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UNLOCKING THE DIGITAL ORGANIZATION: A VIEW OF THE DIGITAL TRANSFORMATION CAPABILITIES

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Unlocking the digital organization: a view of the digital transformation capabilities

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Dedicatória

Dedico esta tese de doutorado ao caminho trilhado. Um longo, silencioso e solitário caminho que, finalmente, encerra uma jornada intensa e imprevisível aos primeiros olhares. Um caminho que, de forma poética, ecoa o filósofo Michel Serres em seu livro "Filosofia Mestiça", quando fala sobre a produção de sentido longe dos equilíbrios postos *à priori.*

Ele diz: *ninguém sabe nadar de fato antes de ter atravessado, sozinho, um rio largo e impetuoso, um braço de mar agitado [...] Parta, mergulhe. [...] Até um certo limiar, você conserva esta segurança: o mesmo que dizer que ainda não partiu. Do outro lado da aventura, o pé confia na aproximação, desde que tenha ultrapassado um segundo limiar: você está tão próximo da margem que pode dizer que já chegou. Margem direita ou esquerda, não importa, nos dois casos: terra ou chão. Você não nada, espera para andar, como quem salta, decola e atinge o chão, mas não permanece em vôo. [...]*

A verdadeira passagem ocorre no meio. [...] O corpo que atravessa aprende certamente um segundo mundo, aquele para o qual se dirige, onde se fala outra língua. Mas ele se inicia sobretudo num terceiro, pelo qual transita. Ele não andará mais nem se erguerá mais como quando só sabia ficar de pé ou andar: bípede antes desse evento, ei-Io agora carne e peixe. Não apenas mudou de margem, [...] também conheceu o traço de união: homem-rã. O primeiro animal desfruta de um domínio, o segundo bicho também, mas o estranho vivente que um dia entrou no rio branco que corre dentro do rio visível, e que teve que se adaptar, [...], às suas águas extravagantes, abandonou qualquer domínio.

Dedico essa tese, portanto, à coragem de ter atravessado tal rio largo e impetuoso e, sobretudo, às conexões que me ajudaram a nutrir esta coragem.

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Em algum momento da história, João de Salisbury atribuiu a outro Bernardo, o Bernardo de Chartres, a seguinte passagem: “Bernardo de Chartres costumava nos comparar a anões empoleirados nos ombros de gigantes. Ele ressaltou que podemos ver mais e mais longe do que nossos predecessores, não porque temos visão mais aguçada ou maior altura, mas porque somos levantados e carregados sobre sua estatura gigantesca.”

Eu, outro Bernardo, me vejo assim nesta jornada do doutorado, um anão empoleirado nos ombros de gigantes. Dessa forma, meus agradecimentos vão, fundamentalmente, aos gigantes que me permitiram elaborar esta tese. Primeiramente, sinto-me muito privilegiado de ter contado com o apoio da minha família (mãe, pai e irmão), cujo suporte incondicional de afeto e atenção representaram um chão sólido no qual eu pude me movimentar e descobrir inúmeras e diferentes realidades.

Outro gigante reconhecido nesta jornada é a instituição UFRGS. Eu vivenciei a UFRGS desde 1996 quando entrei na primeira série no colégio de Aplicação. Desde então, pude desfrutar de um ensino público de qualidade no ensino fundamental, médio, superior, mestrado e, agora, doutorado. Esta instituição representa, de diversas formas, as portas e as pontes que me permitiram desenvolver minha subjetividade, meus alicerces de conhecimento, conexões profundas de trocas significativas e, por duas vezes, o mundo.

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De outra forma, gigantes foram as conexões íntimas de afeto e suporte emocional que me apoiaram na realização desta tese de doutorado. Esta jornada ardilosa e solitária exige um preço alto de determinação e resiliência. Assim, é impossível chegar neste momento sem estar com um sentimento enorme e incrível de gratidão a todas as demonstrações de afeto que eu recebi ao longo deste período. Elas representaram um necessário e essencial tecido que me garantia a saúde emocional e mental.

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ABSTRACT

Digital transformation is a complex process enabled by the application of digital technologies that fundamentally change the business model of organizations, altering their ways of capturing and generating value, their organizational processes, routines, sources of revenue, and resources. It is such a pressing phenomenon in the current context (accentuated by the COVID-19 pandemic) that all organizations will be impacted and will have to deal with it sooner or later. Thus, to understand the mechanisms that assist organizations in creating strategic conditions for successful transformations, this thesis focuses on the phenomenon and seeks a deep understanding of the elements that compose it. Through a comprehensive and robust work that mixes qualitative methods (such as systematic review and multiple case studies) with quantitative methods (such as EFA and PLS), the thesis presents significant and impactful results. Among them are (i) the proposition of a *Digital Transformation Dynamic Capability* framework and (ii) a subsequent capability-based maturity model, and (iii) the proposition of a model (statistically tested in SMEs) about the framework's antecedent factors. A distinct point of this theoretical proposition is the use of dynamic capabilities lens for the framework organization - allowing the understanding of the phenomenon as a process to be continuously pursued. Thus, the main contributions lie in a comprehensive and original approach that can guide organizations to articulate and develop the conditions to unlock the capability to digitally transform their business model - which can lead to a capacity for continuous change in the digital context. Furthermore, it offers robust and timely research whose models condense a knowledge corpus from which future research can benefit.

Keywords: digital transformation; digital maturity; dynamics capabilities; business model

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Chapter 1 - Introduction

Business transformation driven by emerging digital technologies and innovations is not a new issue. The worldwide spread of the Internet in the late 1990s and early 2000s, for example, brought about large-scale revolutions in the operations, strategies, and business models of companies in many different industries, completely revamping some cases (e.g., the music and newspaper industries) and transforming others. While its effects are still spreading, its consequences are still being studied and understood.

However, even if the current digital transformation phenomenon can be seen as a new instance of something we have already experienced, it happens in a complex context that sets it apart. First of all, the digital technologies are different. The current wave of digital transformation is based on the constant emergence of profoundly transformative technologies, such as artificial intelligence, additive manufacturing, augmented and virtual reality, the internet of things, distributed registries (blockchain, for example), and 5G networks. Not restricted to the virtual sphere, these technologies increasingly impact the physical world through smart products, autonomous vehicles, and versatile drones and robots (Iansiti and Lakhani 2014; Porter and Heppelmann 2014).

Second, there is the scale of the phenomenon. The current business scenario is marked by digital players that renew industries and markets (e.g., Spotify, UBER, Airbnb), increasingly informed and demanding consumers (Fernández-Rovira et al. 2021; Shakina et al. 2021; Warner and Wäger 2019), and a global crisis caused by the outbreak of the new coronavirus (COVID-19). This context substantially challenges the logic of business model creation and value proposition (Skog, Wimelius, and Seberg 2018) and puts pressure on companies to seek ways to deliver their products and services digitally (Seetharaman 2020). It is noteworthy that such a context, even before the pandemic, demonstrated a strong orientation to digital (Kane 2019): 87% of companies believed in disruptions caused by technologies in their industries to a large or moderate extent, and 84% agreed or strongly agreed that becoming a digital business was essential to the success of their organization. Thus, with the scale and pace of adoption of digital innovations increasing, it can be expected that new industries will continue to be created, while others will soon become extinct, even if some of the digital technologies employed are still very immature.

