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THE RELATIONSHIP BETWEEN DIGITAL CAPABILITIES
AND
DIGITAL BUSINESS PERFORMANCE

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**THE IMPACT OF DIGITAL CAPABILITIES
ON DIGITAL BUSINESS PERFORMANCE**

Tese de Doutorado apresentada ao Programa de Pós-Graduação em Administração da Universidade Federal do Rio Grande do Sul, como requisito parcial para a obtenção do título de Doutor em Administração.

Orientador: Prof. Dr. Antonio Carlos Gastaud Maçada.

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**THE IMPACT OF DIGITAL CAPABILITIES ON
DIGITAL BUSINESS PERFORMANCE**

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"It has become appallingly obvious that our technology has exceeded our humanity." (Albert Einstein)

ABSTRACT

This research presents a study of digital capabilities in order to better understand these capabilities and the impact of these digital capabilities on digital business performance. The literature indicates that digital capabilities is a critical foundation from which digital business can transform the customer experience, operational processes, and business models. From the theoretical study of these capabilities emerged the following research questions: what are the Digital Capabilities that are related to digital business performance? And, what is the impact of digital capabilities on digital business performance? To answer these questions, the following general objectives were elaborated: to understand what are the digital capabilities that are related to digital business performance, and to measure the impact of digital capabilities on digital business performance. Then research started and is presented in here in four articles that have been developed in sequence in order to answer the research question. So, the first step was a systematic review that was developed in order to understand the digital capabilities state of the art. This research is presented in article 1. In the sequence, qualitative studies were developed, with interviews and case studies presented in article 2 and 3. The second paper examines digital capabilities and their role in the digital business performance. We could better understand the digital capabilities, but it was noticed that ecosystem capability needed more studies as it is a new and fundamental theme for understanding the impact of digital capabilities on the performance of the digital business. So, the third paper was developed to understand the relationship between ecosystems and digital business value. Finally, the research model was adjusted, and a survey was carried out in order to measure the impact of digital capabilities on the performance of the digital business, which is presented in article 4. Finally, it was possible to understand that a digital business should develop digital capabilities in order to be capable of monitoring, being responsive, having efficient digital process and able to belong to other ecosystems what will lead to a improve the digital business performance. In addition, the primary results indicate that responsiveness is a crucial capability that makes a significant impact on digital business performance.

Keywords: Digital capabilities. Sensing, Responsiveness. Process Digitization. Digital Ecosystem.

RESUMO

A presente pesquisa apresenta um estudo das Capacidades Digitais a fim de compreende-las e examiná-las melhor, e analisar o impacto dessas capacidades digitais na performance de negócios digitais. A literatura indica que as Capacidades Digitais são um alicerce fundamental a partir do qual os negócios digitais podem transformar a experiência do cliente, os processos operacionais e os modelos de negócios. Do estudo teórico dessas capacidades emergiram as seguintes questões de pesquisa: quais são as capacidades digitais relacionadas a performance de negócios digitais? E, qual o impacto das capacidades digitais na performance de negócios digitais? Para responder essas questões os objetivos gerais estabelecidos são: entender quais são as capacidades digitais relacionadas ao desempenho dos negócios digitais e medir o impacto dos recursos digitais no desempenho dos negócios digitais. A pesquisa é apresentada em quatro artigos que foram desenvolvidos em sequência de acordo com o processo da pesquisa científica para responder à questão de pesquisa. O primeiro é uma revisão sistemática de literatura que foi desenvolvida para entender as capacidades digitais. Esta pesquisa é apresentada no artigo 1. Na sequência, foram desenvolvidos estudos qualitativos, com entrevistas e estudos de caso apresentados nos artigos 2 e 3. O segundo artigo examina as capacidades digitais e seu papel no desempenho dos negócios digitais. O terceiro trabalho foi desenvolvido para entender a relação entre os ecossistemas digitais e o valor dos negócios digitais. Após isso, o modelo de pesquisa foi ajustado e uma pesquisa quantitativa foi realizada para medir o impacto das capacidades digitais no desempenho dos negócios digitais, que é apresentado no artigo 4. Por fim, foi possível entender que um negócio digital necessita desenvolver capacidades a fim de monitorar o ambiente, ser responsiva, ter processos digitais eficientes e deve ser capaz de pertencer a outros ecossistemas, com isso ela conseguirá melhorar sua performance. Além disso, os principais resultados indicam que a capacidade de resposta é um recurso crucial que causa um impacto significativo no desempenho dos negócios digitais.

Palavras-chave: Capacidades Digitais. Sensoriamento. Responsividade. Processos Digitais. Ecossistema Digital

FIGURE LIST

TABLE LIST

ACRONYMS LIST

AIS	Association for Information Systems
AISel	Association for Information Systems Electronic Library
CMV	Common Method Variance
CRM	Customer Relationship Management
DC	Dynamic Capabilities
Dig C	Digital Capabilities
ERP	Enterprise Resource Planning
IS	Information System
RBV	Resource Based View
SCM	Supply Chain Management
SRMR	Standardized Root Means Square Residual

SUMMARY

1 INTRODUCTION

It's 5:45 a.m. Judith is woken by her smartphone's alarm. She raises herself and checks her notifications: six e-mails; no texts; one birthday reminder from Facebook, and a WhatsApp message from her daughter, currently in Korea: "Skype soon?" While her coffee brews, Judith quickly scans the subject lines of her e-mails. Four, she marks as "read" without opening. One, a departmental meeting request, she accepts, since her calendar automatically declines conflicting events. The sixth e-mail, an urgent query about a work project, sent at 5:21 a.m., requires immediate attention—and a quick search on Google to validate her response. As Judith drinks her coffee, she swipes a WhatsApp message to her daughter and a "happy birthday" post on Facebook. Then, she skims news and opinion articles, about things she cares about, from publications she's added to her Play Newsstand library. Already, today, Judith has acted as coworker, parent, and friend demonstrated her commitment to her employing organization, confirmed her beliefs about the world around her, and reaffirmed that she is a responsive, caring, informed, individual. She feels competent, accepted, and true to herself. It's 6:27 a.m. (Carter & Grover, 2015, p.931).

This brief account brought by Carter and Grover (2015) well illustrates the changes brought on by the digital era. In 47 minutes, Judith exercised diverse roles and resolved various issues agilely and quickly. This was possible thanks to the digital technologies and the internet that are constantly remodeling the way people in general, consumers, and firms communicate and collaborate amongst themselves.

So, it is possible to notice that societies, as well as the business world, are undergoing a digital transformation (Li, 2018). For Remane, Hanelt, Hildebrandt and Kolbe (2016), this transformation is due to recent technological advances that have enabled several new digital business models, which are now transforming industrial-age through digital technologies.

Digital technologies even allow firms to break some of the traditional paradoxes of operational excellence. However, for this, they need capabilities that improve their efficiency and agility, intensify relations with new clients, quickening their response time to market needs, where information's role is central. This way, the firm will have superior performance.

Hence, while the idea of shifting toward digital business was speculative for most CEOs a few years ago, for many, it has now become a reality. A Gartner conducted a survey which reveals that 42 percent of CEOs have begun the digital business transformation. Furthermore, 47 percent of CEOs are being challenged by their boards of directors to make progress in digital business, and 56 percent said that their digital improvements have already expanded profits (Gartner, 2017).

For Boulton (2016) top-performing businesses, in which digitalization is already woven into their planning processes and their business models, are spending 34 percent of their IT budget on investments in digital transformations, with plans to increase that to 44 percent by 2018. Driven by consumers accustomed to such technologies/niceties as mobile apps, smart appliances, and connected cars, the digital business shift is afoot. Tesla and CVS are good examples of this tendency according to many specialists. According to Bock, Iansiti, and Lakhani (2017) digitally transformed organizations ("digital leaders") performed much better than organizations that lagged behind ("digital laggards"), effectively creating a "digital divide" across companies. For these authors, digital transformation involves some significant capability building.

According to Yoo (2013) and Aaker (2015), companies are interested in the discussion on transformation in the digital age, thereby leading IS research to advance theoretically. This transformations modify the processes and structures within and among businesses and other organizations, increasing the relevance of the role played by digital capabilities (Dig C) (Kohli & Grover, 2008; Yoo, Boland, Lyytinen & Majchrzak, 2012; Westerman, Bonnet & McAfee, 2012; Tams, Grover & Thatcher, 2014; Srivastava & Shainesh, 2015; Fernandes et al., 2017; Nambisan, Lyytinen, Majchrzak & Song, 2017).

Another successful example of digital technologies improving information flow quality is the American logistics company, Coyote. Founded in 2006, it overgrew due to investments in technology and, in August 2015, was bought by UPS for 1.8 billion dollars, according to Page (2015) in a Wall Street Journal report. This company stood out for providing its clients access to information on the product in transit in real time.

The example of Coyote makes clear that digital technologies do not mark the end of organizations. Rather, they are the means for them to become valuable by changing and improving the quality and speed of information so that they can comprehend and communicate better with their clients, investors, and other stakeholders (Hansen & Sia, 2015).

The different types of technology that arise at each moment open new doors to improving and diversifying forms of communication through various means, such as smart hand-held devices like smartphones and tablets, and tools that connect to the internet (Chekwa & Daniel, 2014; Nambisan et al., 2017). These authors call these changes a revolution of digital technologies, which originated and continue to impel social media tools and online communities, such as Twitter, LinkedIn, Facebook, and Google.

Therefore, due to the evolution of the internet and new digital technologies, a growing increase in the use of social media, the Internet of things, among other multimedia has been observed, which produce a high flow of data in structured and/or unstructured formats (Hashem et al., 2015). This growth in volume of data and information has also brought alterations to social relations, economics, the way business is conducted, and science (Soma, Termeer & Opdam, 2016).

These changes that firms implement are termed by Mithas, Tafti, Bardhan and Goh (2012) as digital ecodynamics, because of the movement that occurs in and out of the organizations to improve their performance and stay ahead of their competitors. Both the firm and its competitors make investments in Information Systems (IS), and resources will determine, simultaneously, each firm's strategic stance in its competitive environment.

Thus, it is perceptible that the changes brought on by digital technologies along with information speed and volume demonstrate the market's quick evolution and indicate that organizations need to be more and agiler and capable of reconfiguring their resources and capabilities (Daniel, Ward & Franken, 2014). This need resonates with the theory of Dynamic Capabilities (DC), which notes that when the competitive scenario evolves quickly and unpredictably, it is necessary to adapt to it by combining existing resources and capabilities and, if indispensable, developing new ones (Peteraf, 1993; Teece, Pisano & Schuen, 1997; Eisenhardt & Martin, 2000).

The recent study by Gupta and George (2016) illustrates the need to develop new business capabilities, such as in the case where they studied how organizations built big data analytics capabilities and concluded that these capabilities are positively related to firm performance.

Besides capabilities, it is vital to understand that IS resources are needed to improve firm performance, observed in recent studies by Breznik and Lahovnik (2014) and G. Pan, S. Pan, and Lim (2015). This addresses the Resource-Based View (RBV) theory has gained increasing importance in recent years, deepening understanding about resources and capabilities, firm heterogeneity, and sustainable competitive advantage (Fernandes et al., 2017).

Thus, this study utilizes the Resource-Based View and Dynamic Capabilities theories. RBV, for pointing to the firm's need to possess valuable, rare, inimitable, and irreplaceable resources so that it can achieve superior performance (Barney, 1991). These theoretical perspectives indicate the firm's need for conditions to maintain its flexibility, creating capabilities and developing competences to deal with external pressures (Schwarz, Kalika, Kefi, & Schwarz, 2010). The central concept is that when the competitive scenario evolves

unexpectedly and quickly, it is necessary to adapt to it, improving or reconfiguring existing resources and capabilities, and, if necessary, developing new capabilities (Teece et al., 1997; Eisenhardt & Martin, 2000).

According to Bharadwaj, El Sawy, Pavlou, and Venkatraman (2013), many firms are beginning to see the potential of digital resources and understand the need for new capabilities that are broader than those of IT and develop or reconfigure a digital business strategy. These authors point to the example of Amazon, which substantially expanded its online retail strategy, encompassing cloud computing services as a key digital resource, which aims to improve information flow both internally and externally.

Therefore, to become agile and adapt quickly to technological evolution, it is imperative to develop new capabilities, particularly digital capabilities (Nambisan et al. (2017). Tams et al. (2014) define digital capabilities asa set of capabilities that boosts the organization's abilities to effectively develop, mobilize, and utilize organizational resources and improve its processes, like client relationship management, new product development, knowledge management, and collaboration through the use of digital technologies.

According to Barenfanger and Otto (2015), Digital Capabilities make data and information integration possible through a digital ecosystem, which connects the company internally and with its external partners. This integration along with digital technologies, such as social media, mobile technologies, data analysis technologies, have amplified organizations' informational potential (Westerman, Bonnet & Mcafee, 2014).

Regarding strategy, Kane (2015) agrees with highlighting that digital businesses need to review and adapt their strategies to the environment's new changes to improve their performance, focusing on the demands of the new kind of client, who, today, is much more demanding and informed.

Hao and Song (2016, p. 751) reinforce this idea by noting that, "nevertheless, some researchers have questioned whether the mere presence of market orientation can enable firms to achieve superior performance." To illustrate, Tan, Tan, and Pan (2016) bring the example of Alibaba, the largest online B2B marketplace in the world with over 80 million members This Company is a perfect example of how the development of new stretegy and Digital Technologies improve the business performance. "Alibaba.com established itself as a B2B platform in 1999, expanded into a platform for B2C online retail in 2003, and subsequently further transformed its business model by incorporating third-party online-payment and advanced data-centric cloud-computing services and other essential Internet services" (Tan, Tan & Pan, 2016, p. 36).

Currently, one of the main types of firms that make use of digital technologies are the digital business defined by Setia, Venkatesh, and Joglekar (2013) as firms that adopt the use of digital technologies to perceive and respond better to clients' needs.

Another concept for digital business is that of Fichman, Santos and Zheng (2014, p. 335), which defines digital business models as a "new way to create and capture business value, which materializes or is enabled by IT." The authors Weill and Woerner (2013) emphasize the need for a digital platform to deliver value and to be incorporated into complex ecosystems (El Sawy, Malhotra, Park, & Pavlou, 2010).

It is worth noting that this complexity goes beyond the ecosystems structures. This is a counterpoint to the advantages brought on by digital technologies. The evolution of digital technologies increases complexity in the measure that the firms come to have a volume of more and more heterogeneous data and from autonomous sources with distributed and decentralized control, making management and data and information use difficult (X. Wu, Zhu, G. Q. Wu, & Ding, 2014; Gandomi & Haider, 2015).

Consequently, in e-commerce and e-business firms, which use the internet as a new interaction and distribution channel, the need to develop digital capabilities so that they can use the data and information efficiently in their businesses, for example, becomes more evident (Barenfanger & Otto, 2015).

These types of businesses (e-commerce and e-business) were one of the first to be considered digital businesses, and this topic has evolved and gained various approaches since the 1990s. McGee and Prusak (1994) already highlighted the need to rethink processes in electronic businesses, emphasizing that every enterprise in which activities occur through some form of electronic means among participants can be considered to be this type of business or commerce. More specifically, e-commerce "as online retailing has proliferated worldwide and become globally competitive over the past decade" (Fang et al., 2014, p. 408).

It is believed that, therefore, a digital business needs digital capabilities to improve its performance in the face of its competitors, delivering a quality product or service to its clients. The company, however, should also be capable of managing its relations among the multiple agents involved in the business, such as the firm's own suppliers and employees, requiring a new Digital Business strategy (Bharadwaj et al., 2013).

The studies on digital capabilities are recent and present different approaches, with opportunities for further studies on these capabilities. To illustrate this, the research of Henriette et al. (2015) stands out. It presents a systematic literature review in search of digital capabilities impacted by the businesses' digital transformation and seeks to comprehend what these

capabilities are. Henriette et al. (2015) conclude that the main difficulty is identifying these digital capabilities since there is not a specific definition. Seeking to comprehend what these digital capabilities are, their role, and how they can impact business, the authors verified correlated studies, for example, those tied to innovation (Yoo et al., 2012), but did not find studies with the firm's eye in the research bases.

It is understood, therefore, that a theoretical gap exists in discerning the influence of Digital Capabilities on digital business performance and the relationship between digital business strategy and Digital Business performance. The study of digital capabilities will allow understanding of how organizations are dealing with the challenges of the digital era.

1.1 RESEARCH QUESTION

From the contextualization and justifications that motivated this work, two research questions are presented as follows:
- What are the Digital Capabilities that are related to digital business performance?
- What is the impact of digital capabilities on digital business performance?

1.2 OBJECTIVES

1.2.1 General Objective

In order to answer the research question, the following general objective are:
- To understand what are the digital capabilities that are related to digital business performance
- To measure the impact of digital capabilities on digital business performance.

1.2.2 Specific Objectives

In order to achieve the general objective, the following specific objectives were established, which are the objectives of each of the article presented in this thesis.

a) To present a systematic literature review and propose a conceptual model that discusses Digital Capabilities' association with a digital business performance from the perspective of the RBV and Dynamic Capabilities theories (article 1);

b) To examine the relation between of digital capabilities on digital business performance (article 2);

c) To understand the role of ecosystem connectivity capability in a digital business ecosystem (article 3).

d) To comprehend how does a digital ecosystem add value to the business (article 3).

e) To test a model to measure the impact of digital capabilities on digital business performance (article 4).

1.3 JUSTIFICATION

Digital capabilities are a fundamental foundation on which firms can transform the client's experience, operational processes, and business models (Westerman, Bonnet, & McAfee, 2012). In relation to client experience and operational processes, Grover and Kohli (2013) affirm that the digital environment provides greater interconnectivity through digital platforms and digital technologies, such as micro applications that execute functions such as data recovery and data integration. The authors underscore UPS's (International Logistics Company) tracking package as an example of this interconnection, which controls the loads' movement, allowing information flow in real time. This example illustrates the organization's capability to improve client experience, as well as the organization's process.

With respect to business strategy, many organizations are reformulating their traditional business strategies to a new, modular, distributed, inter-functional form, and with global business processes that allow the work to be done without barriers of time, distance, and function (Pavlou & El Sawy, 2010). Thus, this type of business requires capabilities, such as DigC, that contribute to improving its performance.

In this light, Bharadwaj et al. (2013) underscore that digital businesses present a series of emerging internal and external organizational challenges and need to be studied and understood as the new configuration of information flow, transparency, digital ecosystems, and people's behavior. This goes for entirely new business models, which are already born with a digital strategy, or for businesses that had a traditional strategy and had to adapt their strategy.

In the second case, where traditional businesses started to operate in the digital world, it became necessary for the companies to revisit their organizational logic and use of IT infrastructure, requiring new capabilities (Yoo, Henfridsson & Lyytinen, 2010), such as digital capabilities.

Weill and Woerner (2013) emphasize that digital businesses need to invest in sources of competitive advantages, such as digital platforms and other resources, but suggest that it is vital to develop digital capabilities so that they stand out before their clients and improve their performance.

The case exemplified by Collet (2014) illustrates this issue. The author observes that the Latam Airlines group, formed by the companies, TAM and LAN, invested US$ 125 million in digital technologies in 2014. The TAM application, Entertainment, was developed to allow passengers to watch Youtube videos and channels during the flight on their mobile devices. In the firm's operations area, software projected for information management and operating crew coordinators, pilots, and maintenance facilities were implanted on tablets. In this example, digital resources are observed as having improved informational flow.

Sørensen and Landau (2015) meet these affirmations because they believe that a complex set of interconnected organizational phenomena is bringing "digitality" must play a leading role. With the notion that recombination of digital capabilities is necessary, it is able to generate a socio-technical environment quickly, where new combinations emerge. Some of them become important, while others disappear or lose their function, becoming obsolete.

It is worth noting that the study of digital capabilities is a new topic, according to Barenfanger and Otto (2015), who sought to verify what digital capabilities are required for developing a digital business model. Due to the research's exploratory character, the authors arrived at some digital capabilities but suggest that they should be analyzed better and tested empirically. This study points to the existence of a theoretical gap in the study of DigC, drawing attention to the need for greater studies to select the digital capabilities that emerged in the research.

Similarly, Henriette, Feki and Boughzala (2015) seek to understand the digital capabilities that influence firm performance but do not present a categorization of these capabilities. Thus, the authors suggest that future studies be directed towards on the digital capabilities necessary to digital business models, which is the purpose of this research.

Additionally, digital capabilities contribute so that firms that can improve their data visualization, quality, and speed of information flow within the organization and with clients and suppliers through digital platforms and resources, as noted by Westerman et al. (2012). This indicates that DigC can improve the flow of information and responsiveness, which reinforces the existence of a theoretical gap for a better understanding of this relationship between digital capabilities and digital business performance.

In this sense, considering that DigC improves information flow throughout the whole value chain, in permitting the recombination and reconfiguration of three complementary resources: technology, processes, and readiness of business partners (Barua, Konana, Whinston, & Yin, 2004). Also considering that DigC is a foundation for improving informational flow (Westerman et al., 2014), it is necessary to understand the relationship between digital capabilities and Digital Business strategy (DBS) so that the impact of this relationship on firm performance can be verified, particularly the digital businesses as noted by Grover and Kohli:

> Digital business strategies (DBS) offer significant opportunities for firms to enhance competitiveness. Unlike the large proprietary systems of the 1980s, today's "micro-applications" allow firms to create and reconfigure digital capabilities to appropriate short-term competitive advantage. In the quest to provide value to customers through 6 digitization, such applications can be efficiently deployed (Grover & Kohli, 2013, p.23).

So, developing digital capabilities is fundamental to establish an effective Digital Business Strategy, being a digital native or a traditional business which is in a digital business transformation processes. Digital Capabilities are an indispensable part of successful business strategies. As a result, the development of this strategy amplifies the growing influence of IT on the creation and capturing of business value for the firm (Kohli & Grover, 2008; Bharadwaj et al., 2013). For instance, digital business strategies encompass the digitization of a firm's offerings (i.e., its products and services), the utilization of digital channels to interact with customers, digital customer engagement, and the provision of ancillary digital services to end-customers (Yoo et al., 2012). Besides, digital technologies have the potential to transform traditional business models into digital business models (Leonhardt, Haffke, Kranz, & Benlian, 2017).

McKelvey, Tanriverdi, and Yoo (2015), editors of a special issue of the magazine, MISQ, for 2017, emphasize that it is vital to advance theoretically in Information Systems so that new concepts and the complexity of the digital era can be understood. According to these authors, the organizations' new challenges in the digital world present fundamental uncertainties that the traditional and reductionist models are incapable of responding to. It is imperative to go beyond and comprehend how firms can face this new era's challenges.

Thus, it can be observed that the justifications presented above determine that the study of DigC and Digital Business Strategy are relevant areas. Both company practices and research need to be studied. Since there is a theoretical gap in comprehending DigC, what are these capabilities? And, consequently, it is necessary to verify the impact of these capabilities on digital business performance.

Besides academic relevance, business projections indicate a strong tendency towards the development of digital businesses, which reinforces this study's importance. Gartner, Inc (2017), global technology research and consulting firm, points out that CIOs should focus on defining an event-centric digital business strategy because digital business demands a rapid response to events. Organizations must be able to respond to and take advantage of 'business moments,' and these real-time requirements are driving CIOs to make their application software more event-driven. Besides the authors points out that companies must gradually migrate capabilities while implementing digital transformation, which ratifies the relevance of the study that this research proposes.

Still regarding justification and in more practical terms, the study of DigC becomes relevant to organizations so as to understand how some companies are able to improve organizational agility and responsiveness and capability to respond to market demands, allowing them to achieve better performance and competitive advantage (Peppard, Galliers, & Thorogood, 2014; Tams et al., 2014; Hao & Song, 2016).

In this sense, this study intends to comprehend the capabilities necessary to improving digital business performance. Additionally, it seeks to verify the relationships among these capabilities and digital business strategy.

As a contribution, this research will amplify understanding of the digital phenomenon for digital businesses and of digital business strategy. Also, it contributes theoretically for presenting the digital era's challenges, as well as theoretically advancing the topic of Digital Capabilities, highlighting its relationship with digital business performance, since, as evidenced, it is recent, under-researched topic. Another contribution of this work is the development of a research model that allows for understanding Digital Capabilities's influence on digital business performance. For this, the following presents the research question that will guide the present study.

1.4 THESIS ORGANIZATION

This thesis is thus structured, this introduction brings the justification and the research question, followed by the general and specific objectives. Next, the literature review addresses the main themes involved, based on the Dynamic Capabilities and Resource-Based View, followed by the description of the research model and the performance factors. In the third chapter is presented the first article, which is a theoretical paper. In the fourth chapter is presented the second article, followed by the third article in chapter five, both are, qualitative

papers. Chapter six brings the quantitative paper, and the seventh chapter presents the final considerations. This last chapter is followed by the references regarding the chapters one, two and seven because each paper brings their own references.

2 THESIS STRUCTURE

This chapter aims to explain the thesis´s structure, to present theoretical background of all study, to explain the thesis structure, to show the research model and to expose the performance factors. The choice by means of articles is due to the fact that the research was developing exactly in the order in which the respective articles are described, in this way, in sequence. The following figure seeks to illustrate the steps of this thesis.

Figure 1 – Thesis Steps

Source: The author.

Initially, several types of research were carried out to understand the theories that support all study, which is the RBV and Dynamic Capability. This theoretical background is presented in section 2.1 of this chapter.

The theoretical background was developed with a literature review that was based on books and databases. The bases used were: Web of Science and Association for Information Systems Electronic Library (AISel). It was sought, whenever possible, to privilege the Journals of the "Basket of 8", the group of the eight leading reference periodicals pointed out by AIS, they are: European Journal of Information Systems; Information Systems Journal; Information Systems Research; Journal of AIS; Journal of Information Technology; Journal of MIS; Journal of Strategic Information Systems and MIS Quarterly.

The search was done on the theories of Resource-Based View and Dynamic Capabilities. The keywords used were: Resource-Based View, RBV, Dynamic Capability, and Dynamic Capabilities. The searches were done with these words in quotes and combining them.

The searches were firstly done in 2016 and revised at the end of 2017. Given the significant number of results, a refinement was made for seminal articles. For this, in the Base Web of Science was applied the filter "Most cited article in the field." In "Google Scholar" we applied the classification by "relevance" e the number of citations. In "AISel," we applied the classification by "relevance." This analysis will be further detailed in Chapter 3 which presents a theoretical paper on digital capabilities.

Then research started and is presented in here in four articles that have been developed in sequence in order to answer the research question. So, the first step was a systematic review that was developed in order to understand the digital capabilities state of the art. This research is presented in article 1.

In the sequence, qualitative studies were developed, with interviews and case studies presented in articles 2 and 3, according to the protocol (Appendix D), at the end of this document. For each of the qualitative articles, protocol issues were used, and they appear in the appendices of each paper (Appendices A and B).

The second paper examines digital capabilities and their role in the digital business performance. We could better understand the digital capabilities, but it was noticed that ecosystem capability needed more studies as it is a new and fundamental theme for understanding the impact of digital capabilities on the performance of the digital business.

So, the third paper was developed to understand the relationship between ecosystems and digital business value. Finally, the research model was finally adjusted, and a survey was carried out in order to carry out to measure the impact of digital capabilities on the performance

of the digital business, which is presented in article 4. Appendix C, which appears at the end of article 4, refers to the validated measurement items of the survey, and the appendix E, at the end of this thesis, brings the complete questionnaire used in the survey.

Finally, the last chapter presents the general conclusions with a study synthesis, research limitations and suggestions for future studies. Thus, based on the literature studied, this chapter initially addresses the theories that support the present study (2.1), in the sequence the research model (2.2) is presented, and the Performance Factors (2.3) are highlighted.

2.1 GENERAL THEORETICAL BACKGROUND

The theories that are used in this research are the Resource-Based View theory and the Dynamic Capabilities theory. The study of these approaches is due to its complementarity and because they support studies of capabilities and resources, such as digital capability.

Although there are some theoretical divergences on the adherence of the same ones, this study is based on the argument of Barney (2001), one of the foremost theorists of the Resource-Based View, and according to him Dynamic Capabilities theory is not opposed to RBV but instead complements it.

Eisenhardt and Martin (2000) corroborate with this statement emphasizing that Dynamic Capabilities are required, but are not sufficient conditions for competitive advantage, they also argue that DC can be used to enhance existing resource configurations in the pursuit of competitive advantage.

Therefore, it is believed that the combination of these theories provides a complete look at the capabilities surveyed, such as digital capabilities. Then the theory of Resource-Based Vision will be highlighted, and later the Dynamic Capabilities theory will be approached.

2.1.1 Resource-Based View

The theory of the RBV began to develop from the ideas of Penrose (1959) that had a Schumpeterian foundation, as highlighted by herself. She argues that the company is made up of people and resources and can survive its founders, thus introducing an idea, albeit incipient, of sustainability.

Subsequently, some other authors have contributed to this theory, such as Ansoff (1977), who sought to identify strategies that enable companies to develop and maintain a competitive advantage that ensures that they achieve and sustain superior performance.

This new way of looking at organizations came against the focus of the strategic studies of the 1970s and 1980s which followed a logic of analyzing the external environment of companies and then building their strategy.

It is possible to illustrate with the typology composed of three generic strategies proposed by Porter (1980), known as total cost leadership; differentiation and focus, in all these cases the positioning was aimed at the competition. The RBV, on the other hand, suggests that the strategy should emerge from within the organization outwardly, focusing on the identification and development of resources and capabilities that will generate advantages in a competitive external environment.

So, in the 1980s and 1990s, the RBV theory began to be more widely recognized and was developed by Wernerfelt (1984), Barney (1991) and Peteraf (1993). In the following years, several other authors followed, and the theory has been studied until the present day.

The author who presents a more consistent and well-known definition of this theory is Barney (1991) who states that organizations can achieve a competitive advantage and create value from resources that are unique, rare, valuable, and are not easily imitated or replaceable. Also, this author highlights the notion of resources that can be considered as all assets, capabilities, organizational processes, financial resources, physical, human, information, and knowledge.

Given the importance of this theory, many authors have sought to identify or justify specific features as being strategic, and which can contribute to the development of a sustainable competitive advantage by companies.

With this, it has been possible to verify the application of RBV in many areas, such as the Information Systems area. One of the first authors to relate Resource-Based View with IS was Grant (1991), according to which the management of information systems provides a fragmented image of the company's resource-based.

This author acknowledges that the availability of up-to-date information would reflect competitive advantage. It is worth mentioning that this first conception dates to the beginning of the 1990s. Subsequently, other authors carried out studies establishing relations between Information Systems and RBV.

To illustrate, one can highlight the publications in the MIS Quarterly magazine, whose recognition is well known in academic society, as the studies of Bharadwaj (2000), Sambamurthy, Bharadwaj and Grover (2003), Wade and Hulland (2004) and Mani, Barua, and Whinston (2010).

Therefore, it is worth mentioning the Resource-Based View theory approach, which points out that organizations can achieve a competitive advantage and create value from resources that are unique, rare, valuable, and are not easily imitated or replaceable (Barney, 1991). Used for the understanding of digital capabilities. Following, complementing the RBV, the Dynamic Capability Theory will be studied.

2.1.2 Dynamic Capability

The theory of Dynamic Capability is defined as the ability to integrate, build and reconfigure internal and external competences to respond to rapid environmental changes and adopts as a conceptual basis process involving capabilities characterized by dynamism, accelerated environmental turbulence and processes of innovation and renewal continuous (Teece et al., 1997).

Helfat and Peteraf (2009) complement this definition by stating that the dynamic capabilities of an organization purposefully allow it to create, extend and modify its resource base. This author also emphasizes that this theory points out the need for firms to respond to changes in the environment.

Such changes have become non-linear and less predictable. Consequently, the models of success in business are not precise, and the actors of the market are ambiguous or are changing. In this context, dynamic capabilities are necessarily based much less on existing knowledge, and much more on new specific and situational awareness quickly created (Eisenhardt & Martin, 2000).

This theoretical perspective of DC arises from RBV's unclear response to how organizations gain a competitive advantage in a dynamic or changing context (Ambrosini & Bowman, 2009). This theory argues that the differences between organizations are generated by new combinations of resources and capabilities developed by organizations along with their trajectory (Teece et al., 1997).

Regarding the relationship between DC and RBV, some literature criticisms point to an excess of fragmentation in the field of study of the strategy and do not see the complementarity between DC and RBV (Green, Covin & Slevin, 2008).

However, many other studies have pointed out the opposite, that is, Dynamic Capabilities theory complements the RBV to bring the organization to competitive advantage (Peteraf, 1993; Teece et al., 1997; Eisenhardt & Martin, 2000). Based on this theoretical line that this study is supported.

To illustrate, Eisenhardt and Martin (2000) who defend the understanding of the dynamic capabilities providing an improvement of the RBV performance. For these, dynamic capabilities are drivers behind the creation, evolution, and recombination of other resources into new sources of competitive advantage, which can also be defined as the ability to copy, transfer, and recombine resources, especially those based on knowledge within the company.

In the same vein, Barney (2001) revisiting his seminal study recognizes the complementarity between the RBV and the Dynamic Capabilities theory. Therefore, dynamic capabilities cross-functional relationships and provide fast communication between those involved in the process and the external market.

Regarding people and information in real time, it will allow the alert from the beginning of any action enabling a more significant reaction time for adjustments that are necessary for the face of problems and opportunities from the information (Eisenhardt & Martin, 2000).

According to Eisenhardt and Martin (2000), real-time information also builds the intuition about the market in such a way that managers can understand the situation of change more quickly and adapt to it, allowing an improvement in the decision-making process.

