

Impact of digital leadership capability on innovation performance: The role of platform digitization capability

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Abstract

Following a mixed-methods approach, we theorized that digital leadership influences innovation performance by digitalizing the firm's platform. A multiple case study of ten companies was deployed to derive a theoretical model relating digital leadership and innovation performance. The resulting model was empirically tested on a sample of 117 European firms. We find that digital leadership improves a firm's innovation performance by digitalizing the firm's platform. We contribute to IS research by theoretically developing the concepts of digital leadership capability and platform digitization capability and empirically analyzing the relationship of these two critical IT capabilities and their impact on innovation performance.

Keywords: Digital leadership capability, Platform digitization capability, Innovation performance, Digital innovation, Business value of IT.

1. Introduction

Digital technology and its associated disruptive innovations are rapidly transforming industries and allowing companies to conduct multiple initiatives to explore and exploit the benefits that technologies provide (Claver et al., 2000; Bag et al., 2021; Castillo et al., 2021a; Chen et al., 2021; Sia et al., 2021). Indeed, given these disruptive changes, firms are in need to “*jump onto the digital transformation bandwagon*” (Sia et al., 2021, p.35). According to Ernst and Young, around 90% of firms consider digitization as a priority in their strategic planning in the next two years (Sia et al., 2021), and based on the research of Forrester, 85% of firms “*are investing in digital transformation in 2018; 50% feel that they are already too late*” (Sia et al., 2021, p. 35). However, firms struggle to develop an effective strategy to benefit from digital transformation. Digital transformation requires reevaluating the firm’s processes, services, and roles from a technology-enabled perspective (Eden et al., 2019). This involves the establishment of digital transformation programs integrating digital technologies into all areas of the business as well as

changing how firms work and provide value to stakeholders (Gupta and Bose, 2019). An effective digital transformation program requires developing digital capabilities in different areas such as leadership, operations, customer needs, and innovation (Westerman et al., 2012; Fitzgerald et al., 2013). In this sense, digital leaders are paramount to execute digital transformation programs (Ke and Wei, 2008; Westerman et al., 2012) by understanding digitization as being an integral part of the business activities and creating digital thinking for merging information technology (IT) in the firm's business strategy (Sia et al., 2016). Digital leaders refer to both IT leaders with good business skills (business-savvy) and business leaders with strong, practical, hands-on digital skills (IT-savvy) (Weill and Ross, 2009).¹ Thus, digital leadership includes a portfolio of digital, market, business (e.g., product and customer understanding), and strategic leadership skills (intrapersonal and interpersonal skills to create business value through driving actions, strategic mindset, and decision-making) needed to drive the digital transformation of the firm (Husing et al., 2015).

Once a firm's approach becomes digital and more complex, and the firm embarks on digital transformation, the firm needs to establish a global, common system for its processes through technology standardization, shared infrastructure, disciplined business processes, and integrated data to achieve simplification and agility (Weill and Ross, 2009). In this sense, a digitized platform is “*an integrated set of electronic business processes and the technologies applications, and data supporting those processes*” (Weill and Ross, 2009; p.4), which enables the creation of value by making the interactions among users easier (Leong et al., 2019). As an example to illustrate what a digitized platform is and how it is operationalized in a firm, we explain the case of Swiss Re. Swiss Re is an insurance global provider that wanted to finish with its regional

¹ Around 60% of the digital leadership positions in the European Union are in business lines, rather than in IT departments (Husing et al., 2015).

approach (i.e., each region has its own processes that are supported by its own systems) by building a digitized platform in three steps. First, a shared IT infrastructure was built, consolidating data centers and enhancing IT governance. Second, working with business and IT leaders led to the development of global systems to establish common processes. Finally, once the firm implemented common systems, its focus changed to data integration, which allowed straight-through processing for order management system, settlement of the trades, dividend and interest payment, etc. (Weill and Ross, 2009). Digital leadership may play a key role in the digitization of the firm's platform since the standardization and integration of IT infrastructure, IT-enabled business processes, and data will require a composite of digital, market, business, and strategic leadership skills. For example, digital skills may facilitate the integration of the IT infrastructure; data, market, and business skills may be critical to identify, design, and integrate the key business processes of the firm; and strategic leadership skills may be paramount to lead the integration efforts (Weill and Ross, 2009). The firm's platform digitization may facilitate innovation and cost control. A digitized platform *"standardizes and automates business processes, thereby increasing reliability, decreasing operational cost, and ensuring quality"* (Weill and Ross, 2009, p. 16). Moreover, automating what is not changing allows executives to focus *"attention on what is changing in the marketplace"* (Weill and Ross, 2009, p. 16), thus pursuing and improving innovation (Weill and Ross, 2009). Indeed, reports on IT trends suggest that the two key executive's motivations to invest in IT are controlling IT and business cost and pursuing innovation (Gibson, 2017). Numerous managerial researches have shown the growing importance of digital leadership and platform digitization in enabling the coming wave of digital transformations (Weill and Ross, 2009; Schrey and Reynolds, 2018), and academic research has started paying attention to understanding digital transformation (Verhoef et al., 2021) and the role

of digital leadership and platform digitization in firms. However, several gaps still exist in this area.

First, the concepts of digital leadership capability and platform digitization capability have not been defined and analyzed clearly in the literature. Just a few prior studies have conceptualized and analyzed what digital leadership and/or digital leader mean (e.g., Avolio et al., 2000; El Sawy et al., 2016) and how important they are in the digital economy. However, in reality, digital leadership capability is essential to enable digital transformation and, despite its potential to create business value, digital leadership capability is scarce among contemporary firms (Husing et al., 2015). It had been estimated that European Union would need around 250,000 additional digital leaders by 2020 (Husing et al., 2015). Similarly, there is a lack of understanding about what platform digitization capability refers to. Managerial research has suggested the importance of platform digitization to get superior value from their IT-enabled business initiatives (Weill and Ross, 2009; Ingram et al., 2019); however, no prior studies are examining what platform digitization capability means and how it may help firms to create value. Therefore, it is important to examine what digital leadership capability and platform digitization capability really are to be capable to understand how they may contribute to the success of the firm. *Second*, the role of digital leadership capability in innovation performance has not been investigated empirically. Most of the previous studies have suggested theoretically that leaders are key in the success of the firm, without providing any empirical evidence about how digital leadership capability may enable innovation performance, and whether and what actors play a key role in enabling this relationship. *Third*, the antecedents and consequences of platform digitization capability are not well analyzed empirically in the literature. Despite the potential role of the digitized platform in creating value, taking benefits from a digitized platform has a high number of challenges (e.g., high variability across business processes), since tightly linked business processes make that even

small changes in one process affect the whole, being time-consuming, expensive, and risky. There are no prior studies that empirically analyze the role of platform digitization capability in innovation performance. To address these gaps, we develop the concepts of digital leadership capability and platform digitization capability and investigate the role of digital leadership capability on platform digitization capability and innovation performance. Thus, this becomes the first study to theoretically explain and empirically analyze the role of digital leadership capability on platform digitization capability and innovation performance. Therefore, the key research question that this study aims to answer is the following: *How does digital leadership capability affect innovation performance?*

Our central proposition is that digital leadership capability enables firms to digitize the platform, which in turn improves innovation performance. The proposed theory was developed and tested using a mixed-methods approach. First, we conducted a multi-case examination of 10 European companies in order to derive a theoretical model relating digital leadership capability and innovation performance. Second, we tested the proposed model using partial least squares (PLS)-path modeling using survey data on a sample of 117 European companies. The empirical analysis supports our theory. We find that digital leadership capability improves a firm's innovation performance by digitalizing the firm's platform. This paper contributes to the information systems (IS) research by theoretically developing and testing the concepts of digital leadership capability and platform digitization capability, and theoretically explaining and empirically analyzing the relationship between these two critical IT capabilities, and their impact on innovation performance.

2. Theoretical foundations and background

2.1. Organizational capabilities-based theory and IT capabilities in IS research

We draw from organizational capabilities-based theory and IT capabilities to link digital leadership capability and innovation performance through platform digitization capability. Organizational capabilities and how these capabilities are leveraged by the firm are suggested to explain variation in firm performance (Grant, 1996). Specifically, IT capabilities have been found to be significant for increasing firm performance (Rai et al., 2006; Mithas et al., 2011; Goh and Arenas, 2020) by enabling higher-order business capabilities (Benitez et al., 2018a; Braojos et al., 2019). According to the hierarchy of capabilities, we describe the capabilities involved in this study within a hierarchical structure (Collis, 1994), where there are lower-order capabilities that enable higher-order capabilities. These higher-order capabilities provide a superior value because they impact directly on firm performance; however, lower-order capabilities impact indirectly on firm performance through these higher-order capabilities (Benitez et al., 2018a). In this study, digital leadership capability is a lower-order capability that requires platform digitization capability, that is a higher-order capability, to impact innovation performance. Stated differently, digital leadership capability does not directly impact innovation performance, and it requires a higher-order capability (i.e., platform digitization capability) to impact on firm innovativeness. Firms must succeed across the two levels to achieve and maintain superior performance. Then, we posit that digital leadership capability enables the digitization of the firm's platform to innovate more and better.

