensity to innovate is called innovativeness (Marchiori, Popadiuk, Mainardes, & Rodrigues, 2020; Story, Boso, & Cadogan, 2015). In addition, research indicates that information technology can have a positive effect on the development of an innovativeness-oriented organizational environment (Carbonara, 2005; Chen & Tsou, 2012; Dong & Yang, 2019; Hartley, 2011; Kmieciak et al., 2012; Pang, Lee, & Delone, 2014).

However, there is a gap in scientific knowledge in the areas of IT and innovativeness, as there is a lack of studies that have addressed, in an integrated manner, the relationship between IT human capital, IT capabilities, innovativeness, as well as the impact of the interaction of these organizational phenomena on the overall performance of organizations. Hult, Hurley, and Knight (2004) explained that integrated approaches are more realistic. They provide broader and more complete results than more straightforward strategies or observe organizational phenomena in a restricted and limited way.

In this context, a relevant question for research in IT and innovativeness is presented: what is the relationship between the phenomena of human capital, IT capabilities, innovativeness, and their potential impact on organizational performance? Thus, the study aimed to identify the relationships between IT human capital, IT capabilities, innovativeness, and organizational performance from an integrated approach. For that purpose, we developed a model of structural equations based on covariance (CB-SEM), which analyzed the primary data provided by senior IT managers from 258 Brazilian public organizations.

The results and analyses presented in this study may have implications for the literature and the practice of organizations. The study contributes to the IT and innovativeness literature by

identifying that IT capabilities are important antecedents of organizational innovativeness. In addition, by proposing an integrated model, the study helps to understand innovativeness, the nature of its relationship to organizations' ability to deal with technology, and the role of innovation-oriented culture on organizational performance. In addition, the study presents IT human capital from a new perspective, highlighting its conceptual uniqueness and statistically validating a model for its operationalization.

In the practical field, we present recommendations on how managers can create and develop more effective IT teams with more comprehensive skills to contribute effectively to business strategies. In addition, the study highlights the need for IT managers to dedicate themselves to developing the capacity of teams with the expertise to gather, integrate and implement IT resources, with a focus on meeting the needs of organizational processes (Liu et al., 2015). Finally, managers are presented with evidence that creating an environment favorable to innovation supported by information technology is crucial for achieving better organizational results.

The present study is divided in a structured way. After this introduction, the literature review to guide the study is presented, accompanied by the hypotheses and conceptual model adopted. The following section explains the methodological aspects used to collect and analyze the data. The results of the analyses, the hypotheses' assessment, and the discussion of the results are presented below. Finally, the final considerations of the study are made, highlighting the implications of the results, study limitations, and suggestions for future researchers.

6.2 Literature review

6.2.1 IT organizational capabilities

The IT literature explains that for organizations to reap benefits from investing in IT resources effectively, and these must be applied efficiently (Yoon, 2011). Several surveys show that the performance of organizations is increased more significantly with the increase of organizational IT capabilities, compared to direct investments in IT resources (Mata et al., 1995; Powell & Dent-Micallef, 1997; Ray et al., 2005; Stoel & Muhanna, 2009; Stratopoulos & Dehning, 2000). For Liu, Huang, Wei, & Huang (2015), IT capabilities correspond to the skills of organizations to assemble, integrate, and deploy IT resources to meet the needs of their business processes. Stoel & Muhanna (2009) define IT capabilities as complex bundles of resources, IT-related skills, and knowledge exercised through business processes that allow companies to coordinate activities and use IT assets to deliver the desired results.

The concept of IT capabilities has been developing and being discussed from different perspectives. In a seminal study, Bharadwaj (2000) uses the theoretical lens of the resource-

based view (RBV) to examine the relationship between IT capabilities and organizational performance. Following this strand of thought, whose inspiration, as taught by Makadok (2001), can be attributed to David Ricardo (Ricardo, 1917), several studies applied the VBR in studies involving the organizational IT capabilities, highlighting the notion that the focus of organizations should be on the correct selection of resources (Chen, Wang, Nevo, Benitez-Amado, & Kou, 2015; Dehning & Richardson, 2002; Melville, Kraemer, & Gurbaxani, 2004; Stoel & Muhanna, 2009; Yu, Jacobs, Chavez, & Feng, 2017).

The perspective of dynamic capabilities, whose origin, as explained by Makadok (2001), can be attributed to Schumpeter (1950), is another theoretical stream traditionally applied to IT capabilities, highlighting the central importance of organizational capability building process, synergistically combining available resources. Following this tradition, Kim et al. (2011) examined the relationships between IT capabilities, dynamic process-oriented capabilities, and an organization's financial performance, finding evidence of positively significant relationships. Liu, Ke, Wei, and Hua (2013) used the perspective of dynamic capabilities to study the mechanisms of influence of IT capabilities. More precisely, the authors identified that IT capabilities support the development of supply chain absorption and agility, influencing the performance of organizations. Stoel & Muhanna (2009) found evidence that the impact of IT capabilities on organizations is related to how well-tuned those capabilities are with demands outside the organization. Under the lens of dynamic capabilities analysis, more specifically from the notion that an organization must have sufficient ability to create purposely, extend or modify its resource base, the IT literature has recognized the importance of organizational ability to improvise and reconfigure IT resources (Helfat, Finkelstein, Mitchell, Peteraf, Singh, Teece, & Winter, 2007; Oliveira, Maçada, & Oliveira, 2016; Pavlou & Sawy, 2010; Pavlou & Gefen, 2006).

Other theoretical traditions are also being applied to research on IT capabilities. For example, from the Upper Echelons Theory, Lim, Stratopoulos, and Wirjanto (2012) proposed a positive relationship between the structural power of IT executives and the likelihood that the company will develop higher levels of IT capabilities. The authors also found evidence that the contribution of IT capabilities to companies' competitive advantage is more outstanding in organizations where the IT executive has greater power. In other words, the topic of IT capabilities is an open field for applying several theoretical approaches.

In this context, several studies have identified that IT capabilities can bring benefits to organizations, such as the improvement of business processes, the increase in organizational performance and innovativeness, as well as the establishment of competitive advantages (Bharadwaj, 2000; Chen & Tsou, 2012; Kim, Shin, Kim, & Lee, 2011; Kmieciak, Michna, & Meczynska, 2012; Liu et al., 2015; Lu & Ramamurthy, 2011; Oliveira & Maçada, 2013; Rai, Pavlou, & Du, 2012). Literature records contradictory results on the relationship between IT capabilities and organizational agility. On the one hand, IT is seen as an enabler of agility,

allowing faster decisions, facilitating corporate communication, and creating digital options for companies (Lucas Jr. & Olson, 1994; Sambamurthy, Bharadwaj, & Grover, 2003). On the other hand, the literature warns that IT could become a barrier to agility, given the possibility of the existence of relatively fixed physical and technological artifacts, legacy information systems, and rigid and complex IT architectures (Galliers, 2007; van Oosterhout, Waarts, & van Hillegersberg, 2006). Nonetheless, Lu and Ramamurthy (2011) revisited the theme and detected the presence of a positive relationship between IT capabilities and organizational agility. As presented by Wade and Hulland (2004), IT capabilities are a critical organizational competence, emphasizing their ability to integrate with other corporate resources and capabilities.

6.2.2 IT human capital

The theoretical tradition of human capital has origins that date back to the seminal studies by Schultz and Becker in the 1960s (Becker, 1962; Schultz, 1960; Schultz, 1961). Its precepts establish that people are involved in educational processes, as well as that the main effect of education is the improvement of skills and knowledge, in a logic of investment in the human being, that is, of building human capital (Cunha, Cornachione Junior, & Martins, 2010). Organizationally, from the development of human capital theory, the human factor started to be attributed value due to its ability to generate services (Blaug, 1976; Cunha et al., 2010). Thus, researchers in people management point to human capital as the set of productive capabilities of human beings that generate superior results based on their knowledge, skills, and attitudes (Baptiste, 2001; Becker, 1962; Blaug, 1976). Human capital can also be conceived as a specific arrangement between intelligence, skills, and experience of human beings, which gives the organization a distinctive mark. Thus, people in an organization can learn, change, innovate and provide the creative impetus for improving their performance (Kucharčíková, 2011).

Modern literature categorizes human capital as general and specific (van Teeffelen & Uhlaner, 2013). General human capital, such as generic professional experience, can be transferred between organizations as human beings move about in the labor market. However, specific human capital, such as professional experience in the organization, is useful only for the organization in question and is not easily transferable (Becker, 1962; Wang et al., 2014). Insofar as it is immaterial and socially complex, human capital must be understood as a collective resource, especially considering that collaboration between professionals, to a greater or lesser degree, is expected behavior in the professional sphere (Hatch & Dyer, 2004; Ployhart & Moliterno, 2011). In this context, Liu (2014) gathers evidence that human capital is an increasing asset for organizations, being recognized as an element to foster innovation (Subramaniam & Youndt, 2005), increase in organizational performance (Hitt, Bierman, Shimizu, & Kochhar, 2001; Reed, Lubatkin, & Srinivasan, 2006) and as a source of competitive advantage (Barney & Wright, 1998; Coff & Kryscynski, 2011; Ployhart & Moliterno, 2011).