About the relationship between the area of Information Systems and the Dynamic Capability theory, Pavlou and El Sawy (2006) show that dynamic capabilities can be developed as enterprise information technology (IT) capabilities, for example. Similarly, this theory gives support to the study of the Digital Capabilities that seek to provide the character of instantaneous information (Barua et al., 2004; Karimi & Walter, 2015).

Lastly, it is important to highlight that the reconfiguration of operational capabilities and the implementation of new capabilities to meet turbulent environments is the goal of dynamic capabilities that seek to achieve evolutionary aptitude and prevent organizational rigidity (Teece, 2007).

Hence, the characteristics of DC that are the ability to integrate, construct and reconfigure internal and external competences to respond to rapid environmental changes (Teece et al., 1997) will be used to understand digital capabilities.

Also, we can note that the RBV emphasizes the choice or selection of the appropriate resource (s), while the dynamic capabilities emphasize the development and renewal of these and resources and the development of new organizational changes. The following item addresses the concepts of capabilities, resources, and competences to define the concepts developed in this research.

2.1.3 Competence, Capability and Resource

The RBV and DC study presents some concepts that can sometimes overlap and complement each other. Like this, aiming to avoid divergent interpretations and to highlight the conceptual line of the present study the central concepts for skills, resources and competences are presented below.

The first distinction between resources and capabilities is that the former refers to the productive assets owned by the company while the capabilities are what the company can do. Individual resources do not confer competitive advantage; they must work together to build organizational capability (Grant, 2010).

Besides that, in Grant's (1991) conception, resources are inputs to the production of processing, they are the primary units of analysis. The company's assets include capital goods items, each employee's skills, patents, brands, finances and so on.

Resources can still be classified as tangible and intangible assets and human resources. Examples of tangible assets are capital, equipment, facilities and raw materials. For intangible assets, examples may be the skills, judgment, perception, and experiences of individual employees, as well as information and trademarks and patents (Barney, 1991).

Capabilities according to Amit and Schoemaker (1993) and Bharadwaj (2000) refer to the organization's ability to gather, integrate, and distribute valuable resources, usually in combination with other features and capabilities.

According to these authors, the skills may come from the skills of the employees and the structure and resources of the organization. Skills are developed when combinations of resources are applied together to create specific organizational skills (Teece et al., 1997).

M. T. L. Fleury and A. Fleury (2001, p.189) corroborates with the authors explaining that "competence would thus be the ability to combine, mix and integrate resources into products and services," and must be associated with a systematic learning process, which involves discovery/innovation and human resource training.

Regarding hierarchical level, Javidan (1998) points out that at the bottom of the hierarchy are the resources. They are the building blocks of skills. Resources are the inputs to the organization's value chain. Already the capabilities refer to the ability of the company to explore and combine its resources, being the second level in the hierarchy.

Competence is the third level because it is the integration and coordination of capabilities. At the top are the core competences, which are the core competences that distinguish an organization.

Table 1 below summarizes the main concepts discussed in this section and will serve as a basis for the continuation of this research. They are ordered according to the hierarchy of competences of Javidan (1998).

Table 1 – Theoretical Concepts

Hierarchy of competences	Definition .	Authors
Core Competences	It is a set of abilities that are spread by the organization, distinguishing it from its competitors	Javidan, 1998.
Competences	It is a set of abilities, routines, and assets difficult to imitate that they take the organization to reach its objectives using the organizational processes.	Amit; Schoemaker, 1993; Teece; Pisano; Shuen 1997.
Capability	The ability of an organization is mentioned to it to combine, to mount, to integrate and to implant valuable resources, generally, in combination or with the use of organization processes and other capabilities for the desired end.	Amit; Schoemaker, 1993; Bharadwaj, 2000.
Resource	They are assets that can be tangible, intangible and personal, and which serve as the organization's primary unit of analysis, but that without being mobilized does not generate competitive advantage for the organization.	Grant, 1991; Amit; Schoemaker, 1993; Bharadwaj, 2000.

Source: The author, based on the hierarchy of competences of Javidan (1998).

In short, companies create competitive advantage by pooling resources that work together by developing organizational capabilities (Bharadwaj, 2000). In this context, an element is fundamental, the information since according to Amit and Schoemaker (1993) the capabilities are based on the development, flow and exchange of information by the company's human capital and of them with the clients and other external actors. Next, the research model is presented, and the research structure is detailed.

2.2 RESEARCH MODEL

The research model seeks to answer the research question, that is, to measure the impact of digital capabilities on the performance of the digital business. However, for this, the research was developed in phases, which responds to a specific objective and is presented in academic articles.

2.2.1 Article 1

The title is "Digital Capabilities and Their Relation to Digital Business Performance." This is a theoretical paper whose objective is to present a systematic literature review and propose a conceptual model that discusses Digital Capabilities' association with a digital business performance from the perspective of the RBV and Dynamic Capabilities theories.

Four capabilities are presented in the first paper: sensing, responsiveness, process digitization and ecosystem connectivity.

In the conceptual model the digital capabilities are shown, and their relationship with digital business performance, indicating that the four propositions are related to digital business performance (P1, P2, P3, and P4). Figure 2 display the conceptual model.

Figure 2- Conceptual Model
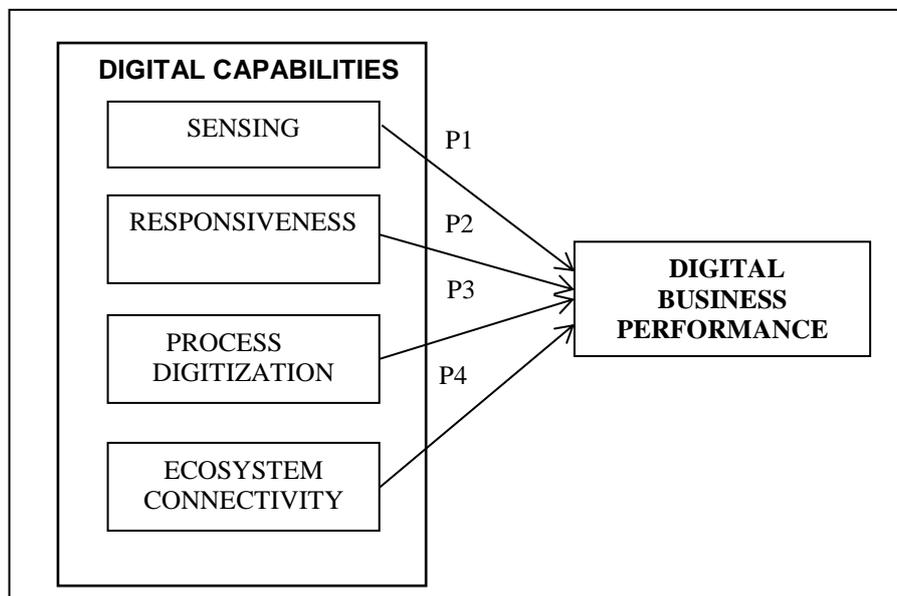
Source: The author.

In the sequence, the field research began. The data collection was performed through in-depth interviews with digital business managers. The results of these interviews are presented in articles 2 and 3 which are purely qualitative.

2.2.2 Article 2

The title of the article 2 is "Examining Digital Capabilities and Their Role in the Digital Business Performance." The article 2 examines the digital capabilities, and their role in the digital business performance and the conceptual model proposed in paper 1 was used.

The qualitative research was carried out, and digital business managers were interviewed. The results indicate that responsiveness is the capability that is directly related to performance. In addition, the article highlights the need for further studies on digital ecosystem. Next, the article 3 is presented.

2.2.3 Article 3

As soon as, the study of article 2 was complete, the researcher noticed that there was a point that deserved a broader study the digital ecosystem. Since there were few studies on the subject in Brazil, the research sought to expand the understanding of this theme in order to deepen the knowledge of their relationship with the business value. So, the article 3 presents a study about the development of digital business ecosystems and the relation between digital ecosystem and business value.

The title of this third paper is "Ecosystems and Digital Business Value." The objective of this paper aims to understand the role of ecosystem connectivity capability in a digital business ecosystem and comprehend how does a digital ecosystem add value to the business.

One of the mains was the emphasis on the orchestration capability, which is the basis for the other capabilities to be developed, among them the connectivity of the digital ecosystem. Thus, it was realized that the orchestration capability is an antecedent capability. Finally, was developed the article 4, that is presented in the next item.

2.2.4 Article 4

The article 4 presents a quantitative study, for which a survey was applied to measure the impact of digital capabilities on the performance of the digital business. For this, the conceptual model proposed in figure 3 was adapted considering the results of articles 2 and 3. The orchestration capability was included as an antecedent to the other capabilities.

In addition, responsiveness was placed as a consequent capability of the others, and their relationship with the performance of the digital business is indicated. Fig. 3 presents the research model for the study. Concerning to the digital business performance.

As it can be seen, in the model is possible to observe the construct "performance." Considering the scope of the theme and the variety of approaches that performance has, in the next item the performance factors considered in this study is presented.

Figure 3 – Research Model
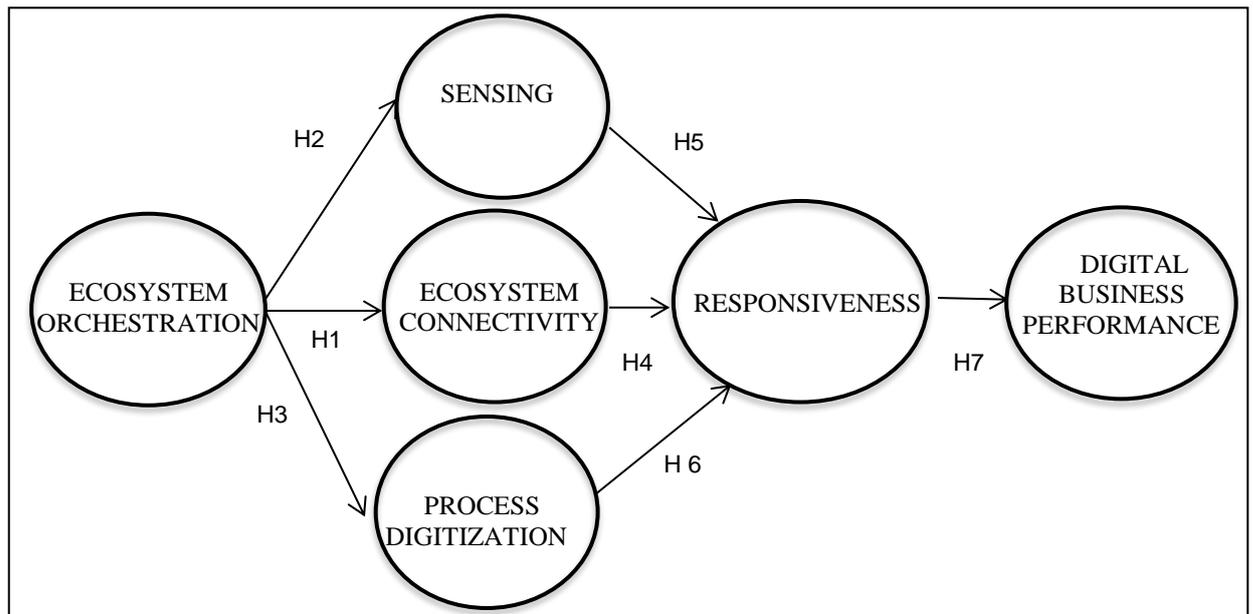
Source: The author.

2.3 PERFORMANCE FACTORS

Performance refers to operating results due to the transformations of the digital business, whose changes involve replacing daily business activities involving paper, telephone and fax-based communication with the electronic transaction and exchange information, a significant redesign of processes, incentives and information technology to enable closer coordination with customers and suppliers.

Such changes can enable companies to improve customer satisfaction, understand customer preferences, reduce inventories, increase inventory turnover, to reduce situations of stock rupture, and improve response time and time to market, which may eventually lead to financial benefits (Barua et al., 2004).

Initially, it is worth remembering that in the late 1990s and early 2000s the use of digital technologies began to be considered a differential for the company. At that moment the speed and precision in which stocks were calculated and the agility in the transmission of information were some operations that started to improve the performance of firms as Brynjolfsson and Hitt (2000) pointed out.

It is worth mentioning that in this period, there were still many questions about the relationship between IT investments and business performance. So, many surveys were conducted to see whether or not there was such a relationship. As a result, several studies have evidenced this relationship in a positive way, for example, in the studies of Bharadwaj (2000), Hu and Plant (2001) and Barua et al. (2004).

With the development of new technologies and the evolution of business, studies on the relationship between the use of digital technologies and performance have also advanced.

Bharadwaj et al. (2013) discuss this issue by pointing out the role of digital technologies that have shaped the new business infrastructure and influenced the new logic and patterns of organizational coordination.

In summary, these authors suggest that in order to verify performance it is necessary to observe both within a company (within the corporate scope) as in the relation of the companies and with other actors, like clients, suppliers, and network of business partners. That is, besides the financial results there are other indicators to measure performance.

In this sense, Rai, Patnayakuni, and Seth (2006) highlight three areas of analysis to measure performance should be observed the relationship of a company's performance to its competition:

• Operational excellence;

• Revenue growth, and;

• The relationship with clients and other stakeholders involved in business processes.

Operational excellence is defined as the ability of a company to respond to customers and productivity improvements in relation to its competitors (Rai et al., 2006).

To illustrate, one could cite the integration of supply chains of e-commerce companies in order to be able to improve the competitiveness of a time-based company, compressing cycle times which improves business performance (Hult, Thomas, Ketchen, & Slater, 2004).

This is due to the fact that integrated supply chains provide operational visibility, coordination of plans, and the aerodynamic flow of goods that shorten the time interval between a customer's request for a product or service and its delivery (Tyndall, Gopal, Partsch, & Kamauff, 1998; Hult et al., 2004).

This decrease in time impacts on the relationship with clients, and it is possible to broaden this view, verifying the satisfaction of all actors involved in the processes both internally and externally according to the authors Rai et al. (2006).

In addition to operational excellence and the relationship with customers, financial performance is also an indicator of performance. This performance can be analyzed by revenue growth, but also, by the return on investments and by the relation between the operating profit, as observed in the study of Chi, Zhao, and Li (2016).

It has been observed, also, that companies should balance transaction costs and service level performance in terms of delivery times to meet customer needs (Fisher, Hammond, Obermeyer & Raman, 1997; Chen, Drezner, Ryan & Simchi-Levi, 2000).

That is, financial performance can be analyzed by one or more of the following indicators: return on investment; profit margin; revenue growth and / or operating profit on the business assets.

It is observed, then, that it is not necessary to analyze all these items, according to the need of the research the authors use different measures. In addition, the indicators presented in this section do not exhaust the subject, they were the ones surveyed for digital business performance.

In this sense, the business capabilities, as well as customer relationship management, the management with suppliers and supply chain management are suggested as fundamental aspects to verify the performance of the company (Sambamurthy et al., 2003; Rai et al., 2006; Chi et al., 2016).

Lastly, Setia et al. (2013) stress that performance may be related to customer orientation. According to these authors, this represents a culture characterized by continuous monitoring of customer needs and improvement of customer value. This customer orientation is a skill that companies can have in order to monitor and leverage digital business strategies with focus and actions on customer needs, customizing information according to the purchasing profile, for example.

This type of orientation can be enhanced by digital technologies. Therefore, when analyzing the studies of this section that seeks to measure performance is observed that there are several ways and different performance indicators of a Digital business.

For the present research, the following indicators are used:

• Financial Performance:

• Relationship with customers and other stakeholders involved in business processes.

Thus, based on the presented theories, RBV and Dynamic Capabilities and following the order of development of the research, the following chapters bring the four articles, beginning with the theoretical article in the next chapter.

3 PAPER 1: DIGITAL CAPABILITIES AND THEIR RELATIONSHIP TO DIGITAL BUSINESS PERFORMANCE

ABSTRACT

Digital technologies and the Internet are continually reshaping the way consumers and firms communicate and collaborate with each other, thereby creating significant changes and impact on business models. The digital economy offers many opportunities for business' improvement and diversification. Thus, for a firm to be agile and adapt rapidly to technological evolution, we argue that it is necessary to develop new capabilities, known as digital capabilities. These capabilities provide firms with the ability to develop, mobilize, use organizational resources effectively and improve their business processes. This study aims to present a systematic literature review and propose a conceptual model that discusses digital capabilities' association with digital business performance. We propose a conceptual model underpinned by the lenses of Resource-Based View and Dynamic Capabilities. Contributions of this article include a deeper understanding of this fairly recent digital phenomenon, presenting the challenges in the digital economy, and advancing the notion of digital capabilities in the area of Information Systems, which has thus far generated limited research.

Keywords: Digital Capabilities; Resource-Based View; Dynamic Capabilities; Digital Business

3.1 INTRODUCTION

Digital technologies and the Internet are constantly reshaping the way consumers and firms communicate and collaborate with each other, thereby creating significant changes and impact on business models. One of the side effects of these changes is the urgent need for traditional businesses to transform their business models into a digital business. Similarly, we have witnessed the growth of digital businesses, which has accelerated in recent years, reaching record levels.

While the idea of shifting toward digital business was envisioned by most CEOs a few years ago, it has become a reality for many in 2017. A recent Gartner survey reports that 42

percent of CEOs have begun the journey of digital business transformation. Furthermore, 47 percent of CEOs are being challenged by the board of directors to make progress in digital business, and 56 percent said that their digital improvements have already generated profits for their companies (Gartner, 2017).

The digital technology revolution has brought about different kinds of technology, and one of the most significant change is the creation of new paths toward improving and diversifying forms of communication. For instance, new technologies such as smart hand-held devices, tablets, cell phones, and other similar gadgets that connect to the Internet can continue to boost the use of social media tools and online communities like Twitter, LinkedIn, Facebook, and Google (Chekwa & Daniel, 2014). These technologies also enable firms to break out of their traditional paradigms for doing business and open up to the digital world. However, to achieve this, they may need a new set of capabilities to improve their efficiency and agility, optimize relations with new customers, and increase speed in response to customer needs, where information plays a key role (Setia, Venkatesh & Joglekara, 2013).

Bharadwaj, El Sawy, Pavlou, and Venkatraman (2013) point out that many firms are beginning to see the power of digital resources and understand the need for new capabilities that are more comprehensive in range and scope than the traditional ones. To become a digital business, firms in the retail market have substantially expanded their online retail strategies, which can be regarded as key digital resources. Firms selling products have also embarked on large-scale digitization efforts.

Digitization refers to the codification of analog information into a digital format (Tilson, Sørensen & Lyytinen, 2010) and represents a widespread, evolving phenomenon that is attracting an increasingly large number of studies (Nambisan, Lyytinen, Majchrzak & Song, 2017). Broadly defined, "digitization refers to the integration of digital technologies to transform activities, processes, agents, and goods from analog to digital to facilitate new forms of value creation" (Frishammar, Cenamor, Cavalli-Björkman, Hernell & Carlsson, 2018, p.1).

On that account, Kohli and Grover (2008) and Fernandes et al., (2017) argue that digital capabilities can create new business value. Thus, Müller, Holm and Søndergaard (2015) add that new and disruptive technologies require building digital capabilities in a digital business context.

Srivastava and Shainesh (2015) suggested that the development of digital capabilities can also be conceptualized as a digital outcome or service, and they emphasize how this development is especially important for emerging countries, where service consumption varies significantly across society's different segments.

One can observe that most articles are addressing the topic of "digital capability" or "digital capabilities" does not present a precise definition for such capability(ies), which is often taken for granted. While recent articles (Yoo 2010; Drnevich & Croson, 2013; Barrett, Davidson, Prabhu, & Vargo 2015) are related to this topic, a clear definition is still not available. In the articles that do present definitions, the definitions are at times conflicting (Srivastava & Shainesh, 2015; Lyytinen, Yoo & Boland, 2016).

Hence, to arrive at a definition and better understand these capabilities, we conducted a comprehensive literature review. Webster and Watson (2002) note that an ideal literature review should, among other things, describe fundamental concepts, delineate research boundaries, review relevant prior literature in the information system (IS) and related areas, and develop a model to guide future research.

As such, we attempt to resolve these issues by presenting a systematic literature review and then propose a conceptual model delineating the relationships between digital capabilities and digital business performance from the perspective of the Resource Based View (RBV) and Dynamic Capabilities theories.

We propose a conceptual model to link the relationship between digital capabilities and digital business performance through the RBV and dynamic capabilities theories. This article contributes by seeking to understand the digital phenomenon's relevance to businesses through organizational theories. We present the challenges in the digital economy, propose a definition of digital capability, and advance the subject's discussion in the area of information systems.

The method is presented next, followed by the analysis of the results in section three. Section four shows the challenges in the digital economy; section five defines digital capabilities. In section six, we analyze digital capabilities to propose a conceptual framework. Finally, we present the conclusion in section seven.

3.2 METHOD

To answer our overall research question of the digital capabilities and its relationship with business performance, the logic of our literature review is as follows. First, we identified all the possible definitions of digital capabilities in the current literature. This first step is to clarify all the possible definitions in the extant literature.

Next we identified the challenges of firms in the current digital economy so as to understand the needs of the digital economy, the types of capabilities that are necessary for

firms in the digital economy and highlight the capabilities that are required for firms to meet the challenges of the digital economy but have not been identified in prior studies.

Finally, we identify all the themes that are related to the digital capabilities and firm performance and provide specific examples of firms that demonstrate the possible relationships that we propose. In this section, we thoroughly explain the procedures adopted for this study. For an overview of prior research on digital capabilities, we conducted a structured literature review following Webster and Watson (2002) and Wolfswinkel, Furtmueller, and Wilderom (2013).

In 2002, Webster and Watson published a paper that has become an established guide to writing literature reviews in the IS field. They showed researchers how to design, conduct, and present literature reviews, and they encouraged other researchers to conduct and contribute to more systematic reviews in the field. To Wolfswinkel et al. (2013, p. 2), "their paper is valuable reading for anyone doing a literature review, especially in the IS field." Wolfswinkel et al. (2013) offered steps for a systematic literature review, using a five-stage grounded theory method to review the literature.

According to Wolfswinkel et al. (2013), before beginning the search, definitions need to be established, such as: defining inclusion/exclusion criteria; identifying fields of research; determining appropriate sources and deciding on specific search terms. The authors suggest that the inclusion/exclusion criteria may include restricting the kinds of publication outlets, setting a particular threshold such as the impact factor of an outlet, or determining a particular time frame of publications. Table 2 demonstrates inclusion and exclusion criteria. According to Webster and Watson (2002), we need to start with the leading journals and then search in databases. Next, it is essential to backtrack by reviewing the citations of the articles identified, so as to determine prior articles, and, finally, go on to use the Web of Science to identify articles citing the key articles identified in the previous steps.

Table 2 - Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
Investigations which focus on digital capabilities and discuss key characteristics	Investigations which deliver no attributes/capabilities/ components or insights to understanding the concept of digital capabilities
Papers from journals which use a double-blind review	Papers from conferences and any other source that is not from a qualified journal

Source: The author.

The next step is to identify fields of research, determine appropriate sources, and decide on specific search terms (Wolfswinkel et al., 2013). We conducted a bibliographic search for articles containing the terms "digital capability" and "digital capabilities" in the database of the Association for Information Systems (AIS) library. We focused on the Senior Scholars Basket of Eight of Journals, which AIS defines as the top IS journals, namely: European Journal of Information Systems, Information Systems Journal, Information Systems Research, Journal of the Association for Information Systems (JAIS), Journal of Information Technology, Journal of Management Information Systems, Journal of Strategic Information Systems, and MIS Quarterly. Additionally, we also searched in EBSCOhost and the Web of Science database for the same terms, researching only papers from journals that adopted the double-blind review.

After all these definitions, the next steps proposed by Wolfswinkel et al. (2013) are "search" and "select." In these phases, the searches are done, and the results are refined. In our study, the search and selection of the papers occurred from July 2 – 18, 2017. The following search parameters were utilized: publications in the last 20 years and academic articles. During this execution, the abstract, keywords, and introduction were read. In addition to following the inclusion/exclusion criteria, for an article to be included in the study, it must have been related to IS and addressed the digital capability topic.

As a result, we identified 97 papers in the first round and excluded six articles due to overlap, resulting in 91. The second step was to verify the context of the studies. It is worth mentioning that only the business context was considered in this review, rather than other areas, for example, teaching, which denotes other concepts, such as the digital divide. As a result, 28 articles were found, and they were exhaustively studied.

Once the papers have been chosen, Wolfswinkel et al. (2013) indicate going to the analysis and the presentation structure of the results. In this study, we used the software NVivo to support the analysis. First, we read all the papers, and then we utilized open coding to create tentative labels for chunks of data to summarize our understanding. We looked for definitions for digital capabilities, what the main capabilities required by digital business are, the challenges for a digital business, and so on.

Next, we started the open categorization where the researcher was categorizing the possible digital capabilities, then moved to the axial categorization, grouping the categories until finding the central concepts emerged with a selective coding.. We were able to correlate digital capabilities with the theories, and the results of this analysis are presented in the next section. As suggested by Wolfswinkel et al. (2013), this phase is called "PRESENT," where we offer the structured results in this article.

3.3 FINDINGS FROM LITERATURE REVIEW

In this section, we examine the descriptive results. Table 3 lists the papers in alphabetical order by author(s), with the year, title, and journal.

Table 3 - List of All Papers Containing Description of "Digital Capabilities" Concept

No	Author(s)/ Year	Title	Journal
1	Aaker (2015)	Four ways digital works to build brands and relationships.	Journal of Brand Strategy
2	Aakhus, Ågerfalk, Lyytinen and Te'eni (2014)	Symbolic Action Research in Information Systems: Introduction to the Special Issue	MIS Quarterly
3	Alam and Campbell (2016)	Understanding the Temporality of Organizational Motivation for Crowdsourcing	Scandinavian Journal of Information Systems
4	Barrett Davidson, Prabhu, and Vargo (2015)	Service innovation in the digital age: key contributions and future directions	MIS Quarterly
5	Chellappa, Sambamurthy and Saraf (2010).	Competing in crowded markets: Multimarket contact and the nature of competition in the enterprise systems software industry	Information Systems Research
6	Davis, Mora-Monge, Quesada, and Gonzalez (2014)	Cross-cultural influences on e-value creation in supply chains.	Supply Chain Management: An International Journal
7	Drnevich and Croson (2013)	Information Technology and Business-Level Strategy: Toward an Integrated Theoretical Perspective	MIS Quarterly
8	Fernandes et al. (2017).	The dynamic capabilities perspective of strategic management: a co-citation analysis.	Scientometrics
9	Gaskin, Berente, Lyytinen and Yoo (2014).	Toward Generalizable Sociomaterial Inquiry: A Computational Approach for Zooming In and Out of Sociomaterial Routines.	MIS Quarterly
10	Grover and Kohli (2013)	Revealing Your Hand: Caveats In Implementing Digital Business Strategy.	MIS Quarterly
11	Hylving, Henfridsson, and Selander (2012)	The Role of Dominant Design in a Product Developing Firm's Digital Innovation	Journal of Information Technology Theory and Application
12	Knight (2015)	Delivering the digital region: Leveraging digital connectivity to deliver regional digital growth.	Australian Planner
13	Kohli and Grover (2008)	Business value of IT: An essay on expanding research directions to keep up with the times	Journal of the Association for Information Systems

14	Liang, Bharadwaj, and Lee (2011)	Interactive and Iterative Service-Composition-Based Approach to Flexible	International Journal of Web Services Research
15	Lyytinen, Yoo, Boland (2016)	Digital product innovation within four classes of innovation networks.	Information Systems Journal
16	Mishra, Konana, and Barua (2007)	Antecedents and consequences of internet use in procurement: an empirical investigation of US manufacturing firms.	Information Systems Research
17	Müller, Holm, and Søndergaard (2015)	Benefits of Cloud Computing: Literature Review in a Maturity Model Perspective.	Communications of the Association for Information Systems
18	Nambisan, Lyytinen, Majchrzakand, and Song (2017)	Digital Innovation Management: Reinventing Innovation Management Research in a Digital World.	MIS Quarterly
19	Rai and Bush (2007)	Recalibrating Demand-Supply Chains for the Digital Economy	Systèmes d'Information et Management.
20	Roberts et al. (2012)	Absorptive Capacity and Information Systems Research: Review, Synthesis, and Directions for Future Research	MIS Quarterly
21	Srivastava and Shainesh (2015).	Bridging the Service Divide Through Digitally Enabled Service Innovations: Evidence from Indian Healthcare Service Providers	MIS Quarterly
22	Tams, Grover, and Thatcher (2014)	Modern information technology in an old workforce: toward a strategic research agenda.	The Journal of Strategic Information Systems
23	Tan, Tan and Pan (2016)	Developing a Leading Digital Multi-Sided Platform: Examining IT Affordances and Competitive Actions in Alibaba.com	Communications of the Association for Information Systems
24	Westerman; Bonnet, McAfee, Andrew (2012)	The digital capabilities your company needs	MIT Sloan Management
25	Yoo (2010)	Computing in everyday life: A call for research on experiential computing.	MIS Quarterly
26	Yoo (2013)	The tables have turned: How can the information systems field contribute to technology and innovation management research?	Journal of the Association for Information Systems
27	Yoo, Boland, Lyytinen, and Majchrzak (2012)	Organizing for innovation in the digitized world.	Organization Science
28	Yoo, Henfridsson, and Lyytinen (2010)	Research Commentary-The new organizing logic of digital innovation: An agenda for information systems	Information Systems Research

Source: The author

       As noted from our literature review, the topic of "digital capability" is rather new and has only recently garnered more attention. As observed from the table, the first publication to mention the term "digital capability" was in 2007, and the number of studies about this topic

has increased over the last five years, with 20 of the 28 papers analyzed being from this period. Furthermore, we observe that most of the journals are from the basket of eight, which indicates an interest in the subject by the AIS community. Additionally, we examined the data using NVivo. Figure 4 shows the word clouds of both the key and general words of all the papers.

Figure 4- Word Clouds

Keyword cloud   General word cloud
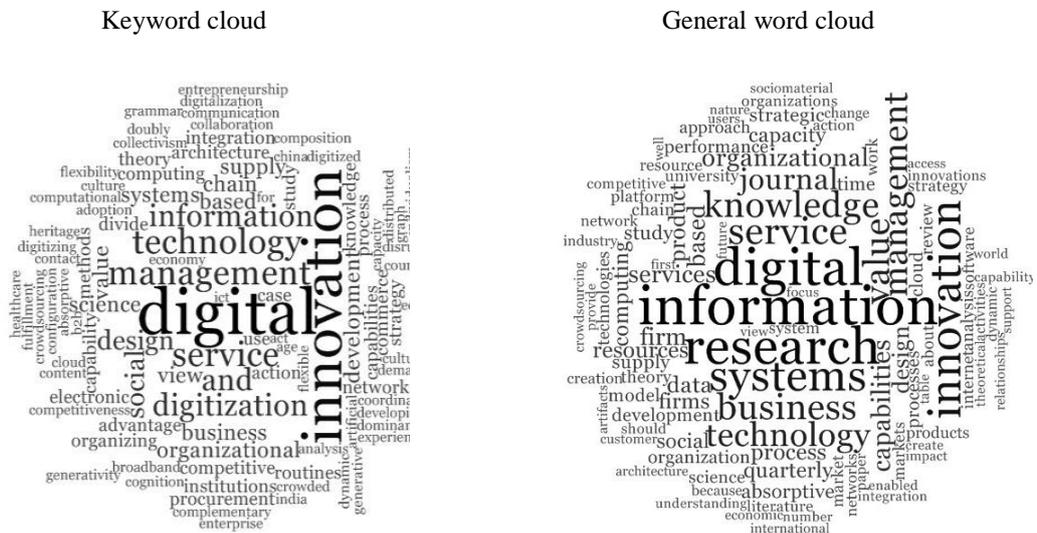
Source: Elaborated by the author based on the literature review.

Some variations can be detected through the word cloud as shown in Figure 4. The word which occurs most frequently in the articles, in general, is "information," and for keywords, "digital." Information is the basis of the whole topic, and its analysis and importance will be further detailed in the description of the definition of "digital capabilities." The term "innovation," which appears in both cases, is presented in seven articles about digital innovation. In the general analysis, it is possible to verify the prominence for the words "research" and "journal," which was clear when analyzing the methods used in the articles.

There are seventeen theoretical articles, six qualitative, four quantitative, and one mixed method approach. From the cluster analysis by word similarity for all articles, using Pearson's correlation coefficient, it was possible to verify a strong correlation between the papers on innovation, with a coefficient of one, which is understandable since they approach the same theme. Also, we observed that more recent articles correlate more closely with each other. In other words, the more recent the article is, the higher the correlation, which indicates that the topic's advancement has converged concepts.

Finally, based on the cluster analysis, articles 25, 27, and 28 stand out because they strongly correlate with each other and with the most recent papers. This correlation caught the attention of researchers who analyzed the most cited articles of the 28 examined. These three articles were found to be the most cited, with article 28 mentioned seven times; article 27, six times; and article 25, quoted five times. When we analyze these papers, we see that they detail this subject very well and are used by the other authors and are essential to understanding digital capabilities, which will be further explained in subsequent sections.

3.3.1 Digital Capabilities and Theories

Analyzing the main theories adopted in the studies, we noticed that of 28 studies, 15 papers use the Resource-Based View (RBV) theory, followed by 12 that use the Dynamic Capabilities theory, and 7 that employ both theories. There are 8 papers that do not use these theories some are literature reviews and others do not address a specific theory. Table 4 shows evidence of the importance of these two theories in the studies on digital capabilities, as well as the possibility of using them complementarily. The following table examines the relationship between these theories and the articles studied.