2.2. Digital leadership

Digital leaders play a paramount role to make the transformation happen because they are change-oriented and adaptable and have "*transformative vision and forward-looking*

perspective," which is key to committing to the transformation and driving the cultural change in turbulent environments (Weill and Woerner, 2018; Kane et al., 2019). Then, digital leaders are key for the success of a digital business transformation because they are responsible for selling the vision internally and externally, choosing and keeping the right team, and performing organizational surgery (e.g., by affecting the structure). Digital leaders usually run their business through a digital artifact, typically a platform (Ingram et al., 2019). Digital technologies have shifted the way of dealing with uncertainty; however, adding new technologies is not enough to drive the transformation because these technologies may be easily copied by other firms, the success of the transformation rests in the firm's ability to integrate processes, technologies, applications, and data (e.g., creating a multichannel experience, a single view of a customer). Digital leaders are the most appropriate to lead the integration efforts because they are enthusiastic and integrative by nature, and their staff is the frontline in the transformation (Weill and Woerner, 2018). Moreover, digital leaders possess good business and digital skills (Weill and Ross, 2009). Digital leadership includes a portfolio of digital ², market, business, and strategic leadership skills (Husing et al., 2015). Thus, digital leadership capability refers to the firm's ability to capitalize on the digital, market, business, and strategic leadership skills of digital leaders to lead and manage interdisciplinary people (digital skilled and non-digital skilled) to transform digitally the firm (Husing et al., 2015). In this sense, this capability is composed of a mix of digital, market, business, and strategic leadership skills.

An illustrative example of the importance of digital leadership capability in driving digital transformation may be seen in Schneider Electric ("global leader in energy management and automation"). Schneider Electric drives the transformation from top to down with a stated

² Digital skills include the competence of leveraging big data analytics and tools, cloud computing and virtualization, mobile app design and development, complex business systems, web development, IT architecture, ERP systems, social media, security skills, etc.

ambition of "digitized to empower" (Weill and Woerner, 2018). Leaders *"proactively deal with the disruption that digitization posed to its business model"* (Weill and Woerner, 2018; p. 26) through changing how they engaged with customers and fostering a highly collaborative firm and a digital culture. Schneider Electric's leaders were ambidextrous by innovating and making the firm more efficient, being *"the architects of the enterprise's change to digital"* (Weill and Woerner, 2018; p. 178).

Despite the importance of digital leadership and the lack of digital leaders in firms (Kane et al., 2019), previous researches, with a few exceptions (e.g., El Sawy et al., 2016; Sia et al., 2016; Kane et al., 2019), have overlooked to study digital leadership. El Sawy et al. (2016) shed light on the foundations for improving firm capabilities for digital leadership. Sia et al. (2016) show the importance of cultivating leadership for digital transformation as one of the main strategic initiatives conducted by DBS Bank (i.e., a large Asian bank) in its digital transformation strategy. Kane et al. (2019) provide insights on how firms can drive a digital transformation by hiring digital leaders, refreshing digital literacy, creating an adequate environment, and cultivating an experimentation culture. Thus, the understanding of the role of digital leadership in achieving innovation is in its initial stage.

2.3. Platform digitization capability

Once the firm embarks on the digital transformation journey, digital leaders usually need digital technologies such as platforms to run their operations and shift the way of dealings with uncertainty (Ingram et al., 2019). In this sense, platform digitization is so important that the firm and the platform become indistinguishable (Ingram et al., 2019). IS scholars have defined a digitized platform as a software-based system, and the electronic business processes that the system supports by providing core functionality for all the modules and interfaces that interoperate (Hanseth and Rodon, 2021). In other words, a digitized platform is *"an integrated set*

of electronic business processes and the technologies applications, and data supporting those processes” (Weill and Ross, 2009; p.4). The digitized platform, which is designed with “*network-centric thinking*” for collaboration among users, enables the creation of value by making easier the interactions among them (Leong et al., 2019) and generates a stable foundation for business operations (Weill and Ross, 2009). Then, a digitized platform may be understood as a global, common system for the firm’s processes based on technology standardization, shared infrastructure, disciplined business processes, and integrated data (Weill and Ross, 2009). We call platform digitization capability to the firm's ability to integrate IT infrastructure, business processes, and data to build and use a digital platform to drive consistent performance.

Being able to efficiently build and use a digital platform is not an easy task. These digitized platforms are characterized by a high number of interconnections and interdependencies among social-technical elements and have a tendency of evolving over time (Hanseth and Rodon, 2021). Moreover, boundaries are constantly challenged because their functionalities are extended, and new social-technical elements come into play, increasing the complexity of the system (Leong et al., 2019; Hanseth and Rodon, 2021).

After analyzing prior research regarding digital leadership/platform digitization and performance (Table 1), we realized that platform digitization capability may be one plausible missing link to explain that digital leadership capability impacts innovation performance. However, no prior research has analyzed the role of platform digitization capability as a mediating artifact between digital leadership capability and innovation performance. Thus, the understanding of the role of platform digitization capability in achieving innovation and its antecedents is very limited.

Table 1: Key research on digital leadership/platform digitization and performance

Author(s)	Methodology/sample	Results
Purvanova and Bono (2009)	Laboratory experiment: 272 undergraduate students WABA analysis	Transformational leaders in virtual teams achieved the highest level of overall team performance. This type of leadership had a stronger effect on team performance in virtual teams than in face-to-face teams.
Karimi and Walter (2015)	136 employees from US newspapers Partial least squares	First-order dynamic capabilities that are built by shifting, expanding, or adapting the existing resources, processes, and values are positively associated with the creation of digital platform capabilities, which in turn impact the digital disruption performance.
Sedera et al. (2016)	189 chief information officers Partial least squares	The enterprise systems platform affects the link between digital platforms and innovation and also has a direct effect on innovation. Conversely, digital platforms do not have a direct impact on innovation.
Ferreira et al. (2019)	938 firms and multivariate statistical analysis	The profiles of entrepreneurs and managers and the adoption of new digital processes by leaders contribute to the firm's greater competitiveness.
Van der Meulen et al. (2020)	Managerial research	Shifting decision rights, adopting a new way of working, conducting organizational surgery, and building a platform mindset are required to improve performance from digital transformation.
Nambisan and Baron (2021)	243 surveys from US-based new ventures	The role conflict of digital entrepreneurs (i.e., ecosystem member and new venture leader) generate stress, which would reduce venture performance. The relationship between role conflict and stress is moderated by ecosystem openness, and the relationship between stress and venture performance is moderated by entrepreneurs' self-control.

2.3. IT impact on firms' innovation activities

The relationship between IT and innovation has been studied by prior IS research (see Table 2). Most of these studies analyze the mechanisms through which IT influences innovation. For example, Kleis et al. (2012) show that IT contributes to innovation through three mechanisms such as knowledge management, innovation production, and inter-organizational coordination. Chen et al. (2015) found that the mechanism through which IT influence innovation is corporate entrepreneurship. Joshi et al. (2010) state that IT contributes to firm innovation through

knowledge capabilities, while Chatterjee et al. (2015) consider organizational virtues and organizational improvisational capabilities as mechanisms to join IT with innovation. Other studies (e.g., Lin, 2011; Xue et al., 2012; Marion et al., 2014) relate IT directly with innovation and show the positive moderator role of IT on the relationship between employee's creativity and innovation. Moreover, other studies focus on the importance of IT on open innovation. For instance, Cui et al. (2015) found that when IT strategies and open innovation strategies are aligned, open innovation performance is enhanced, which in turn affects organizational performance.

Prior IS research points out the importance of IT in pursuing and improving innovation, becoming one of the major motivations for executives to invest in IT (Gibson, 2017). A digitized platform, which is "*an integrated set of electronic business processes and the technologies, applications, and data supporting those processes*" (Weill and Ross, 2009; p. 4), may facilitate innovation by automating what is not changing. Thus, executives may be focused on what is changing in the marketplace to pursue and improve innovation (Weill and Ross, 2009). However, obtaining benefits from a digitized platform is not an easy task since there exists high variability across business processes and even small changes in one process may affect the whole, demanding time and money. Due to the controversial nature of this relationship, our paper aims to shed light on how firms may pursue and improve innovation from a digitized platform.

Table 2: Key research on IT and innovation

Author(s)	Methodology/sample	Results
Cooper (2000)	Case study and survey data from 15 respondents from a large financial institution	Successful employment of new IT-enabled reengineering must be accompanied by creativity to contribute to significant organizational change. Creativity can be fostered by manipulating a variety of individual and group characteristics
Henfridsson and Bygstad (2013)	In-depth case study and case survey research based on a sample of 41 cases	Combinations of adoption, innovation, and scaling are generative mechanisms of digital infrastructure evolution, whose outcomes are more offered services, new services, and increased reach of the infrastructure, respectively
Joshi et al. (2010)	Structural equation modeling of secondary data from 110 firms	<i>"IT provides a set of knowledge capabilities that contribute to firm innovation in different ways. IT applications enable the development of a potential absorptive capacity that in turn facilitates a realized absorptive capacity. This capacity improves the development of new ideas (patents)"</i> (Benitez et al., 2018b), p. 132.
Kleis et al. (2012)	Ordinary least squares regression analysis and two-stage least squares of secondary data from 201 manufacturing firms for the period 1987–1997	IT and research and development positively affect innovation output. IT contributes to innovation through three mechanisms: knowledge management, innovation production, and inter-organizational coordination
Xue et al. (2012)	Longitudinal analysis of secondary data for 341 firms through three-stage least squares estimation	<i>"In industries with higher levels of complexity, IT asset portfolios are associated with a greater increase in innovation. In less dynamic, munificent, and complex industry environments, IT asset portfolios are associated with a greater increase in operational efficiency"</i> (Xue et al., 2012, p. 511).
Srivastava and Shainesh (2015)	Case study related to two IT-enabled ophthalmic healthcare initiatives for rural India	Interactional resources such as technology, knowledge, and institutions can be combined to create innovative service systems to benefit disadvantaged segments of society. The enablers to successfully implement these <i>"IT-enabled service innovations are obsessive customer empathy, belief in the transformational power of IT, continuous recursive learning, and efficient network orchestration"</i> (Srivastava and Shainesh, 2015, p. 256).