Along this line, the literature highlights the distinctive importance of the human capital of information technology teams for organizations (Wang et al., 2014). Ravichandran and

Lertwongsatien (2005) identified that the human capital of the IT areas is an essential input for the development of organizational capabilities, from the technical and business skills of the IT staff, as well as their knowledge of the organization's culture and routines. For Park, Im, and Kim (2011), IT human capital can be considered a rare, valuable, and challenging to imitate resource, and which manifests itself in the skills necessary to manage the IT resources of organizations, involving the skills of technology management, business, interpersonal and management, in addition to the hard skill itself. Hard skills of IT personnel include not only technical knowledge, but also the ability to implement, use and manage that knowledge. In this sense, although the relative mobility of IT staff tends to be high, some IT skills, as corporate-level knowledge assets and technology integration skills, are incorporated into the organization, making it more difficult to obtain, commercialize, imitate, or replace (Hulland, Wade, & Antia, 2007). However, just like the physical capital of the organization (for example, machinery, installations, and equipment), human capital may suffer from obsolescence and must undergo constant maintenance (Cunha et al., 2010; Joseph, Koh, & Foo, 2010; Tsai, Compeau, & Haggerty, 2007).

6.2.3 Innovativeness

Innovativeness is an organization's propensity to create and support new products, processes, and services (Garcia & Calantone, 2002; Pesämaa, Shoham, Wincent, & Ruvio, 2013). For Tsai (2001), the ability to innovate can be understood as the organization's ability to gain new knowledge and stimulate the learning and exploration of knowledge from the organization's external environment. Innovativeness involves an organization's ability to exploit and recombine its resources and capabilities, redefining them and presenting an innovative result (Ruvio, Shoham, Vigoda-Gadot, & Schwabsky, 2014; Shoham, Vigoda-Gadot, Ruvio, & Schwabsky, 2012). In this sense, the notion that innovativeness is a crucial aspect to be developed in the organizational culture of modern organizations is growing (Story et al., 2015).

Innovativeness is a concept applied in a multidisciplinary way by the literature of the management area, with deep connections with other themes, such as strategic management, organizational performance, knowledge management, and market orientation (Marchiori, Popadiuk, Mainardes, & Rodrigues, 2020). From the seminal study conducted by Subramanian and Nilakanta (1996), several studies have found evidence of the positive impacts of innovativeness on organizational performance (Boso, Story, & Cadogan, 2013; Hult, Hurley, & Knight, 2004; Kyrgidou & Spyropoulou, 2013; Panayides & Lun, 2009; Parida, Pesämaa, Wincent, & Westerberg, 2017; Rhee, Park, & Lee, 2010; Rosenbusch, Brinckmann, & Bausch, 2011; Salge & Vera, 2009). The positive relationship between the ability to innovate and the survival of organizations is highlighted in the study by Hyytinen, Pajarinen, and Rouvinen (2015). Story et al. (2015) identified that the relationship between innovativeness and the performance of new products is curvilinear. The strength and shape of this relationship changes according to different levels of market orientation, access to financial resources, and environmental dynamism. Highlighting that network capacity is an essential organizational

capacity, Parida et al. (2017) found evidence that network capacity positively impacts the performance of organizations through innovativeness.

The entrepreneurship literature also recognizes the importance of innovativeness, listing it as one of the dimensions of entrepreneurial orientation, alongside proactivity and a propensity to accept risks. In this context, the ability to innovate reflects the tendency of organizations to get involved and support new ideas, experimentation, and creative processes, which can result in new products, services, or technological processes (Lumpkin & Dess, 2001; Rodrigues & Raposo, 2011).

Regarding identifying the antecedents of innovativeness, Hult et al. (2004) indicated a lack of clarity as to their identification and the lack of information on the driving factors of innovation and how they affect performance. Thus, the authors studied the effects of market orientation, entrepreneurial orientation, and learning orientation on innovativeness and the impact of innovativeness on performance. As a result, it was identified that performance is positively influenced by market orientation, learning orientation, and entrepreneurial orientation through innovativeness. Evidence indicates that organizational innovativeness can be driven by collaboration between organizations (Alexiev, Volberda, & Van den Bosch, 2016). Practices related to developing an organization's human and social capital can also affect its innovativeness (Donate, Peña, & Sánchez de Pablo, 2016). Panayides & Lun (2009) found evidence of the positive effect of trust on innovativeness and supply chain performance. In other words, the literature that involves innovativeness is broad, fragmented, and transversal to different fields in the business area (Marchiori et al., 2020).

6.2.4 Hypotheses and conceptual model

Wang et al. (2014) explain that the IT human capital can be subdivided between technical skills (hard skills), interpersonal skills (soft skills), and the relationship of the IT team with technology. Hard skills are related to the ability to program, analyze, and design systems, networks, and data storage. Interpersonal skills are related to IT staff's expertise to manage roles and interact with users and manage projects. Finally, the team's relationship with IT reflects how well IT staff manages IT functions and engages in IT-related self-learning processes (Byrd & Turner, 2001; Lee, Trauth, & Farwell, 1995). In this sense, it is understood that the human capital of the IT areas is an essential input for the development of organizational capabilities (Ravichandran & Lertwongsatien, 2005). The literature also explains that the IT human capital is an element for building the organizational IT capabilities, from its integrated and synergistic use with other corporate resources, such as equipment, money, patents, brands, among others (Amit & Schoemaker, 1993; Grant, 1991; Makadok, 2001). Thus, the first hypothesis of the present study is presented:

H_1. IT human capital has a direct positive effect on organizations' IT capabilities.

The innovation process in organizations is driven by the availability of a wide variety of resources and the updating of technologies and practices used in business processes (Chen & Tsou, 2012; McDermott & O'Connor, 2002). In this sense, an organization has greater conditions to innovate if it correctly applies the knowledge and technology available to it (Chapman, Soosay, & Kandampully, 2003). IT capability improves communication, information, knowledge sharing, inter-organizational exchanges, and organizational learning processes, which underpin innovation processes (Carbonara, 2005; Kmieciak et al., 2012). Chen e Tsou (2012) proposed that IT capability would be a critical factor in the innovation process. Dong & Yang (2019) indicated that IT capability assists organizations in capturing and recombining knowledge, creating new knowledge, to achieve success in the innovation process. In the context of the public sector, Hartley (2011) suggests that public sector innovativeness can be increased with the application of IT, as public sector organizations create new services that they would not be able to offer without the application of IT. Furthermore, Pang et al. (2014) indicate a positive influence between IT capabilities and resources and the innovativeness of public organizations. Thus, the second hypothesis of the study is presented:

H_2. IT capabilities have a direct positive effect on organizational innovativeness.

Innovativeness is among the most critical determinants of company performance (Panayides & Lun, 2009). Hult et al. (2004) clarify that the success of organizations is influenced by the organizational innovativeness capability, insofar as it is through innovations that companies find solutions to organizational problems and challenges, paving the way for the success and survival of organizations. Innovativeness makes organizations renew existing practices, stimulating exploratory and experimental activities, and being a force of attraction for creative employees, helping them improve their productivity and reduce their turnover (Kyrgidou & Spyropoulou, 2013). Hartley (2015) explains that innovation is a necessary way for organizations to create public value within the public sector. The literature also records other evidence on the positive effect of innovativeness on organizational performance (Parida et al., 2017; Rhee et al., 2010; Rosenbusch et al., 2011; Salge & Vera, 2009; Story et al., 2015). In this context, the third hypothesis of the study is presented:

H_3. Innovativeness has a direct positive effect on organizational performance.

The literature records a variety of studies, mainly built on the theoretical bases of the resource-based view, which indicate that IT capabilities can improve organizational performance (Mata, Fuerst, & Barney, 1995; Powell & Dent-Micallef, 1997; Ray, Muhanna, & Barney, 2005; Stoel & Muhanna, 2009; Stratopoulos & Dehning, 2000). The influence of IT capabilities on performance also extends to the context of small organizations, who generally suffer from resource and time constraints, low formalization of processes, lack of strategic planning, and greater reliance on external knowledge and services for IT operations, given the absence of

precariousness of internal IT departments (Kmieciak et al., 2012; Premkumar, 2003). Pang et al. (2014) proposed that IT capabilities would be a source of superior performance for public organizations within the public sector. In this context, the fourth hypothesis of the present study is presented:

H_4. IT capabilities have a direct positive effect on organizational performance.

From the resource-based view, Wade & Hulland (2004) warned of the importance of identifying the factors that interfere in the relationship between IT and the performance of organizations. Following this line, several researchers find evidence of the indirect relationship between IT and performance, intermediated by other organizational capabilities. For example, Liu et al. (2013) identified that absorption capacity and supply chain agility mediate IT capabilities and company performance. Zeng and Lu (2020) placed the mediating role of inter-organizational relationships in the relationship between IT capabilities and supply chain performance. In the field of the IT-innovation relationship, the literature presents evidence of the contribution of IT in the innovation process of organizations, which, in turn, has an impact on organizational performance (Han & Ravichandran, 2006; Kleis, Chwelos, Ramirez, & Cockburn, 2012). Kleis et al. (2012) explain that IT can contribute to the increase of organizational innovation, as it contributes to the capture and management of knowledge used in the production of innovation, as well as enabling critical elements of the innovation process, such as the identification of opportunities and the development of innovative concepts and design, as well as inter-organizational coordination between the focal company and its innovation partners. Thus, the fifth and last hypothesis of the present study is presented:

H_5. The relationship between IT capabilities and organizational performance is mediated by innovativeness.