Table 4 - Theories

No	Author(s)/ Year	Dynamic Capability	RBV	Others
1	Aaker (2015)			✔
2	Aakhus et al. (2014)			✔
3	Alam and Campbell (2016)		✔	
4	Barrett Davidson, Prabhu and Vargo (2015)		✔	
5	Chellappa, Sambamurthy and Saraf (2010)		✔	
6	Davis et al. (2014)		✔	
7	Drnevich and Croson (2013)	✔	✔	
8	Fernandes et al. (2017)	✔	✔	
9	Gaskin, Berente, Lyytinen and Yoo (2014)			✔
10	Grover and Kohli (2013)		✔	
11	Hylving, Henfridsson and Selander (2012)			✔
12	Knight (2015)			✔
13	Kohli and Grover (2008)		✔	
14	Liang, Bharadwaj and Lee (2011)	✔		
15	Lyytinen, Yoo and Boland (2016)			✔
16	Mishra, Konana and Barua (2007)	✔	✔	
17	Müller, Holm and Søndergaard (2015)		✔	
18	Nambisan el al. (2017)			✔
19	Rai and Bush (2007)	✔	✔	

20	Roberts et al. (2012)	✔	✔	
21	Srivastava and Shainesh (2015).		✔	
22	Tams, Grover and Thatcher (2014)	✔	✔	
23	Tan, Tan and Pan (2016)	✔		
24	Westerman et al. (2012)			✔
25	Yoo (2010)	✔		
26	Yoo (2013) 2	✔		
27	Yoo et al. (2012)	✔		
28	Yoo, Henfridsson and Lyytinen (2010)	✔	✔	
	Total	12	15	8

Source: The author.

We identified the seminal topics authors discussed in each paper. For the RBV concept, it has been suggested that the firm strategy emerges within the organization and move outward, focusing on identifying and developing resources and capabilities that will generate advantages in the external and competitive environment. Among the major RBV supporters are Barney (1991) and Peteraf (1993), especially during the 1980s and 1990s, a period in which the theory began to gain more recognition and acceptance, other authors followed and utilized RBV in their studies. Barney (1991) says that organizations can achieve a competitive advantage and create value from resources that are unique, rare, valuable, and not easily imitable or replaceable.

The Dynamic Capabilities theory complements RBV in leading an organization towards competitive advantage (Peteraf, 1993; Teece, Pisano & Schuen, 1997; Eisenhardt & Martin, 2000). The Dynamic Capabilities approach is defined as the ability to integrate, build, and reconfigure internal and external capabilities to respond to rapid environmental changes (Teece et al., 1997).

Although there have been some theoretical controversies on adherence to these theories, this study is based on Barney's words (2001), one of the main scholars on RBV who believes that the dynamic capabilities theory does not oppose the RBV, but instead complement each other.

Eisenhardt and Martin (2000) point out that dynamic capabilities are necessary but not sufficient conditions for how firms achieve competitive advantage. They argue that dynamic capabilities can be used to improve configurations of existing resources to achieve a competitive advantage. Thus, we believe that the combination of these theories provides a complete view of the capability studied in this work, i.e., Digital Capability.

On the other hand, RBV emphasizes the choice or selection of appropriate resource(s), while dynamic capabilities emphasize the development and renewal of these resources and the

development of new capabilities that will be necessary to confront organizational changes. Taking into account recent major technological changes and the ever-increasing speed and volume of information, the dynamic capabilities theoretical lens becomes more relevant and is well suited for this study.

Thus, for the development of digital capabilities under the theoretical lens of RBV, digital businesses must have the ability to mobilize their digital resources and have an adequate management system. At the same time, considering the dynamics of digital businesses, under the dynamic capabilities perspective, these same digital businesses must be able to integrate, build, and reconfigure their resources and capabilities. In line with this, this study will seek to understand digital capability. However, to this end, it is first necessary to understand this new age's challenges, which are discussed in the next section.

3.3.2 Digital Capabilities Definition

For traditional businesses to operate in the digital world, firms need to review their organizational logic and use of IT infrastructures, which require new capabilities (Y. Yoo et al., 2010). Moreover, digital capabilities will allow the business to face the digital economy's challenges, as we noted in the last section.

Analysis of the 28 reviewed papers revealed only 5 papers which have clearly defined the term digital capabilities. Another observation is that most of the articles simply mention the term "digital capability" or "digital capabilities" and do not specify what these capabilities are. From our overall analysis of 91 articles found in the first round of search, we did not find clear definitions for the term, or descriptions of these capabilities, or studies that measured the relation of digital capabilities with business performance.

Before studying the characteristics of capabilities, we delineate all the definitions of digital capabilities provided in the literature to gain a deeper understanding of extant definitions. Table 5 provides a summary of these definitions.

Table 5 - Existing Definitions of Digital Capability

Journal	Definition	Method	Authors
Journal of the Association for Information Systems	It is a business capability developed by the interaction of technology with a variety of complementary assets, such as process redesign, training, and incentive structures, that can be considered as sources of business value.	Theoretical	Kohli and Grover (2008)
Organization Science	It is the organizational ability "used throughout the organization to support its different functions based on digital technology platforms."	Theoretical	Yoo et al. (2012)

MIT Sloan Management review	"The skills needed to go beyond pure IT to include specific technologies, such as social media or mobile, as well as analytic skills to drive value from big data."	Theoretical	Westerman, Bonnet and Andrew McAfee (2012)
MIS Quarterly	It "can be conceptualized as services that one system provides to another through value-creating, provider-user interactions."	Multiple cases of study	Srivastava and Shainesh (2015)
Journal of Strategic Information Systems	A Digital Capability is "an organization's focused deployment of information and communication technologies (ICTs), abilities to develop, mobilize, and use organizational resources effectively, for instance, customer relationship management, new product development, and knowledge collaboration."	Theoretical	Tams, Grover and Thatcher (2014)

Source: The author.

As can be observed, there is no standard definition for the term "digital capability." However, these definitions indicate that digital capabilities allow organizations to give instant answers, either internally or externally, by using digital technologies and digital platforms that contribute to generating value for the business.

We refined the definition based on analysis and synthesized these prior five definitions to standardize and support future studies. To do so, we enumerated the list of definitions found in extant literature, as presented in Table 5 above. Then, we conducted a cross-comparison of what has already been defined to formulate a precise, comprehensive definition of the term "digital capabilities."

Subsequently, we noted the terms which were considered key to construct the definition, like "the abilities to develop, mobilize, and use organizational resources" as indicated by Tams et al. (2014); "based on digital technology platform" as pointed by Yoo et al. (2012) and "*to respond to the environment and add value as highlighted by* Kohli and Grover (2008), Srivastava and Shainesh (2015) and Westerman et al. (2012)*.*

Besides, we noticed that it is necessary a "combination of skills and processes of a digital business" because it is not clear whether the mere acquisition and possession of packages of resources is enough to achieve superior performance, especially when most of the firms have access to markets with similar factors. On the contrary, organizations should develop new capabilities by adding resources that would make them comparatively more valuable and inimitable.

We also considered that some authors use the term "digital capability" and others the plural form, "digital capabilities." digital capabilities can be understood by the theories of resources and capabilities, which explain the construction of capabilities. They refer to the firms' capability to integrate, build, and reconfigure capabilities, internal and external resources

to create superior capabilities that are incorporated into their social, structural, and cultural context (Grant, 1991; Sambamurthy, Bharadwaj & Grover, 2003).

Finally, we understand that the mobilization of resources and new organizational capabilities becomes vital, focusing on people, facilities, structures, to ensure quality, speed, storage, and information flow, which will enable improvements in processes and client relationships and, thus, superior performance in the digital world.

So, we synthesize all the definitions listed in Table 5 with the definition: "*digital capabilities are the combination of skills and processes of digital business to develop, mobilize, and use organizational resources supported by digital technologies platform to respond to the environment and add value to the organization.*"

In the next section, we present the conceptual framework and propose the capabilities that allow businesses to increase their performance.

3.3.3 Digital Capabilities Emerged

When analyzing the articles highlighted in table 3, we identified some digital capabilities that were being categorized as they emerged. The following table presents the digital capabilities found, a definition and the authors that mention it.

Table 6 - Digital Capabilities Emerged

Digital Capabilities	Definition	Authors
Information and Data Visualization	The ability of displaying data and information in an adequate format (i.e. easily understandable) in all platforms such as mobile devices and websites.	Müller, Holm, and Søndergaard (2015); Gaskin, Berente, Lyytinen and Yoo (2014); Hylving, Henfridsson, and Selander (2012), and Yoo, Boland, Lyytinen, and Majchrzak (2012)
Data Analytics	The ability of analysis of data and information to be used to support the organizational process	Westerman; Bonnet, McAfee, Andrew (2012); Drnevich and Croson (2013); Fernandes et al. (2017) and Lyytinen, Yoo, Boland (2016)
Monitor	The ability of observing and checking the progress or quality of (something) over a period of time; keep under systematic review	Tan, Tan and Pan (2016); Aaker (2015); Grover and Kohli (2013); Barrett Davidson, Prabhu, and Vargo (2015) and Roberts et al. (2012)
Responsiveness	Capability to respond quickly to the firm's internal and external demands	Tams, Grover, and Thatcher (2014); Kohli and Grover (2008); Rai and Bush (2007) and Srivastava and Shainesh (2015)

Internal and external Connectivity	The ability to keep a continued connection of all corporate partners beyond the traditional supply chains, including customers (and consumers) to exchange data and information	Knight (2015); Lyytinen, Yoo, Boland (2016); Rai and Bush (2007); Srivastava and Shainesh (2015); Yoo (2010) and Mishra, Konana, and Barua (2007)
Process Digitization	The ability of developing tasks and mobilizing and using the resource through to automatize business processes using digital technologies.	Nambisan, Lyytinen, Majchrzakand, and Song (2017); Alam and Campbell (2016); Yoo (2013); Müller, Holm, and Søndergaard (2015) and Aakhus, Ågerfalk, Lyytinen and Te'eni (2014)

The theoretical approach must be considered. Due to the dynamic and turbulent where digital business is inserted we are using the Dynamic Capability approach. We decide for this perspective because according to Eisenhardt and Martin (2000) in dynamic markets, it makes sense to use dynamic capabilities to build new resource configurations and new capabilities. Some dynamic capabilities integrate resources, and product development routines by which managers combine their varied skills and functional backgrounds to create revenue producing products and services are such a dynamic capability.

It was observed in the analysis of the articles that the monitoring capabilities will generate the data that will be analyzed so that they can be made available in the organization, in this sense, the definition of Pavlou and El Sawy (2011) that proposed a definition to sensing capability as the ability to spot, interpret, and pursue opportunities in the environment. We comprehend that this definition, captures three digital capabilities, Information and Data Visualization, Data Analytics and Monitor.

Another point that was considered was the concept of ecosystem, integrates the agents (stakeholders) and allows for collaboration and communication between and across firms. So, we rename the internal and external connectivity as ecosystem connectivity since the ecosystem integrates external partners into the parts of the organization. Then we present the digital capabilities emerged from the literature analysis:

- Sensing Capability;
- Ecosystem connectivity;
- Process Digitization
- Responsiveness.

Next we present the challenges in the digital economy.

3.4 CHALLENGES IN THE DIGITAL ECONOMY

Firms need to develop new knowledge in this digital age to overcome the digital economy's market challenges (Barret et al., 2015). Therefore, firms need to understand the challenges in the digital economy to be able to increase their performance.

Furthermore, businesses should know their own goals, the market players (competitors), and the available digital technologies (Aaker, 2015). Accordingly, the processes and structures within and between firms and organizations are changing, and new capabilities are needed for businesses to adapt to this new reality, increasing the importance of digital capabilities (Kohli & Grover, 2008; Westerman, Bonnet & McAfee, 2012).

The evolution of the Internet and digital technologies forces firms to change their interaction and coordination of value-chain activities with clients, suppliers, and other stakeholders. However, as firms operate in a new environment that is "permeated with digital technology, embedded in the very core of the products, services, and operations of many organizations" (Yoo, 2010, p. 1398). Therefore, it is necessary to develop human resources capable of taking advantage of digital technology. Tam, Grover and Thatcher (2014) emphasize the importance of personnel development as technologies change rapidly.

Aakhus, Ågerfalk, Lyytinen and Te'eni (2014) question what digital capabilities will influence large-scale collaborations throughout space and time since digital technologies afford this collaboration between, for example, software developers and firms, clients and firm, among others. The author draws attention to the importance of digital sensing and tracking, which produces Big Data that represent behaviors that were heretofore invisible. Analyzing this data can allow the firm to signal, predict, and determine future social behavior. As proposed by Kohli and Grover:

> Firms should develop the ability to gain visibility into their processes so that they can react to problems or changes. Information plays an important role in enabling sensing, filtering, and sensemaking capabilities. While the capability to gather data from the environment is critical to producing useful information, the organizational value of information comes when the collected data are analyzed through data mining (Kohli & Grover, 2008, p. 32).

However, the Big Data revolution has brought about new challenges such as information overload. Aakus et al. (2014, p. 1194) propose "new strategies for approaching big data, in particular how to advance the analytics of unstructured textual data for theoretical and practical ends. This includes developing ways of stimulating high-quality collaborative content generation in user communities."

Knight (2015 p. 6) suggests that "businesses just emerging into the digital economy may initially choose to cluster with other businesses within their own region, to take advantage of local knowledge and existing relationships, or to reduce risk." Alternatively, the author also offers that businesses may choose to join existing extra-regional clusters to access knowledge and experience not available within the region, which is possible due to advances in digital technologies.

This collaboration can be seen in the development of crowdsourcing, a "form of outsourcing in which an individual or organization outsources tasks to a large yet undefined group of people via an open call" (Alam & Campbell, 2016, p. 92). Yet, to develop crowdsourcing operations, integration among the stakeholders is necessary, which is another challenge in the digital economy.

Consequently, it is necessary to establish an ecosystem to integrate the actors (stakeholders) and to allow this collaboration and communication between and across firms (Y. Yoo, 2010; Y. Yoo, Henfridsson & Lyytinen, 2010; T. C. F. Tan, B. Tan & Pan, 2016; Nambisan et al., 2017). In addition, Nambisan et al. (2017) draws attention to the importance of ecosystem management, which he defines as orchestration. It can be considered a significant challenge since the digital ecosystem includes heterogeneous actors (Y. Yoo, Boland, Lyytinen & Majchrzak, 2012) "who often have different and possibly conflicting interests with highly distinct knowledge bases" (Lyytinen et al., 2016, p. 65).

Another challenge is adapting to partners and suppliers who already use digital technologies and digital processes. Mishra, Konana and Barua (2007) indicate that firms should build on pre-existing assets and develop the necessary skills to implement IT applications.

Nevertheless, along with these challenges, numerous opportunities arise from technological evolution. For instance, digital technologies are redefining traditional business strategies, making business processes modular, distributed, multifunctional, and global, allowing the work to be performed without limits of time, distance, and function. These technologies are also expanding the relationship structure with clients beyond firm boundaries with the use of social media and social networks (Kohli & Grover, 2008; Tan et al., 2016).

In response to this digital age, numerous firms strive to achieve the right to be recognized as digital firms by using a combination of technologies such as websites, blogs, social media, online videos, online commerce, search optimization in their websites (Aaker, 2015). They recognize that digital technology works as a powerful mechanism to build brands and strengthen relationships because it has the unique ability to engage people and communities.

Consequently, because of the changes in doing business, the relation to the development of digital technologies and today's socioeconomic changes is increasingly more significant. To increase the digitization level in our daily socioeconomic system requires processing, storage, and disclosure of the most significant possible number of data, energy, and information, using binary codes represented by zeros and ones (Lyytinen et al., 2016; Yoo et al., 2012).

According to Yoo (2013), pervasive and ubiquitous digitization has brought about new, disruptive changes to the economy, and the author argues that management scholars must offer new conceptual models and insights that guide management practices in the digital economy.

Therefore, studies in IS need to advance because there have been limited in-depth discussions to examine the required competences and skills that are critical in the emerging digital economy and help an organization deal with these new challenges. In this regard, to better understand the challenges and opportunities in the digital age, it is essential to understand the underlying concept introduced by Tilson et al. (2010), previously referenced in the introduction. The authors stated that digitization refers to the codification of analog information into digital form. This way, numerous forms of content such as books, music, pictures, and maps, among others, can be available in digital format, providing faster access to this information and improving image quality. Another definition, referenced above, by Frishammar et al. (2018, p. 1), is that "digitization refers to the integration of digital technologies to transform activities, processes, agents, and goods from analog to digital to facilitate new forms of value creation." Such digitization has led to market transformations, making it a standardized part of existing non-digital products, even durable goods such as books, cars, furniture, and buildings.

Yoo (2010) argues that this generalized digitization wave has brought about new, disruptive changes to the economy. These changes are due to the continuous development of digital technologies such as mobile communication, embedded computing, and miniaturization of microprocessors. In sum, one can note that routine devices are becoming more digital when combined with other technological developments, including sensors and batteries (Yoo, 2013).

For this reason, firms need to be prepared and able to face the digital economy's challenges. As a result, businesses are seeking cutting-edge technology, efficient tools to deal with complex challenges. Table 7 summarizes the multitude of challenges in the digital economy.

Table 7 - Challenges of the digital economy

No	Challenges	Author(s)
1	Difficulty in identifying new business opportunities	Aakus et al (2014); Kohli and Grover (2008)
2	Difficulty in dealing with a multitude of new channels such as social media, IoT, etc.	Müller et al. (2015); Chellappa, Sambamurthy and Saraf (2010)
3	Lack of technology to deal with Big Data and inability to extract value from data and info collected	Aakus et al. (2014); Gaskin et al. (2014); Nambisan et al. (2017); Lyytinen, Yoo, Boland (2016); Westerman et al. (2012)
4	Need for developing new insights and knowledge to cope with market challenges	Barret et al. (2015)
5	Difficulty in being quick to respond to market changes and in satisfying consumer desires	Kohli and Grover (2008); Tams and Grover (2014)
6	Difficulty in understanding changes in consumers' behavior	Hylving, Henfridsson and Selander (2012)
7	The necessity for sharing processes and production of goods with supply chain through digital technologies	Mishra, Konana and Barua (2007); Davis et al. (2014)
8	Difficulty in being recognized as a digital business	Aaker (2015)
9	Lack of digital capabilities and technology to become a digital business	Yoo (2013); Tan, Tan and Pan (2016)
10	Inability to capture and create value from data and information through digital technologies	Drnevich and Croson (2013)
11	Need for innovation (products, processes, and services)	Lyytinen et al. (2016); Nambisan et al. (2017); Parker et al. (2017)
12	Difficulty in knowing and keeping up with forms of business transactions through digital channels	Roberts et al. (2012); Tan, Tan and Pan (2016); Barret et al. (2015)
13	Difficulty in digital integration, collaboration, and communication between and across firms and stakeholders	Hylving, Henfridsson and Selander (2012); Yoo (2012); Alam et al. (2016); Barret et al. (2015)
14	Need to work on digital platforms in different manners, like crowdsourcing, crowdfunding, etc.	Nambisan et al (2017); Alam et al. (2016)
15	Difficulty in coordinating new agents (clients, suppliers, teams, stakeholders, and other players) internally, externally, and across the business.	Drnevich and Croson (2013); Nambisan et al. (2017).

Source: The author.

Thus, organizations will need new capabilities - digital capabilities - to successfully confront these challenges in the digital economy and quickly adapt to the technological evolution's impact, The question then becomes how organizations develop these capabilities to effectively mobilize and deploy organizational resources and improve their processes such as management of client relationships, development of new products, knowledge management, and collaboration by using digital technologies (Tams et al., 2014). Through this study, we attempt to answer this question. We will first define the term "Digital Capabilities," and we present a conceptual model in the subsequent sections.

3.5 CHALLENGES AND DIGITAL CAPABILITIES

To develop the conceptual model linking digital capabilities and digital business performance, we present propositions that were based on our analysis of existing studies. In analyzing the articles with NVivo, we categorized the capabilities highlighted in the studies. For this, we examined the abilities explained by the authors but also sought to categorize the possibilities, skills, resources, and even their needs.

In the second round of analysis, we verified similarities in content, and these similarities were merged into one category. For example, we had the category "responsiveness," which had, among others, the following reference extracted from the texts, "respond quickly to the needs of the consumer."

These categories were then linked to at least one of the fifteen digital economy's challenges, numbered from 1 to 15, according to Table 7. It is worth noting that not every challenge implies a digital capability; on the other hand; we find that one capability may be related to more than one challenge. For example, we cannot identify any of the categorized capabilities for challenge 8, " Difficulty in being recognized as a digital business."

It is important to highlight that we used only the four digital capabilities that emerged from the literature review. The table below illustrate the correlation between the challenges of digital economy and digital capabilities

Table 8 - Challenges of the digital economy and digital capabilities

No	Challenges	
1	Difficulty in identifying new business opportunities	Sensing Capability;
2	Difficulty in dealing with a multitude of new channels such as social media, IoT, etc.	Ecosystem connectivity;
3	Lack of technology to deal with Big Data and inability to extract value from data and info collected	Process Digitization
4	Need for developing new insights and knowledge to cope with market challenges	Responsiveness
5	Difficulty in being quick to respond to market changes and in satisfying consumer desires	Responsiveness
6	Difficulty in understanding changes in consumers' behavior	Sensing Capability;
7	The necessity for sharing processes and production of goods with supply chain through digital technologies	Process Digitization
8	Difficulty in being recognized as a digital business	*
9	Lack of digital capabilities and technology to become a digital business	All capabilities
10	Inability to capture and create value from data and information through digital technologies	Sensing Capability

11	Need for innovation (products, processes, and services)	*
12	Difficulty in knowing and keeping up with forms of business transactions through digital channels	Process Digitization
13	Difficulty in digital integration, collaboration, and communication between and across firms and stakeholders	Ecosystem connectivity;
14	Need to work on digital platforms in different manners, like crowdsourcing, crowdfunding, etc.	Ecosystem connectivity
15	Difficulty in coordinating new agents (clients, suppliers, teams, stakeholders, and other players) internally, externally, and across the business.	Ecosystem connectivity

*No digital capabilities correlated found.

Source: The author.

This correlation reinforce that these four digital capabilities can face with digital challenges and consequently, in theory, to improve digital business performance.

Finally, we also took into consideration the dynamic capabilities and RBV theories because they are essential to understanding that digital capabilities that can be incorporated as operating resources in products and, therefore, create new functionalities and develop new skills (Yoo et al., 2010). According to the RBV theory (Barney 1991), such digital resources must be valuable, rare, inimitable, and irreplaceable to ensure that the digital business achieves superior performance. At the same time, according to the dynamic capabilities concept, these capabilities must be able to integrate, build, and redesign internal and external capabilities to respond to rapid environmental changes (Teece et al., 1997). Based on the surveyed literature and in the light of these theories, the following propositions are presented.

Regarding digital business performance, the analyzed articles indicate several measures, such as cost, speed, efficiency, and quality, as analyzed by Davis, Mora-Monge, Quesada & Gonzalez (2014). Because this is a theoretical article, we will not detail the type of performance, so we have referred these metrics generally as "digital business performance." Below we present table 9 with past studies investigating outcomes of digital business.

Table 9 - Past Studies Investigating Outcomes of Digital Business

Authors	Type and Implementation of Digital Capabilities	Findings with regard to Digital Business Performance	Differences from the Contribution of this Study
Barrett Davidson, Prabhu and Vargo (2015)	Nothing related	ICT-enabled knowledge processes in firms Impact on the financial performance of firms	• They concluded that "digital innovation has become perhaps the single most powerful force for business and social innovation."

Davis, Mora-Monge, Quesada and Gonzalez (2014)	They mention Little is still known about how digital capabilities and environmental factors work together to influence e-business value creation along the supply chain	emphasizes the role of inter-organizational capability building. Specifically, e-business use is considered an indirect driver of performance improvement	• The results of this study highlight the firm performance effects of inter-organizational capability building in SCI
Fernandes et al. (2017).	Agility and responsiveness are critical to the innovative and competitive performance	They showed that e-commerce tends to be associated with increases in the cost of sales for traditional manufacturing companies	• They pointed out the importance of strategy; • To create more value entrepreneurial companies also need to act strategically. This implies integration of entrepreneurial and strategic thinking.
Tams, Grover and Thatcher (2014)	the improvements in agility and responsiveness, firms can achieve more excellent performance and competitive advantage	As the workforce is aging and modern technologies are becoming ubiquitous, there is a strong need for international migration to maintain and increase productivity levels	• To reap expected performance benefits from their digital capabilities and practices, their ICTs have to be efficiently used by their employees

Source: The author.

3.6 PROPOSITIONS AND CONCEPTUAL MODEL

3.6.1 Sensing

From our analysis, we find that organizations are dealing with the challenges of the digital economy and the changes that digital technologies have brought. Hence, it is important to monitor the market, customer demands, and any other data that can be useful for the business. To mitigate the risks from challenges 1, 2, and 3 presented in Table 7, the Sensing Capability can help the digital businesses (Kolhi & Grover 2008; Chellappa, Sambamurthy & Saraf 2010; Westerman et al. 2012; Aakus et al., 2014; Gaskin, Berente, Lyytinen & Yoo, 2014; Müller et al., 2015; Lyytinen et al., 2016; Nambisan et al. 2017).

Digital businesses must have digital sensing and tracking abilities to identify the best business opportunities. Presently, it is imperative to look through the right lens for the right opportunities so as to understand where to concentrate efforts and how to be faster than the competitor. With a deluge of possibilities in terms of potential business opportunities, having the right information becomes critical to business in spotting the right "hit" that is most likely to be successful; and filtering out business opportunities that are likely to flop. Additionally, it is essential to know how to manage and monitor social media, the Internet of Things, among

other multimedia artifacts. This is because customers of digital businesses are users of these platforms and digital businesses must be able to understand customers better through social media and consequently respond to their expectations or frustrations.

The Sensing Capability is defined as the ability of a digitized artifact to monitor and respond to changes in the environment (Yoo, 2010). This capability allows the organizations to keep in perpetual contact with its environment, which now entails new levels of digital sensing and tracking, producing Big Data that represent behaviors that were heretofore invisible (Barret et al., 2015). This way, companies must be able to leverage on Big Data and know how to collect data and information which will add value to the business.

So, it is necessary to rethink the business model, forget the traditional business models that sell products and services to offer a new experience to the customer, use a digital platform to reduce time and costs and be able to answer to the client's needs.

To do so, it is necessary to monitor the market, the clients, the partners, the economy, that is, it is essential to follow all the changes and if possible to anticipate them, because the digital world is speedy.

A digital business can connect factories and the industrial internet, for example. But, regardless of the variety of digital business, most enterprises must to develop new capabilities and adapt the business models to improve their performance.

It also requires a business to think about the relationship between internal, private and public APIs to unlock new revenue opportunities from existing services and information to become fast and improve the business performance.

Kohli and Grover (2008, p. 28) complement this idea and affirm the importance of a "quick sense-and-respond to market demands by pricing, designing, sourcing, manufacturing, and distributing a product." Also, Drnevich and Croson (2013) highlight the importance of monitoring competitors' actions and how it can improve business performance.

Considering the value of information for business, the sensing capability allows the organization to reduce information complexity and uncertainty by delivering data and information in an appropriate format, thus improving the quality of information flow. Therefore, we propose the following.

Proposition 1 (P1): sensing is related to digital business performance.

3.6.2 Responsiveness

Digital capabilities form the foundation upon which other firms can develop complementary products, technologies, and services (Barrett et al. 2015). In this context, responsiveness is an ability that requires velocity and flexibility of processes in an organization and to quickly to respond to a new customer need.

Tams et al. (2014, p. 299), citing the studies of Lavie (2006) and Peppard, Galliers and Thorogood (2014), emphasize that "digital capabilities and practices have become increasingly important for organizations to improve organizational agility and responsiveness. As a result of the improvements in agility and responsiveness, firms can achieve greater performance and competitive advantage, even sustainable competitive advantage."

In this context, Kolhi and Grover (2008) underscore responsiveness as a digital capability, defining it as the capability to respond quickly to the firm's internal and external demands. Consequently, this digital capability can meet the digital economy's challenges, particularly challenges 4, 5, and 6, presented in table 7, supported by Barret et al. (2015), Kohli and Grover (2008); Tams et al. (2014); and Hylving, Henfridsson and Selander (2012).

Because the characteristics of digital products and services are constantly evolving, communication channels have become necessary. In today's competitive world, companies have to be quick to outperform their competitors and meet the customers' needs always.

Therefore, it is crucial that companies respond to market demands and the customers' needs as they become more demanding and forceful and have higher bargaining power. Thus, the responsiveness capability is essential to future operations.

Fernandes et al. (2017) emphasize that the organizations' response speed can imply an improvement in their performance through digital technologies. Müller et al. (2015) also highlight the importance of being responsive to market responses, consumers, and other stakeholders and suggest the use of platforms and cloud computing to acquire responsiveness. Therefore, we make the following proposition.

Proposition 2 (P2): responsiveness is related to digital business performance.

3.6.3 Process Digitization

Process digitization not only improves business processes through the use of digital technologies, but it also removes redundant steps, reduces the number of documents processed, and develops automated decision making. In addition to providing a better customer experience,

a company will be able to save substantial time and money through such process digitization where workflows are improved and automated wherever possible.

Lyytinen et al. (2016, p. 49), in presenting digitization's challenges, affirm that "increasing the level of digitization in our everyday socioeconomic system involves representing, processing, storing, and communicating the widest possible range of matter, energy, and information comprising our world."

Kohli and Grover (2008) argue that firms should develop the ability to gain visibility into their processes so that they can react to problems or changes. In this sense, process digitization is a digital capability that can be developed for organizations to meet the challenges of the digital economy, particularly challenges 7, 9, and 12 indicated in Table 7, as suggested by Mishra et al. (2007); Roberts, Galluch, Dinger & Grover (2012); Yoo (2013); Davis et al. (2014); Barret et al. (2015) and Tan et al. (2016). For example, banks and credit card companies must provide a real-time report for customers because clients are more demanding and would like to have their bank loans to be pre-approved or approved immediately. Today, customers seek to buy a phone from their telecommunications provider and expect to activate and use the phone immediately as soon as it is out of the box. Online services must provide automated access, online solutions, and instant answers.

To achieve customers' expectations, organizations would need most of their business processes to be fully digitized so as to achieve operational excellence. Clearly, this digital capability will bring about speed to the processes and is linked to responsiveness. Once the process is digitized, the response can be instantaneous. Mishra et al. (2007) provide the example of process scanning that improves the quality of information flow within the organization. The authors say that firms with high procurement-process digitization can leverage their infrastructure, experience, and knowledge to implement e-procurement solutions readily and, consequently, improve the organization's performance.

The operant dimension of digitization is the product innovation that redefines products, changes business models or generates new business (Yoo et al., 2010; Lyytinen et al., 2016).

Companies need to adapt the business model to face the challenges of the digital economy. Thus, they will be able to implement new processes, adjust existing ones and have the operations supported by a platform that integrates clients and other stakeholders.

So, developing the process digitization capability the company will be able to transform its business processes to reduce costs, improve productivity, integrate supply-chain partners and differentiate offerings. This way the digital business can improve the digital customer

experience, enhance the digital workplace, transform business processes, optimize infrastructure, simplify management, and become faster.

Lyytinen et al. (2016) suggest that digitization makes it possible to completely reconfigure the conception and production of almost all products in the industrial age. In this regard, process digitization is a capability that permits sharing business processes within and outside of a firm. The authors also note that digitization can reduce information complexity and uncertainty by delivering data and information in an appropriate, quality format, thus improving the quality of information flow. Hence, the following proposition is given.

Proposition 3 (P3): process digitization is related to digital business performance.

3.6.4 Ecosystem Connectivity

In the digital world, where industry boundaries are permeable, every business must reconsider its partnership strategy and fundamental role in the broader ecosystem. Accordingly, it needs to be able to work on digital platforms in different manners, like crowdsourcing, crowdfunding, etc.

In the ecosystem, firms are busy developing new strategies that cater to emerging market dynamics by competing head-to-head on some fronts (e.g., both Apple and Amazon sell hardware) and collaborating on others (e.g., Amazon offers reader applications) (Yoo et al., 2010) to ensure total connectivity. Total connectivity means enabling at any time, at any place, for anyone, for anything and everything in the ecosystem to be connected.

Nambisan et al. (2017) suggest that new digital infrastructures and their associated capabilities can critically complement a firm's practices, for example, collaboration with customers or a broader ecosystem of external partners. Furthermore, the ecosystem's architecture can be built according to the company's needs and structure, and it can also combine with one or more ecosystems. This way, the firm can belong to more than one ecosystem, being responsible for itself and a member of others, such as partner companies, suppliers, etc. So, the ecosystem connectivity capability allows for integrating information from all corners of the organization.

This capability can sustain firms to deal with challenges 13, 14, and 15, demonstrated in Table 7, as noted by Hylving et al. (2012); Yoo et al. (2012); Drnevich and Croson (2013); Barret et al. (2015); Alam and Campbell (2016) and Nambisan et al. (2017).

Companies are integrating their operations and business with third parties and their platforms, shaping a digital ecosystem that unlocks new waves of growth. It then becomes

necessary to develop a Digital Ecosystem that integrates the agents (stakeholders) and allows for collaboration and communication between and across firms. Once in a digital ecosystem, new agents (clients, suppliers, teams, stakeholders, and other players) need to be coordinated internally, externally, and across businesses.

In this context, the digital ecosystem capability will enable companies to connect, coordinate, and orchestrate the agents across the digital ecosystem. For example, a focal organization that has the ecosystem connectivity capability will be able to perform better because of its ability to connect across various stakeholders in the ecosystem and its supply chain from customers, suppliers, etc.

In addition, the digital ecosystem allows companies to collaborate with each other. In this context, the first step towards collaboration is to tear down the walls between the business and its ecosystem partners. Ecosystem players have a stronger potential for profitability since there are potential growth multiplier effects when companies work towards the same goal together.