2.4. Digital leadership and innovation performance

As we have suggested above, digital leadership is an underexplored concept that has been overlooked by IS researchers. To the best of our knowledge, the effect of digital leadership on innovation performance has not been studied before by prior research. However, in an era characterized by fast-changing markets where innovation arises as key to survive and to be competitive, the study about the impact of digital leadership on innovation is necessary to be conducted to show whether digital leadership has something to say about the increasing on innovation performance.

Since previous studies have not analyzed the impact of digital leadership capability on innovation performance, a mixed-methods approach was selected to obtain a bigger explanation and comprehension about the nature of the relationship (Teddlie and Tashakkori, 2003; Venkatesh et al., 2013). First, we conducted a qualitative multi-case study of European companies to capture a holistic understanding of the relation between digital leadership and innovation performance, generating a theoretical model relating both concepts. Second, we tested the proposed model by a quantitative analysis of survey data comprising a sample of European companies.

3. The mixed-methods approach design

This study applies a mixed-methods approach to study the impact of digital leadership capability on innovation performance. The mixed-methods approach combines the strengths of both qualitative and quantitative methods (Venkatesh et al., 2013). Qualitative methods enable the researcher to explore the target phenomenon, identify the critical constructs, and elaborate a good understanding of the mechanisms, whereas quantitative methods provide valuable means to examine the proposed theories and the hypothesized relationships (Venkatesh et al., 2013; Zachariadis et al., 2013). We selected this methodological approach for two reasons. First, within the IS discipline, there have been calls for research pluralism (Hassan and Will, 2006; Cheng, et

al., 2021; Mendling et al., 2021), which has a strong association with the mixed-method approach (Agerfalk, 2013). Second, the mixed-methods approach offers a relatively holistic approach that can provide a global view of the phenomenon under study (Venkatesh et al., 2013; Califf et al., 2020; Hua et al., 2020; Xu et al., 2021).

Following the suggested guidelines for conducting mixed-methods research (Venkatesh et al., 2016), this study follows a developmental design, as a first stage a qualitative study is used to develop constructs and hypotheses, and then a quantitative study was conducted to test the hypotheses.

4. Qualitative study: Developing a theoretical model relating digital leadership and innovation performance

We adopted a qualitative research³ method to elicit the nature of the relation between digital leadership capability and innovation performance, selecting the organization as the primary unit of analysis. Specifically, we followed a grounded theory approach (Glaser, 1992; Corbin and Strauss, 2008). The grounded theory aims at developing inductive theory from data through incremental and systematic progression in knowledge, deriving conceptual deduction and hypothesis (Urquhart, 2013). We collected data from a sample of ten small and medium enterprises (SMEs), which were purposively selected as successful companies, all of them considered high-growth enterprises. "The Organization for Economic Co-operation and Development (OECD)" and "the Statistical Office of the European Communities" (Eurostat, 2007) define high-growth enterprises as "*enterprises with average annualized growth greater than 20% per annum, over a three years period. Growth can be measured by the number of employees or by turnover*". In addition, all companies consider IT to be the key factor

³ Qualitative research has gained acceptance in recent years in IS research as it was expected by Palvia et al. (2004).

contributing to their growth. Thus, all selected companies have in common the fact that they are high-growth SMEs and, more importantly, they add value to their companies by using IT.

4.1. Data collection

Data were collected via a purposeful sampling of interviewees and extensive archival data to provide a comprehensive view of digital leadership and innovation performance in each organization. The first dataset contains 16 semi-structured interviews conducted in the year 2014 with top managers from ten organizations in Spain. Top managers were selected for the interviews due to their total involvement in the company's activities and the fact that they are in a decision-making position, therefore being responsible for the strategies that the organization sets. At least, one top manager per each SME was interviewed (see Table 3). Interview questions were generated based on the research questions and were conducted either face to face or via videoconference. We took into consideration the variety of mediums used for the interviews and followed guidelines published elsewhere (Sturges and Hanrahan, 2004). Interviews, which lasted on average 49 minutes, were conducted by at least two researchers and were recorded and later transcribed for analysis purposes. The interview questionnaire is included in Appendix 1.

Table 3. Profiles of organizations and interviewees

Company	Sector	Description	Number employees	Number interviews	Role of interviewees
C1	IT consulting services	Consulting for manufacturing, retail and distribution, and food and beverage	20	1	Director
C2	IT consulting services	SAP technology consulting business	215	2	General director Director of human resources
C3	Marketing services	Digital marketing	10	1	Director
C4	IT	Technology consulting	32	1	Commercial director

	consulting services	services, systems integration, and managed service providers			
C5	IT consulting services	Data recovery services and digital forensic analysis	22	2	Director Marketing director
C6	Training services	Language training	30	2	Director Director of IT
C7	IT consulting services	Provision of computers, electronic, and telecommunication services	97	2	General director Marketing director
C8	Service	Settlement of industrial assets through an online auction portal and reverse logistics	20	2	Finance director Chief operator officer
C9	Service	Platform of sale and purchase of event tickets	250	1	CEO
C10	Service	International expert advice, employment opportunities, and advertising	32	2	CEO Chief digital officer

The second dataset includes secondary data comprising public reports and news articles about the organizations and the main innovations they have generated. Secondary data were used mainly for triangulation purposes, ensuring construct validity, and offering us a deeper understanding of the phenomenon under study (Yin, 2017). In particular, we checked for the generation of innovative products and services in the organizations and assessed elements such as the use of digital technologies and managers' involvement that were reported. The description of the secondary data sources and the reasoning for leveraging them are provided in Appendix 2.

4.2. Data analysis

In order to analyze the qualitative data, a team of two researchers independently conducted coding of all the transcripts. We followed a three-step coding process as suggested by Urquhart (2013). In a first step, open codes were inductively generated from the transcripts, and then several rounds of discussion were held among the authors to discuss codes and themes. We conducted pilot coding initially, in which four interviews were coded and discussed with the

whole team to produce an initial codebook. In a second step, open codes were grouped into categories; and in a final step, aggregated dimensions and theoretical codes were generated. The details of the coding process are provided in Appendix 3. We utilized the principle of constant comparison, continuously comparing codes between single interviews and different interviews in order to identify new codes and to group them into higher categories.

At the outset of open coding, the interview questionnaire served as the preliminary coding structure for the collected data. Additional codes were created as specific themes or recurring issues were identified. In total, it was generated 147 open codes covering diverse themes about digital leadership, the use of digital technologies, the relevance of platforms, and innovation. Next, during the selective coding phase, the wide variety of codes captured in open coding was organized into 22 selective codes. This step revealed the relevance of concepts such as digital platform and the integration of IT infrastructure, business process, and data. Finally, we conceptualized the selective codes into aggregated dimensions, resulting in 11 dimensions related to three main theoretical codes: digital leadership, platform digitization, and innovation performance. Appendix 4 illustrates the data structure that emerged from our data analysis following Gioia et al. (2013)'s guidelines.

4.3. Building and hypothesizing the theoretical model

The theoretical model arose from the coding process followed during the qualitative analysis. Three major themes emerged from this coding process relating digital leadership and innovation performance: IT infrastructure integration, business processes integration, and data integration. We found digital leadership influences the integration of IT infrastructure, business processes, and data; additionally, such integration impacts the innovation performance of organizations. Building upon the qualitative study findings, we develop a research model relating digital leadership and innovation performance, formulating hypotheses about their relation.

4.3.1. The relevance of digital leadership in platform digitization

A digital platform has been defined by IS scholars as a software-based system and the electronic business processes that the system supports by providing core functionality for all the modules and interfaces that interoperate (Hanseth and Rodon, 2021). A digital platform is a global, common system for business processes through technology standardization, shared infrastructure, and shared data to achieve simplification and agility, which generates a stable foundation for business operations (Weill and Ross, 2009), and it has been suggested as a mean to mediate leaders' venture (Ingram et al., 2019). We call platform digitization capability to the firm's ability to integrate IT infrastructure, business processes, and data to build and use a digital platform to drive consistent performance.