Third, there appear to be no generic paths to successful digital transformation at the enterprise level. Research on the topic is so far multidisciplinary and still developing, with growing interest from researchers (Vaska et al. 2021; Verhoef et al. 2021). However, despite the growing volume of conceptual or empirical research examining how organizations are digitally transformed, the scientific literature seems to lag behind the practical world (Fernández-Rovira et al. 2021; Warner and Wager 2019; Li 2020). For example, success cases differ in many ways, producing few generalizable ideas about how to drive the digital transformation process (e.g., Dery, Sebastian, and Meulen 2017; Soluk and Kammerlander 2021).

This context exposes the fact that digital transformation is a complex phenomenon that goes beyond incorporating new digital technologies into certain activities to optimize internal processes, gain efficiency or productivity, and cost savings (Eling and Lehmann 2017; Bouncken, Kraus, and Roig-Tierno 2019; Bouwman, Nikou, and de Reuver 2019). Especially, this fact became evident

with the pandemic: companies were forced to convert their processes to a digital format and realized that such an effort was not a quick project, nor was it limited to introducing a series of new systems (such as video conferencing solutions) or creating an e-commerce website (Fletcher and Griffiths 2020).

Furthermore, digital transformation is rarely straightforward or simple. It requires substantially renewing a company's organization and strategy (Saarikko et al. 2020). Ultimately, it will involve finding and developing a digitized business model through business model innovation, contemplating new revenue streams, changes in value offerings, and restructuring (Gong and Ribiere 2021; Bharadwaj et al. 2013; Sebastian et al. 2017; Tumbas, Berente, and vom Brocke 2017).

Specifically, the reality of digital transformation can be particularly complex and laborious for pre-digital incumbent organizations. The dependency created on what has already been established as a business model becomes a significant barrier that can erode the process if not overcome (Foss and Saebi 2018; Kim and Min 2015) - which is reflected in the numerous macro-environmental and institutional contingencies. For example, companies may have an insufficient structure that allows them to adapt their value proposition for the digital age (Kane et al. 2018), and in this sense, organizations that have not updated their technological base in recent times may not be able to sustain a digital logic. The organizational resources that allowed companies to succeed in non-digital environments often become rigid, passive, and obsolete (Matt, Hess, and Benlian 2015; Yeow, Soh, and Hansen 2018). Thus, to support a new and digital pace an adequate infrastructure is required.

In addition, the pace of change is increasing, and it is necessary to have the ability to adapt to a rapidly evolving environment. As Rachinger et al. (2018) suggest, the impact of digital transformation is pervasive, and in order to exploit new opportunities, companies need to act and respond differently than before. Working in a digital environment imposes, for example, another pace to business, another culture, and mindset, different ways of collaborating (Warner and Wäger 2019), and another technological and governance structure (Chanias, Myers, and Hess 2019; Skog 2016). Thus, a portion of the challenge lies in the lack of culture and skills in dealing with the phenomenon (Khin and Ho 2019), and beyond information technology skills. According to Carcary, Doherty, and Conway (2016), organizations need competencies that address distinct areas of expertise and that relate to the specific needs of the organization and its specific industry. Equally pressing is the case of leadership posture and behavior. In incumbent companies, managers may be unwilling to experiment with new business model possibilities: there is a tendency to favor models with higher gross margins through rules, norms, and metrics to maintain the status quo and resist experimentation that might threaten existing business models (Warner and Wäger 2019).

On top of all this, it is also important to consider at least two other aggravating factors. The first is that digital transformation takes time. As Teece (2018) points out, business models are more context-dependent than technology-dependent, and business model changes can take time to catch up with technological possibilities. The second aggravating factor, highlighted by Remane et al. (2017a), is established from the possibility that inertia inhibits fundamental change - even when the organization recognizes that change is necessary. In cases where there is no openness to change, what Crittenden, Crittenden, and Crittenden (2019) call inflection points, incumbent companies can

make room for nascent companies (startups) to develop from possible customer frustrations or lack of competence or willingness to change.

Therefore, how to prepare and succeed in transforming the business model in the face of digital disruptions is an open question. In order to answer it, it is necessary to consider different theoretical and conceptual approaches through which the digital transformation phenomenon can be understood. In this regard, some authors (e.g., Kane et al. 2018; and Mettler and Pinto 2018) indicate that studying digital transformation through the concept of digital maturity of companies is a timely approach, as it enables organizations to understand how they can adapt and reduce gaps in engaging in a continuous process of adequacy. Another important matter of the digital maturity approach is the understanding that transformation is typically not linear (Remane et al. 2017b): organizations mature in different ways, at different rates, and in different directions, depending on various organizational characteristics, such as company size, business model, and industry sector. However, understanding the digital maturity of organizations is usually done through maturity models that have some flaws, such as generic approaches based on standardized questionnaires that suggest the existence of a final state of a fully digitalized organization and disregard contingency issues - which happens both in theoretical (Chanias and Hess 2016) and in practice-based models (Remane et al. 2017b). Equally questionable are the ways in which the models are evaluated (Chanias and Hess 2016). In other words, there is a clear gap in digital maturity models and a lack of guidance for organizations to think about forming strategies to generate competitive advantage in the digital age.

Another theoretical-conceptual approach identified in several studies is the use of the dynamic capabilities perspective (Teece 2007) to understand the capabilities required for digital transformation at the firm level. Such a course, as Vial (2019) indicates, seems particularly viable, as this theoretical perspective has been found to be significantly valuable in contexts of environmental turbulence (Teece 2014). Thus, recent studies have attempted to frame which capabilities would be particularly relevant for digital transformation (e.g., Tortora et al. 2021; Enkel and Sagmeister 2020; Warner and Wäger 2019). However, such literature is still nascent and exploratory and considers dynamic capabilities as predictors or facilitators of the digital transformation process. Typically, conceptualizations of DC comprise generic relationships with digital technologies (e.g., Yeow, Soh, and Hansen 2018), context-specific and not generalizable nor exhaustive findings (e.g., Chirumalla 2021; Soluk and Kammerlander 2021; Matarazzo et al. 2021), and, in some cases, incongruous, fuzzy, or overlapping results. One reason for such disconnected and contrasting results may be insufficient theoretical structuring and systematization on the role of dynamic capabilities in digital transformation, which meets a gap identified by Annarelli et al. (2021). The authors pointed out the need to further examine the interface between digital transformation features with dynamic capabilities characteristics through more theory building and testing. Consequently, in line with what Gong and Ribiere (2021) state in their systematic review, the interaction between dynamic capabilities and digital transformation is still an open field that requires further examination.

So, as much as digital business transformation is not a new subject (according to Carcary, Doherty, and Conway 2016), we argue that

1. there is demand for more knowledge about the topic (Spieth, Schneckenberg, and Ricart 2014; Visnjic, Wiengarten, and Neely 2014; Dery, Sebastian, and Meulen 2017);

2. there is a little academic exploration of practical issues, such as, the renewal and composition of digital strategies (Fernández-Rovira et al. 2021; Warner and Wager 2019; Li 2020);

3. there is a lack of literature with a unified perspective that proposes the theoretical foundations for future research (Kohli and Melville 2018). According to Ferreira, Fernees, and Ferreira (2019) and Holmström (2018), there is a need for research that addresses concepts and theoretical constructs that reflect the myriad ways in which digital transformation changes business in practice; and

4. there are significant gaps in approaches to understanding new skill development; agreeing with Lenka, Parida, and Wincent (2016), this field is open to research. Thus, it is necessary to understand what competencies are needed to instigate and induce systematic change for organizations to be successful in promoting a digital business model (Li 2020), and to keep adapting it in the face of digital innovations.