Finally, according to Tan et al. (2016), ecosystem connectivity capability increases the possibility of a firm to seek, explore, acquire, assimilate, and apply knowledge to resources and opportunities and how resources can be configured to explore opportunities. As a result, the fourth proposition offers the following.

Proposition 4 (P4): ecosystem connectivity is related to digital business performance.

3.6.5 Conceptual Model

Finally, we present a synthesis of all the digital capabilities definitions in Table 10, that support the conceptual model that illustrates the relationship between the digital capabilities propositions and digital business performance.

Table 10 - Summary of Digital Capabilities Definitions

Digital Capabilities	Definition
Sensing	The ability of a digitized artifact to monitor and respond to changes in the environment
Responsiveness	The ability to respond quickly to the consumers' needs and the market.
Process Digitization	The ability to improve processes through digital technologies; understand the rules, inputs, and outputs of a process; and reduce the number of paper-based inputs, manual work, and human errors.
Ecosystem Connectivity	The ability to connect, integrate, coordinate, and orchestrate the digital ecosystem's players.

Source: The author.

By observing the conceptual model, we posit that digital capabilities are related to the performance by their digital capabilities, in particular, that of sensing, responsiveness, process digitization, and ecosystem connectivity. This model emphasizes that a digital business requires high responsiveness and digitization flexibility (Yoo et al., 2010; Lyytinen et al., 2016), as well as sensing and the presence of an ecosystem capable of improving digital business performance (Tan et al., 2016).

Figure 5 – Conceptual Model
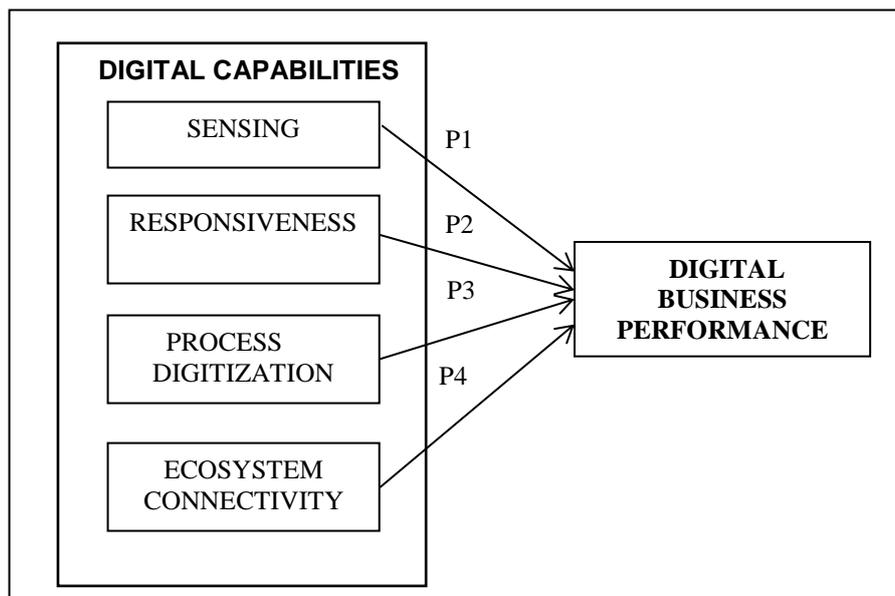
Source: The author.

3.7 CONCLUSION

This paper aims to present a systematic literature review and to propose a conceptual model that discusses the association of digital capabilities with a digital business performance from the perspective of the RBV and Dynamic Capabilities theories. One of the contributions of this article is to amplify understanding of the digital phenomenon for businesses through organizational theories and advance this topic in the IS area.

This objective is met in the section with the propositions and the conceptual model illustrated in Figure 5. Throughout this study, it was also possible to expand understanding of the digital phenomenon for businesses through the RBV and dynamic capabilities concepts, which can be observed in the presentation of the concepts of digital capabilities and digital resources and the capabilities that compose them, respectively.

This article contributes theoretically to the discussion on the digital economy's challenges, which are summarized in Table 7. The study made it possible to broaden comprehension of the digital phenomenon for businesses through the lenses of RBV and dynamic capabilities. Other contributions can be found in the discussions on the concept of digital capability, which, as can be seen, is a recent topic with few studies presenting a specific definition for dynamic capabilities, as well as the resources and capabilities that compose it.

Furthermore, this study also contributed to the understanding that digital capabilities allow a firm to rethink and upgrade their processes, their commitment to clients and business models, thus improving information flow (Westerman et al., 2012).

To conclude, suggestions for future studies include the need to validate the proposed model empirically as well as to develop and test the hypothesis to determine the impact of digital capabilities on digital business performance. We also suggest conducting studies in diverse digital businesses to empirically determine the relation between digital capabilities and digital business performance in different contexts.

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4 PAPER 2 - EXAMINING DIGITAL CAPABILITIES AND THEIR ROLE IN THE DIGITAL BUSINESS PERFORMANCE

ABSTRACT

The digital economy has advanced from the growing investment in digital technologies by organizations in their digital transformation process. Furthermore, digital technologies are reshaping traditional business strategy for performance gains. However, there is still no in-depth discussion regarding the skills and capabilities that can help organizations improve their performance. Thus, the purpose of our research is to examine the role of digital capabilities in digital business performance. We adopted a qualitative research method to explore digital capabilities. To do so, we conducted interviews with 31 executives that work in digital businesses. The research makes several contributions through the conceptualization of digital capabilities, providing some initial results revealed in the previous conceptual framework, based on the literature review, composed of digital capabilities (sensing, responsiveness, process scanning, and ecosystem connectivity) related to digital business performance, and empirically analyzed by interviews with executives. The practical value of this research rests on the relationship between digital capabilities and the digital business performance. As a result, we present four digital capabilities that enhance operational excellence, revenue growth and relationships with customers and stakeholders.

Keywords: Digital capabilities. Digital technologies. Digital business performance.

4.1 INTRODUCTION

Societies, as well as the business world, are undergoing a digital transformation (Li, 2018). For Remane, Hanelt, Hildebrandt and Kolbe (2016), this transformation is due to recent technological advances that have enabled several new digital business models, which are now transforming industrial-age. Moreover, companies are facing the challenges of the digital economy, defined by Zimmermann (2000) as an economy based on the digitization of

information and its respective information and communication infrastructure. Digital capabilities are required to cope with this new context.

Furthermore, digital technologies are reshaping traditional business strategy into modular, distributed, cross-functional, and global business processes that enable work to be carried out across boundaries of time, distance, and function. These technologies are also transforming the structure of social relationships for both the consumer and the enterprise through social media and social networking (Kohli & Grover, 2008; Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013).

While the idea of shifting toward digital business was speculative for most CEOs a few years ago, for many it has now become a reality. A Gartner survey conducted 2017 reveals that 42 percent of CEOs have begun the digital business transformation. Furthermore, 47 percent of CEOs are being challenged by their boards of directors to make progress in digital business, and 56 percent said that their digital improvements have already expanded profits (Gartner, 2017).

For Boulton (2016) top-performing businesses, in which digitalization is already woven into their planning processes and their business models, are spending 34 percent of their IT budget on investments in digital transformations, with plans to increase that to 44 percent by 2018. Driven by consumers accustomed to such technologies/niceties as mobile apps, smart appliances, and connected cars, the digital business shift is afoot. Tesla and CVS are good examples of this tendency according to many specialists. According to Bock, Iansiti and Lakhani (2017) digitally transformed organizations ("digital leaders") performed much better than organizations that lagged behind ("digital laggards"), effectively creating a "digital divide" across companies. For these authors, digital transformation involves some significant capability building.

These transformations modify the processes and structures within and among businesses and other organizations, increasing the relevance of the role played by digital capabilities. According to Aaker (2015) and Yoo (2013), companies are interested in the discussion on transformation in the digital age, thereby leading IS research to advance theoretically. However, there is still no in-depth discussion regarding the skills and capabilities that can help organizations cope with these new challenges.

To fill this void and understand digital capabilities and their role in the digital business model, our research presents the results of the qualitative phase of broader research that has been conducted. Our study is expected to make several contributions. First, we complement the concept of digital capabilities based on the digital literature. Second, our research advances in

identifying the key digital capabilities required to make a digital business model successful, making some adjustments to the conceptual framework previously presented. In practical terms, this research will be of value to executives as it demonstrates the role of digital capabilities in the digital business performance.

The research objective is to examine the role of digital capabilities in digital business performance. The theoretical development opens the paper by presenting the propositions and research model, followed by the method. Then, the results are discussed, and the conclusions are presented.

4.2 THEORETICAL BACKGROUND

The digital business model arose from advertising campaigns promoted by some companies that began using e-business in the late 1990s. "Digital Business" seemingly became popular in the decade of 2000, when consumers witnessed a growing trend of e-business and e-commerce. Many people wondered if it was just the addition of the letter "e," that was not. Although one could think that this transformation in business models through digitization was more fashionable than fact, currently there is enough economic evidence to prove that digitization is a trend that causes deeper implications than just introducing a new distribution channel, as the development of e-commerce did (Barenfanger & Otto, 2015).

For traditional businesses beginning to operate in the digital world, the firms must review their organizational logic and IT infrastructure use, which require new capabilities (Yoo, Henfridsson & Lyytinen, 2010). So, this section presents a systematic literature review and theoretical framework.

4.2.1 Literature Systematic Review

We selected the theory of Dynamic Capabilities (DC) for this study. Eisenhardt and Martin (2000) define DC as the ability to integrate, reconfigure, gain, and release resources to match and even create market change. DC explores the velocity of information, presenting its relationship with organizational processes and people. Karimi and Walter (2015) argue that DC is positively associated with building digital capabilities.

To develop this study, we conducted a full-text search to find articles containing the terms "digital capability" and "digital capabilities." We follow the procedures suggested by Wolfswinkel, Furtmueller, and Wilderom (2013). The search and selection of the papers occurred from July 2 – 18, 2017. The following search parameters were utilized: publications in the last 20 years and academic articles. We have chosen the Association for Information Systems electronic library (AISel), which is a central repository for research papers and journal articles relevant to the information systems academic community. Additionally, we also searched in EBSCOhost and the Web of Science database for the same terms, researching only papers from journals that adopted the double-blind review.

During this execution, the abstract, keywords, and introduction were read. In addition to following the inclusion/exclusion criteria, for an article to be included in the study, it must have been related to IS and addressed the digital capability topic.

As a result, we identified 97 papers in the first round and excluded six articles due to overlap, resulting in 91. The second step was to verify the context of the studies. It is worth mentioning that only the business context was considered in this review, rather than other areas, for example, teaching, which denotes other concepts, such as the digital divide. As a result, 28 articles were found and exhaustively studied.

Once the papers have been chosen, Wolfswinkel et al. (2013) indicate going to the analysis and the presentation structure of the results. In this study, we used the software N'Vivo to support the analysis. First, we read all the papers, and then we utilized open coding to create tentative labels for chunks of data to summarize our understanding. We looked for definitions for Digital Capabilities, what the main capabilities required by digital business are, the challenges for a digital business, and digital transformation.

It is worth highlighting that in this review only the business context was considered, rather than other areas, for example, teaching, which presents other concepts such as digital divide. It is important to say that many articles simply mention the term "digital capability," but do not offer definitions or further implications for this study, so these papers were also excluded from the analysis.

Next, we began axial coding to identify relationships among the open codes, and then we moved onto selective coding to figure out the core variable that includes all the data. So, we were able to correlate Digital Capabilities with the theories, and the results of this analysis are presented next.

4.2.2 Digital Capabilities

Analysis of the 91 reviewed papers demonstrated that only five clearly define digital capabilities, because most of them do not bring clear definitions, descriptions of these capabilities, or studies that measured the relation of digital capabilities with business performance. Another observation is that most of the articles just mention the term "digital capability" or "digital capabilities" and do not specify what these capabilities are.

Before studying the capabilities' characteristics, we decided to comprehend the definition of Digital Capabilities. To gain an understanding, Table 11 summarizes the definitions found in the literature review.

Table 11- Definitions of Digital Capabilities

Journal	Definition	Authors
Journal of the Association for Information Systems	It is a business capability developed by the interaction of technology with a variety of complementary assets, such as process redesign, training, and incentive structures, that can be considered as sources of business value,	Kohli and Grover (2008)
Organization Science	It is the organizational ability "used throughout the organization to support its different functions based on Digital Technology Platforms."	Yoo et al. (2012)
MIT Sloan Management review	"The skills needed to go beyond pure IT to include specific technologies, such as social media or mobile, as well as analytic skills to drive value from big data."	Westerman, Bonnet and McAfee (2012)
MIS Quarterly	It "can be conceptualized as services that one system provides to another through value-creating, provider-user interactions."	Srivastava and Shainesh (2015)
Journal of Strategic Information Systems	A Digital Capability is "an organization's focused deployment of information and communication technologies (ICTs), abilities to develop, mobilize, and use organizational resources effectively, for instance, customer relationship management, new product development, and knowledge collaboration."	Tams, Grover and Thatcher (2014)

Source: The author.

As can be observed, there is no standard definition. However, we can notice that these definitions indicate that digital capabilities allow organizations to give instantaneous answers, either internally or externally, by using digital technologies and digital platforms that contribute to generating value for the business.

We propose a new definition based on analysis of these five definitions to standardize and support future studies. To do so, we enumerated the list of definitions found in extant literature, as presented in Table 11 above. Then, we conducted a cross-comparison of what has

already been defined to formulate a precise, comprehensive definition for the term "digital capabilities."

Subsequently, we wrote the terms considered key to constructing the definition in bold letters, as described next. However, we also took into consideration analysis of the papers. With this study, we noticed that it is not clear whether the mere acquisition and possession of packages of resources is enough to achieve superior performance, especially when most of the firms have access to markets with similar factors. On the contrary, organizations should develop new capabilities by adding resources that would make them more valuable and inimitable.

Some authors use the term "digital capability" and others the plural form, "digital capabilities." Dig C can be understood by the theories of resources and capabilities, which explain the construction of capabilities. They refer to the firms' capability to integrate, build, and reconfigure capabilities and internal and external resources to create superior capabilities that are incorporated into their social, structural, and cultural context (Grant, 1991; Sambamurthy; Bharadwaj & Grover, 2003).

The mobilization of resources and new organizational capabilities becomes vital, focusing on people, facilities, structures, to ensure quality, speed, storage, and information flow, which will enable improvements in processes and client relationships and, thus, superior performance in the digital world.

So, based on table 11, we present the digital capabilities definition: "Digital Capabilities are the combination of skills and processes of a Digital Business to develop, mobilize, and use organizational resources supported by Digital Technologies to respond to the environment and add value to the organization."

This definition indicates that digital capabilities allow organizations to give instantaneous answers either internally or externally by using digital channels that contribute to generating value for the company. These capabilities permit improvement in processes and customer relationships, thereby refining digital business, impacting operational and strategic fields (Westerman, Bonnet & Mcafee, 2012), as we demonstrate in the following propositions.

4.3 PROPOSITION DEVELOPMENT: SKILLS AND RESOURCES REQUIRED FOR DIGITAL CAPABILITIES

In determining which resources and capabilities, when integrated and reconfigured, encompass digital capability based on the literature review, it was possible to identify four components which are presented next.

4.3.1 Sensing

As this study observes, organizations are dealing with the challenges of the digital economy and the changes that digital technologies have brought. Hence, it is essential to monitor the market, customer demands, and any other data that can be useful for the business.

So, sensing capability can help the digital businesses to monitor the competitors, to know the market trends, to understand the customers necessities and to be able to compete in a digital world (Kolhi & Grover, 2008; Aakus, Agerfalk, Lyytinen & Te'eni, 2014; Müller, Holm & Søndergaard, 2015; Lyytinen, Yoo & Boland, 2016; Nambisan, Lyytinen, Majchrzak & Song, 2017).

This capability is defined as the ability of a digitized artifact to monitor and respond to changes in the environment (Yoo et al., 2010). For it, the sensing capability allows the organizations to keep constant contact, which entails new levels of digital sensing and tracking, producing big data that represent behaviors that were heretofore invisible (Barret, Davidson, Prabhu & Vargo, 2015).

Kolhi and Grover (2008, p.28) complement this idea and affirm the importance of a "quick sense-and-respond to market demands by pricing, designing, sourcing, manufacturing, and distributing a product." Also, Drnevich and Croson (2013) highlight the importance of monitoring competitors' actions and how it can improve business performance.

Considering the value of information for business, sensing capability allows the organization to reduce information complexity and uncertainty by delivering data and information in an appropriate, quality format, thus improving the quality of information flow. Therefore, we offer the following proposition.

Proposition 1 (P1): sensing is related to digital business performance.

4.3.2 Responsiveness

Digital capabilities are a foundation upon which other firms can develop complementary products, technologies, and services (Barrett et al. 2015). In this context, responsiveness is an ability that requires velocity and flexibility of processes in an organization and to quickly to respond to a new customer need.

Tams, Grover and Thatcher (2014, p. 299), citing the studies of Lavie (2006) and Peppard, Galliers and Thorogood (2014), emphasize that "Digital Capabilities and practices have become increasingly important for organizations to improve organizational agility and responsiveness. As a result of the improvements in agility and responsiveness, firms can achieve greater performance and competitive advantage, even sustainable competitive advantage."

In this context, Kolhi and Grover (2008) underscore responsiveness as a digital capability, defining it as the capability to respond quickly to the firm's internal and external demands. Consequently, this digital capability can meet the digital economy's challenges (Kolhi & Grover, 2008; Tams, Grover & Thatcher, 2014; Barret et al., 2015).

Müller et al. (2015) also highlight the importance of being responsive to market responses, consumers, and other stakeholders and suggest the use of platforms and cloud computing. Fernandes et al. (2014) emphasize that the organizations' response speed can imply an improvement in their performance. Therefore, we make the following proposition.

Proposition 2 (P2): responsiveness is related to digital business performance.

4.3.3 Process Digitization

Lyytinen et al. (2016, p. 49) affirm that "increasing the level of digitization in our everyday socioeconomic system involves representing, processing, storing, and communicating the widest possible range of matter, energy, and information comprising our world."

Kolhi and Grover (2008) argue that firms should develop the ability to gain visibility into their processes so that they can react to problems or changes. In this sense, process digitization is a digital capability that can build with organizations to let them fast, improve the process like decision making and the business can respond to market demands (Mishra, Konana & Barua, 2007; Yoo, 2013; T. C. F. Tan, B. Tan & Pan, 2016).

This capability will bring speed to the processes and is linked to responsiveness. Once the process is digitized, the response can be instantaneous. Mishra et al. (2007) provide the example of process scanning that improves the quality of information flow within the organization. The authors say that firms with high process digitization can leverage their infrastructure, experience, and knowledge to implement e-procurement solutions readily and, consequently, improve the organization's performance.

For instance, it is reported that more than 175 billion search queries are conducted worldwide each month, including more than 115 billion that are held via Google […] Most queries are a window into someone's intention or interest. 'Google Trends' provides publicly available reports on the query volume of any search phrase providing those data by on a regional and a longitudinal basis […] Such data allow for 'predicting the present' as well as – contingent on certain assumptions – the future (Loebbecke & Picot, 2015, p. 150).

To Lyytinen et al. (2016), digitization makes it possible to completely reconfigure the conception and production of almost all products of the industrial age. In this regard, process digitization is a capability that permits sharing our business processes within our firm and outside of it with partners. The authors also note that digitization can reduce information complexity and uncertainty by delivering data and information in an appropriate format, thus improving the quality of information. Hence, the following proposition is given.

Proposition 3 (P3): process digitization is related to digital business performance.

4.3.4 Ecosystem Connectivity

In the ecosystem, firms are busily developing new strategies that cater to emerging market dynamics by competing head-to-head on some fronts (e.g., both Apple and Amazon sell hardware) and collaborating on others (e.g., Amazon offers reader applications) (Yoo et al., 2010).

Nambisan et al. (2017) suggest that new digital infrastructures and their associated capabilities can critically complement a firm's practices, for example, collaboration with customers or a broader ecosystem of external partners. Furthermore, the ecosystem's architecture can be built according to the company's needs and structure and can also combine with one or more ecosystems. This way, the firm can belong to more than one ecosystem, being responsible for itself and a member of others, such as partner companies, suppliers, etc. So, the ecosystem connectivity capability allows for integrating information from all corners of the organization.

This capability can sustain firms to deal with challenges of digital economy and improve the connections and relation among all stakeholders, as pointed by Hylving, Henfridsson and Selander (2012); Yoo, Boland, Lyytinen and Majchrzak (2012); Drnevich and Croson (2013); Barret et al. (2015); Alam and Campbell (2016); and Nambisan et al. (2017).

Finally, according to Tan et al., (2016), ecosystem capabilities increase the possibility of a firm to seek, explore, acquire, assimilate and apply knowledge to resources and opportunities and how resources can be configured to examine opportunities. As a result, the fourth proposition offers the following.

Proposition 4 (P4): ecosystem connectivity is related to digital business performance.

4.3.5 Performance Indicators

There are several ways to measure the performance of a business, for this study we follow the authors Rai, Patnayakuni and Seth (2006) that emphasize three areas of analysis to measure performance should be observed the relation of the performance of a company about its competition: operational excellence, revenue growth, and the relationship with customers and other stakeholders involved in business processes.

Operational excellence is defined as the ability of a company to respond to customers and productivity improvements about its competitors (Rai et al., 2006). To illustrate, one could cite the integration of the supply chains of e-commerce companies to improve the competitiveness of a firm based on time, compressing cycle times which improves business performance. The supply chains integrated to the business provide visibility, coordination, and streamlined flow of goods that shorten the time interval between a customer's request for a product and its delivery (Hult, Ketchen & Slater, 2004).

The relationship with customers and other stakeholders involved in business processes are an essential performance indicator according to authors Rai et al. (2006). The authors bring affirm that the decrease in time impacts on the relationship with clients, and it is possible to broaden this view, with the satisfaction of all the actors involved in the processes both internally and externally.

Finally, the financial performance is also an indicator of performance. This performance can be analyzed by revenue growth, but also, by the return on investments and by the relation between the operating profit, as observed in the study of Chi, Zhao and Li (2016). In summary, for this study we use the following performance indicators named by DBP1, DBP2, and DBP3:

- Operational excellence (DBP1)

- Financial Performance (DBP2)
- The relationship with customers and other stakeholders (DBP3)

4.3.6 Conceptual Model

Finally, what follows is the conceptual framework that illustrates the relationship between the Dig C propositions and Digital Business performance.

Figure 6 – Conceptual Model
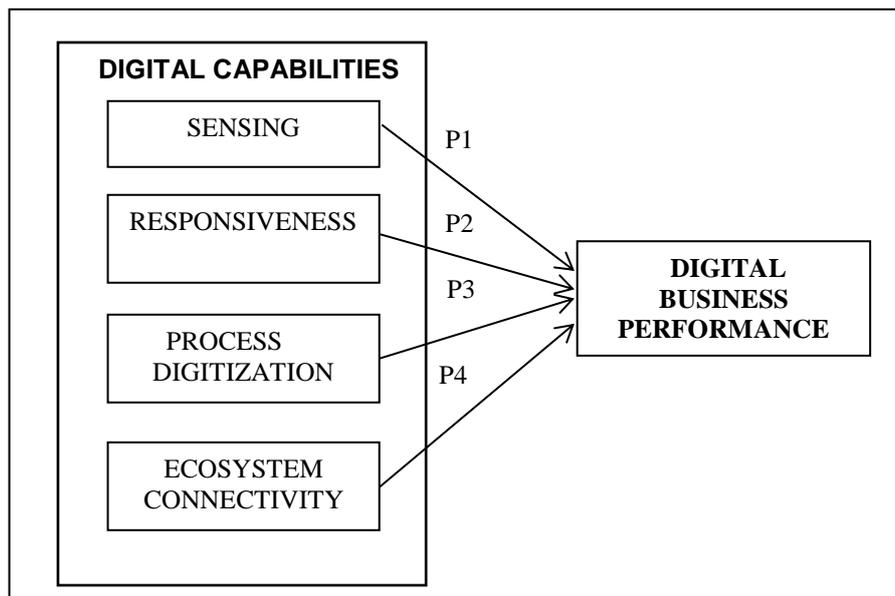
Source: The author.

By observing the conceptual framework, theoretically, digital capabilities are related to the digital business performance by their means of sensing, responsiveness, process digitization, and ecosystem connectivity. This model emphasizes that a digital business requires extreme responsiveness and digitization flexibility (Yoo et al., 2010; Lyytinen et al., 2016), as well as sensing and the presence of an ecosystem capable of improving digital business performance (Tan et al., 2016). Next, we present the methods used in this research.

4.4 METHODS

We adopted a qualitative research method to explore digital capabilities. To do so, we conducted interviews with 31 managers and specialists who work in Digital Business. To Sarker, Xiao and Beaulieu (2013), there is no recommended number of interviews, but the number of meetings must be reported and well-detailed.

We selected respondents from native digital companies and traditional ones that started working with digital, such as e-commerce. This sampling of different-sized organizations from distinct industry sectors contributes to the study's analytical generalization (Benbasat, Goldstein & Mead, 1987). The respondents are executives in IT, business, and company strategy.

4.4.1 Data Collection and Analysis

The interviewees were asked a series of questions based on a semi-structured instrument (Appendix A) that was developed as Myers and Newman (2007) suggests. We prepared beforehand some questions based on the literature review. Three specialists validated the qualitative study's protocol, and, to double check, we conducted a pilot interview before initiating data collection. Only after all these steps were completed did we begin to collect data. Only one researcher conducted all the interviews.

The pilot was conducted at a multinational retail company headquartered in South Brazil. This company is the most significant retail clothing company in the country and with the best financial result in the last years. Were interviewed three managers with experience in digital business, the CIO, the director of E-commerce and director of Digital Marketing. Subsequent participants were obtained through a snowball sampling of these participants, as well as an advertisement made to the community of a university located in one of the state capitals in South Brazil. We were able to reach out to the authors' networks and reach participants from around the country and made a subsequent snowball sampling of all those contacts. All interviewees participated voluntarily without compensation.

In addition to the experience with digital business, we take into account the characteristics of the companies that work. Companies were chosen according to the following rank: profit, revenue, and market share. In the e-service companies and the IT consultant, it was observed whether the companies served met the representativeness indicated above.

The interviews were audiotaped, professionally transcribed, and analyzed, according to suggestions by Walsham (2006). The average interview length was 45 minutes, with interviews as short as 28 minutes and as long as one hour and 17 minutes. However, it is worth mentioning that the unit of analysis are the enterprises. The average experience of the interviewees is 12 years in the area of IT or digital area, being the interviewee with less time has six years and the most experienced, 27 years. A synthesis of our 31 interviewees is provided in Table 12.

Table 12 - Characteristics of respondents

Type of enterprise	Gender/Number of interviewees			Business System/ Service	Origin	
	Male	Female	Total		Digital Native	Digital Immigrant
Retail E-commerce company: Clothing and Accessories	3	2	5	B2C	X	
E-Commerce: Shoes	2	1	3	B2C		X
E-commerce Retail stores groups: electronics and furniture	2	3	5	B2C		X
E-business Ecosystem and marketplace	3	1	4	B2B e B2C	X	
Industry	1	1	2	B2B		X
Private Bank	1	3	4	Financial Service		X
State Bank	2	1	3	Financial Service		X
e-Service	4	-	4	IT Solutions	X	
IT Consulting	1	-	1	IT Consulting		X

Source: The author.

Finally, we analyzed the results by utilizing the content analysis technique (Bardin, 1977). The analysis, with the use of the qualitative analysis software N'VIVO. This analysis was performed by all the researchers, following a qualitative coding analysis protocol developed for this research, which due to lack of space, could not be included here.

Although other pieces of evidence emerged, we opted to present evidence that is mentioned by at least more than two interviewees. To do so, we consider the general idea, not literally the same words, but the general idea and the subcategorization provided by N'Vivo.

So, we select some evidence to illustrate, each table brings four pieces of evidence. The right column of the table expresses to which degree the evidence and proposition relate, according to the analysis extracted from the N'Vivo program, based on the representativeness, according to other managers. We consider high when the idea is mentioned by more than half of respondents, medium when is said by seven to fifteen, and low when mentioned by two to seven.

Besides, we took into consideration the digital business performance indicators presented in section 2, and we evaluate the relationship between the evidence and each

indicator. We named each of them as DBP1 - Operational excellence, DBP2 - Revenue growth, and DBP3 - The relationship with customers and other stakeholders) to help the visualization in the tables of evidence that will be presented in each category, as shown next.

In synthesis, the data analysis codes were initially grouped into inductive themes based on the literature, while the data analysis revealed new themes. The analytical categories were established a priori, based on this set of themes. For this paper, we employed the categories that correspond to digital capabilities (sensing – responsiveness – process digitization - ecosystem connectivity).

It is worth noting that although new categories have emerged, they did not refer to new capabilities and for this study were not considered and can be better analyzed in future studies, since the focus of the objective is to verify the relationships of the model and the new ones would add no value to the study. Next, we present the results.

4.5 DATA ANALYSIS AND RESULTS

This section presents the results of interview analysis. For each category, a table is presented with evidence that aims to verify the relationship between the digital capability and digital business performance and then discussed with the literature.

4.5.1 Sensing

The results from the observations and the respondents suggest that organizations are dealing with the challenges of the digital economy and the changes that digital technologies have brought. Hence, it is important to monitor the market, customer demands, and any other data that can be useful for the business.

The evidence presented in table 13 indicate that sensing is the capability to display business information visually, presenting data and information in an appropriate format, as defined by Yoo et al. (2012). Moreover, data and information are available in all adequate platforms such as laptops, mobile devices, and websites (Bacic & Fadlalla, 2013; Tan et al., 2016).

The Industry Digital Marketing Director highlights the company's sensing capability will make the company's information and communication systems nourish and make all decisions efficiently and effectively. According to him, as a consequence of this decisions will

be possible to respond to the demands of the market, and to meet the needs of customers leaving them more satisfied.

The relation to performance is evident once in the declarations made by the CEO of Shoe E-Commerce he shows the importance of monitoring the environment. The bank director also corroborated with this idea, and he is always analyzing the market because it requires surveillance of market trends and new technologies to sense and seize opportunities (Kohli & Grover, 2008).

Table 13 - Sensing evidence

Proposition	Interviewee	Evidence	Performance	Degree of relation
P1 – Sensing *is related to Digital Business Performance*	Industry IT Manager	We now have hourly sales reports, SMS, and e-mail. Besides, every morning, we have all the previous day's sales volume, and those reports have graphs and are on the managers' iPad.	DBP1	High
	CIO of E-business Ecosystem and marketplace	we access information to the internal and external environment. It is reactive and proactive. We get clippings and various types of information from market analysts, BI, analytics area and social media. Also, there are tools that are used for each unit for monitoring customer and competitor actions. My managers have their decision level and can act accordingly to the situation.	DBP2	High
	Digital Business Manager of State Bank	The bank has developed solutions for clients and our internal team. We are always analyzing the market. Now, Fintechs exist. We have to be fast, and the client must be satisfied. One example is our applications that make it possible to access account data and perform practically all financial operations and communicate with the bank, e.g., every transaction the client receives an SMS, so he can confirm or not the operation, which increases the security and confidence of the client.	DBP2 DBP3	Medium
	CEO of E-Commerce Shoes	Everyone involved in the ecosystem receives an access level and, can give and receive input, participating and viewing information according to each one's role in the ecosystem, including product development. For example, last month, a director went to a shoe fair in Milan. There, he saw the trends, such as designs and colors, he sent photos from his cell phone to our internal communication system, and the discussions to develop those shoes began with people involved in the project. This reduces time, costs and improves productivity.	DBP3 DBP1	Medium

Source: The Author.

4.5.2 Responsiveness

As mentioned by Kohli and Grover (2008), responsiveness is the capability of organizational process flexibility and flexible, fast implementation of operational changes. Responsiveness is the ability to respond to the Market and internally, according to Setia, Venkatesh and Joglekar (2013) and Barenfanger and Otto (2015).

As we can see in table 14, there are internal and external evidence. Externally, this can be evidenced by declarations made by the CIO and Director of Clothing and Accessories Retail E-Commerce, who remind us that a physical store can change its display window each season or, at most, once a month. A digital store changes every minute according to each client's characteristics. It is an example of the operational excellence and the relationship with customers, this way it is possible to improve the performance.

The E-commerce Director complements by citing that the client previously needed to go to the store to make a complaint. With the digital transformation, the client posts the complaint to the store's site. Accordingly, digital has enabled consumer empowerment. If a community begins to complain and makes the store apologize or change its attitude, it can viralize in seconds. Thus, whoever wants to have a strong brand must be more careful and agile, capable of responding instantly, immediately to the client's needs, whether good or bad. Again, it is another example of how to improve the relationship with customers and other stakeholders

Internally, responsiveness is observed in various situations, such as decision making. A situation that exposes this internal agility is one related by the CIO, who said that on the day iPhone 7 was launched in Brazil, online sales were not being converted. The e-commerce platform's systems analysis verified that the clients were not buying because of delivery time, which was longer than that of the competition. Immediately, the CIO contacted the CEO and logistics Director and found an alternative to decrease delivery time, which was done on the site, and, minutes later, sales began to increase. All this activity reveals how responsiveness is a digital capability related to business performance, particularly in the factors operational excellence and the relationship with customers and other stakeholders.

In addition, the CIO and Director of Clothing and Accessories Retail E-Commerce emphasize that practically all efforts and investments are made with the aim of improving responsiveness. These managers point out that it is the responsiveness that leads to an improvement in the reputation of the company and the products. As a result, financial performance increases as a consequence of their responsiveness.