To build and leverage a digitized platform is challenging. These digitized platforms are involved in a high number of interconnections and interdependencies among social-technical elements and tend to evolve over time (Hanseth and Rodon, 2021). Moreover, boundaries are constantly challenged because their functionalities are extended, and new social-technical elements come into play, increasing the complexity of the system (Leong et al., 2019; Hanseth and Rodon, 2021). Thus, it is necessary a portfolio of diverse skills (i.e., digital, market, business, and strategic leadership skills) to be able to see the “big picture” and succeed in the integration of IT infrastructure, business processes, and data (i.e., platform digitization capability).

Digital leadership capability can enable the development of a platform digitization capability in the firm. Standardization and integration of IT infrastructure, IT-enabled business processes, and data will require a composite of digital, market, business, and strategic leadership skills. Digital skills can facilitate the integration of the IT infrastructure and data. Similarly, market and business skills can be critical to identify, design, select, and integrate the key business processes of the firm (Weill and Ross, 2009). Moreover, digital leaders, unlike traditional ones,

communicate largely through their digital presence, what it involves a new medium like a platform, and usually conduct their business through it (Ingram et al., 2019). Digital leaders who run their business through a digitized platform and are able to consider the whole picture may build legitimacy which may be necessary for attracting users and in the success of the business model (Ingram et al., 2019). IT infrastructure integration refers to the firm's ability to standardize and integrate the firm's IT resource infrastructure across business units within the firm and with external partners (e.g., external service providers and business partners) (Rai et al., 2006; Rai and Tang, 2010). In the interviews, it emerged that digital leaders played a key role in the integration of the IT infrastructure. For instance, the director of one of the studied companies explained how a digital leader, the IT director, in this case, has promoted IT integration, and that IT integration contributes to the success of the company:

"An aspect key to the success of the company is that, thanks to the IT Director, we have developed an infrastructure that integrates several technologies, facilitating communication between the team, the transmission of data, and innovation in the company. Until recently, technology [in the company] almost did not exist, and since the incorporation of the IT Director is what is working best, and contributes to us being leaders in the sector". (Director, Company C6).

The CEO of another company noted that a digital leader, the product manager, in this case, has promoted IT integration, and that such integration is key for the organization.

"For us, the use of technology is central. ... Our Internet portal is our main means of communication with our clients and, therefore, it is fundamental. The portal integrates several technologies, and there is a Product Manager in charge of it, who organizes everything". (CEO, Company C9).

In some cases, IT integration is part of the company strategy, with digital leaders playing a central role.

"We have a strategy based on several elements. [One of them is that] everything we do is integrated. The Chief Operation Officer and I promoted the integration of several applications: the auction platform, the CRM, financial applications, etc."

(Financial Director, Company C8).

Business process integration refers to the firm's ability to standardize and integrate the administrative processes (i.e., human resource, finance, and purchasing) and operational processes (i.e., "supply chain, manufacturing, operations, sales, and customer service") within the firm and across its boundaries (Husing et al., 2015; Benitez et al., 2018a). From the interviews, it also emerged that digital leadership influences business process integration. One manager noted:

"[In the alignment between technology and business] we are always looking for ways that IT can contribute to the optimization of processes and the progress of the company. ... We have developed a very tailored and intuitive tool, any customer-service employee can use it saving big costs in the sense that one does not have to generate any paper document, nor one has to go to a repository and look for it, the tool is tailor-made, automating practically all processes". (Director, Company C5)

A typical type of business process integration promoted by digital leaders aims at improving productivity and efficiency, as stated below:

"As a technology-based company, we use technology to improve productivity, both for the members and for all the people who work in the company. From the

point of view of the organization of people's tasks, we work in teleworking and we have the entire system organized by task and hours for each of the employees". (Director, Company C3)

Managers rely on analytic systems to gain insights from organizational data to make better decisions and compete successfully with their rivals (Davenport, 2006). Data integration is the firm's ability to effectively share standardized data (e.g., product, customer, and partner) internally (i.e., among individuals within different parts of the firm) or externally (i.e., with key partners) (e.g., suppliers and customers) (Peng et al., 2011; Husing et al., 2015). Data integration is key for companies, and digital leaders are central in such process, as stated below:

"The Product Director is the intermediary between business and IT. ... We did an innovation project last year integrating data; we put in a single platform different sources of inputs: data on the secondary market, and data on suppliers of the primary market. All the ticket options are on one platform ... The Product Director receives data from the data analysts and the business side, and depending on that he decides what to change and touch, etc. He is at the center of data integration and analysis". (CEO, Company C9).

"For data analysis and integration, we have gone from using Excel to using management tools such as CRM analytics. ... The project managers themselves analyze the data. They through the CRM take out the data and analyze how their projects are going, and we [as senior managers] supervise and complement this analysis". (COO, Company C8).

The amount of data produced and communicated over the Internet is significantly increasing, thereby creating challenges for the organizations that would like to reap the benefits from analyzing this massive influx of data. Emerging technologies such as big data provide companies

with better means to integrate and manage a large volume of data. Digital leadership requires skills to interpret and obtain value from the data.

"We make projects with clients where the data can be either in Hadoop or in a memory site in a server. We analyze the data in a transparent way in real-time. We have experience in applying the predictive part of SAP, and we exploit it. We do an analysis of customer abandonment, customer fraud, etc." (General Director, Company C2)

Overall, the above findings suggest that digital leadership capability facilitates platform digitization capability, since creating digital platforms requires a common understanding and coordination of the IT and business domains (Westerman et al., 2012). IT personnel should understand the business needs and problems, and business personnel should understand the IT possibilities and IT solutions (Weill et al., 2002). A digitized platform is characterized by being generative (i.e., *"it can be reinterpreted and used in unanticipated ways"*) (Yoo et al., 2012). Digital leaders may operate digitized platforms more easily because they are less bounded and less pre-defined than non-digital leaders (Ingram et al., 2019). Digital leadership is necessary to establish the required alignment and common vision to build a digitized platform (Husing et al., 2015). Therefore, we hypothesize that as follows:

Hypothesis 1 (H1): There is a positive relationship between digital leadership capability and platform digitization capability.

4.3.2. Platform digitization impact on innovation performance

Innovation performance refers to the results of the process of changing existing applications, products, and services and/or developing new applications, products, and services (Joshi et al., 2010; Benitez et al., 2018b). The integration of IT infrastructure, business process, and data (i.e., platform digitization) provides firms with a common digital platform for innovation. First,

platform digitization capability can influence innovation performance by providing platform simplification and business agility. The technology standardization and shared infrastructure generate IT efficiencies, enabling firms to be agile and to obtain resources and information more easily, thus to respond quickly to changes and take competitive actions developing new products and services (Roberts and Grover, 2012; Ingram et al., 2019).

As a way of illustration, the following quotes from the interviews show how companies innovated by creating new products and services because of platform digitization.

"We have developed a new product that exploits data analysis, cloud computing and mobility. It is a Business Intelligence product that allows the financial director of a manufacturing company to have the capacity to calculate energy efficiency costs, their consumption and how it affects production and margins. ... We plan to upload the application to the cloud and sell it as a service to companies so they can save on energy". (Commercial Director, Company C4)

"One of our main innovations is a new product, a business management software for technology solution providers. It contains everything necessary to optimize, automate and organize the management of the organization's operations from a web cloud environment. We developed it using open source software, integrating several of the solutions we had developed before".
(Marketing Director, Company C7)

Business agility emerged as a key concept attained via new products, applications, and services that resulted from platform digitization.

"The school portal is the main innovation of last year. The students are in constant contact with us and can select when they want to come to the school. The software is a prism of three faces: teaching, administration and students,

integrating and improving our processes, and exploiting several technologies ... It allows us to be very agile in communicating with potential customers. Before, we were not able to do that". (Director, Company 6)

"Our main innovation is an electronic billing service, which includes an integration of processes and data. ... The reduction of paper and the agility in the billing process is something that is not new. ... However, our target customers are companies that are requiring these solutions". (Director, Company 1)

The integration of business processes and data allows firms to implement a set of digital processes, providing firms with better and consistent analytics, critical decision-making information, and facilitating the introduction of product innovations, thus improving innovation performance (Weill and Ross, 2009).

"Our main innovation in the past year was an online course on digital marketing that has had great success both here in Spain and across Latin America. ... We are constantly analyzing data to improve the arrival to the course by the users. ... We analyze all the data to see what works and what does not work, and reinforce what works". (Director, Company 3)

A digitized platform standardizes, automates business processes, thereby increasing reliability, decreasing operational cost, and ensuring quality. In this sense, platform digitization capability can improve innovation performance by enabling the improvement of the existing products, services, and applications.

"We have implemented a CRM in the cloud to improve our entire sales opportunity cycle and we have involved internal resources because it is a product that we plan to sell to customers". (Director, Company 1)

"Our ERP has been ported to SAP Hana, and in fact, we have done it in part as a reference or test to demonstrate [to our clients] that it could be done in a short time. ... Internally, part of what we do, our experience, we sell it later as a service. ... We have also developed internal system monitoring tools, and then sell them to our customers". (General Director, Company C2)

Data integration and analytics emerged as key in the creation of value within the companies, improving the decision-making process and enabling the enhancement of existing products and services, consequently enabling innovation performance.