Finally, it is noted that most of the research on digital transformation is produced in developed societies and economies characterized by institutional, regulatory, and technological regimes environments that are substantially different from those found in emergent economies such as Brazil. Therefore, there is the need to shed light on local particularities and contingencies. In this context, we highlight the potential benefits that digital transformation can bring to Brazilian companies that successfully innovate their business models. It is also noted that the problem of facing digital transformation is more pressing and complex for small and medium-sized enterprises (Sommer 2015), which make up most of the Brazilian productive fabric. Since the literature on digital transformation in small and medium-sized enterprises is still quite incipient (Chan et al. 2017), the importance of the contribution to be generated by this thesis remains characterized.

1.2 Theme and objectives

Given the research theme of innovation management with an emphasis on digital transformation, seeking to fill a significant theoretical gap in the production of knowledge about the digital transformation phenomenon, the present thesis is based on the gaps identified regarding the need to understand the phenomenon holistically, at the firm level, and addresses the following research question:

> *what are the organizational capabilities involved in the digital transformation process, and how do they assist the organizations in creating strategies and facilitating conditions to carry out the process?*

Therefore, in order to answer the research question, this thesis aims

to structure an analytic framework of the digital transformation process, understanding its relevant factors and variables; and to compose a maturity model based on capabilities that can guide organizations that intend to carry out the digital transformation process.

In order to achieve these objectives, the thesis unfolds in the

1. proposition of an organizational capabilities framework for digital transformation based on the dynamic capabilities lens (Teece 2007), which is developed following the pattern-matching design approach (Bouncken et al. 2021);
2. the development and testing of a maturity model based on the developed framework;
3. the exploration of the antecedent factors proposed in the framework through

1.3 Study design

This section presents the study design by which the defined objectives will be achieved, considering the research method and the working method that will be used.

1.3.1 Research Method

This research is classified, from the point of view of its nature, as applied research because it attempts to solve a specific real-world problem based on scientific method (Gil 2007), which in this case is the process of digital transformation in organizations.

According to its objectives, the research is classified as exploratory since it seeks greater familiarity with the proposed theme. According to Cooper and Schindler (2003), through exploratory research the researcher can develop concepts more clearly, establish new priorities and develop operational definitions that can improve the final planning of the research. Also, the research can be classified as descriptive because it expresses the facts and phenomena of a given reality (Silveira and Cordova 2009), which in this case are, in part, organizations that are in the process of digital transformation.

Considering the research approach, the thesis is classified as qualitative and quantitative because all the information will come from primary and secondary sources and data, and there is a concern with deepening the understanding of a particular phenomenon that occurs within companies and focuses on understanding and explaining some types of relationships (Silveira and Cordova 2009). In addition, it can be classified as prescriptive, because it contemplates the proposition of results that serve to guide/aid decision making.

1.3.2 Methods used

This research is composed and presented in the format of articles and supplementary materials. Regarding the method used, these articles have specific objectives necessary to achieve the general objective of the thesis, and different research methods were used. Table 1.1 and Figure 1.1 show the structure of the work, with the articles' objectives and methods.

Chapter 2 opens the thesis by discussing the main concepts of the digital transformation phenomenon. Besides the context, the aspects discussed in the literature are presented, such as the reasons to digitize a business model, main developments and challenges, main technologies, and

aspects related to the understanding of digital maturity. Next, the theory of dynamic capabilities is presented and discussed, which will serve as theoretical support for the development of the framework of this thesis.

Chapter 3 is an article comprising two complementary research efforts: a systematic review of digital maturity models, and a multiple case study with four companies. Initially thought of as just a systematic review article, along with the evolution of the article during the submission process to scientific journals, the article has been adjusted to contain a theoretical model and an empirical model. Therefore, using an approach of confrontation between theoretical and empirical reality, the final result is a comprehensive study that proposes a framework for the capabilities to carry out the digital transformation process and to scale the digital maturity of a business model supported by the theory of dynamic capabilities.

Chapter 4 is a development of the previous chapter and has as its main objective to make the framework tangible by proposing an instrument to measure the maturity of the capabilities to carry out the digital transformation process. This instrument was tested and validated with experts in the field of innovation and applied to 43 Italian companies. Thus, the main result is a descriptive diagnosis of the main strengths of the organizations, which supports and directs decision-making at the organizational level or, more broadly, such as the constitution of targeted public policies.

Using an analysis that blends qualitative and quantitative methods, the article that constitutes chapter 5 explores the antecedent factors of the capabilities of the framework developed in chapter 3. Thus, this chapter, like chapter 3, comprises two surveys in one article, exploring organizational, cultural, and leadership-related factors. First, an exploratory survey with thirteen specialists in the area of innovation was carried out. As a result, a conceptual model with six constructs and hypotheses was generated. To test it, an instrument was proposed, applied, and validated through quantitative research with a sample of 192 small and medium Brazilian companies. Exploratory factor analysis (EFA) was used to validate the instrument and Partial Least Squares Structural Equation Model (PLS-SEM) for hypothesis testing.

Table 1.1 - Structure of the research stages

Chapter	Purpose	Research methods
Chapter 2: Literature review and theoretical background	Literature review of the main concepts of digital transformation, digital maturity, and dynamic capabilities lens	Bibliographic research through literature review
Chapter 3: The proposition of the framework developed through the article* *Exploring digital transformation capability via a blended perspective of dynamic capabilities and digital maturity: a pattern matching approach.* *The article is in the third round of a major review in the journal Review of Managerial Science (Qualis A1, impact factor 5,435 - 2021)	Definition of a theoretical capabilities model based on digital maturity models. Definition of a capability model based on case studies. Confrontation of the models and proposition of the *the digital transformation dynamic capability framework*	Qualitative research was conducted through (i) a systematic literature review (for the proposition of the theoretical model), (ii) multiple case studies (for the composition of the empirical model), and the confrontation between the models through the flexible pattern matching approach
Chapter 4: proposition of a maturity model based on the framework from chapter 3, developed through the article *Capability-based maturity model development: Digital Transformation Dynamic Capability Maturity Model*	Proposition and application of a maturity model based on the framework of chapter 3 and its application in 43 companies.	Quantitative research was carried out through a survey of 43 companies, with descriptive data analysis.

Chapter 5: the exploration of the antecedent factors of the framework developed through the article* *The contribution of organizational culture, structure, and leadership factors in the digital transformation of SMEs: a mixed-methods approach*). *Article published in the journal Cognition, Technology & Work (Qualis A1, impact factor 2,818 - 2021)	Exploring and modeling the antecedent factors of the framework in chapter 3. Identification of the cultural, structural, and leadership factors that influence digital transformation and the understanding of how they relate to the process and each other	A research proposal with mixed methods. In the qualitative part, a model and hypotheses were developed based on specialist interviews and analyzed using grounded theory methods. In the quantitative part, the model was measured through the proposition and validation of an instrument with a sample of 192 companies. The data were analyzed using Exploratory Factors Analysis (EFA), and Partial Least Squares Structural Equation Model (PLS-SEM)

Source: elaborated by the author

1.4 Research delimitations

The research aims to formulate a firm-level digital transformation framework. Therefore, a number of elements external to the innovation management process are not being explicitly considered, such as the political and economic environment, among other environmental context variables. Another important aspect is that the developed framework has a direct but unmeasured link to performance measurement and results obtained in digital transformation. As will be seen in the sequel, the developed thesis is based on understanding what digitally mature companies present in terms of organizational capabilities. Thus, although the results are linked to the digital transformation process, they do not address a measured relationship between possible organizational results and actual performance.