Table 14 - Responsiveness Evidence

Proposition	Interviewee	Evidence	Performance	Degree in relation
P2 – *Responsiveness is related to Digital Business Performance.*	CIO of E-commerce Retail stores groups: electronics and furniture	We try to be fast in our responses to the clients and also to the market in general. We must capture the latest trend to win our competitors. We have an area that looks at the client and another market intelligence area that looks at the competition. When we look at them internally, the latest trend has to pass through various other sectors, such as style, purchases, production, and even supplier. The supplier must receive this same information in a nutshell since they have to produce with agility to quickly make the product available to the client to let them satisfy.	DBP1 DBP2	High
	IT Director of Private Bank	We have friendly navigation for mobile, the responsive site. It answers itself with the screen's resolution. We brought improvements to the user's navigation area. The stakeholder users are more satisfied, and we measured that our sales through mobile increase even more.	DBP1 DBP3	High
	Industry Digital Marketing Director	Being responsive involves changing the culture, seeking to digitalize processes. For example, one of our clients decides to open a virtual store, so they need to load our products' data, such as images, videos, among others. Thanks to the agility that our resources provide, we can transmit all these data instantly, and they can load up their site quickly and safely, without losing data, which demonstrates our excellent performance, helping our sales.	DBP1 DBP2	High
	CEO of E-business Ecosystem and marketplace	A digital business must be agile, so it must always provide the client with a better experience, the ability to obtain product information at any moment through systems and programs or BackOffice personnel.	DBP1 DBP3	High

Source: The author.

4.5.3 Process Digitization

The evidence featured unveils a relationship between process digitization and business performance, highlighting the flow of information, improvement in data quality, reductions in costs and lead time, coinciding with what Lyytinen et al. (2016) affirm. This capability also contributes to a quick response to the environment.

According to Loebbecke and Picot (2015) in the digital economy era organizations collect, mine, and exploit data that are increasingly available from an enormous variety of internal and external sources. These digital processes are possible due to the digital technologies that allow the processes to become digital. As we can see in the evidence on table 15 "the role of technology evolved from the focus on functionality and usability in the early days, to a means

for online communication and persuasion, and finally to an intelligent entity" (Xiang, 2018, p. 148).

Therefore, the Director of E-Commerce Clothing and Accessories Retail stand out that the ability to digitize the company's processes impact on customer response. According to him, the better the processes, the fewer errors and more satisfied customers, and an improvement in sales.

Besides the improvement in information flow the digitization permit processes such as decision making to be made more quickly and more precisely and this implies in revenue growth and operational excellence as pointed by CEO of E-commerce Retail stores and most of the other respondents. So, it is possible to notice that through the evidence that process digitization is related to digital business performance.

Table 15 - Process digitization evidence

Proposition	Interviewee	Evidence	Performance	Degree of relation
P3 - Process digitization is related to Digital Business Performance.	CEO of E-commerce Retail stores groups: electronics and furniture	We do not need to make any more manual decisions based on outdated reports. Our processes are digitalized, and that reflects in the results and revenue. For example, product restocking was manual. What we sold would come out from there. Someone there would decide how to buy and make the purchase orders. With our digital transformation, we only need to program the system and follow the stock levels, and the system sees how much sells and restocks, even suggesting: do not even restock this product here anymore because we are having market difficulties. So, this process digitization reduces costs and lead time, and consequently increase the revenue.	DBP1 DBP2	High
	Director of E-Commerce Clothing and Accessories Retail	Process digitization improves information flow internally and externally. For example, if we look ten years ago when we began this E-commerce operation, there was no payment gateway. There was no online reconciliation of payments at the firm. Reconciliation was manual, was done by the financial office manually, so there was no online reconciliation. Even the analysis of that credit or that card's risk was made manually. The firm needed to adapt to digital solutions, to bring that to the e-commerce universe, to improve the flow of the e-commerce process. Today all these processes are digitized what reduces losses and let our clients and partners more confident.	DBP1 DBP2 DBP3	Medium
	IT director of a Retail E-commerce company.	We work with the server in the cloud, so we throw information there for the client to see the order, shoot an e-mail. What changes in our digital process are the possibility of negotiations, the client can chat with us and negotiate because we want to hear our clients. At	DBP1 DBP2	Medium

		the same time, there is another technology service that we offer and to check at the same moment if some competitor is offering a lower price. So, we can adjust our offers. With it, our client is always satisfied because we can interact with the client helping them in their searches and give an adequate price for the product.		
	IT Consultant	The software permit decisions to be made more quickly and more precisely, to execute part of the work, to be supplied data analysis. In short, it will speed up decisions. It is a question of survival. We cannot be slow, and there is no way to be fast doing things manually. Process digitization is the result of the search for efficiency. Process digitization is synonymous with quality; it is a question of survival. Also, we can say that process digitization allows information to flow more quickly.	DBP1 DBP3	Low

Source: The author.

4.5.4 Ecosystem Connectivity

The ecosystem architecture can be constructed based on the firm's characteristics—its needs, internal and external clients, suppliers, etc.—or it can be adapted. Also, the ecosystem connectivity allows for condensing large volumes of information from the organization (Garbani, 2015).

The online environment is inspired by biological systems and actively populated by agents that enable communities to collaborate. It can also be socio-technical processes that offer ultimately affordable and trustworthy cooperative solutions through investment and engagement by local stakeholders (Gatautis & Medziausiene, 2014). It is supported by a Digital platform that enables a continued connection of all corporate partners beyond the traditional supply chains, including customers (and consumers) (Karimi & Walter, 2015; Nambisan et al., 2017).

The CIO of E-business Ecosystem and marketplace emphasizes that the connection between the parties has several impacts on the performance, but who perceives better this is the customer who has his needs met quickly. For him, ecosystem connectivity improves the company's ability to respond to market demands.

Noticing this throughout the analysis was possible. The digital businesses examined possess this connectivity capability through the ecosystem, and it is directly related to digital business performance, which can be verified by evidence in Table 16.

Table 16 - Ecosystem connectivity evidence

Proposition	Interviewee	Evidence	Performance	Degree of relation
P2 - Ecosystem connectivity is related to Digital Business Performance.	Director of E-commerce Retail stores	Our ecosystem is very broad. We have the e-commerce platform and an ERP that manages all of the entire company's BackOffice, and then we have to relate this ERP to the platform because product registration, financial management of payments, orders, all these mechanisms must be related to the site. Through it, there exists an integration of these agents in our ecosystem.	DBP1 DBP2 DBP3	High
	IT Director	The ecosystem architecture can be constructed based on the characteristics of a firm. In our case, BI and Analytics tools connect to operating systems, and the information provided is used by managers for ecosystem-wide. These systems such as ERP and SCM, connect with partners to carry out their tasks, such as logistics companies for land and air travel, and Distribution Centers. There are connections to the various suppliers.	DBP3	High
	CIO of E-business Ecosystem and marketplace	Today, a digital operation is very complex. There are more than 200 players connected to one platform. There are payment methods, delivery methods, display windows, risk analysts, recommendation software. In short, there are many partners. To keep that working is complicated, and there will be other systems that will have to connect with the platform, ERP, a CRM, and making that stick is a difficult job. Our IT sector offers a platform that allows the interconnection of all these actors and systems here.	DBP1 DBP2 DBP3	High
	IT Consultant	The big companies' ecosystems enable organizational performance [...] the platforms that compose the ecosystem generate information online to mobile devices. It is a tendency; we need to use it to help our customers. Also, we can consolidate Dashboards, which speeds up the directors' shares, in addition to the stakeholders' integration, which improves results because it decreases lead time and it is possible to sell more.	DBP1 DBP2 DBP3	Medium

Source: The author.

4.5.5 Theoretical Implications: Digital Capabilities and Digital Business Performance

It is possible to identify the degree of the relation between each digital capability and digital business performance. All capabilities analyzed in tables 13, 14, 15 and 16 are related with the performance indicators used in this study, operational excellence, revenue growth, and the relationship with customers and other stakeholders (Hult et al., 2004; Rai et al., 2006; Chi et al., 2016). So, based on the evidence all propositions are confirmed, and we can highlight

that each capability influences in more than one indicator of business performance, as illustrated.

We could notice that responsiveness capability has the highest degree of relation with digital business performance, followed by ecosystem's connectivity capability and sensing capability with high and medium degrees of relation. It was possible to observe that the other capabilities can lead to a better capability of response. And this responsiveness improves customer relationships and consequently impacts the company's performance.

Besides, most respondents highlight the importance of stakeholder integration and the ERP which is still the core technology. The Ecosystem's connectivity allows integration and connection to all the business's systems, thereby improving communication, information flow and promoting better internal collaboration. Concerning to the sensing capability, it is very important to spot the market trends, to know the competitors, to monitor the environment and to look for business opportunities in order to improve the decision-making process. Similarly, for processes to work, good connectivity of the ecosystem is required.

So, the responsiveness is related to the previous ones. For example, to respond quickly it is necessary to know precisely the market demands, so sensing capability, process digitization capability, and ecosystem connectivity capability are fundamental to the responsiveness capability, which is related to business performance. If one realizes, then, that the capability of response can be a consequent capability of the others.

The importance of the digital ecosystem was also highlighted, but it was observed that it is a complex subject that requires more studies. When analyzing the data, one realizes that each ecosystem has its peculiarities, but also has characteristics in common. On the other hand, the large number of ecosystem actors may require greater management. Therefore, new research on the subject is already suggested in order to advance the understanding of the possibilities and demands of the digital ecosystem.

4.5.6 Practical Implications

The answers bring useful insights to managers who may consider investing in digital resources and technologies that develop or enhance existing digital capabilities. For instance, it was possible to observe that responsiveness increases all the stakeholders' satisfaction, mainly the clients, and speeds up decision making. Finally, process digitization leads to a reduction in lead time and restocking, impacting the final consumer's satisfaction. It also contributes to internal collaboration and improves the quality and security of data and information. Therefore,

the evidence presented in the interviewees' statements and the observations highlight the importance of all capabilities to improve the digital business performance.

Most of all respondents are undergoing a digital transformation. The origin, i.e., digital native business or digital immigrant does not bring differences in the respondent's perceptions concerning the digital capabilities.

Thus, the findings contribute to companies that think of turning into digital businesses or even those that already are, to improve their performance. Sometimes the investment seems high, but the results presented in this study prove that the development of a digital ecosystem adds value to the business. Finally, the use of high-performance digital technologies is necessary for business success because they support the sensing, responsiveness and process digitization capabilities.

4.6 CONCLUSIONS

To sum up the study results, we aimed to examine the role of digital capabilities in digital business performance. The study presents evidence to show sensing, responsiveness, process digitization and ecosystem connectivity are digital capabilities related to Digital Business performance.

Ecosystem connectivity and sensing capabilities form the bases for all the others. The former enables collaboration and cooperation among all actors and improves internal communication, but it requires platforms interconnected to the digital business. The latter is the ability to spot, interpret, and pursue opportunities in the environment.

The process digitization capability supports many processes like the decision-making process, which impacts on the client's satisfaction and the company's image. Process digitization also improves informational flow and the quality, security of data and information, and can reduce cost and increase the revenue.

So, the responsiveness capability is tied to sensing, digitization process, and ecosystem connectivity capabilities, allowing the company to act quickly, providing data and information that can be accessed by stakeholders. Consequently, the fast response leads to the client's satisfaction and reduces operating times and costs.

Thus, we could understand that it is essential to be connected and integrated into a digital ecosystem, to monitor the environment to respond to the market and customer through the digital business process to achieve operational excellence and a satisfactory relationship with customers and other stakeholders, and consequently to have revenue growth.

Thus, this study contributes to the academic field by offering the conceptualization of digital capabilities, a conceptual model (figure 6) and the preliminary results from the qualitative part of the study. These results indicate not only the next steps to be taken in this research but offer insights for other researchers and for IS research as a whole. The practical value of this research rests on demonstrating the relation between digital capabilities and the digital business performance model.

This study's main limitation is due to the fact that this is a case study from one country, which although have units abroad and wide coverage, which cannot be generalized. In addition, the capabilities' impact on digital business performance could not be measured quantitatively.

Therefore, in future studies, verification of the model through quantitative research that identifies each digital capability's level of impact on Digital Business performance is suggested. It is also recommended that this study encompass other digital businesses other than e-commerce. Finally, more studies regarding the digital ecosystem and ecosystem capability are required to better understand this theme.

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4.8 APPENDIX A - SEMI-STRUCTURED INTERVIEW

A) Company's General Characteristics

Company Name:
Branch:
Number of employees:

B) Interviewer's data:

Name:
Position:
Area of education:
Time working in the area:
Time in the current company:

C) Interview

- **Digital Business**

1	Can you describe your company, a bit of its history to the present day?
2	Can you describe what kind of business your company develops?
3	Has your company gone through any digital transformations? If so, can you describe this digital transformation process?
4	What digital resources and technologies does your enterprise use?
5	What digital capabilities has your company had to develop to become digital? (Digital abilities and resources)

- **Sensing**

6	How do digital technologies help your company to scan the environment to identify new business opportunities?
7	How do digital technologies help your company to monitor the product development efforts to ensure they are in line with what the customers want?
8	How do digital technologies help your company to capture the clients' needs?
9	Can you describe the relationship between the sensing capability of your company and the business performance?

- **Responsiveness**

10	How do digital technologies help your company respond to your organization's needs?
11	How do digital technologies help your company respond to your clients' needs?
12	How do digital technologies help your company respond to the environment demands?
13	Can you describe the relationship between the responsiveness of your company and the business performance?

- **Process digitization**

14	How does the process digitization affect the flow of information within the organization?

15	In what way is the generation and capture of data and information carried out through the business value chain, including the organization's customers, suppliers, and partners?
16	How are data and information transmitted, integrated, and processed in the business value chain, including the organization's customers, suppliers, and partners?
17	Can you describe the relationship between the process digitization and the business performance?

- **Digital Ecosystem Connectivity**

18	Does your company have a digital platform that connects you internally and externally with your partners (suppliers and customers)?
19	Can you describe the platform's role?
20	Which agents (partners) take part in this corporate ecosystem?
21	What kind of interaction (communication) can be made through the digital ecosystem?
22	Can you describe the relationship between the digital ecosystem and information?
23	How do you handle the complexity of the number of users?
24	How do you orchestrate ecosystem users?
25	Can you describe the importance of the digital ecosystem's network effect?

- **Digital Capabilities and Business Performance**

26	How is the relation between the digital capabilities (sensing/responsiveness/ process digitization/ ecosystem connectivity) and financial performance?
27	How is the relation between the digital capabilities (sensing/responsiveness/ process digitization/ ecosystem connectivity) and operational excellence (the improvements about your competitors) of your business?
28	How is the relation between the digital capabilities (sensing/responsiveness/ process digitization/ ecosystem connectivity) and the business relationship with your customers?
29	What else do you believe your company needs to develop for better digital business performance?

5 PAPER 3 –ECOSYSTEMS AND DIGITAL BUSINESS VALUE

ABSTRACT

Digital technologies are transforming the structure of social relationships and communication for both the consumer and the enterprise. Thus, companies are increasingly dependent on external actors for the continuous supply of new functions and services, requiring a need to be connected to them. As a consequence, digital businesses are taking advantage of the concept of digital ecosystems to orchestrate and improve communication efficiency among internal and external actors belonging to the ecosystem. In line with this call, this paper aims to understand the role of ecosystem connectivity capability in a digital business ecosystem, and to comprehend how does a digital ecosystem add value to a business. To do so, we developed a multiple-case study of four organizations within the context of Digital Business Strategy - four retail companies with e-commerce operations that have undergone a recent digital transformation. As a result, we present and analyze the source of values form the digital ecosystem. It was also possible to observe the necessity of a digital ecosystem orchestration capability to deal with all actors.

Keywords: Ecosystem. Ecosystem Orchestration. Ecosystem Connectivity. Business Value.

5.1 INTRODUCTION

Digital technologies are reshaping traditional business strategy as modular, distributed, cross-functional, and global business processes that allow work to push across boundaries of time, distance, and function. Digital technologies are also transforming the structure of social relationships and communication for both the consumer and the enterprise with social media and social networking (Kohli & Grover 2008; Bharadwaj, El Sawy, Pavlou & Venkatraman, 2013; Flyverbom, Leonardi, C. Stohl & M. Stohl, 2016).

> A recent report from Gartner argues that "with 7 billion people and more than 30 billion devices connected to the internet by 2020, interconnection will create an ecosystem challenge. Digital platforms — wherein participants with different goals and objectives are connected on a commission basis — are how most companies are mediating relationships in ecosystems" (Panetta, 2017, document on-line).

Companies like Facebook, Uber, and Airbnb that employ a platform business strategy to connect goods and services to the masses are the businesses that are most profitable and capture the majority of the market share. To prevent being sidelined, other traditional businesses have also been investing in digital technologies. For example, FedEx is in a digital arms race with UPS; Toyota with Ford; Goldman Sachs with Bank of America; P&G with Unilever; ExxonMobil with Royal Dutch Shell. Those companies and their numerous competitors are actively acquiring application development, user experience, software architecture, data analytics, system integration, business analysis, and project management expertise (Preston, 2015).

These transformations modify the processes and structures within and among businesses as well as other organizations, increasing the relevance of the role of digital capabilities. According to Aaker (2015) and Yoo (2013), firms are interested in understanding how they should transform in the digital age, which implies that there is a need for greater theoretical advancement in IS research to address this gap. However, hitherto, there is no in-depth discussion on what skills and abilities are required to help organizations cope with the new challenges in business for the emerging digital economy.

Companies are increasingly dependent on external actors for the continuous supply of new functions and services, requiring a need to be connected to them (El Sawy, Malhotra, Park, & Pavlou, 2010). This is due to the new digital technologies such as mobile technologies, product tracking technologies, cloud computing, and social media (Aloysius, Hoehle, Goodarzi & Venkatesh, 2016; Nohadani, Dunn & Klimeck 2016). To be continually and efficiently connected, they rely on digital platforms to empower ecosystems, and this connection allows these companies to add more value (Mohagheghzadeh & Svahn, 2016).

Hence, the ecosystem architecture can be constructed based on the firm's characteristics—its needs, internal and external clients, suppliers, etc.—or it can be adapted. In addition, ecosystem connectivity allows for condensing large volumes of information from the organization (Garbani, 2015).

To embrace the changes and the challenges of the digital economy, digital businesses are taking advantage of the concept of digital ecosystems to orchestrate and improve communication efficiency among internal and external actors belonging to the ecosystem. Although the structure may vary, the crucial point for the ecosystem's success is easy communication.

With the advances of digital technologies and the challenges of digital business, some authors have drawn attention to the necessity of comprehending how ecosystems connect and

coordinate all the actors and how this connection can influence digital business performance. Bharadwaj et al. (2013), for example, affirm that is necessary to understand the sources of value of a digital business strategy and study the role of digital technologies on changing business scope both inside a company (corporate scope) and in an ecosystem (a company's network scope). Nambisan, Lyytinen, Majchrzak and Song (2017) and Parker, Van Alstyne and Jiang (2017) call for more studies related to ecosystem and business value. In line with this call, this paper aims to understand the role of ecosystem connectivity capability in a digital business ecosystem, and to comprehend how does a digital ecosystem add value to a business.

To do so, we developed a multiple-case study of four organizations within the context of Digital Business Strategy - four retail companies with e-commerce operations that have undergone a recent digital transformation.

The paper begins by presenting the literature review, followed by a description of the method in Section 3. In Section 4 we present our findings and results, and in Section 5, we conclude the paper and provide several business implications.

5.2 LITERATURE REVIEW

We selected the Dynamic Capabilities theory as the theoretical lens for this study because our focus is on digital businesses that are characterized by dynamism, rapid changes, and environmental turbulence. Dynamic Capabilities are defined as the ability to integrate, reconfigure, gain, and release resources to match and even create market change (Teece, Pisano & Schuen, 1997; Eisenhardt & Martin, 2000).

For the literature review, we follow the steps suggested by Wolfswinkel, Furtmueller, and Wilderom (2013) who affirm that before starting the search, it is necessary to determine the appropriate sources and to decide on the specific search terms. So, we conducted a full-text search to find articles containing the terms "ecosystem" and "platform" in the Association for Information Systems (AIS) library.

The results offered 156 papers, considering only peer review papers. Analyzing the period of publications, most of them were published since 2013, which shows that it is a new theme and needs more work to be well understood as highlighted by Bharadwaj et al. (2013) and Nambisan et al. (2017). Then, we used the software N'Vivo to support the analysis.

Subsequently, we present the main concepts found that will be used in the analysis of the case studies.

First, we present some concepts about "Platforms and the Digital Platforms" and then, we approach the "Ecosystem" from three subtopics: "IT's Orchestration Role in the Ecosystem," "Ecosystem Connectivity Capability," and "Value Creation and Ecosystem."

5.2.1 Platforms and Digital Platforms

The notion of a data platform moved toward using the term ''product platform,'' which has made its foray into many distinct streams of literature, including information system (IS), strategy, organization science, and marketing. Other commonly used and related terms include organizational platforms, market platforms, and platform ecosystems. Although platform configurations vary greatly depending on context and application, extant literature typically depicts the platform as built around a core that is stable over time and similar across different instances of the application (Saarikko, 2016).

Over time, the development of technologies utilized by platform underwent significant changes and scholars later presented one more detailed definition for the platform as a software package that enables the realization of application systems (Taudes, Feurstein & Mild, 2000). Together with the hardware and the organizational knowledge about planning, designing, and operating application systems, the software platforms in use constitute a firm's information technology infrastructure. Here we see the notion of infrastructure and some of its possibilities, like decision-making support, the internal connection among different areas of the organization, and the possibility of integration with some partners.

On the other hand, the authors also draw attention to the importance of coordination across these actors. Taudes et al. (2000) also outlined that platforms do not directly generate value, but they enable different value generating applications to be implemented.

Parker and Van Alstyne (2005) introduce the concept of the two-sided market, where user groups, typically one who is a content creator and the other is content consumers, value growth in their markets. The third participant that connects these relationships are firms that produce tools to support both content creators and end consumers, which essentially form the platforms. They suggest that the platform intermediaries operating in two-sided markets seek to profit by transferring surplus from seller to consumer. They offer some examples that can better illustrate this idea: Apple, and Microsoft, who support software developers as well as

private and business and eBay coordinate buyers and sellers, while Visa coordinates merchants and cardholders.

Platform business models have become a ubiquitous feature of the information economy (Parker & Van Alstyne 2017). These new business models bring about greater innovation, openness, and the duration of intellectual property protection in markets characterized by platforms and the idea of ecosystems but consider applications in the ecosystem.

Therefore, Eisenmann, Parker, and Van Alstyne (2006) present new platform roles such as strategic and innovative roles into two-sided market context. This study shows that the more demand from one user group increases the demand from another user group belonging to the same platform. In addition, this relationship brings about the need to establish rules and contracts for the platform users and developers, which is especially important for regulators and platform systems designers.

A platform provides the infrastructure and integration that facilitate different user groups' transactions and can take many forms. For example, in some cases, platforms rely on physical products, as well as of consumers' credit cards and merchants' authorization terminals.

More recently, the emergence of digital technologies has brought new perspectives to the new digital platforms. Parker and Van Alstyne (2012, p. 14) highlight that "the problem of building a digital platform is like that of playing 3-dimensional chess. Each of these competing industries has a role to play in delivering digital goods and services, and matching consumers with advertisers." There are some significant characteristics of this new concept that makes it distinct from the "traditional" platform and make the digital platform environment more complex and volatile. For instance, the increasing number of participants, the huge volume of data collected by each participant, the types of data across different participants, the speed with which new product and services are developed are a few key characteristics of digital platforms (Chellappa, Sambamurthy & Saraf, 2010; Parker & Van Alstyne, 2012; Westerman, Bonnet & McAfee, 2012).

Ghazawneh and Henfridsson (2015, p. 199) build on Tiwana, Konsynski and Bush (2010, p. 676) definition of 'digital platform' to denote software based external platforms providing a core functionality shared by multiple modules and allows new modules to interoperate with it creating an extensible codebase.

Building a digital platform not only creates economies of scale whereby multiple suppliers can make the same components, but it also builds up an increased heterogeneity for the platform by attracting a large number of developers to build different kinds of products for

other user bases in the same digital platform (Chellapa et al., 2010; Parker & Van Alstyne 2012, Yoo, Boland, Lyytinen & Majchrzak, 2012).

Westerman et al. (2012) point out that with the digital transformation and Big Data, for digital business success, it is necessary for a digital platform to integrate data and processes and to provide a common view of products, services, and other business entities. This integration provided by a digital platform can also execute the innovation process because digital platforms can connect diverse communities (Lyytinen, Yoo & Boland, 2016).

However, Saarikko (2016) outlines that the extant platform literature does not adequately address strategies related to digital platforms. The author calls for more comprehensive and in-depth studies to explore the distinct properties of digital platforms on their own as well as on one another.

Based on Tilson, Sørensen and Lyytinen (2010), De Reuver, Sørensen and Basole (2017, p. 5) add that "embedded case study approaches are required that take into account the full network of participants engaging in distributed innovation arrangements."

Similarly, De Reuver et al. (2017) show that it is necessary for more studies related to a digital platform in many perspectives and present a research agenda. Their "first recommendation is therefore for scholars to provide clear definitions of what is meant by the terms ''digital platform'' and ''digital ecosystem''. As we have already presented some definitions on a digital platform, we present the following in-depth study on the Ecosystem.

5.2.2 Ecosystem

The use of the term "ecosystem" in business literature was coined by Moore (1993), who made an analogy to biological ecosystems. For current businesses dealing with the challenges of innovation, there are clear parallels and profound implications. To extend a systematic approach to strategy, Moore (1993, p. 76) suggest that a company be viewed not as a member of a single industry but as part of a business ecosystem that crosses a variety of industries. In a business ecosystem, companies coevolve capabilities around a new innovation: they work cooperatively and competitively to support new products, satisfy customer needs, and eventually incorporate the next round of innovations.

Since then, many scholars subsequently picked up and expanded on this idea. The general idea suggested by Iansiti and Levien (2004) is to advance and update the

conceptualization of business ecosystem to present the possibility of utilizing a platform to connect the actors. They draw attention to two big companies that developed their business ecosystems and improved their performance at that time: Microsoft and Wal-Mart. Iansiti and Levien (2004) considered that the success of these two very different companies was due only partly to the organizations themselves; a bigger factor is the success of the networks of companies with their partner connect through a platform.

In IS research, the concept of an ecosystem is recent and increasing in use. Most studies begin after 2010, driven by the development of digital technologies, digital products, platforms, and infrastructure (Bharadwaj et al., 2013; Markus & Loebbecke, 2013).

The definition of ecosystem implies a notion of participation and coordination of several members, as demonstrated by Adner (2017, p. 42), "the ecosystem is defined by the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize."

Thus, the ecosystem may facilitate participation, collaboration, and co-creation inside a new business model, such as a Digital Business. The ecosystem can be considered a combination of technologies, public and private organizations, communities, institutions, and the skills and resources that they can mobilize individually and collectively to drive a transformational change that is scalable and sustainable (Jha, Pinsonneault & Dubé, 2016).

For all these actors to participate, interoperability emphasizing the role of data and business process and the platforms or technologies that support the interconnections is required. Karimi and Walter (2015) add that these platforms must support some digital capabilities to provide standards, connectivity and rules for mediating production, search, and delivery of digital content and information goods among users of digital platform ecosystems.

In this context, the notion of orchestration has been used to capture ecosystem's role in a digital business context. The ecosystem does more than connect players and partners - it coordinates and establishes rules across all members. Next, we present the concept of orchestration, which can be observed to be fundamental to the ecosystem success.

5.2.2.1 Ecosystem Orchestration

Before understanding IT's orchestration role in developing the ecosystem, it is necessary to know the possible members of a digital ecosystem. Markus and Loebbecke (2013)

point out that companies in an ecosystem include not only the customers and suppliers, but also other organizations and partners, for example, producers of complementary products and services, logistics providers, outsourcers, and financiers.

Nambisan et al. (2017) have suggested the concept of orchestration wherein one or more firms (or entities) assume the responsibility for coordinating value co-creation and value appropriation. This way digital businesses need to reconsider how to standardize infrastructures and business processes around them, and this also requires agility to respond to rapidly changing ecosystem conditions. It also requires the orchestration of digital resources that are more multifaceted, data-rich, and dynamic (Bharadwaj et al., 2013).

So, we notice that orchestration adds value to the business. Pagani (2013) agrees with this idea and defines network orchestration as the set of deliberate, purposeful actions undertaken by the hub firm (digital delivery platform) as it seeks to create value and capture value from the network.

Markus and Loebbecke (2013) have also theorized about digital business strategy and have taken the perspective of ecosystem orchestrators, whose position in the ecosystem gives them the substantial power to dictate terms to more dependent companies. So, the owner can establish rules and procedures, internally and externally, across their partners and other agents within the ecosystem.

These authors provide some examples that can help illustrate the ecosystem's orchestrator role, as the original equipment manufacturers (OEMs) in the automotive and high-tech industries and leading consumer product retailers. But partners in an orchestrator's ecosystem might also be members of additional ecosystems. For example, a supplier of a particular automobile component or subassembly may supply all U.S. OEMs; the respective OEMs' ecosystems would be at least partially overlapping. The broader the concept of the ecosystem, the more likely it is to include organizations belonging to multiple overlapping ecosystems.

Kazan and Damsgaard (2016) developed a study on the ecosystem and added another idea of orchestration that complements the example above. According to this author, most payment services are based on a four-party scheme (i.e., payer, payee, acquirer, card issuer), where these agents process payment transactions through orchestrated business models.

In the case of information products, the concept of orchestration is also applicable. For instance, the two-sided market of newspapers with its two customer groups, readers, and advertisers, is changing due to digitalization. This formerly stable, profitable market has

suffered lately from both decreasing subscription and advertising revenues, so it was necessary to provide a connection across the entire ecosystem (Eriksson, Akesson & Lund, 2016).

Thus, we can comprehend that the ecosystem's orchestrator role goes beyond the connection with the agent that takes part of one digital ecosystem, coordination, moderation, and governance are some roles that can contribute to the digital business by adding value and improving its performance. To achieve these results, it is necessary to develop new digital capabilities, such as the ecosystem orchestration capability as presented above and the ecosystem connectivity capability which we discuss next.

5.2.2.2 Ecosystem Connectivity Capability

According to Yoo et al., (2012) and Tan, Pan, Lu and Huang (2015), ecosystem connectivity capability enables a firm "to search, explore, acquire, assimilate, and apply knowledge about resources, opportunities, and how resources can be configured to take advantage of opportunities."

In the ecosystem, firms are busily developing new strategies that cater to emerging market dynamics by competing head-to-head on some fronts (e.g., both Apple and Amazon sell hardware) and collaborating on others (e.g., Amazon offers reader applications) (Yoo, Henfridsson & Lyytinen, 2010).

Nambisan et al. (2017) suggest that new digital infrastructures and their associated capabilities can critically complement a firm's practices, for example, collaboration with customers or a broader ecosystem of external partners. Furthermore, the ecosystem architecture can be built according to the company demand, because it is a combination of one or more elements of the same architecture. So, the ecosystem connectivity capability allows the information to be integrated from all corners of the organization

This capability can sustain firms to deal with the digital economy's challenges, like developing a Digital Ecosystem to integrate and coordinate new agents (costumes, suppliers, teams, stakeholders, and other players) internally, externally, and across the business (Drnevich & Croson, 2013; Nambisan et al., 2017).

Additionally, the ecosystem connectivity capability allows for collaboration and communication between and across firms (Hylving, Henfridsson & Selander, 2012; Barret, Davidson, Prabhu & Vargo, 2015; Alam & Campbell, 2016;) and to work on digital platforms

in different manners, like crowdsourcing and crowdfunding (Alam & Campbell, 2016; Nambisan et al. 2017;).

The digital infrastructures also enable the digital platform's generativity upon which many organizations can innovate (Barret et al., 2015). An example of innovation presented by T. C. F. Tan, B. Tan and Pan (2016) is a digital multi-sided platform ecosystem which consists of both the platform and the constituents specific to it. This multi-sided platform ecosystem attracts enough customers from both the paying and subsidized groups and provides them with adequate value to achieve sustainable growth in its ecosystem.

Kazan and Damsgaard (2016, p. 477) reinforce this idea that "firms design their offerings in a way that creates reciprocal business value among different types of users (e.g., payer and payee) that, in turn, creates a self-reinforcing and expanding network effect."

Aside from the ecosystem connectivity capability, the ecosystem can add value to the business. The next topic provides insight on how the ecosystem can add value to the organization.

5.2.2.3 Ecosystem and Value Creation

This literature review shed light on how the digital ecosystem may bring various benefits to the organization and even add value to it, as highlighted by Altman and Tushman (2017 p. 3) "ecosystems are business strategies that incorporate organizations interacting with an enabling, external individuals, organizations, and communities to create value through interactions".

Floerecke and Lehner (2016) argue that a business ecosystem has evolved whereby new types of market players have emerged, breaking up the traditional value chain of IT service provision. In addition to the basic vendors of infrastructure, platforms, and applications, providers have entered the market, generating new services, combining or integrating existing services into one or more adapted services, integrating cloud solutions into the customer's existing IT infrastructure, or offering consultation services.

Therefore, for the business to add value, Bharawaj et al. (2013, p. 477) affirm that "Google, Facebook, and eBay are just a few examples of new value created from information that goes beyond niche areas such as financial services whose business models rely on accurate, timely information."

The authors point out that the development of a digital ecosystem can improve communication and the flow of information between different agents. They mention that "in the case of mobile ecosystems, the value capture involves complex coordination between app developers, the mobile OS (Apple, Android, Windows, or Blackberry), hardware manufacturers, telecom operators, and service providers such as Facebook, YouTube, and others" (Bharawaj et al., 2013, p. 478). Thus, they present some ways that digital business can increase value:

- Leveraging value from information - i.e., from real-time information, quality of information (e.g., precision) to serve multi-sided platform users;
- For better orchestration of multi-sided users - e.g., the decision on which supplier to use or drop can be easily attained;
- Handling the complexity of the number of users;
- Increasing value of network effects.