"An improvement we have made is to port our web to mobile responsive technology. With analytics, we see how [clients] behave according to their device, how they use it. ... You see the steps they follow and that more users have more problems on mobile phones than on desktops. ... Therefore, we decided that we must change. ... we opt for mobile responsive technology". (CEO, Company C9)

"Our main product is a social network connecting professional women ... To improve processes and customer experience, we monitor the use of data, integrate data, and apply data analytics. ... Being a social network you have to be very active in this area". (CDO, Company 10)

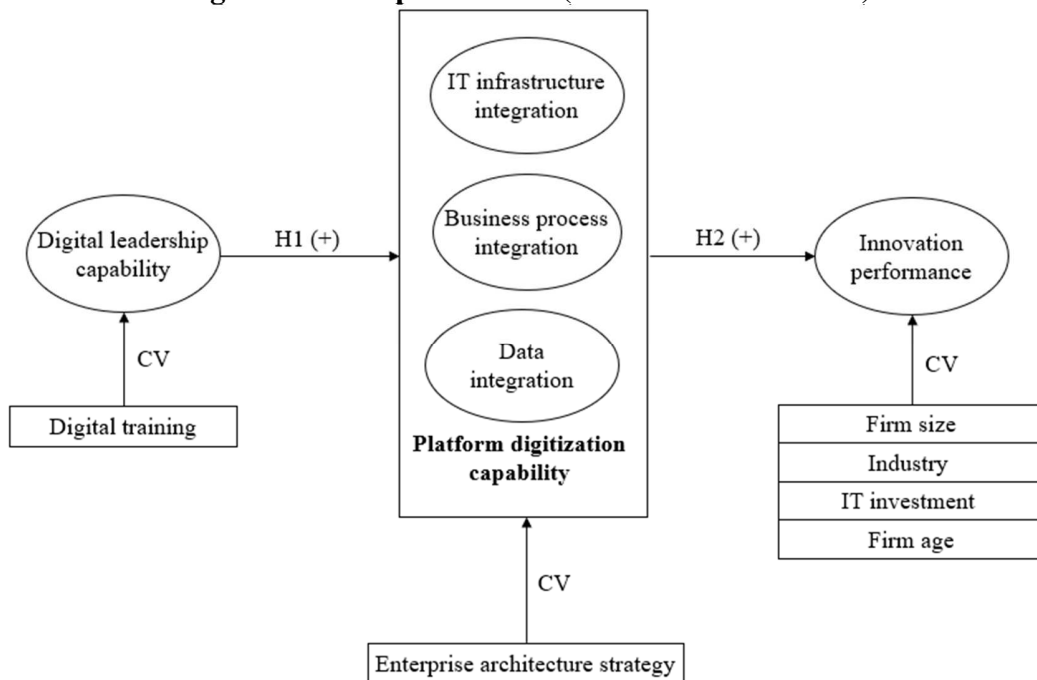
Our qualitative findings show that IT infrastructure integration, business process integration, and data integration influence the creation and improvement of products, services, and applications, i.e., platform digitization capability influences innovation performance. Hence, we hypothesize that as follows:

Hypothesis 2 (H2): There is a positive relationship between platform digitization capability and innovation performance.

5. Quantitative study: Validation of the theoretical model

The three key constructs included in the proposed theory are digital leadership capability, platform digitization capability, and innovation performance. We theorize that there are positive relations between digital leadership capability and platform digitization capability and between platform digitization capability and innovation performance. Platform digitization is a second-order IT capability composed of a mix of three first-order IT capabilities: IT infrastructure integration, business processes integration, and data integration. Figure 1 depicts the proposed model.

Figure 1: Conceptual model (CV = control variable)



5.1. Participants, settings, and procedures

We tested the measurement and structural proposed model with a sample of 117 European firms. A questionnaire was developed and administered in the context of the European Research Project

entitled "e-Leadership Skills for SMEs," in which participated a significant number of IS faculty members from several leading European Business Schools. The original dataset contained 132 firms, and we removed from the dataset those firms that included a significant number of missing values, thus generating a final sample composed of 117 European firms. The firms included in the sample came from nine industries: IT services (47 firms, 40.171%), services (28, 23.932%), industrial and manufacturing (11, 9.402%), education (7, 5.983%), financial services (4, 3.419%), nonprofit (3, 2.564%), healthcare (2, 1.709%), consumer goods and retail (2, 1,709%), and other industries (13, 11.111%). The firms included in the sample came from two European countries (i.e., Spain and Bulgaria). On average, the firms of the sample had 44,051 employees [standard deviation (S.D.) = 76,584].

5.2. Data and measures

5.2.1. Type of constructs

Previous studies have used latent variables and artifacts to conceptualize, operationalize, and estimate constructs. Latent variables refer to unobservable attributes (i.e., they are not directly observed) which are related to observable variables (i.e., observable behaviors). These observable variables infer the latent variable through a measurement model, thus latent variables are measured through these observable variables (Borsboom et al., 2003). Latent variables can be modeled as reflective and causal-formative measurement model (Henseler, 2017). The reflective measurement model assumes that the reflective latent variable causes the observed indicators, whereas the causal-formative measurement model assumes that the observed indicators cause the causal-formative variable. A typical example of a reflective latent variable in IS is behavioral intention to use IT since it reflects the user's intention, and plan to use IT in the future (Benitez et al., 2020a). A typical example of a causal-formative latent variable in IS is IT interaction behavior which refers to the user's interaction with IT to carry out a task (Benitez et al., 2020a).

Artifacts are conceptualized as a set of ingredients. These ingredients do not cause the construct but make up the artifact. Artifacts are "human-made" or "firm-made" objects which are a result of theoretical thinking (Benitez et al., 2020a). Using a composite model is the way of modeling artifacts. As all the constructs included in the conceptual model were conceptualized and operationalized as artifacts, they were modeled as composite (Henseler, 2017). A typical example of composite in IS research is IT infrastructure capability (Benitez et al., 2018c).

5.2.2. Digital leadership capability, platform digitization capability, and innovation performance

Prior IS research (Husing et al., 2015; El Sawy et al., 2016; Li et al., 2016) has highlighted digital, market, business, and strategic leadership as critical skills that digital leaders should have. Drawing from this prior research, we operationalized digital leadership capability as a composite first-order construct composed of four indicators that encompass digital, market, business, and strategic leadership skills. Since digital leaders need to be "knowledgeable strategic executors" and be able to drive successful alignment between business and digital technology, digital leadership capability needs to be composed of a variety of skills such as digital, market, business, and strategic leadership skills (Li et al., 2016).

Based on Weill and Ross' (2009) managerial research, we conceptualized platform digitization capability as a composite second-order construct composed of three first-order capabilities: IT infrastructure integration, business process integration, and data integration. IT infrastructure integration was evaluated as a composite first-order construct through two indicators encompassing the effective technology standardization and infrastructure sharing across business units within the firm and with external partners. Business process integration was measured as a composite first-order construct composed of two indicators, which include the effective standardization of administrative processes and operational processes across business units within

the firm and with external partners. Data integration was operationalized as a composite first-order construct with two indicators, which consider the effective sharing of standardized data internally (i.e., among individuals within different parts of the firm) and externally (i.e., with key partners such as suppliers and customers).

Innovation performance was operationalized as a composite first-order construct measured through five indicators, which encompass revenues, the effectiveness at developing new applications, effectiveness at changing/improving products and services, customer retention rate, and percentage of sales from new products and services. Our measure is consistent with prior measures of innovation performance in IS research (Kleis et al., 2012; Benitez et al., 2018b).

5.2.3. Control variables

Digital training served as a control variable for digital leadership capability as digital training may enable digital leadership capability. Digital training was measured considering that at least one of the individuals who drove the firm's growth and development had both formal IT training and business training. Enterprise architecture strategy also served as a control variable for platform digitization capability since enterprise architecture strategy may influence the development of a platform digitization capability. Enterprise architecture strategy was conceptualized as a composite second-order construct composed of two dimensions: internal and external enterprise architecture strategies. The internal and external enterprise architecture strategies measure the importance of the firm's competitiveness to coordinate activities with regards to IT applications and infrastructure, business processes, and data across business teams/units within the firm and with external partners, respectively (Ross et al., 2006).

We controlled for firm size, industry, IT investment, and firm age on innovation performance. Larger and more experienced firms may invest more in innovation activities than smaller and less experienced firms (Benitez and Walczuch, 2012; Benitez et al., 2018d). Thus, we controlled for

firm size and firm age. Firm size was operationalized as the natural logarithm of the total number of employees (Benitez et al., 2018c), and firm age was measured as the natural logarithm of the number of years operating the firm. Since innovation performance may also depend in some ways on the external environment in which the firm runs, we controlled for the firm industry (Cui et al., 2015). The industry was operationalized as a dummy variable (0: non-IT firm, 1: IT firm). Firms that largely invest in IT may show a greater propensity to innovate since, for example, IT enables efficient design capabilities which help to digitize new products design (Kleis et al., 2012). IT investment was measured as the approximate annual IT investment on the annual revenue (Benitez et al., 2018a).