Furthermore, the organizations verified in the development of the thesis are limited to their contingent contexts. However, there was an effort to conduct international research; chapters 4 and 5, for example, count only on companies from one country.

1.5 Organization of the thesis

This thesis has a structure that reflects the complexity of dealing with a subject that was developing throughout the thesis building. In particular, due to an exchange carried out during the thesis (and during the intermediate phase of the pandemic) and the operationalization of the thesis as a collection of articles, some of the results have been added as appendices. This is the case of Appendix 3C, which was prepared during the exchange period at Politecnico di Milano (Italy) while the article in Chapter 3 was in the process of submission. Thus, the results obtained during the exchange were added in the sequence of the article as an appendix. Figure 1.1 is intended to aid in understanding what was accomplished in the thesis.

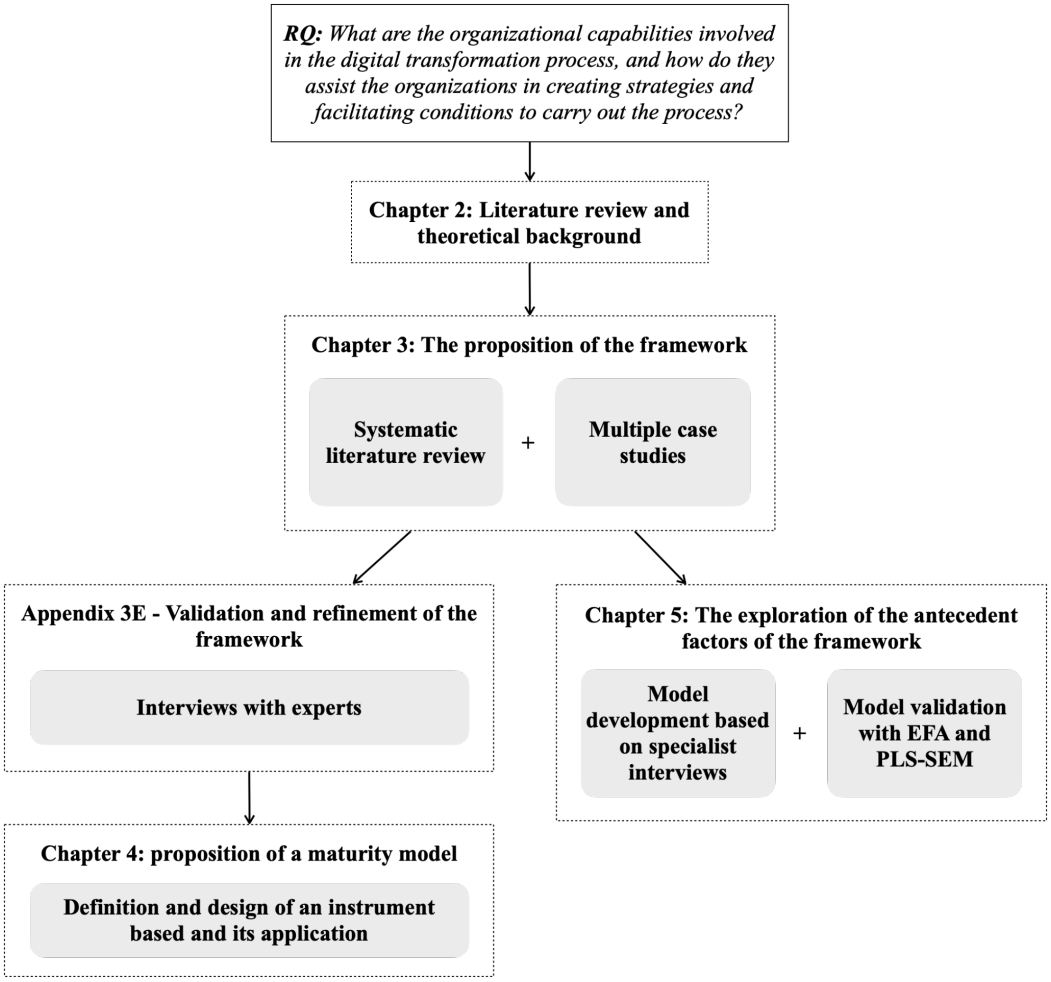

Figure 1.1 - The thesis structure

Source: elaborated by the author

Chapter 2 - Literature review and theoretical background

This chapter presents the literature review and the theoretical background by exploring the main elements that constitute the theme of digital transformation. Because this thesis comprises three articles, this section provides a compendium of the theoretical and conceptual framework unfolded in each article.

Strongly inspired by the works of Vial (2019) and Gong and Ribiere (2021), the first part of the chapter is structured in the following sections:

1. Concepts, outcomes, and implications
2. Reasons to transform
3. Digital strategy
4. Digital technologies and resources involved
5. Barriers and challenges

Next, concepts linked to digital maturity and dynamic capabilities theory are presented and discussed.

Figure 2.1 helps in understanding the big picture of the digital transformation theme, contemplating the aforementioned topics within a scheme of the phenomenon's main characteristics.