In the next section, we describe the method developed in this study to answer the research questions presented.

5.3 METHODS

We performed a multiple-case study of four organizations which have a structured platform business and digital ecosystem with e-commerce operations. These four retail companies are from Brazil and began as "traditional" companies. They started out as brick-and-mortar companies in the retail sector and have successfully transitioned into digital businesses by developing their digital and e-commerce strategies. Today, all of them rely on a hybrid system, i.e., having both digital and traditional businesses. All the companies have B2B and B2C operations. Some of them have international operations, and one even has a head office in the United States. All the companies' names will be omitted upon the managers' request. The cases' descriptions are presented in the next section.

We employed the multiple case method because multiple cases allow us to compare emergent findings (Myers, 2013). To address concerns about the scientific rigor of case study

research, we adhere strictly to the methodological recommendations of Yin (2017), and a description of all our cases are detailed in the next section.

5.3.1 Data Collection and Data Analysis

We selected these four organizations because they offered excellent settings for exploring our research question. We conducted purposeful sampling as the sample was collected from organizations of different sizes and industry sectors to improve the study's generalizability (Benbasat, Goldstein & Mead, 1987). In each company, we identified respondents who are IT executives (CIOs, IT directors, and IT managers) and business managers. We conducted 16 semi-structured interviews. Before the interviews, we developed a survey with open-ended questions. We then invited three industry specialists to test and provide feedback to our questions. We revised the questionnaire according to their comments and employed three Ph.D.s in IS to validate the survey (Appendix B).

We interviewed four managers in company A and three managers each in companies B, C, and D. In total, we collected data from sixteen interviewees. Each semi-structured interview took an average of 50 minutes. The interviews were conducted during the period October 2016 - April 2017, and they were transcribed and analyzed by utilizing the content analysis technique (Bardin, 1977). The analysis categories were defined a priori, based on the literature (ecosystem, platform, connectivity and business value), but new themes emerged during the analysis. We used the qualitative analysis software N'VIVO®. We named the 16 respondents by codes, from IA1 to ID4. Moreover, interviewee details such as positions and experience in the company are highlighted in the following table 17:

Table 17- Interviewees and years of experience

Company A	Company B	Company C	Company D
CIO/ 3 years – IA1	IT Director /2 years – IB1	IT Director/ 26 years – IC1	CIO/ 9 years – ID1
E-commerce Director/ 4 years - IA2	E-commerce Director / 7 years – IB2	E-commerce Director/ 8 years – IC2	E-commerce Director / 7 years – ID2
IT Director/ 7 years – IA3	Supply Chain Manager /4 years – IB3	Digital Marketing Manager/ 3 years – IC3	Marketing Director / 13 years – ID3
IT service and Applications Manager / 9 years – IA4	Marketing Director / 13 years – IB4	Supply Chain Manager /2 years – IC4	Sales Director/ 8 years – ID4

Source: The author.

Our data sources include interviews, business publications, and private material provided by interviewers and collected from the company's websites and through 11 site visits. To strengthen our analysis, we triangulated data collected from interviews with data collected from the company visits, and secondary data from the companies, like meeting notes consisting of 16 printed pages. It is important to mention that the most of the companies use digital documents, so we also accessed thirteen websites. Some of the companies have more than one and large digital content including newsletters, PDFs, PowerPoints, videos, and so on. Table 18 demonstrates the secondary data and observations.

Table 18 - Secondary Data and Observations

	Company A	Company B	Company C	Company D	Total
Number of Visits	4	3	4	3	14
Hours of Observation	8 hours	6 hours	8 hours	9 hours	31 hours
Number of pages of secondary data	12	4	2	5	23
Websites	3	3	3	4	13

Source: The author.

During these company visits, the first author was able to observe firsthand how employees within the company worked with information technology. We selected employees in that organization who interact most with IT. For example, the first author was provided with a detailed walk-through on the use of various data and tools such as data collection, dashboards used for decision making, and simulations and their results, etc. In company C, the first author was able to access and view the design system in action. Furthermore, a run-through of a product development simulation and the exact workflow through which employees within the firm use these systems were demonstrated to the first author.

In each company, we used the cell phone voice recorder to note the researcher's impressions, especially during the visits and in transit. In addition, when possible, we took pictures and made notes that were analyzed with the secondary data and the interviews. Next, we examine the results of this data analysis.

5.4 CASES DESCRIPTIONS

Company "A" is one of the largest fashion retailers in the country regarding revenues and market share. Currently, company A has more than 350 operations and encompasses three types of retail stores in its group which we denote as A1, A2, and A3, respectively. A1 is the leading retail outlet for clothes, accessories, and footwear for men, women, and children. The second type of store, A2, is also an apparel store but with a different target customer base consisting mainly of a younger group with more purchasing power. The last store, A3, is a home utensil shop that sells cooking utensils, dinnerware, ornaments, cutlery, linens, and towels. With its three stores, it is present in the country's five regions and employs over 17,000 people. According to Interbrand, Company A's brands were considered one of the most valuable in Latin American retail (Bianchi & Almeida, 2017). Besides the physical stores, it has an e-commerce site for each type of store. Since 2015, revenue from e-commerce sales outperformed traditional business revenue.

The connections within Company A's ecosystem are formed internally across business functions and externally by connecting multiple parties such as government, partner organizations, and customers.

In the first part of the value chain, the company supplies its physical stores from its distribution centers (DC) located in São Paulo, Santa Catarina, and Rio de Janeiro, near the main highways in the country and areas with a higher concentration of suppliers and stores.

The customers are connected via e-commerce sites. The three e-commerce sites connect externally with customers directly through their platform and indirectly through social networks. Internally, e-commerce connects to operating systems and server.

Also, each e-commerce has its cost center and connects externally with government oversight bodies, such as the Federal Revenue Service and private partners such as banks and credit card companies. The sales transactions in Brazil are controlled by an electronic invoice system governed by the Federal Revenue Service. All companies must integrate electronically with this supervisory body. Company A centralizes all processes in favor of physical stores and e-commerce.

Thus, BI and Analytics tools also connect to the operating systems, like Enterprise Resource Planning (ERP), Customer Relationship Management (CRM) and Supply Chain Management (SCM) and the information they provide is used by principals for ecosystem-wide actions. These systems such as ERP and SCM, in turn, connect with other partners to carry out

their tasks, such as logistics companies for land and air travel and Product Distribution Centers. In Company A's case, there are three distribution centers. There are connections to the various suppliers, which, in turn, connect directly to Company A and DC because oftentimes orders are delivered directly from the DC.

Its external connections allow Company A to load all the products' data after buying them in digital format so that they can easily publish these data and extra information on each e-commerce website.

Company B is a retail company that sells furniture, home appliances, and electronics. Currently, it has 262 stores, two distribution centers, and more than 5,500 employees in the southern states of Brazil. Like Company A, B has an Internet presence through its e-commerce platform.

Company B's ecosystem integrates multi-channel sales, including street stores, malls, telesales, sales by cell phone, and e-commerce. All these channels are integrated internally to the underlying ERP, CRM, and SCM systems. Within the multi-channel strategy, it operates in the segments of street stores, shopping malls, premium stores, and virtual stores (e-commerce). It stands out in the retail technology, electronics, and furniture in southern Brazil.

Moreover, since 2003, it has diversified by entering the financial services industry through a financial Unit (B2) that offers credit to their customers to purchase electronic appliances and furniture. B2 offers "Money in an Hour," a personal credit or cash loan available as an online service through its digital platform. This financial unit is also integrated into its platform.

Externally, the company is also linked to external online social networking sites, forging direct links with customers. Each unit platform connects to customers through these channels or via email. To differentiate itself from competitors, company B utilizes personalized marketing extensively. It segments customers according to their profiles and activities in online social networks and proactively sends customized emails automatically, and this channel is integrated into the ecosystem. The company has its own logistics system and two distribution centers.

Other than the data center which is on the premises, all other services employ software as a service. For instance, the company employs Google solutions such as Google Analytics. Just like the other companies, Company B integrates directly with the Federal Revenue Service, banks, and credit card payment systems. The company collaborates with partners to develop apps, for technical assistance, follow-up, and it has a direct channel with investors. The company connects to a third party (another company) which performs automatic conversion of

documents to XML format to facilitate the conversion of these data into an electronic catalog. In other words, external documents are passed on digitally by this company for automatic conversion and are integrated into the ecosystem as well.

Company C is a retail company that owns exclusive technology in the production of footwear for the women, men, and children. The Company represents a multitude of recognized and successful brands and operates nationally and internationally, serving 17 countries in Europe, Asia, North America, and South America. It performs B2C with two e-commerce sites to serve Brazil, one for all general products and the other for an exclusive brand of women's footwear. It has another electronic platform for international sales, for B2B business. Within Brazil, its primary operation is B2B, with their digital technologies and most of their sales perform based on Internet operations or operations across partners integrated as part of its ecosystem. Also, it also acts as the intermediary for licensing celebrities and cartoon characters targeted toward children and adolescents.

Company C has a complex ecosystem because it is fully integrated with an installed capacity of 250 million pairs of shoes per year. The ecosystem is composed of six industrial units, 11 shoe factories, one polyvinyl chloride (PVC) factory for to produce its footwear, and with distribution logistics ranging from distributors to traditional and non-traditional retailers throughout Brazil and abroad.

Company C's ecosystem is composed of 3 e-commerce platforms, two for national sales and one for international sales. Each e-commerce site connects externally with its customers, and each unit has access to data on online social networking sites. All actions are integrated, and data is analyzed by IS as a whole. C's platform connects all its factories, logistics, and brick-and-mortar stores.

Additionally, this platform also integrates its office located in the United States. Just like the other two companies, their digital platform connects with the Federal Revenue Service, banks, and credit card payment providers.

The company connects externally with international vendors in 17 countries through a mobile platform called "Smart Tablet." This solution was developed by the company and connects directly with production but allows for integration with other areas and sellers to interact with the company by providing ideas. For instance, sellers can send photos of shoes that are popular in their country. Through this feedback channel, the design unit, which is also integrated into the ecosystem, can customize their next product for a specific country. It is a form of crowdsourcing because sellers and buyers can participate and follow the creation process through the vendor's platforms.

The company has an integrated system for product development. This system allows designers, fashion professionals, and managers in strategic areas, such as finances and marketing, to interact online and participate in the entire product development process. This system provides an opportunity for external agents to join in a project.

Depending on the target region in Brazil, different weather and temperature characteristics result in different types of footwear sold in the South versus those the North. Through C's platform, partners can analyze their market share and provide feedback to the company through crowdsourcing.

Another difference in Company C's ecosystem is the extent of interactions it generates. Through its digital platform, the company develops many proactive interactions with partners and customers, social media, and the marketing system, both within each subsystem and across subsystems. For instance, the company frequently conducts experiments to find out when the company should advertise on television and when to seek feedback from customers for the development of its product selections. The company also uses this approach to examine the effectiveness of their advertising (e.g., if a celebrity endorsing their products influence customers) and adapts accordingly by modifying the product or abandoning the selection's production.

Company D has two manufacturing units, one that produces mattresses, furniture, and upholstery and the other produces foam used to manufacture mattresses and upholstery. To ensure quality products for its customers, the company has a digital platform linking its customers and partner companies in the North to the South of the country. Additionally, this platform extends its reach to traditional brick-and-mortar stores, e-commerce, and a financial unit.

The first division of the company, D1, focuses on the retail trade of a wide range of items, including electronics (e.g., computers), appliances, furniture and decoration, tools, construction, etc. D1 has physical stores in more than 80 cities in the southern region of the country and operates throughout Brazil through e-commerce.

Another major division, D2, has physical and e-commerce stores specializing in the sale of Apple products. D2 is a part of the Apple Premium Reseller (APR) program and only offers Apple devices and accessories compatible with these products.

The third division, D3, like Company B's financial unit (B3), provides credit, financing, and investment to its customers. In the area of financing, D3 offers products such as credit loans to customers at highly differentiated rates and terms to meet customer needs. Also, this unit provides credit to whole group's B2B clients, for example, as working capital.

Overall, the ecosystem is formed by internal and external users, both within and beyond the company's boundaries. The three e-commerce systems facilitate a direct connection with customers and an indirect connection through online social networking sites such as Facebook. Internally, e-commerce connects to ERP and the Data Warehouse.

In addition, each division has its financial unit connected externally with the government through the Federal Revenue Service because they are supervised by this body, and they also have a connection with private partners, like the banking system and credit card companies. All subsidiaries and the two factories are connected to its ERP and SCM systems, which, in turn, connect with other partner organizations to carry out their tasks, such as logistics companies to fulfill operations.

Likewise, for Company A, BI and Analytics tools connect to its ERP, and the information they provide is used by managers for ecosystem-wide actions. They run B2B operations where various commercial representatives distribute the materials produced by the mattress factory throughout the country and franchises. It facilitates production control based on consumer demand for mattresses in Company C1's stores.

It is worth mentioning that the mattresses sold through B2B operations do not compete with D1's mattress sales because they serve different customer segments. The overall sales of mattresses for D1 is higher compared to C1 due to the higher quality product range D1 offers.

According to each company's description, it is possible to understand each ecosystem's complexity and verify that each one has some unique characteristics of their own. On the other hand, some connections are more common. This is in line with the findings of our literature review, i.e., each business's characteristics and peculiarities (Markus & Loebbecke, 2013; Jha et al., 2016).

Figure 7 illustrates a generic ecosystem which we find across all the companies we examined. As shown in the figure, the entire ecosystem is rather complex with a large number of actors in the system that is being connected to each other via the information systems.

Figure 7 - Generic Digital Ecosystem
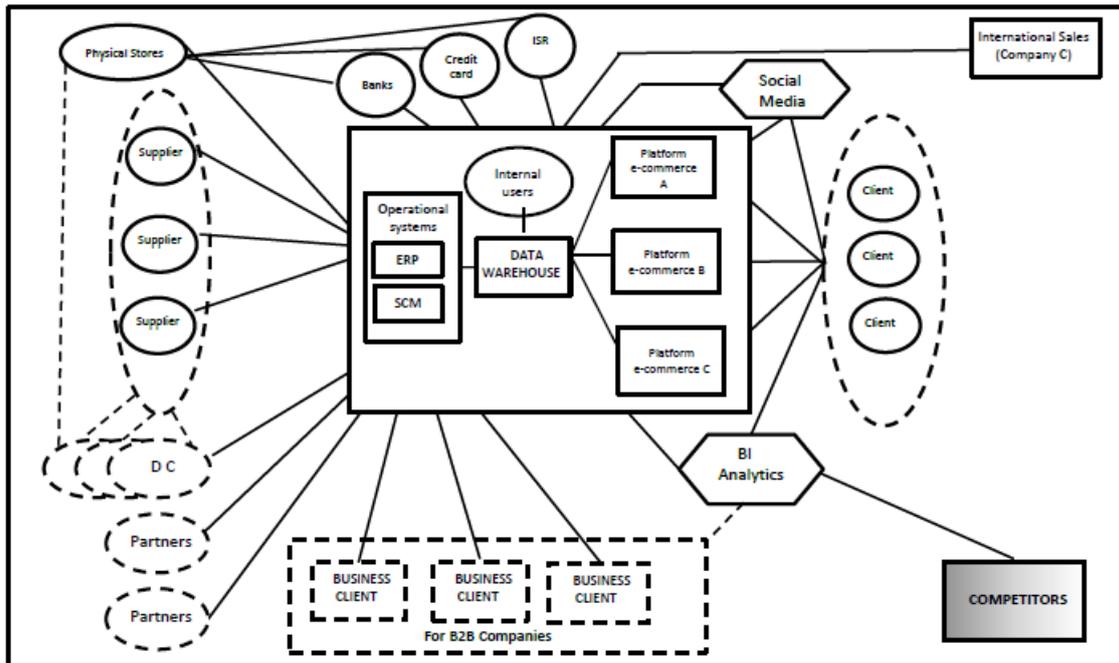
Source: The author.

All companies underwent a somewhat successful digital transformation. Presently, all of them rely on a hybrid system, whereby players in its ecosystem may be considered to be both traditional businesses and digital businesses. All sites are in the retail industry. Companies C and D have industrial operations. Company C produces shoes, and Company D produces furniture. All four companies make use of solutions and software as a service, and B uses infrastructure as a service Companies A, C, and D have a hybrid structure with a data center on location and solutions in structure as a service (SaaS), and company B has its entire SaaS). The following table illustrates the main similarities and differences between the four cases.

Table 19 - Case Descriptions

Companies	Business	E-commerce Products	Industrial operations	Private label credit cards	Have own logistics
A	B2C	A1 - clothes and accessories A 2 – clothes A 3 – home products	No	Yes	Yes - for local (Outsourced for long distances)
B	B2C	B1- Electric and electronic appliances B2- Financial Unit (loan)	No	Yes	Yes
C	B2B and B2C	C1 – Shoes C2 - Shoes (differentiated brand) C3 – Shoes *	Yes – shoes	No	Yes - for local (Outsourced for long distances)

D	B2B and B2C	D1 –Electronics, Appliances, Furniture, and Decoration	Yes - mattres ses	No	Yes - for local (Outsourced for long distances)
		D2 - Apple products			
		D3 - Financial Unit (loan)			

*International on-line operations.
Source: The author.

The complexity of the digital ecosystem of the companies is evident, and we observed a need for ecosystem coordination, in other words, orchestration.

5.5 RESULTS ANALYSIS AND DISCUSSION

In this section, we present the results in main topics. First, we describe the cases and then analyze the results of the multiple cases studied.

5.5.1 Orchestration

"Digital business strategy has often taken the perspective of ecosystem orchestrators, whose position in the ecosystem gives them the substantial power to dictate terms to more dependent companies" (Markus & Loebbecke, 2013, p. 13). Accordingly, partners in an orchestrator's ecosystem might also be members of additional ecosystems. The authors complement that "the broader one defines the ecosystem concept, the more likely it is to include organizations belonging to multiple overlapping ecosystems" (Markus & Loebbecke, 2013, p. 13).

Analyzing the results, it is possible to deny this situation in which a partner can exercise different roles in more than one ecosystem. In Company D, which has the most complex ecosystem, the D3 business unit acts as a member of the D-company ecosystem and at another level in its Apple stores' ecosystem, which includes physical stores and e-commerce.

Moreover, the evidence shows how the four companies establish their ecosystems' coordination, management, and actions. In other words, we could understand how orchestration

occurs. In company A, for instance, there is a daily meeting usually in the middle of the day to review the performance of the stores and other agents by analyzing a dashboard.

Company A's CIO explains that:

[…] we have a daily meeting at noon to follow along with performance. In this meeting, our strategic managers (CIO, Marketing Director, Financial Director, Operations Director, and others invited to the meeting) analyze online data available on Dashboard and reports from each area. Immediate strategies are formulated that may involve all the sectors, e-commerce businesses, and physical stores. For example, marketing campaigns and promotions can be generated quickly in response to news or events discussed on the Internet, whether it is a social network or a news site.

During the company visits, the first author noticed that the dashboards used during this meeting consisted of a set of large display panels that presented several kinds of information. The displayed pieces of information include sales performance, which stores are selling a more particular product, time of delivery, number of complaints from each region if products are missing in a specific place, and other such information.

IA2 stresses the importance of such coordination because company A has three e-commerce sites. Through the digital platform, coordination is possible because of information is shared and decisions can be integrated. For example, customer complaints over delivery from one of the stores can anticipate the need to adjust with the logistics of others, or a truck's delay from a particular distribution center may entail actions in the three stores. Therefore, coordinating the ecosystem becomes fundamental.

The need for orchestration was also evidenced through analysis of company D. Company D's E-commerce Director illustrates the ecosystem's complexity:

Today we are structured in some areas. We have an infrastructure area, technical support, Telecom, services center, systems area, systems development, a software factory, and an SAP center. Just in the software factory, we have a team of approximately 30, 40 people qualified to develop solutions and products. For our Group's units, today we develop around 150 projects per year. The vast majority are focused on the systems area in order to create new products, new systems, and functionalities of the systems that already exist for the group's activity, mainly for e-commerce retail (ID2).

In addition to the demand for solutions, the IT sector also gets feedback from suppliers, customers, and shareholders, etc. that helps to coordinate the ecosystem, verifies needs, and presents quick solutions. For example, if the company received feedback about late delivery,

the CIO can track the product to check where is the problem to correct the problem to avoid other negative feedbacks.

When asked if rules are established regarding information use and information security within the ecosystem, ID2 replied that IT sector management is about CIO coordination. However, there is excellent flexibility in the use of communication so that information flows. On the other hand, there is a great deal of attention drawn to IT security. It's a daily dilemma, highlights ID2, "because there is a need to look for a connection with suppliers and customers, but without neglecting security. Therefore, the rules are necessary."

The researcher was able to visit the software company to discover the information security concerns from the employees. After observing the information access rules, these concerns become evident. We could see that there are several actors in the ecosystem generating information, so it is necessary to orchestrate these actors and establish rules for better use of data and information. Further, interaction is actively sought out with partners, especially customers, through numerous actions on social networks seeking information that can improve the company's products' performance.

Thus, companies must be able to orchestrate the ecosystem as indicated by the literature and are evidenced in the context above. So, it can be seen the companies aim is not only to ensure effective communication but also orchestrate agents and elements. One has to coordinate, manage, and act, as noted by Pagani (2013) and Markus and Loebbecke (2013), who agree that the owner can establish internal and external rules and procedures across their partners and other agents in the ecosystem. Ecosystem orchestration capability is the base of the connection and is essential to adding value to the company. The next section provides more details about ecosystem connectivity.

5.5.2 It and Digital Business Ecosystems

In the four cases, it was possible to verify IT as the protagonist in digital transformation and, consequently, in developing the digital ecosystem. As the four companies have developed e-commerce operations, we noticed evidence that IT is the underlying backbone for the development of online sales operations and the company as a whole.

As observed in Figure 7, the ecosystems of all four companies are formed by internal and external users, both within and beyond the company's boundaries. The four companies connect the e-commerce to ERP and the Data Warehouse. Furthermore, the e-commerce

website facilitates a direct connection with customers and an indirect connection through online social networking sites such as Facebook, Twitter, and WhatsApp.

Both companies B and D have a software company, and most of the solutions are developed in-house, as revealed in an interview with IB1 and ID2. On the other hand, companies A and C seek most of their solutions through outsourced companies.

The ecosystem was observed to be supported by digital platforms to provide connectivity and rules for mediating the production, search, and delivery of digital content and information goods among users as noted by Karimi and Walter (2015). The interviewee illustrates IT's role,

> […] the platform also integrates the group's financial sector, and a Visa and Mastercard branded card. To have an idea of the size of Company A's ecosystem, traditional resources, such as ERP, CRM, the company both virtually and physically, offer good experiences in all interactions and leverage them.

IB1, Company B's IT director, draws attention to IT's role due to the complexity of the ecosystem. According to IB1, "Our digital operation is extremely complex. There are more than 200 players connected to a platform. There are means of payment, means of delivery, shop windows, risk analysts, shop windows, recommendation software – in short, many partners."

IC1 gives another example of a virtual design area which involves the use of software that supports crowdsourcing. For example, the company tests a new pair of shoes with some clients and reports back immediately on their feedback, so that all the areas of the company can view the evaluation of the product by using the software and also provide their feedback, somewhat like an internal social media channel. In this way, a meeting for each product is connected via the platform and a physical meeting for each product which used to be done in the past, is no longer necessary.

> It is digital information; at any moment, I can look at it and give suggestions: This product will not be accepted by the market. It is not worth R$ 29.90 to the market; it is a 19.90 product – rework is necessary. Another can counter, and we go back to the client for testing, and even see that acceptance. That is, it is an internal and external integration. (IC1)

> Finally, Company C's IT director highlights:

> While IT cannot turn the world around, there are many business areas they are doing… They can, for example, take a picture of a new shoe and upload it to our system, and we can start discussing the product. This adds a lot of value to the business. New technology

has another role today: to provide integration, collaboration, agility, responsiveness because we live in the digital age (IC1).

We observe that IT can enable the ecosystem in many ways, with a primary role in Digital Ecosystem development and performance. With a digital ecosystem, it is possible to add value to the business, and we will elaborate this point in the next section.

5.5.3 The Ecosystem and Business Value

To Adner (2016), the notion of ecosystems has raised awareness about and drawn attention to new models of value creation and value capture. According to him, ecosystem architecture offers a complementary approach to considering interdependent value creation. Other authors also highlight the relationship between the ecosystem and value creation (Grover & Kohli, 2013; Keen & Williams, 2013; Kazan & Damsgaard, 2016; Altman & Tushman, 2017).

The present study provides evidence to support this relationship between the ecosystem and business value and achieve the second objective of this paper, we used the topics suggested by Bharawaj et al., (2013) as sources of value to categorize the data and structure this analysis:

- Leveraging Value from Information
- For better orchestration of multi-sided users;
- Handling the complexity of the number of users;
- Increasing value of network effects.

5.5.3.1 Leveraging Value From Information

To Bharawaj et al. (2013, p. 477) "the digital business context brings new opportunities to create value from information." The authors French and Shim (2016) complement that the entire ecosystem is a key driver in value creation and also in value capture. During research, we found several pieces of evidence that reinforce that information is a driver for the organization to add value to the four companies.

In company A, for instance, there are two Distribution Centers in Rio de Janeiro (Southeast) and Santa Catarina (South) that are automated with machinery that allows loading

the system with the products' data as soon as they are unloaded from the truck onto a conveyor belt. So, the e-commerce websites have the means to update information on delivery times and avoid product shortages or delays.

During the company visits, the first author noticed that the aforementioned dashboards used in daily meetings consisted of a set of large display panels presenting several kinds of information. Data and information are captured and analyzed quickly, thereby speeding up decisions and improving company performance.

One example of how the company makes use of these panels is through a visual map dotted with all the company's physical stores across the country in two colors – green if sales were in the average, and red if there was a problem. When the manager clicks on the individual store icon, they can view each store's performance at higher levels of granularity (e.g., by sector). If necessary, they can contact each store directly.

Similarly, another screen allows the manager to view how e-commerce sales are performing by client access and actual sales. It was possible to analyze which items were sold and which were searched but not purchased, and thus decisions could be made. In another part of the dashboard, it was possible to check the stock market's performance, news on the economy and from several national and international agencies. The CIO demonstrated how this dashboard helped to capture information from e-commerce across multiple partners like credit cards, banks, the company's own card, the distribution center, and logistics area, demonstrating connectivity with these multiple agents. Additionally, he showed different ways to view the data and make decisions that can involve one or all the ecosystem's agents, e.g., with regards to a marketing campaign in response to the news.

The way information is treated is valuable because it makes it possible to analyze each e-commerce or a specific sector in detail. In particular, we observed that information provides value through "slicing" and "dicing" and rendering the information into various formats and forms via information systems. The directors have access to a system that provides, for example, only the e-commerce's financial performance during a certain period across multiple partners like credit cards, banks, and the company's own card. It is possible to see the clients' preferences and what items are being sold and analyze the relationship between the client's geographical location and what they are buying. The Directors can suggest actions in other parts of the country or give discounts on specific items. The CIO explained that many decisions could be made.

During the second simulation, the CIO demonstrates the management of a logistics problem through the system by identifying the issue at a particular location on the map and was

able to immediately verify if the problem was located either in the distribution center or at a transportation company. In response to this, the company could get in touch with the clients to explain a possible delay if it was a small problem or change the distribution center if they have a problem with a partner, a TV supplier. A director can decide to take the products to another DC and use another transportation company.

These two simulations made it possible to see how the connection across several agents in the ecosystem may help the company respond to the market, solve some problems, take advantage of some opportunity, and keep clients informed. Through the information provider and the rendering of this information in different ways, the company was able to leverage on them and add tremendous value to the company.

At company B, the IT Director (Interviewee IB1) mentioned that "we use EDI Networks by using the Value-Added Networks (VANs) to directly contact the client and get feedback." He added that "we can decide on our products or our delivery system to correct some point or see an opportunity for additional action." For him, the EDI "simplifies the communication process by reducing the number of parties with which a company needs to communicate."

Hence, the information and all the trading partner's documents are automatically transmitted. For example, when company B buys some notebooks to resell, it is possible to know the product's entire movement, and it can be mapped automatically. The company receives all the information about the product, which can be easily uploaded to the site. All pictures and descriptions can be displayed to the clients instantaneously. When the notebooks arrive at a Distribution Center, it is possible to know where they are kept. When they are sold, the client is kept informed, from the moment the notebooks leave the DC to the moment it arrives in the final client's hands. Therefore, company B can keep its clients informed from sale to final delivery.

Subsequently, the client can offer feedback that the company receives so that it can improve its process. All data and information are transmitted through the EDI. If there is any problem, some decisions can be made efficiently. For example, if there is a complaint, it is possible to quickly select a new supplier.

In Company C, interviewee IC2 stresses that "interconnection among all the stakeholders creates value not only for our company, but also for the clients, suppliers, and logistics providers because information travels faster in the supply chain."

Concerning innovation, Marketing Digital Manager (IC3) exemplifies that through collaboration, being online is the best possible manner to innovate and test products. He highlights:

We are B2B with the majority of our products and B2C with some, so as not to compete with our B2B clients. Because of this trust, we maintain partnerships that are responsible for attending to our consumers for one of our specific products. Through them, we access some selected clients and get feedback from these customers about the models in development. Sometimes we send some products as a prize, but what interests us is the feedback for improvement. Sometimes we present a new product on TV programs, and our partners get feedback from the clients. We had a sandal that a famous artist wore on a TV program and then on a Magazine cover. Before we contacted these partners, they informed us that the clients were sending e-mails and Facebook messages asking about when that product would be for sale, and, of course, it was a success. When there are problems, we adjust designs, colors, as well as other characteristics of our products.

Company D brings a very recent example whereby information allows real-time and high-quality information to flow to different partners and customers. The company is Apple's main partner in Brazil, and interviewee ID3 emphasized that:

[…] we released the iPhone 7, and the demand was below than expected was to order the product, so it was huge. Today, when we put it on sale, we had to put a very long delivery forecast to the client, and we are without conversion, People are looking and saying, but I'm just going to get it in seven days.

So, we checked with logistics to see what we can do to ensure that the customer receives it on time if not earlier. The online site is great to work with because you can view heatmaps, allowing you to figure out which page the person is interested in at that moment, on which section of the page or which item does the person stay longer.

So, it was clear what we needed to do. We knew why the client was leaving, and they were going to another place because they are not going to wait to get the iPhone. So, "we reduced the delivery time, and sales start to rise." In this example, Company D was able to use the information flow connecting the different parties in the ecosystem, including the customers and logistics suppliers to make decisions that affect the bottom line.

The evidence presented above gives an account of the importance of using information and how it can add value to the company.

5.5.3.2 For Better Orchestration of Multi-sided Users

Kazan and Damsgaard (2016) indicate that multi-sided platforms are designed in a way that creates reciprocal business value among different types of users. For instance, the payer and payee create self-reinforcing and expanding network effects. They present the example of

a multi-sided payment services platform (e.g., PayPal) to argue that it is essentially a manifestation of multi-sided platforms that have the function to connect and equip various platform stakeholders.

According to Bharawaj et al.:

[…] the logical extension of multi-sided business models is a recognition that value creation and capture in digital settings often involve complex and dynamic coordination across multiple companies. So, if ones develop an efficient orchestration it is possible to add value to the business acting rapidly, for example, the decision on which supplier to use or drop can be easily made (Bharawaj et al., 2013, p. 478).

The companies we studied present more evidence, as demonstrated next.

Interviewee IA3 highlights that "we access information from the internal and external environment. It is reactive and proactive." According to IA1, IA2, IA3, and IA4, the company captures customers' data through credit cards, draws the customer's profile, and offers products aligned with this purchasing profile.

Also, the business units A1, A2, and A3 can capture several types of information from market analysts, BI, Social Media, company A's analytics section.

Data and information are mined and disclosed on Dashboards, and during the daily meetings, the directors can analyze the information and make decisions. As mentioned before, in company A, some tools are used to orchestrate and coordinate each business unit, e.g., for monitoring customers and competitors' actions. As observed, each employee has their decision level, and they can act accordingly to the situation. They are now using many tools from Google, such as Google analytics, to optimize results.

In company C, concerning B2B operations, the Digital Marketing Manager affirms, "I can monitor the performance of products that I launched at every strategic sales point in Brazil." They can get immediate customer feedback and share it with company C's factory. If necessary, the company can react quickly. This way, both clients and company C are satisfied. Consequently, this kind of action adds value to the company because the company's image is always preserved.

During observation of company B, the IT Director explained how he controls the ecosystem and coordinates communication across the company.

The company uses the Cognos software by IBM, which brings great results and adds value to the business. According to IB1, "it is possible to hear our consumers, which is an extremely important aspect. So, today all the contacts, complaints, compliments, and management are controlled by us, and the directors can discuss and make decisions online".

During the visit, he showed us the system and repeated, "We hear the market to the market, record and save all the complaints and compliments, likes and dislikes. If you ask today who complains the most – which product, which line has the most problems – today, at company B, we have mapped everything through testing boards, online cockpits to view this information. To communicate with our employees, they rely on other software that is responsible for supporting all this communication within the company. He said that all employees have access levels and that the directors can access to all and who manages the system is the area of IT under his supervision.