5.3. Empirical analysis

5.3.1. Estimation strategy of the quantitative study

Our constructs are assumed to be composite, then we performed a PLS path modeling estimation to run a confirmatory composite analysis (Henseler et al., 2014; Henseler et al., 2016) and evaluate the measurement and structural model. PLS path modeling is a suitable method of estimation to estimate and test composite models (Henseler, 2015; Benitez et al., 2020a), which has been used extensively in the IS research field (e.g., Chong et al., 2018; Xu et al., 2020; Castillo et al., 2021b). We used the software Advanced Analysis for Composites (ADANCO) 2 Professional for Windows (<http://www.composite-modeling.com/>) (Henseler and Dijkstra, 2015) for the PLS estimation. ADANCO is a new software for variance-based structural equation modeling which has implemented the newest developments in the field of PLS. Composites, common factors, and constructs with a single indicator may be modeled with ADANCO (Rueda et al., 2017; Benitez et al., 2020b). We used the bootstrap procedure, relying on 4999 subsamples to estimate the level of significance for weights, loadings, and path coefficients.

To check for the minimum sample size to have enough statistical power to find the effects of interest in the proposed model, we conducted a statistical power analysis (Benitez et al., 2020a). We assumed a medium effect size ($f^2 = 0.150$), a statistical power level of 0.800, and an alpha level of 0.05. The highest number of independent variables which receive an endogenous variable in the proposed model was five (the number of links received by innovation performance in the research model) (Benitez et al., 2018a). Based on the Cohen's power tables, the minimum sample size is 91. Our sample size is 117, higher than 91, suggesting that our sample is adequate to detect the effects of interests (Benitez et al., 2020a).

5.3.2. Measurement model evaluation

We conducted a confirmatory composite analysis (Henseler et al., 2014; Henseler, 2015) to check the overall model fit with a saturated structural model. In the saturated model, all the constructs can freely correlate. This model enables to assess potential misspecification in the measurement model (Benitez et al., 2020a; Henseler, 2017). The confirmatory composite analysis evaluates the discrepancy between the empirical correlation matrix and the saturated model-implied correlation matrix. We calculated and evaluated three types of discrepancies: standardized root mean squared residual (SRMR), unweighted least squares (ULS) discrepancy (d_{ULS}), and geodesic discrepancy (d_G) (Henseler et al., 2014; Henseler and Dijkstra, 2015) to evaluate the discrepancies at first-order, second-order, and control variables levels (Benitez et al., 2018a). Table 4 shows the results of the confirmatory composite analysis. *"All discrepancies are below the 95%-quantile of the bootstrap discrepancies, thus the saturated model should be not rejected based on an alpha level of 0.05, which suggests a very good measurement model fit"* (Benitez et al., 2018a, p. 138; Benitez et al., 2020a).

Table 4: Results of the confirmatory composite analysis (saturated model)

Discrepancy	First-order constructs			Second-order constructs			Control variables		
	Value	HI ₉₅	Conclusion	Value	HI ₉₅	Conclusion	Value	HI ₉₅	Conclusion
SRMR	0.087	0.279	Supported	0.027	0.048	Supported	0.035	0.048	Supported
d _{ULS}	0.908	9.339	Supported	0.007	0.023	Supported	0.034	0.064	Supported
d _G	0.286	4.642	Supported	0.004	0.009	Supported	0.010	0.022	Supported

Digital leadership capability, platform digitization capability, and innovation performance were modeled as composite. We ran a 4999 subsamples bootstrap analysis to evaluate multicollinearity, weights, loadings, and its level of significance, the usual criteria to evaluate the measurement properties of composites (Cenfetelli and Bassellier, 2009; Benitez et al., 2020a). Firstly, we checked whether variance inflation factor (VIF) values were below the suggested threshold of ten (Tanriverdi and Uysal, 2015). There was not a problem of multicollinearity because the indicator/dimension VIFs range from 1.049 to 3.743. All indicators of the different first-order constructs have significant weights (range: 0.256^{***}–0.608^{***}) and significant loadings (range: 0.489^{***}–0.932^{***}). In the same vein, the dimensions of business process integration and data integration also have significant weights (0.602^{***}–0.351^{***}) and significant loadings (0.924^{***}–0.814^{***}). Although the weight of the IT infrastructure integration dimension is not significant (0.233) the loading is (0.682^{***}), thus suggesting that we should keep this capability (Cenfetelli and Bassellier, 2009). Table 5 presents the measurement model evaluation at the first- and second-order levels.

Platform digitization capability is a composite second-order construct; thus, we perform the two-step approach to estimate the proposed model. First, to obtain the latent variables scores of the dimensions of platform digitization capability (IT infrastructure integration, business process integration, and data integration), we freely correlate the key first-order constructs (digital leadership capability and innovation performance) and the dimensions of the second-order

constructs (IT infrastructure integration, business process integration, and data integration). In a second step, we use these latent variable scores for the three dimensions as the ingredients to measure platform digitization capability. We used the correlation weights (mode A) to measure all constructs to increase stability, with the exception of innovation performance which was measured using sum scores (predefined weights) (Benitez et al., 2020a).

Table 5: Measurement properties evaluation at first- and second-order level⁴

Construct/indicator	Mean	S.D.	VIF	Weight	Loading
Digital leadership capability (Mode A)					
We have sufficient internal staff members who have the skills to exploit new IT trends	3.316	1.257	2.399	0.280***	0.842***
We have sufficient internal staff members, who have the skills to innovate strategic business and operating models, and envision and drive change for business performance	3.112	1.214	2.555	0.281***	0.871***
We have sufficient internal staff members who are effective in identifying and successfully deploying innovative IT applications and services to improve competitiveness	3.129	1.212	3.743	0.352***	0.932***
We have sufficient internal staff members who are capable of leading interdisciplinary staff and influencing stakeholders across boundaries (functional and geographical)	3.044	1.155	1.614	0.256***	0.750***
Platform digitization capability (Mode A)					
<i>IT infrastructure integration (Mode A)</i>					
We have reached an efficient level of technology standardization and infrastructure sharing across business units within our firm	3.216	0.985	1.310	0.562***	0.853***
We have reached an efficient level of technology standardization and infrastructure sharing with external partners	2.871	1.068	1.310	0.598***	0.871***
<i>Business process integration (Mode A)</i>					
We have effectively standardized administrative processes (e.g., HR, finance, and purchasing) and operational processes (e.g., supply chain, manufacturing, operations, sales, and customer service) across business units within our firm	3.164	1.030	1.383	0.600***	0.886***
We have effectively standardized administrative processes (e.g., HR, finance, and purchasing) and operational processes (e.g., supply chain, manufacturing, operation, sales, and customer service) with external partners (e.g., external service providers, and business partners)	2.974	1.153	1.383	0.544***	0.860***
<i>Data integration (Mode A)</i>					
We are effective at sharing standardized data (e.g., product, customer, and partner) internally (i.e., among individuals within different parts of the firm)	3.461	1.054	1.230	0.574***	0.836***
We are effective at sharing standardized data (e.g., product, customer, and partner) externally (i.e., with key partners) (e.g.,	3.070	1.111	1.230	0.608***	0.856***

⁴ Except where otherwise indicated in the table above, the possible range for measures was from 1 to 5 (1: strongly disagree, 5: strongly agree).

suppliers, customers, and other partners)					
Innovation performance (sum score)					
Natural logarithm of the percentage that firm's total revenue changed, on average, over the past two years	2.198	1.501	1.069	0.378***	0.489***
We are effective at developing new applications (e.g., application development projects are on time, within budget, and within scope)	3.284	1.298	1.049	0.378***	0.526***
Natural logarithm of the number of months that products and/or services last before they are removed or changed significantly	2.426	1.493	1.097	0.378***	0.519***
Last year, what percentage of sales came from products or services launched in the last two years?	44.776	32.602	1.055	0.378***	0.551***
Last year, approximate what percentage of customers do not change (e.g., lost or replaced) relative to the previous year (customer retention rate)	83.357	20.383	1.088	0.378***	0.559***
Digital training: At least one of the individuals responsible for firm growth and development has both formal management and IT training	3.427	1.263			
Enterprise architecture strategy (Mode A)					
<i>Internal enterprise architecture strategy (Mode A)</i>	3.877	1.101	1.118	0.766***	0.909***
It is important to our competitiveness to coordinate activities across business teams/units within our enterprise with regards to IT applications and infrastructure	3.838	1.159	1.481	0.509***	0.860***
It is important to our competitiveness to coordinate activities across business teams/units within our enterprise with regards to business processes (administrative and operational)	3.897	1.058	1.399	0.352***	0.759***
It is important to our competitiveness to coordinate activities across business teams/units within our enterprise with regards to data (e.g., product, customer, and partner)	3.897	1.091	1.509	0.370***	0.799***
<i>External enterprise architecture strategy (Mode A)</i>	3.501	1.221	1.118	0.441*	0.689***
It is important to our competitiveness to coordinate activities with external partners with regards to IT applications and infrastructure	3.521	1.208	1.449	0.341***	0.769***
It is important to our competitiveness to coordinate activities with external partners with regards to business processes (administrative and operational)	3.496	1.250	3.089	0.421***	0.915***
It is important to our competitiveness to coordinate activities with external partners with regards to data (e.g., product, customer, and partner)	3.487	1.215	3.145	0.386***	0.913***
Firm size: Natural logarithm of the total number of employees	2.747	1.498			
Industry: Non-IT industry (0) or IT industry (1)	0.402	0.492			
IT investment: Annual IT budget as of total revenue	9.667	14.189			
Firm age: Natural logarithm of the number of years operating the firm	2.343	0.537			