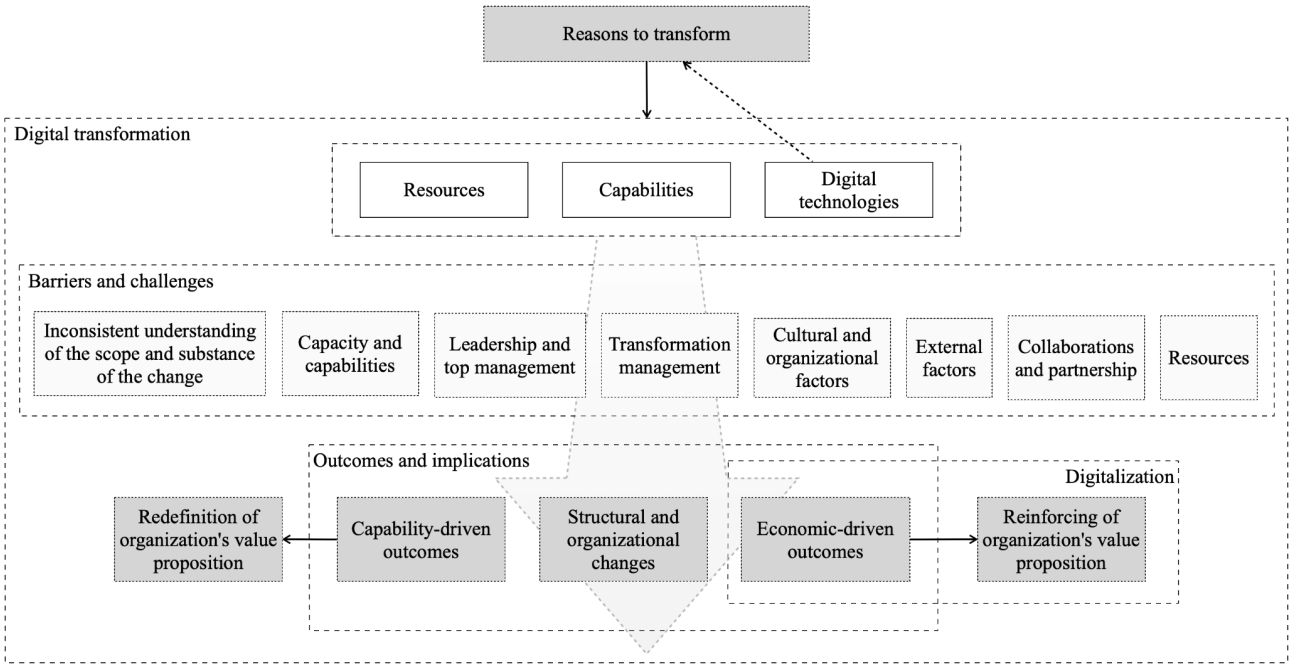

Figure 2.1 - Digital transformation main characteristics

Source: elaborated by the author

2.1 Concepts, outcomes, and implications

The theme of digital transformation, with its various developments and impacts, has attracted the attention of academics and practitioners in recent years. The attention paid to the phenomenon by the generalist press and consulting firms is remarkable. Gartner, a leading technology strategy consultancy, reports that digital transformation is the third biggest concern for

the coming years by executives heard in the 2018 CEO Survey, only behind timeless concerns such as corporate growth and development (Duerst and Tratz-Ryan 2018). Consulting firm McKinsey also emphasizes the revolutionary potential of digital transformation and the prominent interest devoted to the phenomenon by executives and strategists (Sieber and Seager 2017).

From an academic and theoretical-scientific point of view, attempts to define and understand the digital transformation phenomenon and its effects are usually structured from a multidisciplinary and plural perspective (Martín-Peña, Díaz-Garrido, and Sánchez-López 2018). In general, the literature on the phenomenon addresses themes as diverse as the determination of types and classes of digital business models (Zhang, Lichtenstein, and Geer 2015). It includes, for instance, decentralization of teams (Lyytinen, Yoo, and Bole Jr. 2015), redefinition of time and space boundaries of processes, products, and services (Nambisan et al. 2017; Zheng, Yang, and Cheng 2018), impact on organizational *modus operandi* arising from the entry into the workforce of the so-called 'born digital' (Sawy et al 2016), social impacts of digital transformation (Loebbecke and Picot 2015; Davison and Ou 2017), determining capabilities to undertake digital transformations (Gupta and George 2016; Li 2020) or benefit from them (Helfat and Raubitschek 2018), and measuring the level of digital maturity of organizations (Mettler and Pinto 2018), among others. Hence, despite the growing volume of research conducted on the topic, it is clear that the current state of theory on digital transformation is still fragmented and incipient (Holmström 2018). The literature is beginning to capture the specifics associated with the phenomenon, but in general, efforts are primarily exploratory, mostly based on case studies (Sawy et al. 2016; Kien, Soh, and Weill 2016; Rymaszewska, Helo, and Gunasekaran 2017; Sánchez-Montesinos et al. 2018) and the theoretical perspectives, diffuse (Gong and Ribiere 2021).

Such fragmentation generates divergence about the term and reflects the difficulty of having a definition for the phenomenon. According to Warner and Wäger (2019), this is problematic because the misuse of terms creates confusion. In this sense, according to Kotarba (2017), the meaning of "digital" and "digitization" tends to be either highly underestimated (e.g., when it is limited to the conversion of analog to digital media) or highly overestimated, turning the topic into a mystical "invisible hand" of innovation and social development. For example, Yeow, Soh, and Hansen (2018) and Rogers (2016) indicate that "digital" does not belong only to technical instances but is certainly a transformational and organizational phenomenon and that "digital transformation is not fundamentally about technology, but about strategy." However, in the literature, there are pieces of evidence of different utilization of the terms. Many studies use the terms *digitization*, *digitalization*, and *digital transformation* equivalently, while multiple works do not even define the boundaries of the phenomenon they are discussing. In any way, this is problematic as it generates questioning results and implications on the theoretical and practical. Thus, it is necessary to promote a brief discussion about the phenomenon definition in order to show evidence of the limits and references that will be used in this thesis (Table 2.1)

Table 2.1 - Concepts definition

	Digitization	*Digitalization*	*Digital transformation*
Definition	Technical process of converting analog information into digital information	How digital technologies can be used to change existing business processes	The way in which "a firm employs digital technologies to develop a new digital business model that helps to create and appropriate more value for the firm
Main outcomes	The dissociation of form, function, and access	Economy-oriented results (reinforcement of the organization's value proposition): efficiency gain, productivity gain, cost reduction and error elimination, and customer experience optimization.	Capability-driven outcomes (redefining the organization's value proposition): business model innovation, new revenue streams, radical changes in offerings, and revolutionary restructuring. A digitized business model in which technology significantly impacts value capture, value proposition, and value creation, not just on certain activities of the company.
Examples	The conversion of a typed textbook into a digital format. Converting music from disks to digital formats (e.g., MP3)	Using robots in production; adding digital components to product or service offerings; introducing digital distribution and communication channels.	Netflix: moved from a model of renting movies stored on physical media to becoming the first large-scale provider of streaming video services.

Source: elaborated by the author

Starting with the term Digital Transformation, recent studies have attempted to structure its best definition (e.g., Gong and Ribiere 2021; Verhoef et al. 2021; Vial 2019; Warrner and Wager 2019). In the present thesis, we follow the definition of Verhoef et al. (2021, p.1), who understand the phenomenon as

> *the way in which "a firm employs digital technologies to develop a new digital business model that helps to create and appropriate more value for the firm"*

This definition allows us to understand the phenomenon in a holistic instance, and helps mitigate the literature's confusion about the terms *digitization*, *digitization*, and *digital transformation* (Mergel, Edelmann, and Haug 2019). It is possible to understand these three concepts as phases (e.g., Soluk and Kammerlander 2021; Verhoef et al. 2021) or domains (e.g., Saarikko et al. 2020) characterized by their own layers of complexity and implications for value creation, technology management, business strategy, and organizational culture (Saarikko et al. 2020).

Digitization describes the technical process of converting analog information into digital information (Tilson, Lyytinen, and Sørensen 2010; Verhoef et al. 2021). It can be labeled as the first stage of the DT process (Soluk and Kammerlander 2021) and is a fundamental precondition for technological advances, from smartphones to artificial intelligence (Saarikko et al. 2020), as it enables the dissociation of form, function, and access to information. Two cases help realize the power of digitization. The first is the conversion of a typed textbook to a digital format (Brennen and Kreiss 2016) and the subsequent creation of digital businesses (e.g., the transition from physical books to e-books - Rachinger et al. 2018; Liu, Li, and Yang 2012). The second stems from the way different music formats are accessed. A piece of music used to rely on an analog format (e.g., vinyl records made of gum, cassette tape, CDs), which manifested a close link between form, function, and access. In other words, it was not possible to separate the data (the music) from the medium (the record), and it could only be accessed through a specific technology (a record player). But when music is digitized, it can be distributed in different formats (e.g., MP3) using different media (e.g., physical disc, online streaming) and can be accessed through various devices (e.g., CD player, computer, smartphone) (Saarikko et al. 2020).