In this sense, Figure 1 presents a synthesis of the above hypotheses in a conceptual model.

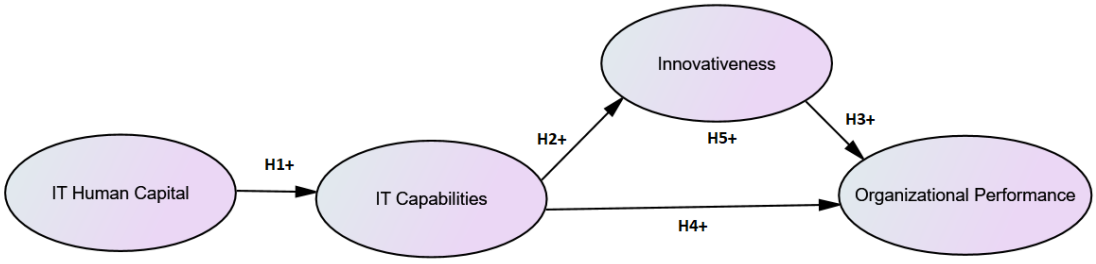

Figure 6.1 – a conceptual model
Source: Own

6.3 Methodology

The present study can be classified as quantitative and descriptive. We used primary data obtained in a transversal way through a survey in August 2019. The main IT executives from 798

public agencies, linked to the three branches established in Brazil, received an invitation to participate (Executive, Legislative and, Judiciary) and the three spheres of the Brazilian public sector (Federal, State and, Municipal). The chief information officer (CIO) definition as a key informant followed that established by previous studies (Chen, Wang, Nevo, Benitez-Amado, & Kou, 2015; Kim et al., 2011). We make direct and individual contacts with all CIO by phone or email. The link to the form was sent by email, and the questionnaire was divided into two parts. The first was intended to collect data for the characterization of the sample. The second contained questions related to the observed variables of the constructs selected for the study: IT human capital, IT capabilities, innovativeness, and organizational performance.

To operationalize the human capital of IT, a 2nd order construct, we base it on the strategy described by Wang et al. (2014), with the use of a three-factor solution, that is, technical skills, interpersonal skills, and the relationship of the IT team with technology. For the 2nd order IT capabilities construct, we used a five-factor solution based on the adaptation of the scale used by Chen et al. (2015). More precisely, we measure the constructs of IT flexibility, IT integration, alignment between IT and business, and IT management, with the IT reconfiguration capability dimension, as proposed by Oliveira, Maçada, and Oliveira (2016). The 1st order innovativeness construct was based on the strategy followed by Hult, Hurley, and Knight (2004) and Tajeddini (2011). Finally, considering that the IT literature indicates that the perception of IT managers and users adequately reflects the actual performance of the organization (Tallon, 2010; Tallon & Kraemer, 2006), the 1st order organizational performance construct was operationalized by adapting the perceptual scale used by Gould-Williams (2003). A five-point Likert scale was used in all cases, ranging from strongly disagree to agree strongly.

The application of the questionnaire was preceded by primary care. The instrument was submitted to the content evaluation process. Three experienced researchers specialized in information systems and five IT managers participated, adequately representing the target audience of the research. After removing and adapting some items, we move on to the pre-test phase of the instrument. For this purpose, we applied the questionnaire to twenty-one other IT managers, who did not report problems with the issues. In addition, we carried out a preliminary analysis of the data collected, which did not point out any issues with specifying the model. Therefore, we applied the questionnaire from the Google Forms platform. After three weeks of collection, we received 278 completed questionnaires, resulting in a response rate of 34.8%.

As a focus on the objective of the study, we defined the covariance-based structural equation modeling as an approach to data analysis (CB-SEM), with the application of confirmatory factor analysis (CFA), in two stages (Anderson & Gerbing, 1988). We used the statistical packages IBM SPSS and IBM AMOS, version 27. After specifying the measurement model, we verify the possible existence of multivariate outliers through the squared Mahalanobis distance (D^2). We perform the calculation from the specification of a submodel containing all items in the

questionnaire and before any fitting is made (Marôco, 2014). By adopting a conservative approach, 20 responses were excluded, with p1 and p2 values greater than 0.001, reducing the final sample to 258 observations. In the sequence, we evaluated the normality of the variables through the analysis of the skewness (Sk) and kurtosis coefficients (Ku), and no results were found to suggest violations of the normal distribution (|Sk|<2 and |Ku|<7) (Marôco, 2014).

After the data processing phase was completed, the CFA measurement model was adjusted. The first step was the assessment of the factor loadings without detecting problems (Hair, Black, Babin, Anderson, & Tatham, 2009). Then, we evaluated the Modification Indices indicated by AMOS, considering that values higher than 11 indicated problems of local adjustment and the measurement errors that were theoretically justified were correlated (Marôco, 2014). In having obtained a satisfactory result, we proceeded to the specification of the structural model, according to the research hypotheses. To assess the model's specification broadly, the convergent validity of the constructs was calculated through the analysis of factor loadings, the average variance extracted (AVE), and the level of composite reliability (CR). We also verified the discriminant validity, by comparing the percentages of the AVE, for any two constructs, with the square of the estimate of their correlation (r^2) (Hair et al., 2009).

Next, given the possibility of specifying a structural model with the goodness of fit indicators, but with incorrectly specified causal relationships (Mulaik et al., 1989), we calculated the RNFI (Relative Normed Fit Index), that considers equivalently the contribution of the measurement and structural models (Marôco, 2014). The mediation ratio specified in the structural model was assessed using the maximum likelihood method. The significance of the structural coefficients was evaluated with a Z test produced by bootstrap simulation. Finally, the existence of differences between groups formed based on the characteristics of the organizations (size and scope of action), we investigate with the specification of MIMIC models (Multiple Imputation and Multiple Causes), as proposed by Joreskog and Goldberger (1975). According to Marôco, this is an agile and robust way to identify differences between groups based on a structural model (Marôco, 2014).

6.4 Results and discussion

As a first step of the CFA, the measurement model was specified, with the first version built showing goodness of fit indicators below that suggested by the specialized literature: χ^2 = 2160.22; χ^2/df = 2.184; CFI = 0.873; TLI = 0.861; GFI = 0.736; RMSEA = 0.068; SRMR = 0.0652 (Hair et al., 2009). However, based on the assessment of the factor loadings of the items, we identified and eliminated two items (INN5 and INN7) that presented a factor loading lower than 0.7 (Hair et al., 2009). The final version of the questionnaire is presented in Appendix 3.

Following, from the Modification Indices (MI > 11), errors of observed variables were correlated that were theoretically justified, restricted to the same construct. Thus, the goodness of fit

indicators improved significantly, presenting the following values: $\chi^2 = 809.321$; $\chi^2/df = 1.655$; CFI = 0.951; TLI = 0.944; RMSEA = 0.050; SRMR = 0.0652. The observed result for the GFI indicator (lower than 0.9) can be justified by the number of variables observed in the model and by the sample size (Marôco, 2014), not meaning model fitting problems. Next, we proceed to analyze the convergent and discriminant validities of the constructs used. For this purpose, the levels of construct reliability (CR), we calculated the values of the average extracted variance (AVE) and the correlations between the constructs. Table 6.1 presents the results in detail, accompanied by the acceptance criteria for each test (Hair et al., 2009).

Table 6.1 - Reliability and validity of the structural model

CONSTRUCT	RELIABILITY	CONVERGENT VALIDITY	DISCRIMINANT VALIDITY									
	CR >=0.7	AVE >= 0.5	AVE > r²									
	CR	AVE	r²									
			FLE	INT	ALI	MAN	REC	ISK	TSK	RWT	INN	PER
Flexibility -FLE	0.877	0.644										
Integration – INT	0.846	0.648	0.240									
Aligment - ALI	0.850	0.546	0.215	0.090								
Managem. - MAN	0.923	0.707	0.327	0.224	0.342							
Reconfigur. – REC	0.885	0.664	0.204	0.070	0.225	0.269						
Soft Skills - SSK	0.929	0.622	0.179	0.052	0.203	0.189	0.316					
Hard Skills – HSK	0.842	0.574	0.309	0.050	0.221	0.270	0.336	0.554				
Relat.Techn. - RWT	0.868	0.569	0.181	0.026	0.324	0.177	0.295	0.564	0.458			
Innovativen. – INN	0.926	0.716	0.185	0.104	0.190	0.242	0.223	0.116	0.156	0.282		
Performance - PER	0.886	0.662	0.177	0.065	0.157	0.201	0.196	0.161	0.232	0.274	0.354	

Source: Own

In other words, no convergent or discriminant validity problems were detected. The analysis continued and, given the possibility of specifying a structural model with the goodness of fit indicators, but with incorrectly specified causal relationships (Mulaik et al., 1989), the RNFI (Relative Normed Fit Index) was also calculated (Marôco, 2014). No problems were detected in this regard.