Concerning to the e-commerce websites of the four companies described in Table 19, we noticed that they use the PayPal payment services platform, which, like Kazan and Damsgaard (2016) explain, has the function to connect and equip various platform stakeholders. According to documents, sites, and interviewees IA1, IB1, IB2 IC2, IC3, ID1, and ID2, in analyzing the users' level of satisfaction regarding the payment system, it is possible to understand that this adds value to the business.

However, it was possible to observe the complexity in managing so many agents in the ecosystems we studied.

5.5.3.3 Handling the Complexity of the Number of Users

Digital technologies can contribute to interconnecting and integrate numerous members of the ecosystem. The number of agents that compose the ecosystems is increasing, as can be seen in the case descriptions. With digital technologies, it is possible to use loosely affiliated ecosystems. Firms can harness a global network of partners they have never met (Parker et al., 2017).

Saarikko (2016) also agrees that digital technologies have contributed to the ecosystem's connection and management. According to the author, the advent of digital technologies has opened up several new possibilities as they allow us to combine physical and digital components that provide effective interconnection among ecosystem members. The digital ecosystem allows instances of co-creation between different firms that are tantamount to finding a shared perspective of what constitutes value.

Knowing how to handle a large number of agents in the ecosystem efficiently and effectively and leaving everyone satisfied can add value to the business. Accordingly, interviewee IB2 gives an example that clarifies the importance of this integration complexity.

> We also have it, but we have partners who shoot out e-mails. We have integration. We have partners who operate risk analysis; we have information. We have partners who manage their credit card; we have integration. We have partners who integrate payment through bank slips; this happens daily. And there are sub-integrations in here, which are the specific companies that perform specific services, which we call data translation […].

Interviewees IB1, IB2, and IB3 highlight that company B uses XML to communicate with the ecosystem to deal with this complexity, which allows for security and streamlines communication. When an agent does not work with this language, the company has a partner that offers Solutions XML translation services. According to the interviewees, this solution adds value to the business.

Furthermore, we noticed that they also work with Google solutions to support integration with products in transit in real time. They are integrated with Facebook to follow feedback of company products in real time. They are integrated with e-mail marketing tools and also with the companies that do remarketing, in case of product abandonment, when a product is left in the cart, and a message comes.

That is how integration with partners and clients is done, so that that the user can familiarly navigate, and the company does not leave their radar. Thus, they have excellent indices of satisfaction and few complaints, adding value to the business

In Company D, ID2 underscores the IT sector's ability to manage the complex number of agents in the ecosystems. As he illustrates below,

> […] today we have a very well-structured IT area with almost 100 people in our ecosystem. We have various integrated partners, and our largest partner is HP. We are Apple partners since we sell their products, and we interconnect our e-commerce business on this platform, the ERP system of the whole group that we just finished implementing SAP. Still concerning e-commerce, today we operate with the best and reputable technologies in the market. Our e-commerce platform is the Oracle ATG, considered by Gartner as one of the three best e-commerce platforms of the world. We were the first Oracle ATG client in Brazil. Today we run three sites there. We also have the mobile interface, a mobile site. We can access the same tool, the same platform through a mobile device. We have modern service tools that help us deal with the huge number of members in our ecosystem.

As we can see, the companies can deal with the complexity of the number of ecosystems users with high-quality digital technologies. Whether developing in-house solutions, such as firms that own software companies, or outsourcing solutions. It was possible to observe the need for investment in quality digital technologies. Also, there is a great concern to update the technologies. Depending on the situation, the company even contributes to its partner by sharing a technology that it does not have in order to minimize any problem. The evidence of handling the complexity of the number of users, therefore, reinforces the idea that ecosystem connectivity capability and orchestration capability must be developed. Moreover, with the increasing use of digital technologies, it becomes necessary to understand how to extract value from network effects.

5.5.3.4 Increasing Value of Network Effects

The network effect is related to innovation, as noted in the literature review. For instance, Parker et al. (2017, p. 262) argue that "to understand how network effects drive innovation, consider the following mechanism that allows more users to attract more developers and more developers to attract more users." The authors suggest that the advantage of open innovation is broadening the market.

Network effects can add value to the business, and the business obtains competitiveness by having the capability to induce positive network effects. Participants on one side of a platform benefit when more participants join the other side (Kazan & Damsgaard, 2016; Altman & Tushman, 2017).

Adner (2017, p. 50) complements that "a key strategic priority in platforms and multi-sided markets is to grow the relevant sides of the market to increase value through the direct and indirect network." The cases bring evidence that business can increase value from network effects.

An example of the use of EDI can be seen in Company C, as IC2 emphasizes, "We transacted with our suppliers electronically, which is the EDI of suppliers, but we also have a system where they can get some information through the system." Interviewee IC1 complements that they use data transmission via API throughout the whole ecosystem, which speeds up and improves flow, quality, and data speed.

At Company B, interviewee IB2 highlights that they use a server in a cloud to communicate to clients. Moreover, they use an electronic trading platform for potential negotiations, and many suppliers and other partners are adhering to this platform. With it, the buyer can face the client, check if some competitor is offering the same price at the same time, and it can get these negotiations on appropriate dates. It is another technology service that we provide to our partners.

As for relations with online costumers, their platform allows "cross transition, a transition of devices, a tendency that they call cross-device. The user can begin on the tablet and finalize on the cell phone or go to the computer" (IB2).

Interviewee B2 provides an example of how the Ecosystem adds value to the business by showing that service increases according to the number of people using it. IB2 mentioned Black Friday as an example:

> Black Friday is not every month; it occurs one day in the year. So, the company thinks that this system must talk to the client who wants to access the site on that day. So, we do what we do. We resize the site's ability to respond to the customer. Today, if you think that the company has a thousand accesses to the site per day, the company will have around thirty thousand accesses on it on Black Friday.

In other words, ecosystem flexibility allows resizing the site's access ability without losing quality. However, it involves not just the site alone but the whole ecosystem. All connections must be readjusted because the volume of transactions increases significantly, and all sectors and partners, payment gateways, logistics, etc. must function. Therefore, more clients can use it, accessing the website and buying products.

Interviewee IC3 emphasizes the importance of this integration with clients and logistics, highlighting the automatic repositioning system. He affirms that:

> […] the big retail challenge today is shortage or supplies or products that are out-of-stock. Presently, around 30% or 40% of sales are lost as a function of shortage. For B2B partners, they cannot give themselves the luxury of the product being in stock and not being at the point of sale. In the case of B2C e-commerce, service in the amount of time promised has to be strictly kept.

Due to Company C's ecosystem integration, the products replacement and raw material supply are automatic. They continuously analyze the whole process so as to avoid disruption of not having products available. This fast solution is possible because all partners use and take advantage of the automatic repositioning system. The more stakeholders use the system, the greater the customers' satisfaction.

5.5.4 Theoretical and Practical Implications

We contribute to the literature on ecosystems and digital ecosystems by presenting a literature review and multiple case studies. Our findings are novel in that they suggest IT enables the development of digital business ecosystems. Our analysis reveals that today, due to enhancing digital resources, technology has an extended role – to provide for the companies' integration, collaboration, agility, and responsiveness.

So we could understand the role of ecosystem connectivity capability in a digital business ecosystem, through the analysis of the case of study. We observed the IT role as a protagonist in the digital transformation and the development of the digital ecosystem. And we observed the necessity of digital ecosystem orchestration, as a complementary capability.

We also could comprehend how can the digital ecosystem add value to the business? using the sources of value presented by Bharadwaj et al. (2013) as categories of analysis: leveraging value from Information, better orchestration of multisided users, handling the complexity of the number of users, and increasing value from network effects.

It was possible to verify the relationship between digital ecosystem development and the companies' capacity for innovation. Some examples include possibilities for new forms of product development and collaboration such as crowdsourcing and the need to establish an efficient ecosystem to support innovative activities.

Figure 7 presents the generic ecosystem across all the companies in our study. The illustration clearly demonstrates an ecosystem's complexity and reinforces the need for its orchestration, as detailed in the study.

In addition, Figure 7 indicates the need for connectivity between the agents involved, thus, the need for digital capabilities. We present ecosystem connectivity as a digital capability that enables a business to search, explore, acquire, assimilate, and apply knowledge about resources, opportunities, and how resources can be configured to take advantage of opportunities.

We also highlighted the crucial role of ecosystem orchestration capability as a base for the development of digital capabilities, such as ecosystem connectivity capability. This study provides insight that can serve as a basis for further studies as well as for practical application.

5.5.5 Implications for Business Design

The cases are companies undergoing a digital transformation. Thus, these cases contribute to companies thinking about turning into digital businesses or even to companies that already have to improve their performance. Sometimes the investment seems high, but the results presented in this study prove that the development of a digital ecosystem adds value to the business.

Therefore, it was possible to identify the need for orchestration capability development by the ecosystem actors since a member can participate in more than one ecosystem in different positions. For example, an X e-commerce company should be able to orchestrate its customers, suppliers and other actors according to their demands. It is important to keep in mind that these actors can participate in other ecosystems with different norms, procedures, and systems so that this orchestration capability will contribute to the rules of company X being followed. That is why it is crucial to establish information access rules and understand how agents can participate and collaborate within the ecosystem.

The use of high-performance digital technologies is necessary for business success. Considerable evidence and practices may be useful, such as Company A's daily meetings to analyze the whole ecosystem. This study not only stimulates new entrepreneurs, but it also brings several management ideas to the table that can contribute to the business's success.

5.6 FINAL REMARKS

We developed a multiple-case study of four organizations within the context of Digital Business Strategy: four retail companies with e-commerce operations that have undergone a digital transformation. The research answered the two research questions we addressed. First, we could comprehend how IT enables the development of digital business ecosystems. We observed many situations, like the use of EDI, API, and so on.

In response to the second research question, we could note that the digital ecosystem can add value to the business through the sources of value proposed by Bharawaj et al. (2013), as highlighted in the previous section. The study has made theoretical progress through a

literature review, analysis, and results. Nevertheless, as digital technology is continuously changing, further studies are necessary.

5.6.1 Future Research

Future research could study different kinds of companies from other sectors and compare the results with our findings. Studies can approach digital businesses with digital DNA and present the digital technologies that can support digital ecosystem development.

We also suggest the development of a framework to measure the digital ecosystem's impact on digital business performance and other quantitative studies that may bring new results and points of view on the digital ecosystem's role.

5.6.2 Limitations

Finally, we stress that this study cannot be generalized since it observed retail companies in the process of a digital transformation. As previously mentioned, studies on the ecosystems of other sectors and with other digital businesses are necessary.

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5.7 APPENDIX B - SEMI-STRUCTURED INTERVIEW

A) Company's General Characteristics

Company Name:
Branch:
Number of employees:

B) Interviewer's data:

Name:
Position:
Area of education:
Time working in the area:
Time in the current company:

C) Interview

- **Digital Business**

1	Can you describe your company, a bit of its history to the present day?
2	Can you describe what kind of business your company develops?
3	Has your company gone through any digital transformations? If so, can you describe this digital transformation process?
4	What digital resources and technologies does your enterprise use?
5	How do digital technologies support the ecosystem?
6	What digital capabilities has your company had to develop to become digital? (Digital abilities and resources)

- **Digital Ecosystem**

7	Does your company have a digital platform that connects you internally and externally with your partners (suppliers and customers)?
8	Can you describe the platform's role?
9	Which agents (partners) take part in this corporate ecosystem?
10	What kind of interaction (communication) can be made through the digital ecosystem?
11	Can you describe the relationship between the digital ecosystem and information?
12	How do you handle the complexity of the number of users?
13	How do you orchestrate ecosystem users?
14	Can you describe the importance of the digital ecosystem's network effect?

- **Agility and Responsiveness**

15	How does the digital ecosystem drive your business's agility?
16	How does this occur?
17	How do the digital ecosystem and technologies help your company respond to your organization's needs?
18	How does digital ecosystem help your company respond to your clients' needs?

- **Digital Ecosystem and Informational**

19	In what way is the generation and capture of data and information carried out through the business value chain, including the organization's customers, suppliers, and partners?
20	How are data and information transmitted, integrated, and processed in the business value chain, including the organization's customers, suppliers, and partners?
21	How can the digital ecosystem contribute to your company's use of information?
22	How can the digital ecosystem contribute to information quality at your company?

- **Digital Ecosystem and Business Value**

23	How does the digital ecosystem add value to your business?
24	How is the digital ecosystem related to business performance?
25	What else do you believe your company needs to develop for better digital business performance?

6 PAPER 4: THE IMPACT OF DIGITAL CAPABILITIES ON DIGITAL BUSINESS PERFORMANCE

ABSTRACT

Digital businesses are one of the leading types of firms that make use of digital technologies, and they require digital capabilities to improve their performance. Digital capabilities are a key component of a company's success in this new digital business landscape. This study aims to present a research model that seeks to measure to what extent digital capabilities affect digital businesses performance. The theoretical lens of this study is the dynamic capabilities approach. A survey was developed and applied to companies belonging to two national associations that integrate digital businesses, the Brazilian E-commerce Association and the Brazilian Association of Digital Agents. The hypotheses were tested using partial least squares structural equation modeling (PLS-SEM) through the SmartPLS package. The primary results indicate that responsiveness is a crucial capability that makes a significant impact on digital business performance.

Keywords: Digital capabilities. Ecosystem. Responsiveness. Sensing. Process Digitization.

6.1 INTRODUCTION

Digital technologies have brought many contributions and profound effects on entrepreneurial processes and opportunities for businesses to improve their performance at the same time that they require digital businesses to develop digital capabilities so as to be up-to-date and able to respond rapidly to market needs (Von Briel, Davidsson & Recker, 2018). Digital technologies enable new venture creation processes and can become malleable, editable, self-referential, and interactive, which is why they require digital capabilities (Nambisan, Lyytinen, Majchrzak & Song, 2017)

Digital businesses are one of the leading types of firms that make use of digital technologies. Setia, Venkatesh and Joglekar (2013) define them as firms that adopt the use of digital technologies to perceive and respond better to clients' needs. In presenting such a definition, it can be noted that the authors emphasize the importance of customer perception.

Thus, digital technologies have boosted the development of digital businesses in all continents. In South America, Brazil is one of the countries that stands out in this scenario. This country has 110 million internet users and 64 million e-shoppers. Companies like Amazon, Alibaba, Otto, La Poste, DHL, and Adidas already have perceived this opportunity and are reaching these e-consumers. The Brazilian e-commerce segment ended 2016 with US$13.4 billion in earnings, a 7.4 percent increase compared to 2015 (Brazil, 2017).

As such, digital capabilities have proven to be a key part of a company's success in this new digital business landscape. Fernandes et al. (2017) reinforce this idea by highlighting that a digital business must be able to utilize the technological resources available, which may lead companies to gain competitive advantages. Consequently, the authors argue, digital capabilities can create new business value.

The theoretical lens for this study is the dynamic capabilities approach as presented by Teece and Pisano (1994) as a source of competitive advantage. According to these authors, in order to adapt to environments undergoing constant change, companies need both external and internal skills, thereby emphasizing the central role of the capacity for management.

Moreover, dynamic capabilities enable the firm's capabilities by updating, integrating, and reconfiguring its existing operational capabilities and resources (Helfat et al., 2007). Past research has empirically confirmed that dynamic capabilities affect performance indirectly in multiple ways (Mikalef & Pateli, 2017), by facilitating market transformation (Rice, Liao, Galvin & Martin, 2015) and enabling the development of new digital capabilities (Karimi & Walter, 2015).

Although there are several studies on digital capabilities, there are still few that highlight the relationship between these capabilities and the performance of digital businesses. To illustrate, Freitas, Maçada and Brinkhues (2017) identify the effects of the relationship between digital capabilities and performance, such as the client's satisfaction and reduction in operation times and costs, according to the presented evidence. However, they do not distinguish the measurement of this relation.

This study aims to measure the impact of digital capabilities on digital businesses performance and presents a research model that seeks to measure this impact. To do so, we have developed empirical research with digital businesses, such as e-commerce and e-services, in South America, with such companies based in Brazil.

The study is organized throughout five sections. In the following section, we present the theoretical background and the hypothesis. The third section depicts the method, which is then followed by the results and the conclusion.

6.2 LITERATURE REVIEW

This study applies the Dynamic Capabilities theory. The central concept is that when the competitive scenario evolves unexpectedly and quickly, it becomes necessary to adapt to it, through the improvement or reconfiguration of extant resources and capabilities, and, if necessary, the development of new capabilities (Teece, Pisano & Schuen, 1997; Eisenhardt & Martin, 2000).

According to Bharadwaj, El Sawy, Pavlou, and Venkatraman (2013), many firms are beginning to see the potential of digital resources and understand the need for new capabilities that encompass more than those of the IT department and develop or reconfigure a digital business strategy. These authors point to the example of Amazon, which substantially expanded its online retail strategy by incorporating cloud computing services as a critical digital resource, thus aiming to improve information flow both internally and externally.

Therefore, to become agile and adapt quickly to technological evolution, it is imperative to develop new capabilities, particularly digital capabilities (Tams, Grover & Thatcher, 2014). Kohli and Grover (2008) propose that firms must first discover what capabilities are required and then identify what it takes to build them in order to improve digital business performance. In the following section, we examine the relationship between digital capabilities and digital business performance.

6.2.1 Digital Capabilities and Digital Business Performance

According to Bharadwaj et al. (2013) the post-dotcom decade has seen both established and startup firms take advantage of the decreased prices and computing performance levels (hardware and software) as well as global connectivity through standard protocols (e.g., Internet and mobile web) so as to adapt their business infrastructure to the new digital era. Consequently, the new digital business model has appeared as an advantageous way to apply all digital technology possibilities to improving business performance.

Fichman, Santos and Zheng (2014, p. 335) define a digital business model as a "new way to create and capture business value, which materializes or is enabled by IT." The authors Weill and Woerner (2013) emphasize the need for a digital platform to deliver value and to be incorporated into complex ecosystems (El Sawy, Malhotra, Park & Pavlou, 2010).

E-commerce and e-business are examples of digital businesses that use the internet as an interactive and distribution channel; therefore, they need to develop digital capabilities so as to be able to utilize data and information efficiently in their activities and improve customer satisfaction and financial performance (Barenfanger & Otto, 2015).

Digital capabilities can be considered as the set of capabilities that boosts the organization's abilities to effectively develop, mobilize, and utilize organizational resources and consequently improve its processes, like client relationship management, new product development, knowledge management, and collaboration through the use of digital technologies (Tams et al., 2014). In the next section, we present the Research Model and Hypotheses based on the relationship between digital capabilities and digital business performance.

6.3 DEVELOPMENT OF THE MODEL AND HYPOTHESES

Bharadwaj et al. (2013) affirm that there are no generic metrics for firm performance, and they underscore the importance of researchers to examine the effects of digital business in order to theorize over and develop metrics. However, the authors maintain that it is necessary to observe both aspects within a company and about the companies and with other agents, like the clients, in order to verify performance.

Rai, Patnayakuni and Seth (2006) demonstrate that three areas of analysis for measuring performance should be observed in the relationship of a company's performance to its competition: operational excellence, the relationship with clients and other stakeholders involved in business processes, and revenue growth.

Operational excellence is defined as the ability of a company to respond to customers and productivity improvements regarding its competitors (Rai et al., 2006). The relationship with clients and other stakeholders involved in business processes is a consequence of this operational excellence since it is necessary to keep verifying the satisfaction of all the agents involved in both internal and external operations, according to the authors Rai et al. (2006).

In addition to operational excellence and customer relations, financial performance is also a performance indicator. Performance can be analyzed by revenue growth, but it can also be examined through return on investments and its relation to the operating profit, as observed by Chi, Zhao, and Li (2016). In other words, financial performance can be analyzed by one or

more of the following indicators: return on investment, profit margin, revenue growth, and operating profit on business assets (Power, Schoenherr & Samson, 2010). Based on the stated goals of this research, Figure 8 presents the proposed model for the study concerning digital business performance.

Figure 8 - Research Model
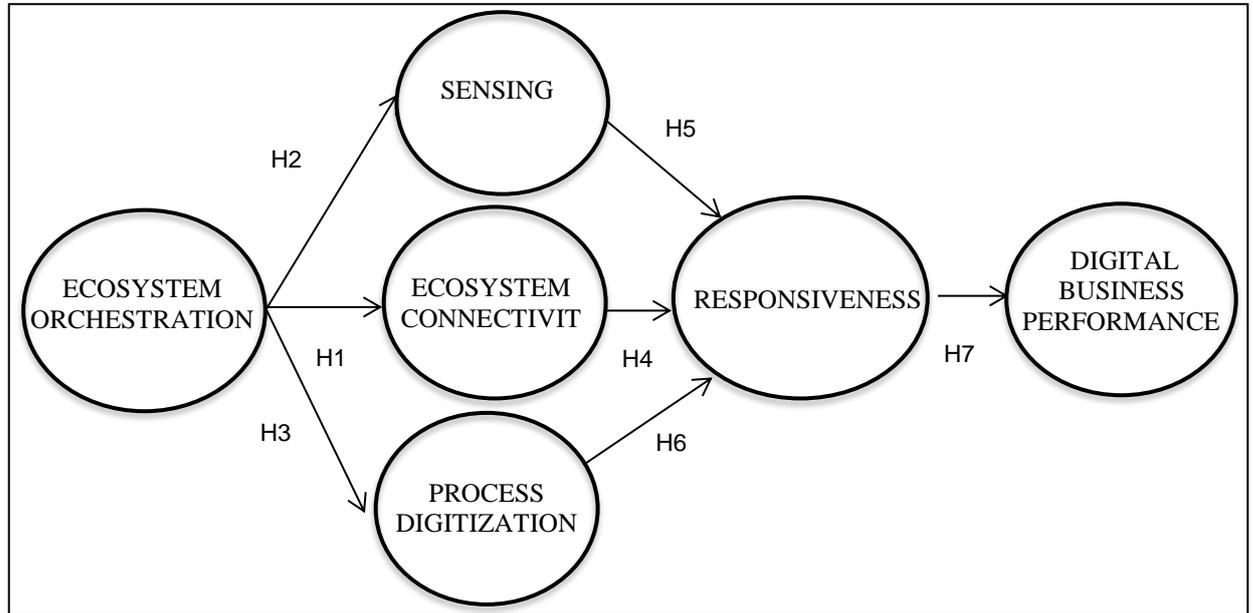
Source: The author.

Thus, for this study, we consider Power et al. (2010) Financial Performance and Customer Relationship Performance (Rai et al., 2006; Lin, Chen & Kuan-Shun, 2010), as presented in the appendix C. In the following items, we illustrate this study's Hypotheses.

6.3.1 Ecosystem

In the ecosystem, firms are busy developing new strategies that cater to emerging market dynamics by competing head-to-head on some fronts (e.g., both Apple and Amazon sell hardware) and collaborating on others (e.g., Amazon offering reader applications) (Yoo, Henfridsson & Lyytinen, 2010; Bühler, Wallenburg & Wieland, 2016) so as to ensure total connectivity. Total connectivity means enabling the connection at any time, any place, for anyone, anything and everything to the ecosystem.

Nambisan et al. (2017) suggest that new digital infrastructures and their associated capabilities can critically complement a firm's practices, such as collaborating with customers or a broader ecosystem of external partners. Furthermore, the ecosystem's architecture can be

built according to the company's needs and structure, and it can also join one or more ecosystems.

Therefore, digital businesses must reconsider how to standardize infrastructures and business processes around them, which also requires agility to respond to rapidly changing ecosystem conditions. It also calls for the orchestration of more multifaceted, data-rich, and dynamic digital resources (Bharadwaj et al., 2013). Nambisan et al. (2017, p. 230) have also suggested the concept of orchestration "wherein one or more firms (or entities) assume the responsibility for coordinating value co-creation and value appropriation."

It becomes necessary to orchestrate the digital ecosystem so as to monitor the environment and assess the digital process among the ecosystem's agents and consequently connect them. Therefore, we divided the ecosystem approach into ecosystem orchestration and ecosystem connectivity.

6.3.1.1 Ecosystem Orchestration

Markus and Loebbecke (2013) indicate that companies in an ecosystem include not only the customers and suppliers, but also other organizations and partners, such as producers of complementary products and services, logistics providers, outsourcers, and financiers. It is then necessary to orchestrate all these ecosystem agents.

Thus, we observe that orchestration adds value to the business. Pagani (2013) corroborates this idea and defines network orchestration as the set of deliberate, purposeful actions undertaken by the hub firm (digital delivery platform) as it seeks to create and capture value from the network.

Markus and Loebbecke (2013) have also theorized about digital business strategy and taken the perspective of ecosystem orchestrators, whose position in the ecosystem gives them the substantial power to dictate terms to more dependent companies. That way, the owner can establish internal and external rules and procedures across their partners and other agents within the ecosystem.

These authors provide some examples that can help illustrate the orchestrator's role in the ecosystem, such as the original equipment manufacturers (OEMs) in the automotive and high-tech industries and leading consumer product retailers. However, partners in an orchestrator's ecosystem might also be members of additional ecosystems. For example, a supplier of a particular automobile component or subassembly may supply all US OEMs; therefore, the respective OEMs' ecosystems would be at least partially overlapping. The

broader the concept of the ecosystem, the more likely it is to include organizations belonging to multiple overlapping ecosystems.

Kazan and Damsgaard (2016) developed a study on the ecosystem and added another idea of orchestration that complements the example above. According to these authors, most payment services are based on a four-party scheme (i.e., payer, payee, acquirer, card issuer), where these agents process payment transactions through orchestrated business models.

In the case of information products, the concept of orchestration is also applicable. For instance, the two-sided newspaper market with its two customer groups, readers, and advertisers, is changing due to digitalization. Therefore, the following hypotheses are proposed:

H1 – Ecosystem orchestration is positively related to the ecosystem connectivity capability.

H2 – Ecosystem orchestration is positively related to the sensing capability.

H3 – Ecosystem orchestration is positively related to the process digitization capability.

6.3.1.2 Ecosystem Connectivity

Barenfanger and Otto (2015) argue that ecosystem connectivity is a digital capability. Dong, Hussain and Chang (2007) note that digital ecosystems aim to improve communication efficiency among internal agents and to structure the existing Business Ecosystem. An ecosystem's architecture can be constructed based on the firm's characteristics—its needs, internal and external clients, suppliers, etc.—or it can be adapted.

Additionally, this ecosystem allows for condensing information from all corners of the IT organization (Garbani 2015). According to Yoo et al. (2010), ecosystem capabilities enable a firm "to search, explore, acquire, assimilate, and apply knowledge about resources, opportunities, and how resources can be configured to exploit opportunities."

H4 – Ecosystem connectivity is positively related to the responsiveness capability.

6.3.2 Sensing

The sensing capability is defined as the ability to spot, interpret, and pursue opportunities in the environment (Pavlou & El Sawy, 2011). Digital technologies employed by digital businesses allow them to better sense and respond to customer needs (Setia et al., 2013).

Continental Airlines, for example, "has adopted a data warehousing platform to gain access to real-time customer and flight information that helps them better understand and meet their passengers' needs and wants" (Setia et al., 2013, p. 566).

The sensing capability enables digital businesses to face some challenges, such as the difficulty in identifying new business opportunities (Kohli & Grover, 2008; Aakus, Ågerfalk, Lyytinen & Te'eni, 2014). This capability also helps companies to deal with a multitude of new channels such as social media, IoT, etc. (Chellappa, Sambamurthy & Saraf, 2010; Heer, Bostock & Ogievetsky, 2010; Müller, Holm & Søndergaard, 2015).

Thus, this digital capability plays an essential role in gathering data from the environment by producing useful information, since the organizational value extracted from information results when the collected data are analyzed through data mining in order to create a meaningful difference in operational excellence and competitive market response (Kohli & Grover, 2008; Gupta & George, 2016).

Moreover, digital businesses depend on the sensing capability for subjective evaluation and decision making. Whenever these firms sense a need to search outside for such solutions, they tend to seek support through their established relationships so as to be able to respond to demands (Lin, Su & Higgins, 2016).

Mikalef and Pateli (2017) corroborate this idea by denoting that the sensing capability can help ensure that a competitor's motions are closely monitored and that sufficient feedback by customers is received and analyzed for informing management decisions to respond to possible shifts in the business environment. Therefore, the following hypothesis is proposed:

H5 – The Sensing Capability is positively related to the responsiveness capability.

6.3.3 Process Digitization

Process digitization is the transition from running a traditional business to a digital one, according to Barnir, Gallaugher, and Auger (2003). These authors also affirm that digital resources obtained through the Internet, though available to all firms, often require unique capabilities that are more present in some firms than in others and that offer benefits that are more important to some firms than to others.

Kohli and Grover (2008) add that firms should develop the ability to gain insight into their processes so that they can react and respond to problems or changes as fast as possible. In this sense, process digitization is a digital capability that can be developed for digital businesses.

Grover and Kohli (2013) offer some examples of process digitization, thereby demonstrating that there are currently many applications that perform various functions ranging from data retrieval (e.g., UPS's package tracking) to data integration to disparate services (e.g., Kayak's airfare comparison) to more complex applications that create a business process (e.g., Auto Slash, a car rental monitoring application that rebooks a rental when cheaper options become available).

Lyytinen, Yoo and Boland (2016, p. 49) affirm that "increasing the level of digitization in our everyday socioeconomic system involves representing, processing, storing, and communicating the widest possible range of matter, energy, and information comprising our world."

Täuscher and Laudien (2018) reinforce the crucial role of the digitization process capability by emphasizing that digital business interactions go beyond highly automated processes in electronic commodity trading or stock markets. They illustrate the example of marketplaces that use a digital platform to develop many digitized processes to integrate clients and stores but do not substantially produce or trade goods or services itself.

This digitization may be related, for instance, to the development/launch of electronic businesses, such as the e-marketplace, e-commerce, among others (Koch, 2010). Furthermore, according to Barnir et al. (2003), process digitization benefits informational flow in several business sectors, such as marketing and IT, which implies good responsiveness.

Therefore, this digital capability enables speed to the processes and is linked to responsiveness. Once the process is digitized, the response can be instantaneous (Mishra, Konana & Barua, 2007; Markovitch & Willmott, 2014). As a result, the reach of digitized processes ensures more agility and responsiveness in accessing information for the customers and within the firm (Setia et al., 2013; Stratman & Roth, 2002). Thus, the following hypothesis is proposed:

H6 – The process digitization capability is positively related to the responsiveness capability.

6.3.4 Responsiveness

Digital Technologies are known to be key enablers of digital capabilities that allow digital businesses to respond to clients' needs and desires quickly and efficiently, leading to improvements in the company's performance (Setia et al., 2013). Kohli and Grover (2008) argue that responsiveness is a required capability for responding to market competition.

Responsiveness leads digital business to face some challenges, such as the need for developing new insights and knowledge in order to cope with market demands (Bernardes, 2010; Barrett, Davidson, Prabhu & Vargo, 2015), and difficulties in responding quickly to market changes and in satisfying consumer desires (Kohli & Grover, 2008; Tams et al., 2014). Responsiveness also helps companies understand changes in consumers' behavior so as to satisfy them (Hylving, Henfridsson & Selander, 2012).

In this sense, digital capabilities act as a foundation upon which other firms can develop complementary products, technologies, and services (Barrett et al., 2015). For example, applications and websites that are more responsive can lead to higher attractiveness, implying more sales and a more significant financial return, as suggested by Grover and Kohli (2013).

Responsiveness improves customer satisfaction, which brings several benefits, such as good recommendations from social media and a decreased number of complaints, attracting more consumers and, consequently, more sales or services. In other words, customer satisfaction is related to business performance (Tarafdar, Tu & Ragu-Nathan, 2010).

Setia et al. (2013) stress that performance may be related to the customer response capability, thereby representing a culture characterized by continuous monitoring of customer needs and improved customer value. Hence, responsiveness is a capability that companies can have for monitoring and leveraging digital business strategies, such as focusing actions on customer needs and customizing information according to the purchasing profile. Because of improvements in agility and responsiveness, firms can achieve a higher level of performance and competitive advantage (Teece, 2007; Tams et al., 2014).

Therefore, the improved response speed, effectiveness, and efficiency in coping with environmental changes can positively affect competitive performance by enabling firms to take advantage of market capitalizing motions and operational adjustments for reducing costs (Mikalef & Pateli, 2017).

Accordingly, responsiveness can be defined as an ability that requires speed and flexibility in an organization's processes, and that responds quickly to a new customer need so as to improve business performance (Setia et al., 2013; Tams et al., 2014; Barenfanger & Otto 2015). Therefore, the following hypothesis is proposed:

H7 – The responsiveness capability is positively related to digital business performance.

6.4 METHODOLOGY

A survey was developed and applied to respondents within the digital business to collect data and measure the constructs in the research model (Fig.8). We adopted the definition of survey research by Pinsonneault and Kraemer (1993), which focuses on the survey's purpose to produce quantitative descriptions of some aspect of the populations studied by asking people structured and pre-defined questions through a sample.

6.4.1 Measurement and Data Collection

We collected data from digital businesses such as e-commerce and e-services to test the hypotheses. We contacted companies belonging to two national associations that integrate digital businesses, the Brazilian E-commerce Association and the Brazilian Association of Digital Agents.

We collected data using SurveyMonkey, which is an electronic survey instrument that contained questions, drawing on all measures from the existing literature (Appendix C). The most significant advantage of data collection through an electronic survey is the cost-benefit ratio since it requires few people and practically no paper (Hair, Babin, Money & Philip, 2005).

We made preliminary contact and followed up with the return of the electronic surveys in order to improve the response rate, as indicated by Cooper and Schindler (2003). The initial notification was made by either telephone or e-mail with the company of interest, requesting permission and the respondents' names and positions in order to send the questionnaire. The respondents were IT managers who manage the digital area

Following the initial invitation to participate in the survey, three e-mail reminders were sent out with a three-week interval between them. The duration of the data collection process was approximately four months (November 2017 – April 2018), and the average completion time was about 18 min.