Typically, *digitization* alters components, creating possibilities for new interactions and new links to other components in the surroundings and, as we will see later, can force an entire industry to adopt new possibilities and reinvent itself at a rapid pace. It is possible to indicate, in this way, that the digitization of a component generally does not change the core design concept behind it (Tekic and Koroteev 2019), but it does (enable) the process of digital transformation. As a process itself, digitization can be complicated and requires technical expertise. However, it can be largely outsourced or managed by a relatively small group of experts and thus can be isolated from other aspects of an organization (Saarikko et al. 2020).

The second term, *digitalization*, refers to the process of using digital technologies to change existing business processes (Verhoef et al. 2021), reinforcing and enhancing the organization's value proposition and impacting the organization primarily economically (Gong and Ribiere 2021). Thus, through digitalization, companies apply digital technologies to optimize existing business processes, enabling more efficient coordination between processes and/or creating additional customer value by enhancing user experiences (Pagani and Pardo 2017). Many innovative companies base their competitive advantage on digitalization by adopting technological innovations that only affect their value proposition with respect to products, services, and solutions rather than a more complete business model innovations-which may be the right strategy for some companies and industries (Caputo et al. 2021; Fakhar Manesh et al. 2020).

However, as Gong and Ribiere (2021) pointed out, although every transformation is a change, not every change is a transformation. In this sense, it is necessary to distinguish the development and introduction of technologies to enhance value propositions (digitalization) from their exploitation to redefine the entire business (digital transformation). In a practical sense, the diffusion of a fragmented digitization approach may give the impression that a larger process such as digital transformation would be an "old wine in a new bottle" - such as a mere reformulation of topics such as the implementation of Enterprise resource planning (ERP) and Customer Relationship Management (CRM) systems (Mergel, Edelmann, and Haug 2019). However, such an impression must be viewed as a result of the evolution of digital technologies implementation: companies were primarily involved in applying internal information management systems (Boersma and Kingma 2005) to improve business processes, for example, gain efficiency, gain productivity, save costs, and eliminate errors (Gong and Ribiere 2021; Eling and Lehmann 2017).

In such a context, following Gong and Ribiere (2021), a "radical" rather than "incremental" change should be considered as one of the critical attributes to differentiate digital transformation from digitalization - and the very concept of "transformation" should indicate the quality and scope of the fundamental change. According to Bouncken and Barwinski (2020), digitally transformed companies have developed a business model in which digital technologies (disruptive or less innovative) significantly impact value capture, value proposition, and value creation, not just certain activities of the company. This agrees with Verhoef et al. (2021) and Gong and Ribiere (2021), who suggest that digital transformation comprises the pursuit and development of business model innovations in order to create new revenue streams, radical changes in offerings, and revolutionary restructuring that will furthermore entail the emergence of *capability-driven outcomes*.

To help understand the scope of digital transformation, Verhoef et al. (2021) identified and proposed digital growth strategies for companies that undertake efforts to create and develop business models through digital platforms. According to the authors, there is a variety of digital growth strategies that involve goals such as (i) penetrating a different market, (ii) market development by introducing new solutions, (iii) product development or co-creation platform, and (iv) platform diversification. The latter is often deployed by large and successful platforms with the goal of creating additional growth in untapped markets with new products. In this context, it is important to understand that, as indicated by Li (2018), not all business model innovations will create radically new business models. Some of them will serve to create the conditions for the firm to implement a broader range of redefinition of crucial business model elements such as value proposition, value creation and ownership (Teece and Linden 2017), value network articulation, orchestration, and governance (Latilla et al. 2020).

The digital transformation also enables value creation at numerous stages of the customer journey. Among possible implications are changes to existing products/services and the offering of new digitized products and services, or the transition or increase of physical product sales with the sale of services as an integral part of the value proposition (Soluk and Kammerlander 2021; Eling and Lehmann 2017). Moreover, with the "mobile revolution" and the growing power of social media and data analytics (Rachinger et al. 2018), it is possible to promote omnichannel strategies, enhancing the creation of value for the customer during the purchase phase, raising their level of information, entertainment and sensory appeal (Matarazzo et al. 2021). Or, through possibilities such as individualization, integration of the environment, interaction, and transparency, it is possible to promote benefits at the level of convenience, relevance, experience, and economy (Reinartz et al. 2019). An excellent example of creating new value propositions through digital technologies is Netflix, whose business model was originally based on renting movies stored on physical media. Over the years, Netflix has moved away from this value proposition to become the first provider of large-scale video streaming services, with heavy use of data leveraged by its use in the recommendation engine and production of new series (Günther et al. 2017). In addition, the diffusion and growth of e-commerce platforms, such as Alibaba, Amazon.com, and eBay.com, have changed the value delivery process (the "place") and the relationship with customers (e.g., Li et al. 2018; Ramaswamy and Ozcan 2018).

Similarly, going back to the example of the music industry initiated in the context of digitization, it is well known that digital technologies have forced the music industry to adopt new possibilities and reinvent itself at a rapid pace. However, it can be seen that the business change has essentially happened through the transformation of business models, which required not only technical ability, but the ability to use digital technologies wisely. For example, Apple got the licenses from the big four record labels (Warner Music Group, Sony BMG, EMI, and Universal Music Group) in 2003 and established iTunes, an online MP3 store for downloading tracks and albums. This not only radically changed or digitized the way people listened to music but also the way value was proposed, creating opportunities for streaming services, where listening and having access to a song is more important than owning it (Gong and Ribiere 2021). Also, by leveraging Digital Rights Management (DRM), Apple created lock-in effects where iTunes sales boosted iPod

sales, which had large revenue margins. On the other side are companies like Blockbuster and Kodak, which failed to innovate their business models to survive digital technological changes and new economic paradigms and ended up losing ground (Chesbrough 2010; Wirtz et al. 2010).

Therefore, digital transformation as a phenomenon is not just about optimizing internal processes or incorporating new technologies; but fundamentally changing business models (Loebbecke and Picot 2015; Bouwman, Nikou and de Reuver 2019) and creating comprehensive digital solutions (Soluk and Kammerlander 2021; Mergel, Edelmann and Haug 2019). In this sense, it is by no means a simple process - which became evident during the coronavirus pandemic. As the scale of the pandemic became increasingly apparent, companies realized just how digital transformation is complex, strategic, and has many implications.

For example, one change reported by the literature is the decentralization of teams (Lyytinen, Yoo, and Bole Jr. 2015). From the use of technology as a resource that enables connectivity independent of physical location, the creation of virtual work teams, open innovation, and crowdsourcing platforms is verified. From the reduced cost for communication, increased connection speed, and the use of communication and process management tools, the distribution of control and resources enables remote coordination and collaboration among participants (Loebbecke and Picot 2015; Lyytinen, Yoo, and Bole Jr. 2015). This leads, according to Nambisan et al. (2017), to organizational structures with fewer limits to their boundaries, greater diversity and continuous involvement of different actors, causing fully fragmented and decentralized work teams that act in networks to emerge (Lyytinen, Yoo, and Bole Jr. 2015) rather than a local, predefined team.