Data analysis started with the sample's characterization, which is presented in detail in Appendix 4. Still, it can be summarized as follows: the most extensive participation was registered among midsize organizations, with 500 and 1,500 employees (29.1%) linked to the Federal sphere (71.7%). The main areas represented were education (22.1%) and judicial (20.8%). Despite the relative concentration of organizations in the Federal sphere, that is, organizations with national operations, the sample did not present severe biases or trends that would contraindicate its use, considering the study's objectives. Regarding the key respondents, most of the 258 IT managers who sent responses have between 40 and 49 years of age (39.9%) and more than 20 years of professional experience (34.3%), as well as took specialization courses (post-graduation *lato sensu*) (43.4%). In addition, it is noteworthy that the vast majority of executives are men (90.7%). This concentration is much higher than what has been observed about the participation of men and women in the market for IT professionals (Kenny & Donnelly, 2020), which provides exciting subsidies for researchers interested in gender and the labor market, inside and outside the IT area. In other words, the data suggest that the restriction for women to access IT management posts may be even greater than in other areas, research trail that future researchers can follow.

Subsequently, the existence of differences between groups, based on the characteristics of the sample, was investigated through the specification of MIMIC models. The analysis focused on two groups formed from the size of the organizations. Organizations with up to 1,500 public servants were grouped (N = 153) and organizations with several workers above this limit (N = 105). Thus, bearing in mind that the size of organizations has been presented in the literature as having a significant role in research on IT capabilities (Damanpour, 2010; Kim, Xiang, & Lee, 2009; Oliveira et al., 2016), a dummy variable was specified to represent the largest organizations. However, no statistically significant differences were found for any of the nine constructs analyzed, as shown in Table 6.2. The structural model is presented in Appendix 5.

Table 6.2 - Statistical significance of the effects for the group of large organizations

Relations between constructs			Estimates	S.E.	C.R.	P
Innovativeness	<---	Large organizations	0.140	0.156	0.901	0.368
Flexibility	<---	Large organizations	0.122	0.111	1.094	0.274
Integration	<---	Large organizations	-0.169	0.199	-0.851	0.395
Alignment	<---	Large organizations	0.232	0.128	1.805	0.071
Management	<---	Large organizations	0.207	0.151	1.371	0.171
Reconfiguration	<---	Large organizations	-0.049	0.079	-0.627	0.531
Soft Skills	<---	Large organizations	-0.049	0.097	-0.509	0.611
Hard Skills	<---	Large organizations	0.086	0.127	0.681	0.496
Relation with Technology	<---	Large organizations	-0.075	0.117	-0.638	0.524

Source: Own

The second analysis was dedicated to comparing the organizations that are part of the federal sphere of the Brazilian public power with those linked to local administrations. The choice of these groups was inspired by the literature that indicates that the sector in which organizations operate can influence the IT capabilities of organizations (Kim et al., 2011; Oliveira et al., 2016; Stoel and Muhanna, 2009). In addition, the fact that federal organizations generally follow central guidelines for structuring and managing IT areas and applying IT resources contributes to justifying the definition of groups. Thus, a dummy variable was specified to represent organizations at the federal level (N = 185), compared to state and municipal organizations (N = 73). The results can be seen in Table 6.3. The structural model is presented in Appendix 5.

Table 6.3 - Statistical significance of the effects for the group of federal organizations

Relations between constructs			Estimates	S.E.	C.R.	P
Innovativeness	<---	Federal organizations	-0.041	0.170	-0.239	0.811
Flexibility	<---	Federal organizations	0.023	0.121	0.191	0.848
Integration	<---	Federal organizations	-0.645	0.216	-2.980	0.003
Alignment	<---	Federal organizations	0.515	0.141	3.661	***
Management	<---	Federal organizations	0.045	0.165	0.275	0.784
Reconfiguration	<---	Federal organizations	0.010	0.086	0.119	0.905
Soft Skills	<---	Federal organizations	0.093	0.106	0.877	0.381
Hard Skills	<---	Federal organizations	0.259	0.140	1.853	0.064
Relation with Technology	<---	Federal organizations	0.164	0.127	1.290	0.197

*** p<0.001
Source: Own

In this case, differences between organizations at the federal level about the others (state and municipal) in the integration and alignment factors were detected. In the first case, we identified that national organizations have a lower degree of IT integration; that is, less capacity was detected to perceive and respond to changes and opportunities in the context external to the

organization and integrate them into internal processes. On the other hand, federal organizations had a more remarkable ability to devise an IT strategy that is consistent with the overall strategy of the organization, as well as to support it in formulating and realizing its innovation objectives. We did not detect significant differences for the other factors of IT capabilities, IT human capital, the perception of performance, and the innovativeness of organizations.

Then, to allow the assessment of the hypotheses launched, the second part of the CFA was conducted, that is, the specification of the structural model. The result can be seen in Figure 6.2. Table 6.4 shows the statistical significance of the relationships analyzed.

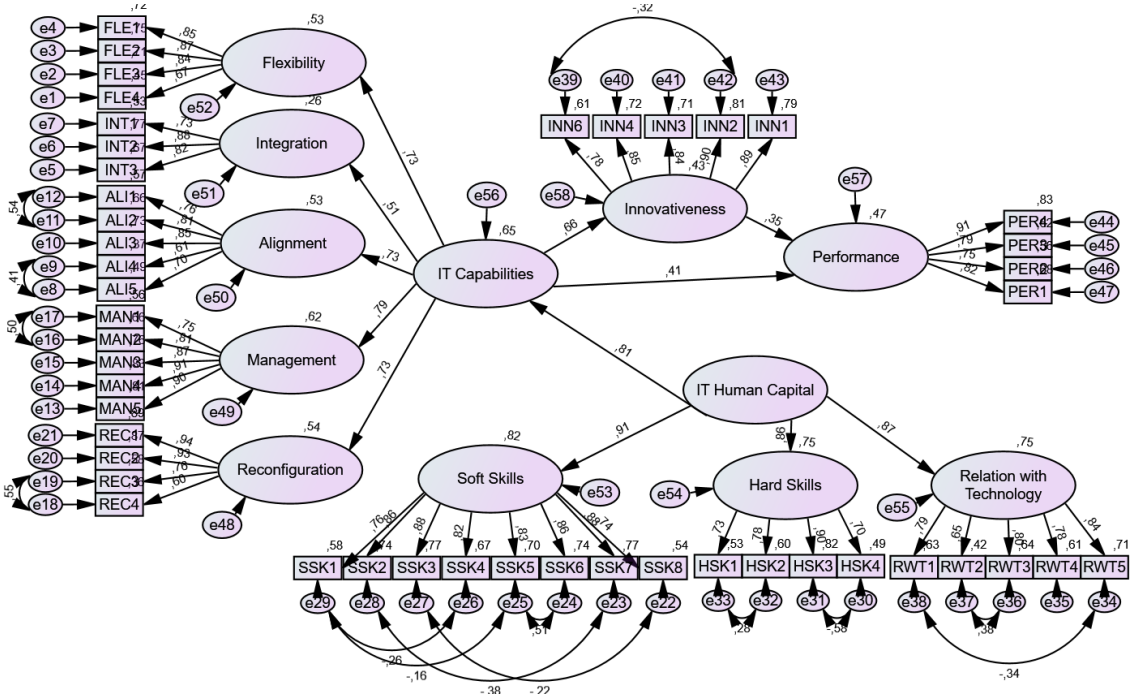

Figure 6.2 - Structural model
Source: Own

Table 6.4: statistical significance of the relations

Relations between constructs			Estimates	S.E.	C.R.	P
IT Capabilities	<---	IT Human Capital	0.512	0.061	8.396	***
Innovativeness	<---	IT Capabilities	1.270	0.176	7.205	***
Performance	<---	IT Capabilities	0.717	0.156	4.590	***
Performance	<---	Innovativeness	0.320	0.071	4.497	***

*** p < 0,001
Unstandardized estimates
Source: Own

The direct, indirect, and total effects are shown in Table 6.5, with all the observed relationships being statistically significant ($p \leq 0.05$).

Table 6.5 - Direct, indirect, and total effects

Relations between constructs			Direct Effect	Indirect Effect	Total Effect
IT Capabilities	<---	IT Human Capital	0.805	-	0.805
Innovativeness	<---	IT Capabilities	0.658	-	0.658
Performance	<---	Innovativeness	0.349	-	0.349
Performance	<---	IT Capabilities	0.405	0.230	0.635

Standardized estimates
Source: Own

In this context, this study's first hypothesis (H1) indicated that IT human capital directly affects IT organizational capabilities. In this sense, the model showed that IT human capital was responsible for explaining 65% of the variation in IT capabilities. In other words, a direct solid positive effect was detected, supporting hypothesis 1, a result that is in line with previous studies (Amit & Schoemaker, 1993; Park et al., 2011; Ravichandran & Lertwongsatien, 2005; Wang et al., 2014). The IT human capital has multidimensional characteristics involving technical aspects of human relations, which encompasses the proactive attitude of professionals towards the evolution of IT. Thus, organizations must make efforts to form IT teams that can interact appropriately with people in the business areas and basic technical knowledge, the updating of which must be a constant concern of organizations. Organizations need to be creative to design attractive careers for IT staff, as well as invest in training, development and adopt new strategies for the selection and retention of technical personnel, in the same way, that careful planning is required in the acquisition of technology platforms to ensure that the IT infrastructure is always up to date (Ravichandran & Lertwongsatien, 2005). In addition, the IT professionals themselves must adopt a proactive attitude in search of updating the technical knowledge they need to perform their tasks (Wang et al., 2014), especially considering that they are increasingly subject to the risk of professional obsolescence, given the rapid evolution of IT (Joseph et al., 2010; Tsai et al., 2007).