5.3.3. Structural model evaluation

We examined the beta coefficients and their level of significance of the proposed relationships (Benitez et al., 2018a), the R^2 and adjusted R^2 values, the overall fit of the estimated model, and the effect size (f^2) for each relationship (Benitez et al., 2020a) to test the hypotheses. To do that,

we include a model which includes the direct effect from digital leadership capability to platform digitization capability and from platform digitization capability to innovation performance. Moreover, we control for digital training on digital leadership capability for enterprise architecture strategy on platform digitization, firm size, industry, IT investment, and firm age on innovation performance. The empirical analysis supports our hypothesized relationships, suggesting that digital leadership capability enables firms to digitize the platform (H1) ($\beta = 0.379$, $p_{\text{one-tailed}} < 0.001$), which in turn improves innovation performance (H2) ($\beta = 0.193$, $p_{\text{one-tailed}} < 0.010$). Regarding to control variables, as expected, we found that digital training is associated with digital leadership capability ($\beta = 0.307$, $p_{\text{one-tailed}} < 0.001$) and enterprise architecture strategy with platform digitization capability ($\beta = 0.341$, $p_{\text{one-tailed}} < 0.001$). Moreover, we found that innovation performance depends on the firm size ($\beta = 0.169$, $p_{\text{one-tailed}} < 0.050$), firm industry ($\beta = 0.481$, $p_{\text{one-tailed}} < 0.001$), and IT investment ($\beta = 0.289$, $p_{\text{one-tailed}} < 0.001$). However, we did not find any relationship between firm age and innovation performance ($\beta = 0.037$, $p_{\text{one-tailed}} > 0.100$). Table 6 presents the estimation results.

We evaluated the R^2 and the adjusted R^2 of the endogenous variable innovation performance which were 0.324 and 0.294, respectively. Moreover, we evaluated the discrepancy between the empirical correlation matrix and the model-implied correlation matrix of the estimated model (Benitez et al., 2018b; Henseler, 2015). *"All discrepancies were below the 99%-quantile of the bootstrap discrepancies"* (Benitez et al., 2018a, p. 138), thus the proposed model has a good model fit since it *"should not be rejected based on the alpha level of 0.01"* (Braojos et al., 2019, p. 8; Henseler and Dijkstra, 2015). The hypothesized relationships have f^2 values of 0.053 and 0.201, indicating weak-medium effect sizes between the different variables in the proposed model (Henseler and Fassott, 2010).

We performed a mediation analysis to check the significance of the indirect effects involved in the proposed model. We added a link between digital leadership capability and innovation performance to estimate and analyze the indirect effect and whether it was significant or not (Zhao et al., 2010). The results show that the indirect effect was significant at 0.05 level ($\beta = 0.062$, $p_{\text{one-tailed}} < 0.050$), while the direct effect was not significant ($\beta = 0.071$, $p_{\text{one-tailed}} > 0.100$) (see Table 7) (Benitez et al., 2018a), suggesting that there exists a mediation of platform digitization capability in the impact of digital leadership capability on innovation performance. This means that digital leadership capability influences innovation performance through platform digitization capability. Table 8 shows the correlation matrix.

Table 6: Estimation results

Beta coefficient	Model		Mediation analysis	
Digital leadership capability → Platform digitization capability (H1)	0.379 ^{***} (3.897) [0.176, 0.553]		0.379 ^{***} (3.897) [0.176, 0.553]	
Platform digitization capability → Innovation performance (H2)	0.193 ^{**} (2.318) [0.023, 0.352]		0.164 [*] (1.775) [-0.030, 0.335]	
Digital leadership capability → Innovation performance			0.071 (0.792) [-0.089, 0.260]	
Digital training → Digital leadership capability (control variable)	0.307 ^{***} (3.210) [0.117, 0.490]		0.307 ^{***} (3.210) [0.117, 0.490]	
Enterprise architecture strategy → Platform digitization capability (control variable)	0.341 ^{***} (4.801) [0.213, 0.489]		0.341 ^{***} (4.801) [0.213, 0.489]	
Firm size → Innovation performance (control variable)	0.169 [*] (2.046) [0.010, 0.337]		0.165 [*] (1.982) [0.004, 0.334]	
Industry → Innovation performance (control variable)	0.481 ^{***} (6.194) [0.321, 0.624]		0.460 ^{***} (5.548) [0.283, 0.610]	
IT investment → Innovation performance (control variable)	0.289 ^{***} (3.339) [0.096, 0.437]		0.284 ^{***} (3.289) [0.094, 0.432]	
Firm age → Innovation performance (control variable)	0.037 (0.384) [-0.163, 0.213]		0.031 (0.320) [-0.168, 0.207]	
Endogenous variables	R²	Adjusted	R²	Adjusted

		R²		R²
Digital leadership capability	0.095	0.087	0.095	0.087
Platform digitization capability	0.312	0.300	0.312	0.300
Innovation performance	0.324	0.294	0.328	0.291
Discrepancy	Value	HI₉₉	Value	HI₉₉
SRMR	0.075	0.075	0.073	0.075
d_{ULS}	0.310	0.312	0.289	0.307
d_G	0.060	0.087	0.059	0.085
f²				
Digital leadership capability → Platform digitization capability (H1)	0.201		0.201	
Platform digitization capability → Innovation performance (H2)	0.053		0.031	
Digital leadership capability → Innovation performance			0.005	
Digital training → Digital leadership capability (control variable)	0.104		0.104	
Enterprise architecture strategy → Platform digitization capability (control variable)	0.163		0.163	
Firm size → Innovation performance (control variable)	0.040		0.038	
Industry → Innovation performance (control variable)	0.286		0.238	
IT investment → Innovation performance (control variable)	0.106		0.102	
Firm age → Innovation performance (control variable)	0.002		0.001	

Table 7: Mediation analysis

Relationship	Direct effect	Indirect effect	Total effect
Digital leadership capability → Innovation performance	0.071 (0.792) [-0.089, 0.260]	0.062* (1.597) [-0.009, 0.145]	0.133* (1.592) [-0.027, 0.297]

Table 8: Correlation matrix

	1	2	2.1	2.2	2.3	3	4	5	6	7	8	9	9.1	9.2
1. Digital leadership capability	1.000													
2. Platform digitization capability	0.447	1.000												
2.1. IT infrastructure integration	0.330	0.682	1.000											
2.2. Business process integration	0.339	0.924	0.484	1.000										
2.3. Data integration	0.473	0.814	0.449	0.595	1.000									
3. Innovation performance	0.304	0.242	0.104	0.270	0.157									
4. Firm size	0.155	0.066	0.055	0.089	0.001	0.251	1.000							
5. Industry	0.358	0.174	0.176	0.130	0.155	0.446	0.191	1.000						
6. IT investment	-0.115	-0.154	-0.213	-0.121	-0.090	0.068	-0.100	-0.353	1.000					
7. Firm age	0.086	-0.028	-0.043	-0.003	-0.046	0.034	0.152	0.031	-0.129	1.000				
8. Digital training	0.307	0.422	0.265	0.392	0.356	0.172	-0.127	0.230	-0.081	0.025	1.000			
9. Enterprise architecture strategy	0.210	0.412	0.344	0.375	0.304	0.098	0.209	0.150	-0.136	0.072	0.318	1.000		
9.1. Internal enterprise architecture strategy	0.216	0.351	0.227	0.338	0.270	0.075	0.210	0.139	-0.126	0.155	0.296	0.909	1.000	
9.2. External enterprise architecture strategy	0.102	0.326	0.386	0.263	0.221	0.091	0.107	0.098	-0.090	-0.106	0.207	0.689	0.324	1.000

6. Discussion and core conclusions

This study used a mixed-methods approach by performing two stages. In the first phase, we used a multi-case study to elicit the nature of the relation between digital leadership capability and innovation performance using 16 semi-structured interviews from ten SMEs. Building upon the qualitative study findings, we found three major themes relating to digital leadership capability and innovation performance: IT infrastructure integration, business process integration, and data integration (i.e., platform digitization capability). Then, this research examined the role of two critical IT capabilities, which are digital leadership capability and platform digitization capability, in their impact on innovation performance. In the second phase, we tested our research model on a sample of 117 European firms, and the empirical analysis suggests that digital leadership capability helps firms to digitize the platform, which in turn impact innovation performance.

The empirical analysis suggests that digital leadership capability has a positive relation with platform digitization capability, which in turn has a positive relationship with innovation performance. This may be explained because digitize the platform, that is, standardizing and integrating IT infrastructure, business process, and data, requires a composite of digital, market, business, and strategic leadership skills. Having deep expertise about IT architecture and business processes, as well as deep knowledge about domain, industry, products, and customers along with the ability to facilitate the translation between people who talk business and people who talk IT, facilitates the integration of IT infrastructure, business process, and data. Moreover, platform digitization capability provides platform simplification and business agility, enabling firms to increase efficiency, to be agile, and thus to respond quickly to changes and develop new products and services, improving innovation performance (Roberts and Grover, 2012). The results support our theory (i.e., digital leadership capability enables platform digitization capability, which in

turn enables innovation performance). This research makes four major theoretical contributions to the IS research.