With regard to positions and roles played by professionals, IDG (2018) indicates that managerial processes need to keep pace with the digital transformation and that, as Loebbecke and Picot (2015) indicate, digital transformation has the potential to impact organizations in such an extent that the authors are convinced that many existing positions and institutions will not survive intact. Furthermore, the digital transformation also changes the nature of innovation capabilities and business activities, as it demands conditions for the creation of new positions, new relationships, and new knowledge (Lyytinen, Yoo, and Bole Jr. 2015) in order to handle and support the new processes (Heinze et al. 2018). This, as a consequence, may lead not to the disappearance but to changes in the core of particular jobs, as Loebbecke and Picot (2015) point out: professions that rely on analysis, diagnostics, and even education will have to be profoundly modified. Still, on roles and positions, many organizations are being (and will be) impacted not only by the qualifications arising from the adopted digital technologies but also by the so-called 'born digitals' (Sawy et al. 2016), people born in the digital age who have values and characteristics that confront the traditional paradigms of flexibility, schedules, access to information and the work environment.

2.2 Reasons to transform and strategies

While it seems evident that it makes sense in the current scenario to digitize a business model, it is necessary to understand how the process is triggered within organizations. Digital transformation is usually born out of the possibility of delivering greater value to stakeholders -

customers, partners, suppliers, etc. (Gong and Ribiere 2021; Li 2020; Henriette, Feki, and Boughzala 2015). In general, the literature suggests that this is linked to increased competitiveness and the need for survival and maintenance of the value proposition. Research conducted by SAP News Center (2017), for instance, revealed that 84% of global companies consider the main reason to digitize their business model to be survival - even though the Global Human Capital Trends survey (Deloitte 2018) indicates that only 11% of respondents believe they know how to build an organization for the future. Furthermore, the literature indicates that the quest for greater competitiveness drives organizations to maintain and increase market share and service quality (Ferreira, Fernees, and Ferreira 2019) and be future-proof (Weill and Woerner 2015).

In this context, we identify that the phenomenon is triggered and shaped mainly by external factors and market impositions, such as the adoption of new digital technology (Henriette, Feki, and Boughzala 2015; Warner and Wäger 2019). For Carcary, Doherty, and Conway (2016), the importance of adopting new technologies is one of the primary triggers, as it is too risky not to adapt to the possibilities that digital brings. For example, Teece (2018) indicates the importance of being connected as a sufficient reason for new business models to be triggered, as the internet is necessary to be able to scale any business. Chanias, Myers, and Hess (2019) indicate that the risk of not adapting to industry changes is tied to the organization's future viability and maintaining its competitive position. This is increasingly significant, as Warner and Wäger (2019) and Garud et al. (2020) indicate, as the growing and disruptive presence of rapidly penetrating new digital entrants transform competition and drives a more challenging quest for creating and delivering new value propositions. Thus, digital adaptation emerges as a potential source of competitive advantage (Karimi and Walter 2015; Svahn et al. 2017).

Yet another compelling reason concerns users and customers: transformation is substantially driven by customer interactions and demands (Linz, Müller-Stewens, and Zimmermann 2017; Berman and Bell 2011). Customers and users have more and more choices, higher expectations and demands, and greater digital empowerment (they understand technology as much as companies do - if not more). Thus, organizations are subjected to the quest to meet more specific and personalized needs (Rachinger et al. 2018; Nylén and Holmström 2015), which leads to the need to reevaluate how they propose value (Warner and Wäger 2019).

Finally, the pandemic caused by COVID-19 intensified pressure in most industries, where businesses struggle to cope with a range of uncertainties regarding supply and demand (Dwivedi et al. 2020). According to Almeida et al. (2020), COVID-19 has accelerated digital transformation processes in companies, individuals, and public entities. For example, a series of political decisions protecting society have generated lockdowns and imposed disruptions to everyday business activities. All that has amplified needs, such as minimal physical contact and security, forcing organizations to seek digital solutions or identify ways to digitally deliver their products and services (Seetharaman 2020). Also, Cazeri et al. (2021) indicate that the COVID-19 crisis significantly impacts most companies' transition.

2.3 Digital strategy

Digital transformation is a response to an environment marked by technological volatility, complexity, and uncertainty. Hence, its breadth of scope and far-reaching consequences make it an essential phenomenon for the study of strategic change (Warner and Wäger 2019) and fundamentally different from traditional forms of strategic change (Matt, Hess, and Benlian 2015). Thus, in this context, the literature has discussed the importance of firms having a digital strategy.

The digital strategy encompasses a merger view that explicitly recognizes the embedding of information technology (IT) throughout the organization, unlike the traditional view that considers one strategy for IT and another for the business as two separate frameworks to be aligned. The IT strategy usually presents system-centric roadmaps for future uses of technologies in a company or is strictly linked and security-oriented, primarily focused on maintaining operations, but does not necessarily include the transformation of products, processes, and structural aspects that accompany technology integration. In digital strategy, thus, IT strategy is viewed as a core competency and integrated with business strategy with no further distinction between them (Matt, Hess, and Benlian 2015; Chanias, Myers, and Hess 2019; Bharadwaj et al. 2013; Galliers 2011; Mithas et al. 2012). In another way, digital strategy is a plan that supports companies in controlling the transformations that arise due to the integration of digital technologies into their operations, and one of the main drivers of this continuous merging is the very nature of digital technologies and their unique properties that allow companies to innovate in new and different ways (Yoo et al. 2012).

However, digital business strategy alone is not enough and companies usually need a standalone digital transformation strategy to help managers navigate the transformation process (Hess et al. 2016). Matt, Hess, and Benlian (2015) suggest that digital transformation strategies have certain elements in common regardless of industry or company. These elements can be attributed to four essential dimensions: the use of technologies, changes in value creation, structural changes, and financial aspects. In addition to these elements, the digital transformation strategy needs to be holistic (Chanias, Myers, and Hess 2019), spanning and coordinating numerous independent segments, business-centric and technology-inspired (Yeow, Soh, and Hansen 2018), and needs to start with digital scenario planning (Warner and Wäger 2019). It is also emergent, iterative, and influenced by evolving organizational competencies (Galliers 2011). Crittenden, Crittenden, and Crittenden (2019) indicate that digital transformation does not require radical changes in an incumbent (established) organization. However, there must be an understanding that digital investment must be strategic to protect the business core. Through digital strategy, it is possible to organize actions taking into account the existing critical background of the company, which includes cultures and ways of doing things that can have a significant impact on digital innovation. The digital transformation strategy thus provides insights into how a strategy can be developed and implemented for the entire organization (Hess et al. 2016; Matt, Hess, and Benlian 2015), without necessarily replacing any previous strategies, but aligning with them, recognizing that realized strategies from the past feed into strategy episodes in the present (Chanias, Myers, and Hess 2019).

In relation to the changes promoted, it is important to understand that strategy should be seen as something organic. The digital transformation does not follow a linear logic (Crittenden,

Crittenden, and Crittenden 2019) and varies in accordance with the organization's contingencies (Ferreira, Fernees, and Ferreira 2019). Then, as Chanias, Myers, and Hess (2019) indicate, digital strategy should be something like a "moving target" that seems to be continuously developing without a predictable end. In other words, a continuous process that never ends (Yeow, Soh, and Hansen 2018; Agarwal and Helfat 2009; Tsoukas and Chia 2002) and that needs to be in constant re-evaluation (Matt, Hess, and Benlian 2015; Chanias, Myers, and Hess 2019). Hence, companies need to create dynamic business models that feedback growth cycles.