The second hypothesis (H_2) suggested that IT capabilities directly positively affect organizational innovativeness. In this sense, 43% of the variation in innovativeness was explained by IT capabilities. Thus, hypothesis 2 was supported, which is by Carbonara (2005), Chen and Tsou (2012), Dong and Yang (2019), Hartley (2011), Kmieciak et al. (2012), and Pang et al. (2014). In this scenario, several possibilities arise for organizations to boost the innovation process through IT. For example, organizations can apply IT resources and capabilities to promote teamwork, such as videoconferences, groupware, and intranets, which aid collective learning processes, with a known effect on innovativeness (Carbonara, 2005). In addition, technological resources can be applied to developing projects and the launch of new products and services. Organizations can explore the potential that IT provides for interaction with customers and users, analyzing their behavior and identifying needs, preferences, and trends, which can pave the way for innovation projects (Carbonara, 2005; Chen & Tsou, 2012). Organizations can apply IT to expand the dissemination of internal knowledge and facilitate the assimilation of external knowledge, which can foster the potential for developing innovations

(Dong & Yang, 2019). Finally, bearing in mind that the more developed IT capabilities are, the more conducive the organizational environment for innovation will be, investment in employees' IT skills and knowledge will result in increased innovation activity in organizations, based on IT knowledge and knowledge dissemination mechanisms (Kmieciak et al., 2012).

The third hypothesis (H_3) proposed that innovativeness has a direct positive effect on organizational performance. We observed that this relationship was statistically significant, that is, hypothesis 3 was sustained, which is in line with previous studies (Hartley, 2011; Hult et al., 2004; Kyrgidou & Spyropoulou, 2013; Panayides & Lun, 2009; Parida et al., 2017; Rhee et al., 2010; Rosenbusch et al., 2011; Salge & Vera, 2009; Story et al., 2015). The results suggest that organizations should create a strong culture of innovation to obtain superior results. Managers must be innovative and seek to establish a continuous state of innovation (Hult et al., 2004; Kyrgidou & Spyropoulou, 2013). A possible path to be followed to foster innovativeness is to stimulate the practice of continuous learning, to build a learning-oriented organizational culture, given its potential reflexes on innovation (Rhee et al., 2010). In this context, Hult et al. (2004) explain that, in general, decisions that affect organizational culture are made by senior management, and decisions that affect innovation are often made at lower levels, as in the marketing, operations, and R&D departments. The present study results add that the IT of the organizations must be included in this list. Thus, organizations must coordinate the efforts of these sectors to maximize the effect of innovative activities on performance (Kyrgidou & Spyropoulou, 2013). However, managers should not fail to consider guidelines by Rosenbusch et al. (2011) in the sense that there must be a balance of efforts between the creation of innovations and their practical implementation, bearing in mind that the conversion of innovative ideas into new products, processes, and services is a central element for the success of innovation.

The fourth hypothesis (H_4) indicated that IT capabilities directly affect organizational performance, which was supported by data. The direct relationship observed between IT capabilities and performance was positive and statistically significant. The result is in line with the literature (Mata et al., 1995; Pang et al., 2014; Powell & Dent-Micallef, 1997; Ray, Barney, & Muhanna, 2004; Stoel & Muhanna, 2009; Stratopoulos & Dehning, 2000). Along these lines, because organizations have limits to increase their endowment of IT resources, managers must dedicate themselves to redesigning their activities, routines, and processes, to exploit resources more efficiently and effectively; that is, they must build and develop IT capabilities (Ray et al., 2004). In addition, managers and researchers should consider that, despite the results showing that IT capabilities, as a conceptual unit, have a positive effect on performance, organizations are heterogeneous in developing each factor of capabilities. The organization may have a good development about the interpersonal relationship of IT personnel, but low levels of hard skills, for example. Thus, it is indicated that organizations seek to balance each aspect's development to enhance the final result, as pointed out by Stoel and Muhanna (2009). Within the public sector, managers can apply the potential for data capture and processing that IT provides to discover needs and opportunities for new public services, such as creating systems to monitor

risks to collective health (Pang et al., 2014). In this sense, the COVID pandemic19 reinforced the importance of quickly and accurately treating this type of information, focusing on decision-making. Finally, organizations must understand how environmental conditions can help them determine which parts will benefit most from IT investments to rationalize and obtain the maximum return (Stoel & Muhanna, 2009).

The fifth hypothesis (H_5) suggested that the relationship between IT capabilities and organizational performance is mediated by innovativeness, in an indirect connection. The data indicated that, in fact, in addition to the direct effect (hypothesis 3), IT capabilities also positively affect performance indirectly through innovativeness. The statistical significance of the indirect relationship found was evaluated with a *Z* test, produced using bootstrap simulation by AMOS. The result is in line with those found by Han and Ravichandran (2006) e Kleis et al. (2012). In addition, the result is related to that observed by Chen and Tsou (2012), as it was observed that IT capabilities influence organizational performance through intermediate elements. In the present case, innovativeness. This understanding puts organizations in a better position to develop appropriate strategies for developing IT capabilities to achieve superior performance (Chen & Tsou, 2012). To provide a technological environment favorable to innovation, organizations must develop effective strategies for selecting and acquiring resources to maintain an adequate asset base of personnel, technology, and relationships to support IT initiatives (Ravichandran & Lertwongsatien, 2005). In turn, public organizations must increase their investments in e-government projects (electronic government), initiatives that combine the application of IT resources innovatively, with a focus on creating public value (Hartley, 2015).

6.5 Conclusions

The study pursued the objective of identifying the relationship between IT human capital, IT capabilities, innovativeness, and organizational performance, in an integrated manner. The results showed that the human capital of IT positively impacts the organizational capabilities of IT, but it is not part of its composition since it is a corporate resource. Thus, the IT human capital is one of the necessary and fundamental inputs for the construction of IT capabilities, but it should not be confused with IT capabilities *per se*. (Ravichandran & Lertwongsatien, 2005; Amit & Schoemaker, 1993; Grant, 1991; Makadok, 2001). In addition, the study presented evidence that IT capabilities, in turn, have a direct positive effect on organizational performance and indirectly, mediated by innovativeness. In other words, IT capabilities have proven to be a robust antecedent of innovativeness. In this sense, the objective of the study was achieved.

The analyzed data also showed that the concentration of men who exercise the role of CIO, from the sample studied, it is much higher than that observed in IT functions in general, information that deserves to be better discussed by research dedicated to gender and the labor market. It was also observed that organizations with a greater scope of action (national), showed superior skills to design IT strategies consistent with general strategies than regional or local organizations. On

the other hand, broader organizations had less capability to perceive and respond to changes and opportunities in the external context and integrate them into internal processes. Therefore, we suggest that these insights be explored by future research.

As a theoretical implication, the study contributes to the IT and innovation literature, empirically validating the proposition that IT capabilities should be added to the antecedent list of innovative organizational capability. In addition, by proposing an integrated model, the study helps to understand innovativeness, the nature of its relationship to organizations' ability to deal with technology, and the role of the culture of innovation in organizational performance. This integrated approach is a more fruitful and realistic strategy than simpler bivariate approaches (Hult et al., 2004). In addition, the study presents the IT human capital from a new perspective, highlighting its conceptual uniqueness, as well as statistically validates a model for its operationalization. The present study proposes that the nature of IT human capital is an organizational resource, not being part of IT capabilities per se. Thus, the concept must be operationalized and measured independently, considering three factors that can be identified in the IT teams, that is, the hard skills of the team, the soft skills of its components, as well as the nature of the team's relationship with technology.

From a practical point of view, the results indicate several paths. First, organizations must select and hire IT professionals who, in addition to the evident hard skills, they also demonstrate adequate soft skills and a proactive stance in constant search of updating and obtaining new technical knowledge. Organizations should adopt continuous training programs for IT professionals that involve the technical aspects of interpersonal relationships and encourage self-learning behaviors. IT managers should always seek to build IT capabilities and not just select and apply resources, whether human, material, or knowledge assets. IT capabilities effectively influence organizational performance, not simply direct investments in IT resources (Mata et al., 1995; Powell & Dent-Micallef, 1997; Ray et al., 2005; Stoel & Muhanna, 2009; Stratopoulos & Dehning, 2000). Also, consider the role of innovativeness on performance, including leveraging the effect of organizational IT skills. Organizations should seek to establish an enabling environment for encouraging innovation. Workers are not automatically punished for possible failures in the process. In addition, organizations must “learn to learn,” that is, they must develop a culture oriented to learning, an environment conducive to the flourishing of new products, processes, and services.