First, this research introduces and develops the constructs of digital leadership capability and platform digitization capability. We develop and test digital leadership capability as the firm's ability to capitalize on the digital, market, business, and strategic leadership skills of digital leaders to lead and manage interdisciplinary people to transform digitally the firm. Drawing from the managerial research of Weill and Ross's (2009) on platform digitization, we define and operationalize the concept of platform digitization capability as the firm's ability to integrate IT infrastructure, business processes, and data to build and leverage a digital platform to drive consistent performance. *Second*, the role of digital leadership capability in a variation on firm performance has been underexplored empirically. Using a mixed-methods approach, we contribute to shed light on this topic by providing theoretical and empirical evidence about how digital leadership capability may enable innovation performance. Embracing the organizational capabilities-based theory and IT capabilities, we found that digital leadership capability is a lower-order capability that affects innovation performance indirectly because it needs a higher-order capability to impact innovation performance.

Third, this research takes important steps toward a comprehensive understanding of the role of platform digitization capability in creating value. Guiding by the qualitative study results, we found platform digitization capability as a mediator variable between digital leadership capability and innovation performance. Prior managerial studies have suggested the importance of a digitized platform; however, there are challenges about taking benefits from a digitized platform in terms of time, money, and risk. This is because highly integrated business processes make that even small changes in one process affect the whole. We found that digital leadership capability enables platform digitization capability which in turn enables innovation performance. A

digitized platform may provide simplification and business agility, which enable a firm to respond quickly to changes and take competitive actions in developing new products and services (Roberts and Grover, 2012). *Forth*, we contribute to IS research and extend the organizational capabilities-based theory and IT capabilities by arguing theoretically and testing empirically that there also exists a hierarchy of capabilities of IT. In the same way, there are lower-order organizational capabilities that enable higher-order organizational capabilities, and there are lower-order IT capabilities that affect indirectly firm performance through higher-order IT capabilities. In our study, we found that digital leadership capability is a lower-order IT capability that needs platform digitization capability, which is a higher-order IT capability, to influence innovation performance. These higher-order IT capabilities influence firm innovation directly, providing a superior value (Benitez et al., 2018a).

Even though this research has important contributions for IS area, the results are not exempt from limitations. First, due to the sample nature, our results can be only referred to European firms because we have not analyzed whether our hypotheses are supported in non-European firms. Due to the potential different cultures between European firms and non-European firms, IS research should examine whether these results are supported in firms outside Europe. Second, we may not claim causality with absolute certainty and we encourage IS scholars to obtain evidence based on longitudinal research (Chen et al., 2015).

The findings of this research also provide lessons to managers. This research unveils that the leaders are key in developing and executing digital transformation programs by integrating IT infrastructure, business processes, and data. Leaders must be ambidextrous, able to speak business and IT, and consider platform digitization as paramount to the success of the firm. In this way, leaders need to acquire a portfolio of digital, market, business, and strategic leadership skills to lead the transformation of the firm. Moreover, leaders must reexamine the architecture of

its platform to satisfy the growing demands from stakeholders to engage digitally and facilitate innovation. By standardizing and automatizing business processes, leaders may focus attention on what is changing and pursue and improve innovation.

7. Key conclusions

In this research, we examined the role of digital leadership capability in the contribution to innovation performance. Guiding by the mixed-methods approach results, we found platform digitization capability as a necessary factor in the relationship between digital leadership capability and innovation performance. Platform digitization capability is composed of three elements: IT infrastructure integration, business process integration, and data integration and is considered as a higher-order IT capability that is facilitated by digital leadership capability (i.e., a lower-order IT capability) and impacts on innovation performance. Then, we concluded that digital leadership capability is positively associated with platform digitization capability, which in turn is positively associated with innovation performance. Our results show to business leaders that they need to develop digital leadership capability to be able to digitize the platform to innovate and outperform direct competitors. Quo Vadis?

8. References

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Appendix 1. Interview questionnaire

Background and overview of the company

- When and by whom was the company founded?
- Where is the company headquartered? Does it have units elsewhere?
- How many employees are there in the firm (by year for last 3 years)?
- What are the core products/services of the company?
- In what sector does the company provide those products/services?
- Who are the customers of the company?

Use of digital technologies in the company

- Overall, how is ICT used strategically in your organization and who is responsible for those uses?
- Is there an equivalent to a chief information officer – i.e., someone who is responsible for orchestrating application development, operation, and maintenance?
- Does your organization have an informal or formal ICT or digitization strategy? If so, what is it and how was it developed?
- How is total spending (capital plus operations excluding depreciation) on ICT distributed across these three areas (in terms of percentages)?

Digital leaders and innovation

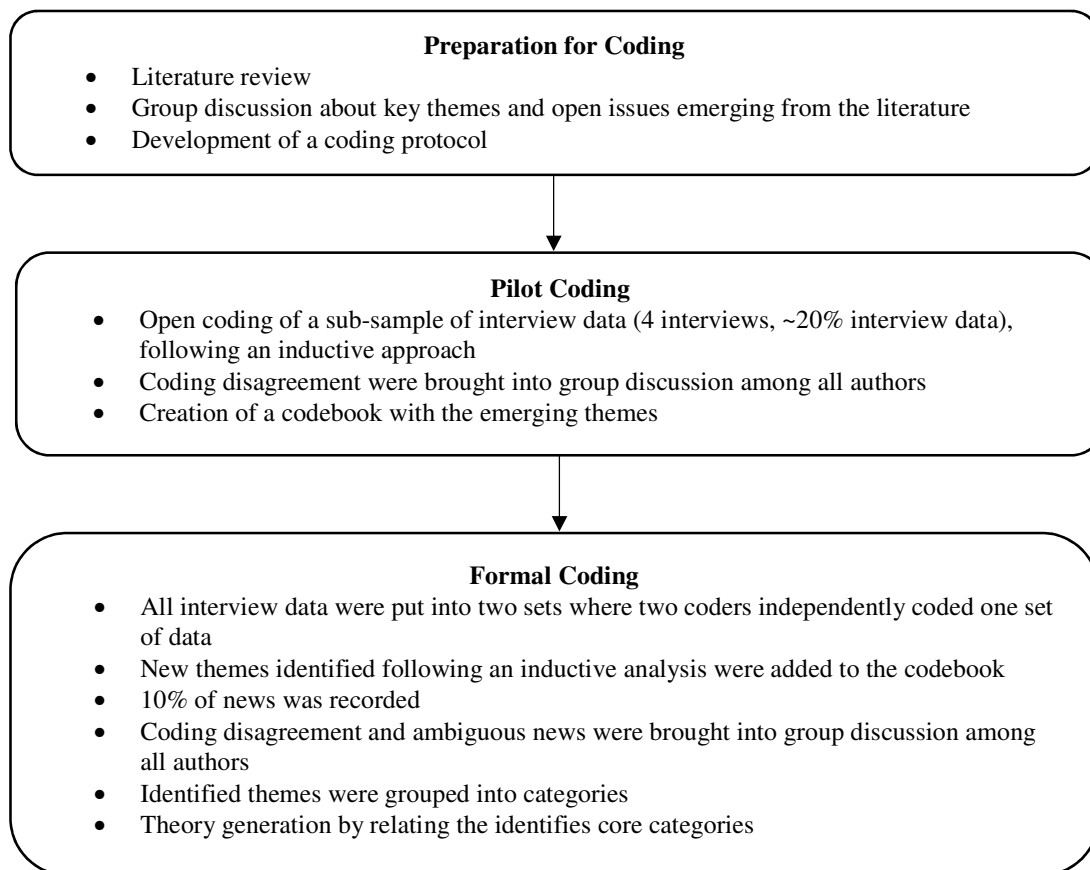
- What was the most significant innovation that was realized during the last year?
- What was the process by which the innovation was developed?
- What role(s) did ICT have in the process? Did the innovation rely on any of the following ICT?
 - Mobility and mobile apps development
 - Cloud computing
 - Data analytics (e.g., "big data")
 - Social media technologies
 - The Internet of things (IoT) (incl. wearable computing)
- Who were the key leaders involved in the innovation process responsible for managing the uses of ICT? What did they do during the process?
- How did your firm obtain advanced ICT skills for using any of the aforementioned technologies? Was it difficult to find any advanced ICT skills? (if so, please explain)
- Did you rely on partners, consulting services, or other external service providers to access the ICT skills needed for the innovation? (if so, please explain)

Appendix 2. Table showing details of data sources for qualitative data collection

Our data were collected from two primary sources. Details of each data source and its use in the analyses are provided in the table below.

Data source	Details and use in the analysis
Interviews with companies Number of companies: 10 Number of informants: 16 Date: 2014	Interviews lasted on average 49 minutes. Interviews were conducted on-site or via Skype. Interviews were transcribed and accounted for a total of 179 double-spaced pages. Questions in the interviews inquired about the use of digital technologies, digital leaders, skills required by digital leaders, and innovation performance. The list of questions is provided in Appendix 1.
Archival data obtained or published by the companies between 2014 and 2015, including company reports and press releases. Number of documents: 76	Triangulate observations about digital leaders, platform digitization, and innovation performance.

Appendix 3. Coding process



Appendix 4. Data structure summarizing the data analysis process during the qualitative study