We contacted 994 companies from the abovementioned associations, and the return rate was approximately 33%, with a total of 328 responses. The sample's purification was performed, and incomplete questionnaires were excluded, as well as outliers. Questionnaires that contained 90% or more of the answers in one same item were removed, as well as those that had answers in only two items, as suggested by Hair, Sarstedt, Hopkins and Kuppelwieser (2014). Therefore, 20 questionnaires were excluded.

Concerning the sample size requirements, the 308 responses received exceeded both the specifications of (1) ten times the largest number of formative indicators used to measure one construct and (2) ten times the largest number of structural paths directed at a particular latent construct in the structural model (Hair et al., 2014).

Table 20 - Description of the Companies

Activity Type	Number	Percentage
E-commerce	215	69,8%
E-service	67	21.8 %
Others	26	8,4 %
Total	308	100%
Business Source		
Digital Native	194	63%
Became a digital business	87	28,2%
In the digital transformation process	27	8,8%
Total	308	100%

Source: The author.

Of the 308 respondents, 176 are men and 132 are women, there was the option of not identifying in terms of gender, but all responded. In terms of business experience, 189 with more than 5 years of experience in the field, 52 from 2 to 5 years and 67 with less than 2 years of business experience.

Regarding the roles, all hold management positions, but the denominations vary, in some companies are CIO chamos, in other director of IT. But overall, 148 respondents claimed to hold management positions, 139 management positions and 21 other positions as an IT analyst.

The data collection instrument was a questionnaire with 31 closed-ended, pre-defined questions based on the Information Systems (IS) literature. The seven-point Likert scale of agreement was used. The instrument's validation was performed according to the steps in the validation process, as proposed by Koufteros (1999), the development of the study's theoretical basis, definition of the variables, face and content validities, and the pre-test.

The instrument development was based on the literature, using predefined scales, but adapting to the digital business context, in order to be validated and tested next. The authors are described in the correspondent column of each item, as present in appendix A.

The instrument's face and content validities were developed by three Ph.D. professors in IT and three IT managers. The evaluators read and analyzed the instrument and gave their suggestions in essays and descriptions of some items, which were taken into consideration in the adjustments made afterwards, prior to conducting the pre-test.

The pre-test was applied to 53 IT managers, MBA students in programs focused on Information Systems. The research was applied by paper in the classroom by the researchers, with the consent of the institutions and respondents.

Therefore, in addition to analyzing the results, it was possible to get feedback in the application phase of the survey. The comments were all noted for further discussion, and the final wording of the items was adjusted to the final text of the questionnaire (Appendix C).

6.4.2 Statistical Techniques

The data collected were tabulated and then analyzed with the help of the SPSS software (Statistical Package for the Social Sciences), version 21, used to analyze reliability and descriptive and exploratory statistical data.

The hypotheses were then tested using partial least squares structural equation modeling (PLS-SEM), and precisely through the SmartPLS software package (Ringle, Wende & Will, 2005). PLS-SEM is deemed particularly appropriate for this study since it permits the simultaneous estimation of multiple causal relationships between one or more independent variables and one or more dependent variables (Hair et al., 2014). According to these authors, researchers appreciate SEM's ability to assess latent variables at the observation level (outer or measurement model) and test relationships between latent variables on the theoretical level (inner or structural model).

Moreover, care was involved in developing the study in order to control common method variance (CMV), as emphasized by Podsakoff, MacKenzie, Lee and Podsakoff (2003). If systematic method variance is not controlled, this variance will be lumped together with systematic trait variance in the construct. This is a problem since it can lead to erroneous perceptions about the appropriateness of a scale's reliability and convergent validity.

Following the suggestions of Malhotra, Kim, and Patil (2006), we attempted to reduce the probability of inserting this type of systematic error by counterbalancing the order of questions, using widely validated instruments in the literature, applying different scales to measure constructs, and, finally, ensuring the confidentiality and anonymity of respondents in stating that there are no right or wrong answers, that is, that each item must be answered honestly in order to represent reality.

After data collection, Harman's one-factor test was conducted to assess common method bias. Six factors were extracted, accounting for 45.96% of the variance explained, less than 50%, which is the satisfactory level according to Podsakoff et al. (2003).

6.5 RESULTS

We analyzed the proposed model using PLS-SEM, a predictive modeling technique that performs bootstrap re-sampling as a non-parametric means of drawing statistical inferences based on the sample provided. We utilized the SmartPLS to perform both item validation and predictive analysis because it is robust for small sample sizes, is an exploratory research and does not rely on the assumptions of normality required for parametric inferential analysis (Sharma & Kim, 2013).

6.5.1 Measurement Model

The measurement model, considering the first-order reflective latent variables were subjected to reliability, convergent validity, and discriminant validity tests. Reliability was gauged at the construct and item level. Convergent validity was achieved when all items in a measurement model were statistically significant (Zainudin, 2011).

In this research composite reliability (CR) and Cronbach alpha (CA) values were above the threshold of 0.70, suggesting acceptable construct reliability (Nunnally, 1978; Hair, Ringle and Sarstedt, 2011). Convergent validity was assessed by examining whether the average variance extracted (AVE) was above the lower limit of 0.50, therefore, it explains that the items measure at least half of the variance in the construct (Fornell & Larcker, 1981).

Discriminant validity was assessed by using the Fornell-Larker criterion, where each construct's square root of AVE exceeded their correlations with all other constructs. The results in Table 21 depict reliability, convergent validity and discriminant Validity (Hair et al., 2011; Hair et al., 2014).

Table 21 - Reliability, Convergent Validity and Discriminant Validity

	A	CR	AVE	ECO_O	ECO_C	PERF	PRD	RESP	SNS
ECO_O	0.846	0.897	0.621	**0.863**					
ECO_C	0.776	0.845	0.510	0.824	**0.781**				
DBS	0.912	0.930	0.690	0.604	0.560	**0.831**			
PRD	0.912	0.938	0.792	0.603	0.548	0.519	**0.890**		
RESP	0.899	0.929	0.767	0.628	0.580	0.541	0.874	**0.876**	
SNS	0.877	0.912	0.678	0.502	0.465	0.492	0.840	0.870	**0.823**

Note: CA = Cronbach alpha; CR = composite reliability; AVE = average variance extracted ECOC=Ecosystem Connectivity; ECOO = Ecosystem Orchestration; PRD= Process Digitization; RSP =Responsiveness; SNS = Sensing; DBS = Digital Business Performance.
Source: The author.

For item purification, Corrected Item-Total Correlation (CITC) values were calculated. Items with more than 0.50 CITC values are considered for the study (Hair et al., 2005). Two items with less than 0.5 were excluded considering they are too low (ECOO 5 and ECOC 5). Next it is presented the structural model.

6.5.2 Structural Model

We used the coefficient of determination (R2), which represents the amount of explained variance of each endogenous latent variable (Hair et al., 2014), to assess the model's quality. As we can see in Figure 9, the proportion of the total variance of each endogenous construct explained by the model is 68 % for ecosystem connectivity, 36.8% for process digitization, 84% for responsiveness, 26.2% for sensing, and 29.3% for digital business performance. Accordingly, the R2 values are satisfactory since the exogenous digital capabilities (sensing, responsiveness, and ecosystem connectivity) explain 84% of the variance in the dependent variable "Responsiveness." Also, the Responsiveness variable explains 29.3% of the variance in the dependent variable "Performance."

Figure 9 - PLS Structural Model
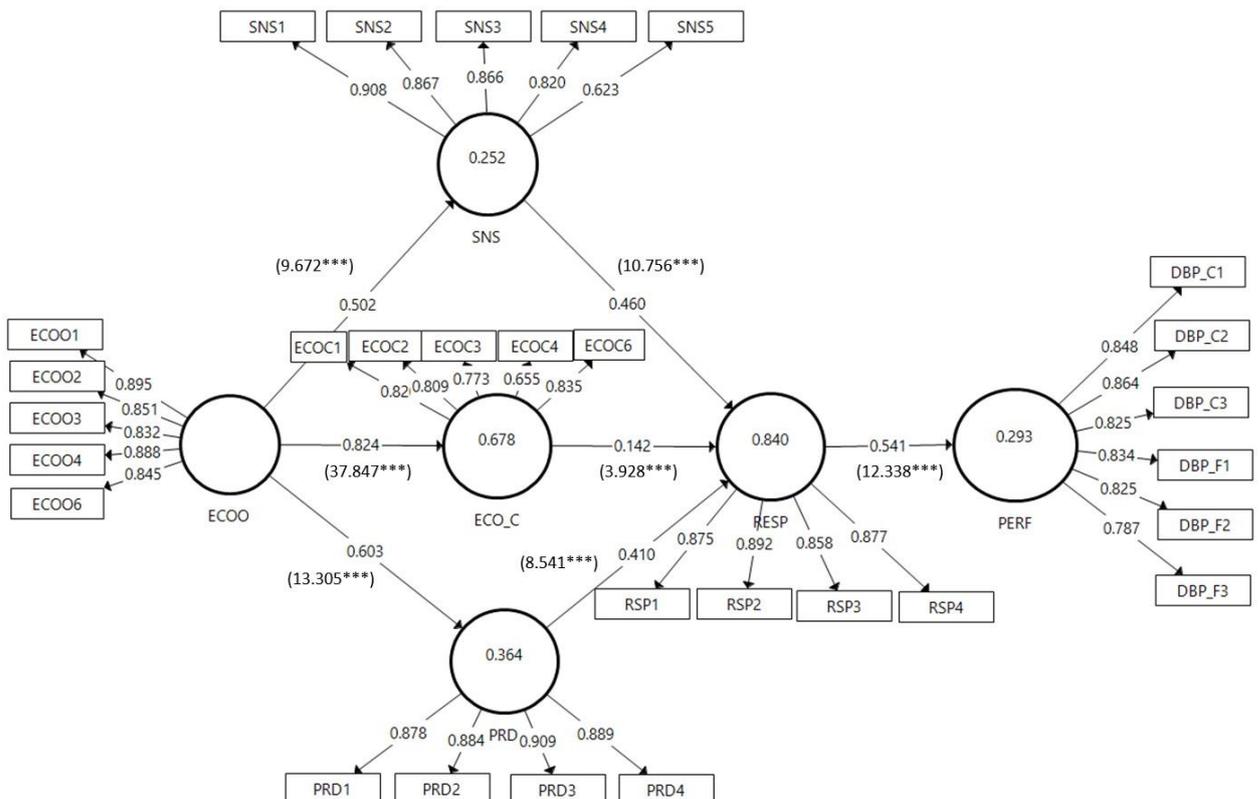
Source: SmartPLS 3.

The hypotheses were tested by examining the structural model results; a bootstrapping approach was employed through 5,000 re-samples (Hair et al., 2011; Hair et al., 2014). We then utilized bootstrap re-sampling to determine T statistics and significance values. Figure 9 shows the results of the predictive model analysis, including path β coefficients, associated ρ values for each dependent variable performed in SmartPLS.

Following the parameters of Hair et al., (2011) for using bootstrapping to assess the path coefficients' significance, the minimum number of bootstrap samples is 5,000, and the number of cases should be equal to the number of observations in the original sample. Critical t-values for a two-tailed test are 1.65 (significance level = 10 percent), 1.96 (significance level = 5 percent), and 2.58 (significance level = 1 percent). Results indicate that all seven hypotheses in the model were supported, as shown in Table 22.

Table 22 - Effects on endogenous variables (direct effects).

	Paths (Hypotheses)	(β)	T Statistics (a)	P Value	Status
H1	ECOO -> ECO_C	0,824	37.847***	0.000	Supported
H2	ECOO -> SNS	0,502	9,672***	0.000	Supported
H3	ECOO -> PRD	0,603	13.305***	0.000	Supported
H4	ECO_C -> RESP	0,142	3.928***	0.000	Supported
H5	SNS -> RESP	0,460	10.756***	0.000	Supported
H6	PRD -> RESP	0,410	8.541***	0.000	Supported
H7	RESP -> PERF	0,541	12.338***	0.000	Supported

Note: (a) t-values for a two-tailed test: *** t-value 2.58 (significance level = 1 %) (Hair et al., 2014).

Source: The author.

The structural model's predictive relevance was assessed by Stone–Geisser's Q^2 measure. The results confirm that the structural model has satisfactory predictive relevance with a value of 1.936 for Q^2, since, according to Chin (1998), a Q^2 value greater than 0 implies that the model has predictive relevance.

It was also used the fit the criterion for PLS path modeling, i.e., the standardized root means square residual (SRMR). This criterion represents the root of the square discrepancy between the observed correlations matrix and the model-implied, i.e., the Eucleadian distance between two matrices. Assuming a cut-off value of 0.08, as proposed by Hu and Bentler (1999), the model presented in this study shows an acceptable fit of SRMR=0.060.

6.6 DISCUSSION

Our objective was to measure the impact of digital capabilities on digital business performance. To do so, we presented a research model that aims to measure their impact. We developed the study based on digital businesses, e-commerce, and e-services in South America, with such companies based in Brazil.

It was possible to verify that the ecosystem orchestration capability is an antecedent of the other digital capabilities. Additionally, the sensing capability, the process digitization capability, and the ecosystem connectivity capability were observed to cause an impact on the responsiveness capability.

Responsiveness, therefore, is a consequence of the other capabilities, and this configuration boosts digital business performance. Thus, this study brings theoretical and practical implications, as presented in the following.

6.6.1 Theoretical Implications

Our study makes several contributions to IS research. This paper expands on the understanding of digital capabilities, demonstrating its relationship with digital business performance.

Likewise, it theoretically advances studies on the ecosystem by indicating the importance of the digital ecosystem in digital transformation. Ecosystem orchestration and ecosystem connectivity are analyzed as two different factors, with orchestration being an antecedent capability. This maintains the relationship of the role of orchestrators within ecosystems, as highlighted by Kazan and Damsgaard (2016) and Markus and Loebbecke (2013).

Consequently, the company that manages the ecosystem must establish internal and external rules and procedures with its partners and other ecosystem agents so as to monitor, connect agents, communicate, and develop their operations.

Furthermore, the model reveals responsiveness to be a consistent capability, reinforcing the importance that a digital business must be agile and responsive. It was possible to observe that other digital capabilities (sensing, process digitization, and ecosystem connectivity) affect the responsiveness capability, leading to better business performance.

To illustrate, digital processes directly influence responsiveness since they improve responsiveness to information accessed by customers and within the company, as already emphasized by Setia et al. (2013). It was also possible to verify that the sensing capability is positively related to responsiveness, according to Pavlou and El Sawy (2011).

We can, therefore, conclude that a digital business's critical point is its responsiveness. It takes speed to respond to the market, to customers, and to stakeholders because competitiveness is very high, thus making it possible to improve performance, particularly, in customer satisfaction and, consequently, in improving financial performance.

6.6.2 Practical Implications

This paper stresses that digital businesses must develop digital capabilities so that managers can prioritize their investments. However, two main points deserve the managers' particular attention – the orchestration and responsiveness capabilities.

Although the literature has already argued that companies participate in several ecosystems, the research model evidences the impact of the orchestration capability on the others and, consequently, on performance.

In developing or investing in technologies, digital businesses must be capable of monitoring, being agile and belonging to other ecosystems that can help improve performance. E-Commerce, for example, can have its own ecosystem and still be integrated with others through its customers and suppliers, which will incorporate the ecosystem and thus require a greater need for orchestration. Another example is the e-marketplace that increasingly integrates more agents, also requiring more orchestration and connectivity.

Responsiveness is essential for managers to direct their investments in Digital Technologies that lead companies to respond quickly and efficiently to customer demands and wishes and, as a consequence, improve their performance which corroborates with the statements Setia et al. (2013).

Thus, to improve responsiveness, companies can develop the interface with customers with more responsive sites, using APIs, IOT, BI tools, applications, etc. In other words, they must monitor the market and incorporate the use of digital technologies that can increase their responsiveness.

Accordingly, responsiveness increases the speed in response to market changes and in satisfying consumer desires (Kohli & Grover, 2008; Tams et al., 2014). Also, managers will be able to decipher changes in consumer behavior (Hylving et al., 2012).

From the results relating digital capabilities to performance, other practical implementations emerge. The main point is that the widespread application of digital capabilities can certainly contribute to digital business performance.

6.7 CONCLUSION

This study aims to measure the impact of digital capabilities on digital business performance. It was possible to verify the direct and indirect effects of the digital capabilities (ecosystem orchestration, ecosystem connectivity, sensing, and process digitization) on responsiveness and this capability on digital business performance.

The research considered digital businesses, such as e-commerce and e-service, in Brazil. Thus, this study presents a research model that measures the impact of digital capabilities on digital business performance, as highlighted in the results. The study also introduces theoretical and practical implications that may contribute to studies on the subject of digital transformation, with the main results pointing to the importance of the companies' capability to respond to this new scenario brought on by the digital era and the ecosystem's orchestration capability.

A limitation of this study is the number of respondents. Therefore, a suggestion for future research is to extend the analysis to other countries in order to theoretically advance on this topic. The use of control variables, such as the types of digital businesses, is also recommended.

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6.9 APPENDIX C – QUESTIONNAIRE ITEMS

	Measurement Items	Authors
	Please rate the digital capabilities of your business through effective and quick responses using a scale ranging from " totally disagree" (value = 1) to "totally agree" (value = 7).	
SNS 1	We have a high-level digital technology that allows us to quickly monitor the environment to identify new business opportunities through our digital platform and tools.	Pavlou and El Sawy (2011)
SNS 2	We use the information we monitor to identify new opportunities for our business We have a high-level digital technology that allows us to effectively use the information and identify new opportunities for our business	Pavlou and El Sawy (2011)
SNS 3	We have a high-level digital technology that allows us to visualize better the data and information properties (e.g., to see patterns, spot trends, and identify outliers)	Pavlou and El Sawy (2011)
SNS 4	We have a high-level digital technology to allow us to display the digital data and information in our company as needed	Pavlou and El Sawy (2011)
SNS 5	We have a high-level digital technology that allows us to analyze data from multiple sources of our business environment	Gupta and George (2016)

RSP 1	We have a high-level digital technology that allows us to quickly to respond to a new customer need when we identify it.	Bernardes, E. S. (2010)
RSP 2	We have a high-level digital technology that allows us to take corrective action immediately when we find that customers are unhappy with our product/service.	Setia, Venkatesh, & Joglekar (2013)
RSP 3	We have a high-level digital technology that allows us to incorporate the latest digital technologies in our products/services to satisfy our customers.	
RSP 4	We have a high-level digital technology that allows us to satisfy the new needs of customers easily.	
PRD 1	Our digital technologies allow us to share our business processes within our firm.	Mishra; Konana; Barua (2007)
PRD 2	Our firm has automated the development of services and production goods integrated with the supply chain through digital technologies	
PRD 3	We have a high-level digital technology that allows us to share information with our business partners.	Stratman & Roth (2002)
PRD 4	We have real-time reports and dashboards of our Business Process Performance Metrics.	Markovitch and P. Willmott. (2014).
	Please rate the ecosystem connectivity - the ability that measures the internal and external connections via the digital platform- using a scale ranging from "totally disagree" (value = 1) to "totally agree" (value = 7). In the next two questions, answer according to the situation of each member of the digital ecosystem	
	We can easily get and exchange information with the following parties using our current digital platform and tools.	
ECOC 1	Suppliers	Karimi and Walter (2015); Bühler, Wallenburg, and Wieland (2016)
ECOC 2	Partners	
ECOC 3	Employees from other functional areas	
ECOC 4	Customers	
ECOC 6	External firms or people (e.g., by publishing APIs or web services to entities outside the company ecosystem)	
	We can orchestrate internally and externally the following parties via digital ecosystem using our current digital platform and tools.	
ECOO 1	Suppliers	
ECOO 2	Partners	
ECOO 3	Employees from other functional areas	
ECOO 4	Customers	
ECOO 6	External firms or people (e.g., by publishing APIs or web services to entities outside the company ecosystem)	
	The next questions are related to the digital business performance. Please rate next three items using a scale ranging from "totally disagree" (value = 1) to "totally agree" (value = 7).	
CP 1	We have a strong and continuous relationship with customers	Rai et al. 2006
CP 2	We have a precise knowledge of customer buying (demands) patterns	
CP 3	We have a high level of recommendations and indications from our customers	

	Indicate your financial performance relative to your competitors' performance on some dimensions, using a scale ranging from "far worse" (value = 1) to "far better" (value = 7).	
P 1	Profit over the past five years;	
P 2	Revenue over the past five years.	Power et al. (2010)
P 3	Return on invested capital (ROIC) over the past five years;	

7 GENERAL CONCLUSION

In addressing digital capabilities, this study proposes a research model to measure their impact on digital business performance. Due to the complexity of the theme, this doctoral thesis has been divided into four papers.

The first paper (Chapter 3) proposes a conceptual model that reveals the relationship between digital capabilities and digital business performance through the RBV and dynamic capabilities theories. A systematic literature review led to the identification of four digital capabilities, namely: sensing, responsiveness, process digitization and ecosystem connectivity.

Thus, using the lenses of two organizational theories, this paper contributes to our understanding of the way the digital phenomenon impacts business. The challenges in the digital economy are displayed, and a definition of digital capability is suggested. This theoretical paper also demonstrates that digital capabilities enable firms to rethink and upgrade their processes, their commitment to clients and business models, thus improving information flow.

The second paper (Chapter 4) examines the role of digital capabilities in digital business performance, applying the theoretical model developed in the first paper. To do so, a qualitative research method was adopted to explore digital capabilities. The interviews conducted with executives reinforced the role of digital capabilities and their relationship with digital business performance. As a result, the study shows the ways in which digital capabilities enhance operational excellence, revenue growth and relationships with customers and stakeholders.

Responsiveness is shown to have the highest level of relationship with digital business performance, followed by ecosystem connectivity and sensing with high and medium levels. The other capabilities are found to improve the response capability, which in turn leads to improved customer relationships and consequently positively impacts company performance.

The importance of the digital ecosystem was also highlighted, but it was observed that it is a complex subject that requires more studies. When analyzing the data, one realizes that each ecosystem has its peculiarities, but also has characteristics in common. So, the third paper was developed.

The third paper (Chapter 5) highlighted that companies are increasingly dependent on external actors for the continuous supply of new functions and services, requiring a need to be connected to them. So, this third paper analyzed how digital businesses are taking advantage of the concept of digital ecosystems to orchestrate and improve communication efficiency among internal and external actors belonging to the ecosystem.

It was developed a multiple-case study of four organizations within the context of Digital Business Strategy - four retail companies with e-commerce operations that have undergone a recent digital transformation. It was possible to identify and analyze the different sources of value in a digital ecosystem. Besides, the paper showed the complexity in managing the multitude of actors in the ecosystems we studied needing a digital ecosystem orchestration capability to deal with all actors.

Thus, the crucial role of ecosystem orchestration capability as a base for the development of digital capabilities was inferred. Then, it was possible to understand that ecosystem connectivity capability is a consequence of ecosystem orchestration capability. Finally, the results presented in this third paper proved that the development of a digital ecosystem adds value to the business.

The fourth paper (Chapter 6) presented the final research model. During the whole research, the research model presented in articles 1 and 2 was adjusted, based on the results of previous papers.

Besides, it was possible to verify the presence of the orchestration capability of the digital ecosystem as an antecedent to the other capabilities. It is also noted that responsiveness is impacted by the capabilities that precede it. As a result, it was possible to test the model to analyze the results.

So, during the hypothesis test, it was analyzed the direct and indirect effects of digital capabilities (ecosystem orchestration, ecosystem connectivity, sensing and process digitization) on the responsiveness and this capability on the digital business performance.

As a result, two main points deserve particular care of the managers, the orchestration capabilities, and the responsiveness capabilities.

The orchestration, because although the literature has already argued that the companies participate in several ecosystems, the presented research model evidences the impact of this capability in the others and consequently in the performance.

The responsiveness, because the managers can direct their investments in Digital Technologies that lead companies to respond quickly and efficiently to customer demands and wants and consequently improving its performance. Thus, to improve the responsiveness, companies can develop the interface with customers.

So, acquiring or investing in technologies digital business must be capable of monitoring, being agile and able to belong to other ecosystems can improve performance. E-Commerce, for example, can have its ecosystem and be integrated with others of its customers and suppliers, for example, will incorporate the ecosystem and consequently require a greater

need for orchestration. Another example is the marketplaces that increasingly integrate more actors also requiring more orchestration and connectivity capabilities.

In conclusion, these four papers make a contribution better undesrtand the digital capabilities, to validate the research model and to understand how digital capabilities are related to digital business performance, and to measure the impact of the digital capabilities on digital business performance, thus achieving the general objective and specific objectives of this thesis.

Nonetheless, each paper presents its limitations, the qualitative studies is due to the fact that the respondents and the companies studied are from only one country, and although some companies have units abroad and wide coverage, it is believed the results cannot be generalized. The quantitative paper limitation is the number of respondents.

Therefore, a suggestion for future research is to extend the analysis to other countries in order to theoretically advance on this topic. The use of control variables, such as the types of digital businesses, is also recommended. Finally, more studies regarding the digital ecosystem are required to better understand this theme.

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APPENDIX D - CASE OF STUDY PROTOCOL

1) Case Study General Data

A) General Purpose of the Study:

- To examine the role of digital capabilities in digital business performance.

B) Research Question:

- What is the impact of digital capabilities on digital business performance?

C) Sources of Information:

- Semi-structured interviews;
- Document Analysis:
- institutional presentations, corporate websites, reports, organization chart, spreadsheets about suppliers and
- buyers, and other materials that are possible and allowed to access.

D) Procedures

- Define criteria for selection of companies;
- Select the companies to be visited that have a supply chain
- structured within the organization;
- Conduct a survey of the general information of the companies studied;
- Contact the companies and schedule a visit;
- Visiting companies;
- Identify the respondents;
- Hold meetings and record interviews;
- Transcribe recorded conversations
- during meetings;

- Analyze the material: interviews, documents, notes in conjunction with existing theory and concepts; and,
- Make an executive report for companies.

2) Data Collection

A) Company's General Characteristics

- Company Name:
- Branch:
- Number of employees:

B) Interviewer's data:

- Name:
- Position:
- Area of education:
- Time working in the area:
- Time in the current company:

C) Interview

- **Digital Business**

1	Can you describe your company, a bit of its history to the present day?	Lyytinen, Yoo e Boland (2016)
2	Can you describe what kind of business your company develops?	
3	Has your company gone through any digital transformations? If so, can you describe this digital transformation process?	Chekwa and Daniel (2014)
4	How do digital technologies support the ecosystem?	Adner (2016)
5	What digital resources and technologies does your enterprise use?	Westerman; Bonnet and Mcafee (2014); Tams, Grover and Thatcher (2014)
6	What digital capabilities has your company had to develop to become digital? (Digital abilities and resources)	

- **Sensing**

7	How do digital technologies help your company to scan the environment to identify new business opportunities?	Karimi and Walter (2015)
8	How do digital technologies help your company to monitor the product development efforts to ensure they are in line with what the customers want?	Tams, Grover and Thatcher (2014)
9	How do digital technologies help your company to capture the clients' needs?	

10	Can you describe the relationship between the sensing capability of your company and the business performance?	Lyytinen et al. (2016)

- **Responsiveness**

11	How do digital technologies help your company respond to your organization's needs?	Fernandes et al. (2017)
12	How do digital technologies help your company respond to your clients' needs?	Kolhi and Grover (2008); Tams, Gorver and Thatcher (2014); and Hylving, Henfridsson and Selander (2012).
13	How does digital ecosystem help your company respond to your clients' needs?	
14	Can you describe the relationship between the responsiveness of your company and the business performance?	
15	How do digital ecosystem and technologies help your company respond to the environment demands?	

- **Process digitization**

16	How does the process digitization affect the flow of information within the organization?	Koch (2010); Mishra, Konana and Barua (2007) Barenfanger and Otto (2015)
17	In what way is the generation and capture of data and information carried out through the business value chain, including the organization's customers, suppliers, and partners?	
18	How are data and information transmitted, integrated, and processed in the business value chain, including the organization's customers, suppliers, and partners?	Koch (2010); Mishra, Konana and Barua (2007) Barenfanger and Otto (2015)
19	Can you describe the relationship between the process digitization and the business performance?	

- **Digital Ecosystem**

20	Does your company have a digital platform that connects you internally and externally with your partners (suppliers and customers)?	Yoo (2012); Nambisan et al. (2017)
21	Can you describe the platform's role?	Alam et al. (2016);
22	Which agents (partners) take part in this corporate ecosystem?	Barenfanger and Otto (2015)
23	What kind of interaction (communication) can be made through the digital ecosystem?	
24	Can you describe the relationship between the digital ecosystem and business performance?	
25	How do you handle the complexity of the number of users?	
26	How do you orchestrate ecosystem users?	

27	Can you describe the importance of the digital ecosystem's network effect?	Nambisan et al. (2017)
28	How does the digital ecosystem add value to your business?	Yoo, Henfridsson and Lyytinen, 2010
29	How does the digital ecosystem drive your business's agility?	Karimi and Walter (2015)
30	How does this occur?	

- **Digital Ecosystem and Information**

31	In what way is the generation and capture of data and information carried out through the business value chain, including the organization's customers, suppliers, and partners?	Nambisan et al. (2017) Alam et al. (2016);
32	How are data and information transmitted, integrated, and processed in the business value chain, including the organization's customers, suppliers, and partners?	
33	How can the digital ecosystem contribute to your company's use of information?	Barret et al. (2015); Drnevich and Croson (2013)
34	How can the digital ecosystem contribute to information quality at your company?	

- **Digital Capabilities and Business Performance**

35	How is the relation between the digital capabilities (sensing/responsiveness/ process digitization/ ecosystem connectivity) and financial performance?	Tan et al. (2016); Yoo et al. (2010); Tams, Gorver, and Thatcher (2014); Lyytinen, Yoo and Boland (2016)
36	How is the relation between the digital capabilities (sensing/responsiveness/ process digitization/ ecosystem connectivity) and operational excellence (the improvements about your competitors) of your business?	
37	How is the relation between the digital capabilities (sensing/responsiveness/ process digitization/ ecosystem connectivity) and the business relationship with your customers?	
38	What else do you believe your company needs to develop for better digital business performance?	

Note: The shading colors indicate in which article each question was used.

	Items used only in paper 2
	Items used in papers 2 and 3
	Items used only in paper 3

APPENDIX E: QUESTIONNAIRE MEASUREMENT ITEMS

Digital Capabilities	Measurement Items	Authors
	Please rate the digital capabilities of your business through effective and quick responses using a scale ranging from " strongly disagree" (value = 1) to " strongly agree" (value = 7).	
Sensing	1. We have a high level digital technology that allows us to easily monitor the environment to identify new business opportunities through our digital platform and tools.	Pavlou and El Sawy (2011)
	2. We use the information we monitor to identify new opportunities for our business We have a high level digital technology that allows us to effectively use the information and identify new opportunities for our business	
	3. We have a high level digital technology that allows us to better visualize the data and information properties (e.g., to see patterns, spot trends, and identify outliers)	Adapted from Heer, Bostock and Ogievetsky (2010).
	4. We have a high level digital technology to allow us to display the digital data and information in our company as needed	
	5. We have a high level digital technology that allows us to analyze data from multiple sources of our business environment	Gupta and George (2016)
Responsiveness	6. We have a high level digital technology that allows us to quickly to respond to a new customer need when we identify it	Setia, Venkatesh and Joglekar (2013).
	7. We have a high level digital technology that allows us to take corrective action immediately when we find that customers are unhappy with our product/service.	Bernardes (2010)
	8. We have a high level digital technology that allows us to incorporate the latest digital technologies in our products/services to satisfy our customers.	
	9. We have a high level digital technology that allows us to easily satisfy the new needs of customers.	Setia, Venkatesh and Joglekar (2013)
Process Digitization	10. Our digital technologies allow us to share our business processes within our firm.	Mishra, Konana and Barua (2007)
	11. Our firm has automated the development of services and/or production goods integrated with the supply chain through digital technologies	
	12. We have a high level digital technology that allows us to share information with our business partners.	Stratman and Roth (2002)
	13. We have real-time reports and dashboards of our Business Process Performance Metrics.	Markovitch and Willmott (2014).
	Please rate the ecosystem connectivity - the ability that measures the internal and external connections via digital platform- using a scale ranging from " strongly disagree" (value = 1) to " strongly agree" (value = 7).	

	In the next two question, answer according to the situation of each member of the digital ecosystem	
Ecosystem Connectivity	14. We can easily get and exchange information from the following parties using our current digital platform and tools. a. Suppliers b. Partners c. Employees from other functional areas d. Customers e. Public Sector f. External firms or people (e.g., by publishing APIs or web services to entities outside the company ecosystem)	Adapted from Bühler, Wallenburg, and Wieland (2016)
	15. We can orchestrate internally and externally the following parties via digital ecosystem using our current digital platform and tools. a. Suppliers b. Partners c. Employees from other functional areas d. Customers e. Public Sector f. External firms or people (e.g., by publishing APIs or web services to entities outside the company ecosystem)	
Performance	The next questions are related to the digital business performance. Please rate next three items using a scale ranging from " strongly disagree" (value = 1) to "totally agree" (value = 7).	
Customer Relationship Performance	16. We have a strong and continuous relationship with customers	Rai et al. 2006
	17. We have a precise knowledge of customer buying (demands) patterns	
	18. We have a high level of recommendations and indications from our customers	Lin, Chen and Kuan-Shun (2010)
Financial Performance	Indicate your financial performance relative to your competitors' performance on a number of dimensions, using a scale ranging from "far worse" (value = 1) to "far better" (value = 7). 19. Profit over the past 5 years; 20. Revenue over the past 5 years. 21. Return on invested capital (ROIC) over the past 5 years;	Power et al. (2010)