However, the present study has limitations that contraindicate the generalization of the results and conclusions. Data were collected through a non-probabilistic sampling process and available for convenience, as the respondents’ participation was voluntary. In addition, the investigation focused on Brazilian public agencies. Therefore, we suggest that future research expand the scope of research to other countries and sectors and adopt intercultural perspectives. In addition, longitudinal studies could provide additional information. Finally, the study used perceptual data from a single informant in each of the organizations surveyed, which raises the

question of possible biases. In this sense, future researchers can employ alternative research projects, including objective data, multiple informants, and longitudinal data.

Chapter 7

Final considerations

7.1 Conclusions and main implications

The general objective of this thesis was to identify the role of information technology capabilities and innovativeness in organizational performance in the context of the public sector. To this end, the study sought to achieve a series of complementary objectives, which can be divided into two main blocks. The first group of objectives, explored in chapters 2 and 3 of this study, we intended to identify, analyze and map the high-impact literature on innovativeness and IT capabilities, respectively, specifically in the context of the literature on management. Thus, we sought not only to reveal the conceptual and intellectual structures of the theme, but also to review and detail the state of the art of the research and present a survey of opportunities for future research.

Thus, the analyzes indicated that the literature on innovativeness has its roots in different fields, such as knowledge management, diffusion of innovation and acceptance of technology, entrepreneurship, marketing, and strategy. Thematic analysis strengthened the connection between the capacity to innovate and other areas, with emphasis on strategic management, organizational performance, knowledge management, and market orientation. In addition, the analysis of the quotations revealed that the connections between these areas are not uniform. For example, the knowledge management cluster was strong with strategy and marketing. However, there was not the same relationship between knowledge management and marketing and entrepreneurship, which corroborates the inference that connections between these themes can be explored by future studies on innovativeness. In the same context, work to spread innovation and technology acceptance appears relatively isolated and weak links with other areas, opening another path for new approaches. For example, future researchers can analyze the effects of the perceived utility and ease of use of technological resources on organizational results, based on the mediating effects of the ability to innovate or using the theoretical perspective of dynamic capabilities. The most active channel for disseminating knowledge on the theme of innovativeness in management literature is the Journal of Product Innovation Management. The United States, the United Kingdom, China, and the Netherlands are the largest knowledge producers in the field. Ten active fronts have also been identified in recent literature. Namely: family businesses, self-service services, export markets, coopetition, organizational networks, entrepreneurial orientation and its dimensions, interactions with the market, open innovation and absorption capabilities, resistance to innovation, orientation, and entrepreneurial culture. These strands represent the state of the art of research related to

innovativeness, driving research development, and providing a wide range of opportunities for future researchers duly summarized in this study.

In turn, the literature analysis on IT capabilities made it possible to present a consistent and harmonious narrative about the origin of the academic community, the evolution and future of research on IT capabilities. The fundamental themes for structuring the set of scientific production on IT capabilities, that presented a higher level of development and connection with external research flows, are the organizational performance, the strategic management, the vision based on resources and the value. Thus, future researchers will find underlying the literature on IT capabilities in the business context a rich and varied literature involving these main themes, as well as several sub-themes associated with each theme-engine, as presented in the course of the article. Another contribution of the present study is the presentation to the academic community of the main intellectual structures of the field, that is, those studies with high levels of co-citation and that can be grouped into relatively cohesive thematic blocks. These study clusters explore organizational performance, competitive advantage, organizational agility, leadership, organizational learning, knowledge management, use of IT, and value and supply chain management. Another significant contribution of the study was identifying the main paths taken in recent years by researchers, that is, state of the art in the literature on IT capabilities. In this sense, recent research on business analytics, ambidexterity, organizational agility, new product development, and IT supply stand out. These five themes represent the main study strands in activity in the field.

Following, the second block of objectives, explored in depth in chapters 4, 5, and 6 of the present study, sought to clarify the nature of the relationship between various phenomena related to the application of technology and the propensity to innovate in organizations, as well as its role on organizational performance, focusing on the public sector. More specifically, chapter 4 of this thesis analyzed the relationship between IT capabilities, innovativeness, and organizational performance. The presented study measured the impact of IT capabilities on organizations' innovativeness, as well as the effect of these two sets of organizational skills on overall performance, as perceived by managers. In addition, the study analyzed the theoretical frameworks and empirical data that justify including the IT reconfiguration capability among the factors that make up the IT capabilities of organizations. The results supported the four hypotheses formulated. That is, we identified that the IT reconfiguration capability must be listed among the IT capabilities of public organizations. The data also indicated that IT capabilities play a role in fostering innovativeness of public organizations and that both (IT capabilities and innovativeness) have a positive impact on the performance of organizations.

In chapter 5 of this thesis, we present an alternative proposal for operationalizing the IT human capital, as well as analyze the relationship between human capital and IT capabilities in organizations. The study proposed and tested a new theoretical model for operationalizing the human capital of IT organizations, formed by the factors of technical skills, interpersonal skills,

and the team's relationship with technology, as well as measuring the impact of human capital on the IT capabilities of organizations. The results supported the hypotheses formulated. In other words, the proposed model proved to be theoretically grounded and statistically reliable and found evidence that supports the importance of human capital for the formation of organizations' IT capabilities.

Finally, in chapter 6, we pursued the objective of identifying the relationship between IT human capital, IT capabilities, innovativeness, and organizational performance, in an integrated way. The results showed that the human capital of IT positively impacts the organizational IT capabilities, but it is not part of its composition since it is a corporate resource. Thus, the human capital of IT is of the necessary and fundamental inputs for the construction of IT capabilities, but it should not be confused with IT capabilities per se. (Ravichandran and Lertwongsatien, 2005; Amit and Schoemaker, 1993; Grant, 1991; Makadok, 2001). In addition, the chapter provided evidence that IT capabilities, in turn, have a direct positive effect on organizational performance, as well as indirectly mediated by innovativeness. In other words, IT capabilities have proven to be a robust antecedent of innovativeness.

As an academic implication, this thesis contributes to the IT and innovation literature, as this research work identifies and interprets the main research questions on the themes of innovativeness and IT capabilities, as well as the evolutionary pattern of academic debate. In addition, it provides insights into new or under-explored issues that may be the subject of future research, as well as providing additional avenues to promote a greater understanding of the topics. In this sense, compared to previous literature reviews, this thesis focuses on the intellectual structure of research on innovativeness and IT capabilities, demonstrating the evolution of the themes under investigation over time, providing a comprehensive view of historical origins and research trends, reconstructing the debate in terms of academic journals, topics, theoretical frameworks, and contexts.

Still, in terms of research contributions, this thesis empirically validates the proposition that IT capabilities should be added to the list of antecedents of organizational innovativeness. Furthermore, by proposing an integrated model, the study helps to understand innovativeness, the nature of its relationship to the ability of organizations to deal with technology, as well as the role of the culture of innovation in organizational performance. This integrated approach is a more fruitful and realistic strategy compared to simpler bivariate approaches (Hult et al., 2004). In addition, the thesis presents the IT human capital from a new perspective, highlighting its conceptual uniqueness, as well as statistically validating a model for its operationalization. The study further proposes that the nature of IT human capital is an organizational resource, not being part of IT capabilities per se. Thus, the concept must be operationalized and measured independently, considering three factors that can be identified in IT teams, that is, the technical skills of the team, the interpersonal skills of its components, as well as the nature of the team's relationship with technology.

As for practical contributions, the elements presented in this thesis can serve as a basis for professionals interested in knowing the field of research, pointing paths to practical applications of knowledge about the phenomenon of innovativeness. In addition, the result of the study can serve as support for researchers, academics, and professionals interested in making new advances in this field of research, from the moment the study updates them on the evolution of the knowledge framework, as well as pointing out promising paths for its research efforts, taking scientific knowledge on the field of innovativeness to a new level. Finally, as a methodological contribution, the study that makes up this thesis, especially chapters 2 and 3, are examples of how to combine various techniques and tools for quantitative analysis in an area of knowledge. In addition, the study also shows how to combine quantitative and qualitative analyzes, with the aim of better understanding and in greater depth the different faces of a scientific field.

Still, as contributions to management practices in organizations, several paths are indicated. First, organizations must select and hire IT professionals who, in addition to the obvious technical skills, also demonstrate have adequate soft skills and a proactive posture in constant search of updating and obtaining new technical knowledge. Organizations must adopt continuous training programs for IT professionals that involve the technical aspects, of interpersonal relationships and encourage self-learning behaviors. IT managers should always seek to build IT capabilities and not just depend on the selection and application of resources, whether human, material, or knowledge assets. It is IT capabilities that effectively influence organizational performance, not simply direct investments in IT resources (Mata et al., 1995; Powell and Dent-Micallef, 1997; Ray et al., 2005; Stoel and Muhanna, 2009; Stratopoulos and Dehning, 2000). Also consider the role of innovativeness on performance, including enhancing the effect of organizational IT skills, organizations should seek to establish an enabling environment for encouraging innovation, in which workers are not automatically punished for possible failures in the process. In addition, organizations must “learn to learn”, that is, they must develop a culture oriented to learning, an enabling environment for the flourishing of new products, processes, and services. Thus, considering the breadth and robustness of the results found in the various studies present in this thesis, we consider the objectives outlined for this research work as achieved.

7.2 Limitations and future lines of investigation

As occurs in all academic studies, this thesis has limitations that contraindicate the generalization of the results and respective conclusions. Firstly, the limitations arising from the choice of keywords and the use of only one database must be recognized. Therefore, future studies may expand the research base to include works published in the Scopus database, generally considered to be broader in scope than the WoS database, that would be especially relevant for mapping smaller areas of research that are beyond the WoS scope (Zupic and Čater, 2015). However, during the pre-processing phase, in addition to dealing with duplications, researchers need to be aware of the differences between these bases. For example, Scopus contains data about all authors in the cited references, unlike WoS, which only details the

information about the main author, a factor that can cause distortions in the analytical procedures of citation and co-citation. In addition, future research may seek to expand the results of the present work, as well as to compare the results found, using other promising research techniques, such as bidirectional analysis of citations (Galgani et al., 2015). Finally, another opportunity to advance the application of bibliometric approaches to literature would involve the development of software dedicated to combining data from different sources (Scopus, WoS, etc.), as well as the application of pre-processing procedures. This would allow already processed data to be exported to other bibliometric tools in an intuitive and accessible way for researchers who do not have advanced knowledge of database manipulation or programming skills.

Another set of limitations of this thesis stems from the fact that the data used in the studies presented in chapters 4, 5, and 6 were collected through a non-probabilistic sampling process and available for convenience since the participation of respondents was voluntary. In addition, the investigation focused on Brazilian public agencies. We, therefore, suggest that future research expand the scope of research to other countries and sectors, as well as adopt intercultural perspectives. In addition, longitudinal studies could provide additional information. Finally, this thesis used perceptual data from a single informant in each of the organizations surveyed, which raises the question of possible biases. In this sense, future researchers can employ alternative research projects, which include the use of objective data, multiple informants, and longitudinal data.

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Appendices

Appendix 1

Questionnaire - Chapter 4

Construct	Base		Observed Variable
Flexibility	Chen et al (2015)	FLE1	The information systems of this organization have a high level of scalability.
		FLE2	The information systems of this organization have a high level of compatibility.
		FLE3	The information systems of this organization have a high level of modularity.
		FLE4	This organization's information systems are widely used to share information.
Integration	Chen et al (2015)	INT1	This organization shares data with external entities (supplier companies, other public agencies, etc.)
		INT2	This organization connects its information systems with the systems of external entities (supplier companies, other public bodies, etc.), allowing exchanges of information in real-time.
		INT3	This organization combines information from different external entities (supplier companies, other public bodies, etc.) to support decision-making.
Alignment	Chen et al (2015)	ALI1	This organization's IT plans reflect the objectives of the business areas.
		ALI2	This organization's IT plans support organizational strategies.
		ALI3	This organization's IT plans consider the forces of the external environment of the organization.
		ALI4	Does the organization's strategic planning refer to IT plans?
		ALI5	Business area plans have reasonable expectations about IT.
Management	Chen et al (2015)	MAN1	Compared to other public organizations, this organization stands out in terms of the effectiveness of IT planning.
		MAN2	Compared to other public organizations, this organization stands out in terms of IT project management practices.
		MAN3	Compared to other public organizations, this organization stands out in terms of security control planning, standardization, compliance, and disaster recovery.
		MAN4	Compared to other public organizations, this organization stands out in terms of the effectiveness of IT policies.
		MAN5	Compared to other public organizations, this organization stands out in terms of IT assessment and control systems.
Reconfiguration	Oliveira et al (2016)	REC1	Can reconfigure existing IT resources to design new products or services for business areas.
		REC2	It is able to reconfigure existing IT resources to design new products or services for citizens or customers.
		REC3	It is successful in defining its actions as new demands for IT solutions emerge.
		REC4	It is able to improvise during the performance of its activities, in order to meet the demands of the organization.
Innovativeness	Hult et al (2004)	INN1	The sectorial managers of this organization are actively seeking innovative ideas.
		INN2	The sectorial managers of this organization readily accept innovations based on technical studies.
		INN3	The servers/employees of this organization present many suggestions for innovation.
		INN4	The servers/employees of this organization readily accept innovations.
		INN5	In this organization, those responsible for ideas that do not work usually suffer punishments.
		INN6	There is a general climate of incentive to innovativeness in this organization.

		INN7	Innovating is an avoided attitude in this organization, as it is considered too risky.
Performance	Gould-Williams (2003)	PER1	This organization provides an excellent service to citizens or customers.
		PER2	This organization performs an excellent management of public resources.
		PER3	The citizens or customers of this organization have little reason to complain.
		PER4	In general, this organization performs very well.

Appendix 2

Questionnaire - Chapter 5

Construct	Base		Observed Variable
Flexibility	Chen et al (2015)	FLE1	The information systems of this organization have a high level of scalability.
		FLE2	The information systems of this organization have a high level of compatibility.
		FLE3	The information systems of this organization have a high level of modularity.
		FLE4	This organization's information systems are widely used to share information.
Integration	Chen et al (2015)	INT1	This organization shares data with external entities (supplier companies, other public agencies, etc.)
		INT2	This organization connects its information systems with the systems of external entities (supplier companies, other public bodies, etc.), allowing exchanges of information in real-time.
		INT3	This organization combines information from different external entities (supplier companies, other public bodies, etc.) to support decision-making.
Alignment	Chen et al (2015)	ALI1	This organization's IT plans reflect the objectives of the business areas.
		ALI2	This organization's IT plans support organizational strategies.
		ALI3	This organization's IT plans consider the forces of the external environment of the organization.
		ALI4	Does the organization's strategic planning refer to IT plans?
		ALI5	Business area plans have reasonable expectations about IT.
Management	Chen et al (2015)	MAN1	Compared to other public organizations, this organization stands out in terms of the effectiveness of IT planning.
		MAN2	Compared to other public organizations, this organization stands out in terms of IT project management practices.
		MAN3	Compared to other public organizations, this organization stands out in terms of security control planning, standardization, compliance and disaster recovery.
		MAN4	Compared to other public organizations, this organization stands out in terms of the effectiveness of IT policies.
		MAN5	Compared to other public organizations, this organization stands out in terms of IT assessment and control systems.
Reconfiguration	Oliveira et al (2016)	REC1	Can reconfigure existing IT resources to design new products or services for business areas.
		REC2	It is able to reconfigure existing IT resources to design new products or services for citizens or customers.
		REC3	It is successful in defining its actions as new demands for IT solutions emerge.
		REC4	It is able to improvise during the performance of its activities, in order to meet the demands of the organization.
Hard skills	Wang et al (2014)	HSK1	One is qualified for the development of stable applications.
		HSK2	One is qualified in computing or distributed processing (virtualization, containers, etc).
		HSK3	One is qualified in network management and maintenance.
		HSK4	One is qualified in decision support systems (business intelligence, business analytics, etc).
Soft skills	Wang et al (2014)	SSK1	One has the capability to teach others.
		SSK2	One has the capability to plan, organize and lead projects.
		SSK3	One has the ability to plan and execute his/her work in a collective environment.
		SSK4	One has the capability to perform multiple tasks simultaneously.
		SSK5	One works well in multidisciplinary teams to solve problems in the business areas.
		SSK6	One has the capability to work cooperatively in a project team environment.

		SSK7	One has the capability to work in partnership with users.
		SSK8	One has the capability to write clear, concise and effective memos, reports and documentation.
Relationship with Technology	Wang et al (2014)	RWT1	One is well informed about the main factors that must be present for the organization to be successful.
		RWT2	One is encouraged to learn new technologies that can be applied in the organization.
		RWT3	One closely follows current technology trends.
		RWT4	One has a clear understanding that IT actions must be planned and carried out consistently and over the long term.
		RWT5	One has a willingness to learn and employ new techniques.

Appendix 3

Questionnaire - Chapter 6

Construct	Base		Observed Variable
Flexibility	Chen et al (2015)	FLE1	The information systems of this organization have a high level of scalability.
		FLE2	The information systems of this organization have a high level of compatibility.
		FLE3	The information systems of this organization have a high level of modularity.
		FLE4	This organization's information systems are widely used to share information.
Integration	Chen et al (2015)	INT1	This organization shares data with external entities (supplier companies, other public agencies, etc.)
		INT2	This organization connects its information systems with the systems of external entities (supplier companies, other public bodies, etc.), allowing exchanges of information in real-time.
		INT3	This organization combines information from different external entities (supplier companies, other public bodies, etc.) to support decision-making.
Alignment	Chen et al (2015)	ALI1	This organization's IT plans reflect the objectives of the business areas.
		ALI2	This organization's IT plans support organizational strategies.
		ALI3	This organization's IT plans consider the forces of the external environment of the organization.
		ALI4	Does the organization's strategic planning refer to IT plans?
		ALI5	Business area plans have reasonable expectations about IT.
Management	Chen et al (2015)	MAN1	Compared to other public organizations, this organization stands out in terms of the effectiveness of IT planning.
		MAN2	Compared to other public organizations, this organization stands out in terms of IT project management practices.
		MAN3	Compared to other public organizations, this organization stands out in terms of security control planning, standardization, compliance and disaster recovery.
		MAN4	Compared to other public organizations, this organization stands out in terms of the effectiveness of IT policies.
		MAN5	Compared to other public organizations, this organization stands out in terms of IT assessment and control systems.
Reconfiguration	Oliveira et al (2016)	REC1	Can reconfigure existing IT resources to design new products or services for business areas.
		REC2	It is able to reconfigure existing IT resources to design new products or services for citizens or customers.
		REC3	It is successful in defining its actions as new demands for IT solutions emerge.
		REC4	It is able to improvise during the performance of its activities, in order to meet the demands of the organization.
Hard skills	Wang et al (2014)	HSK1	One is qualified for the development of stable applications.
		HSK2	One is qualified in computing or distributed processing (virtualization, containers etc).
		HSK3	One is qualified in network management and maintenance.
		HSK4	One is qualified in decision support systems (business intelligence, business analytics etc).
Soft skills	Wang et al (2014)	SSK1	One has the capability to teach others.
		SSK2	One has the capability to plan, organize and lead projects.
		SSK3	One has the ability to plan and execute his/her work in a collective environment.
		SSK4	One has the capability to perform multiple tasks simultaneously.
		SSK5	One works well in multidisciplinary teams to solve problems in the business areas.
		SSK6	One has the capability to work cooperatively in a project team

			environment.
		SSK7	One has the capability to work in partnership with users.
		SSK8	One has the capability to write clear, concise and effective memos, reports and documentation.
Relationship with Technology	Wang et al (2014)	RWT1	One is well informed about the main factors that must be present for the organization to be successful.
		RWT2	One is encouraged to learn new technologies that can be applied in the organization.
		RWT3	One closely follows current technology trends.
		RWT4	One has a clear understanding that IT actions must be planned and carried out consistently and over the long term.
		RWT5	One has a willingness to learn and employ new techniques.
Innovativeness	Hult et al (2004)	INN1	The sectorial managers of this organization are actively seeking innovative ideas.
		INN2	The sectorial managers of this organization readily accept innovations based on technical studies.
		INN3	The servers/employees of this organization present many suggestions for innovation.
		INN4	The servers/employees of this organization readily accept innovations.
		INN5	In this organization, those responsible for ideas that do not work usually suffer punishments.
		INN6	There is a general climate of incentive to innovativeness in this organization.
		INN7	Innovating is an avoided attitude in this organization, as it is considered too risky.
Performance	Gould-Williams (2003)	PER1	This organization provides an excellent service to citizens or customers.
		PER2	This organization performs an excellent management of public resources.
		PER3	The citizens or customers of this organization have little reason to complain.
		PER4	In general, this organization performs very well.

Appendix 4

Sample characterization - Chapter 6

Characterization of participating organizations

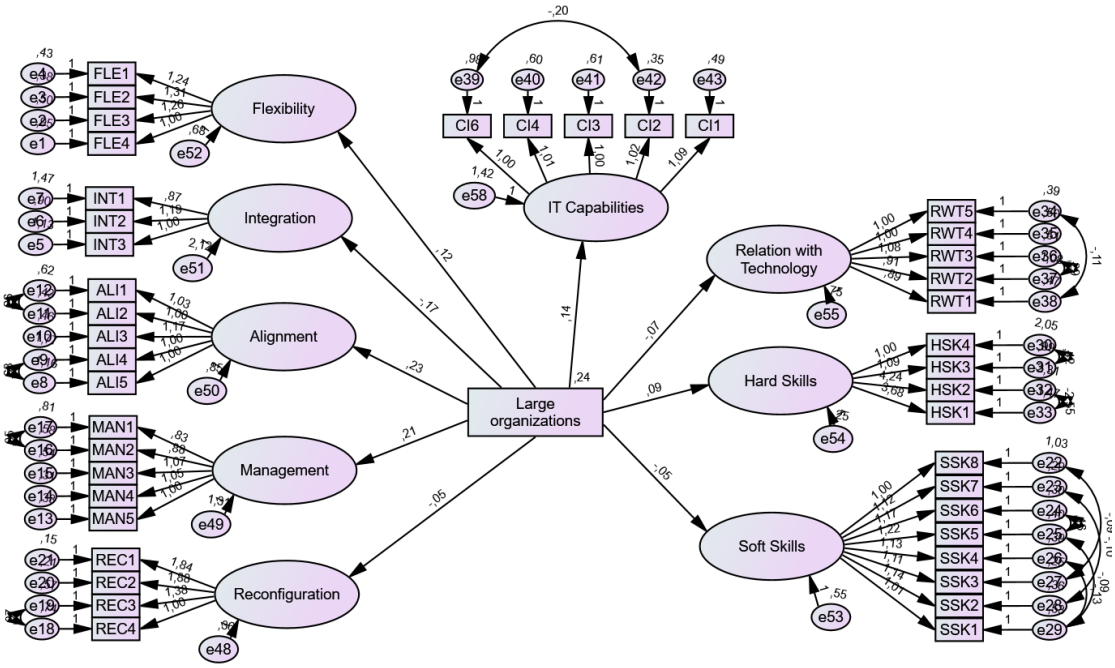
	Frequency	Percentage	Accumulated percentage
Size			
up to 100 workers	29	11.2	11.2
between 101 and 500 workers	49	19.0	30.2
between 501 and 1,500 workers	75	29.1	59.3
between 1,501 and 5,000 workers	69	26.7	86.0
between 5,001 a 10,000 workers	21	8.1	94.2
over 10,000 workers	15	5.8	100
level			
municipal organizations	23	8.9	8.9
state organizations	50	19.4	28.3
federal organizations	185	71.7	100
Field			
justice	54	20.9	20.9
education	57	22.1	43.0
health	27	10.5	53.5
research and education	15	5.8	59.3
public security	6	2.3	61.6
banking and economic	7	2.7	64.3
military	5	1.9	66.3
transportation	11	4.3	70.5
municipal government	23	8.9	79.5
others	53	20.5	100

Characterization of key respondents

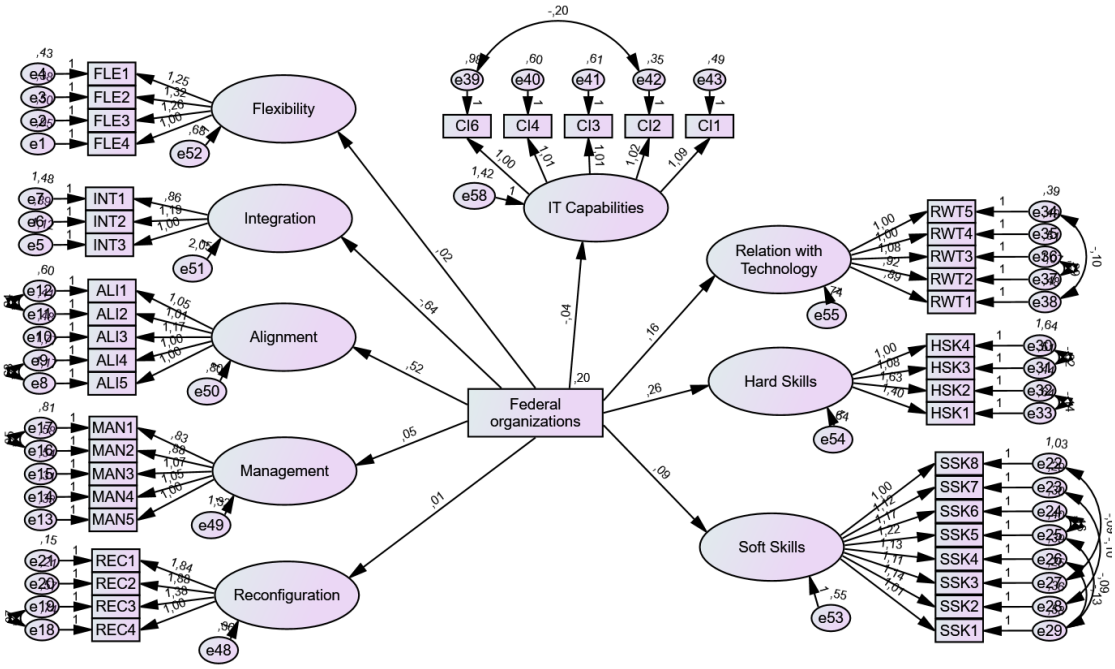
	Frequency	Percentage	Accumulated percentage
Formal Education			
high School/Technical/Other	7	2.7	2.7
university level	45	17.4	20.2
specialization course	112	43.4	63.6
master's or Doctorate	94	36.4	100
Gender			
women	24	9.3	9.3
men	234	90.7	100
Professional experience			
up to 2 years	10	3.9	3.9
between 2 and 5 years	32	12.6	16,5
between 6 and 10 years	48	18.9	35.4
between 11 and 15 years	50	19.7	55.1
between 16 and 20 years	27	10.6	65.7
21 years or older	87	34.3	100
Age			
up to 29 years	7	2.7	2.7
between 30 and 39 years	85	32.9	35.7
between 40 and 49 years	103	39.9	75.6
between 50 and 59 years	55	21.3	96.9
60 years or older	8	3.1	100

Appendix 5

MIMIC Models - Chapter 6



MIMIC model for large organizations



MIMIC model for federal organizations