In practical terms, it can be said that the essential foundation of the digital transformation strategy is the promotion and maintenance of a change mindset (Velu 2017). In this *mindset*, cultural and policy guidelines must contemplate appreciation for new ideas and experimentation, customer-centric thinking, working in an agile and flexible manner, in a collaborative and interdisciplinary way, as well as being open-minded and creative - following the fail fast, fail early principle (Chanias, Myers and Hess 2019). Such a perspective is critical in the process, as digital transformation usually begins with the strategic renewal of the company's business model, and such changes tend to lead to broader changes in the company's collaborative approach, which, if executed correctly, will lead to greater changes in organizational culture (Chanias, Myers, and Hess 2019; Warner and Wäger 2019). That is, the company as a whole is invited to promote changes that go beyond individual changes (Chanias, Myers and Hess 2019; Yeow, Soh and Hansen 2018): the process modify how people collaborate (Warner and Wäger 2019), how the organization maintains its historical values, how it updates its corporate culture (Warner and Wäger 2019), how it modifies its technological and governance structure (Chanias, Myers and Hess 2019; Skog 2016), etc.

2.4 Digital technologies and resources involved

When approaching digital transformation, it is necessary to understand that it encompasses a process that necessarily requires adopting and using new technologies from a strategic change perspective (Warner and Wäger 2019). In these circumstances, digital technologies play a central role as an enabler, representing a means to strategic ends rather than representing the digital transformation itself (Tekic and Koroteev 2019; Vial 2019).

The process of adopting technologies in order to improve organizations is not new and has been going on for a long time. In a brief historical summary, Heavin and Power (2018) indicate that the adoption of technologies and their benefits have increased over the years. For example, vacuum tube computers from 1943-1958 led to transformations in accounting, decision support, and transaction processing. The 1960s saw the introduction of manufacturing robots, online transaction processing, and time sharing. By the mid-1970s, the personal computer revolution began and accelerated throughout the 1980s. The 1990s brought data warehouses, local area networks, global Internet, digital data storage, and digital phones. The 2000s saw the emergence of affordable cell phones, faster parallel processors, distributed computing and storage, and digital cellular networks. Digital data storage and computing resources increased exponentially in the early 2010s. However, by the end of the second decade of the 21st century, the main enablers of digital business (and involved in the digital transformation discussion) refer to advanced digital technologies such as artificial intelligence, machine learning, big data, cloud computing, Internet of Things, and social

media (e.g., Shakina et al. 2021; Matarazzo et al. 2021; Fernández-Rovira et al. 2021; Pisoni 2020; Hinings, Gegenhuber, and Greenwood 2018).

These new technologies have blurred the boundaries between the world of physical (tangible) artifacts and cyberspace (intangible), enabling, for example, analytic technologies to provide real-time monitoring, digital assistants, personalization, distributed decision support, and predictive analytics. Moreover, they enable bits, atoms, and even cells to combine in new and interesting ways previously impossible (Tekic and Koroteev 2019). Among some examples that allow us to understand how new digital technologies enable new types of innovation that differ from the analog processes of the industrial age are the following (Westerman, Bonnet, and McAfee 2014):

- the emergence of innovative business models based on digital platforms (Helfat and Raubitschek 2018; Teece 2018) and their unfolding in terms of smart and connected products (Porter and Heppelmann 2014; Zheng, Yang, and Cheng 2018) with the potential to reinvent industries (e.g., Uber's reshaping of the structure of the urban passenger transportation industry);
- the replacement of products and services (e.g., the replacement of physical books with Kindle by Amazon);
- the creation of new digital businesses (e.g., Nike + Sensor connectivity for Apple devices);
- the reconfiguration of value delivery models (e.g., Volvo's incorporation of digital artifacts in cars);
- the reconfiguration of value propositions: e.g., servitization (Cenamor, Parida and Wincent 2019; Sánchez-Montesinos et al. 2018); or dynamics of value co-creation (Oliveira and Cortimiglia 2017).

Therefore, discussing digital transformation is not about old wine in a new bottle, and a significant part of this discussion involves deep understanding of digital technologies. Different technologies can be used to, for example, create digital variants of products or services to enable communication and interaction between machines, people, and objects. They can be considered for a specific use or general purpose and can be grouped differently according to their nature or context (Zangiacomi et al. 2019). For example, the EU Commission proposes four main categories for technologies: mobile, social media, cloud, and data analytics (European Commission). Other useful macro-categories include platforms (Tiwana et al. 2010), advanced and additive manufacturing technologies (Savastano et al. 2019), and algorithmic decision-making (Newell and Marabelli 2015; Brunetti et al. 2020).

Furthermore, Sebastian et al. (2017) proposed six groups identified by the acronym SMACIT (acronym for social, mobile, analytics, cloud, and Internet of Things). SMACIT technologies shape and are central to the entire digital transformation process due to their characteristics. In his study, Chirumalla (2021) indicates, for example, that they have real-time capability, intelligence, interoperability, virtualization, decentralization, connectivity, service-orientation, and analytical capabilities, among other characteristics. In addition, as Weichert (2017) indicates, the wide diffusion of digital technologies has generated a large production of data, highlighting the need for machine learning and data analysis in organizations. Such analysis

becomes essential, given the potential and importance that artificial intelligence holds to become a general-purpose technology and drive technological progress (Brunetti et al. 2020). Table 2.2 summarizes the main technologies usually associated with digital transformation.

Table 2.2 - Main technologies involved in the digital transformation

Technology	Explanation/Example	References
Artificial Intelligence (AI)	Technology for data acquisition and analysis. It is often also addressed through specific techniques and solutions such as *machine learning* or *deep learning*	Eling and Lehmann 2017; Pagoropoulos, Maier and McAloone 2017; Dornberger et al. 2018; Sousa and Rocha 2019; Cuquet and Fensel 2018; Holotiuk, Pisani and Moormann 2017
Big data	Technology for data acquisition and analysis. Capturing and processing large volumes of data on which different analysis techniques can be applied	Eling and Lehmann 2017; Pagoropoulos, Maier, and McAloone 2017; Cuquet and Fensel 2018; Heberle et al. 2017; Heinze et al. 2018; Berman 2012; Loebbecke and Picot 2015. Sousa and Rocha 2019
Internet of Things (IoT)	Technology for data acquisition and analysis. Integration of sensors and distributed processing power into real-world objects, as well as related technologies such as wearable devices	Eling and Lehmann 2017; Kiel, Arnold, and Voigt 2017; Pagoropoulos, Maier, and McAloone 2017; Rymaszewska, Helo, and Gunasekaran 2017; Carcary, Doherty, and Conway 2016; Krotov 2017; Saarikko, Westergren, and Blomquist 2017
Blockchain	Technology for distributed data storage with peer-to-peer logging	Eling and Lehmann 2017; Holotiuk, Pisani, and Moormann 2017; Larios-Hernández 2017; Cuquet and Fensel 2018; Hinings, Gegenhuber, and Greenwood 2018
Cloud computing	Data warehousing technology refers to the non-local paradigm for accessing and using communication and information technologies, platforms, and solutions, with obvious potential to impact the competencies and business models of organizations that use and/or offer this enabling technology	Eling and Lehmann 2017; Marston et al. 2011; Mitra, O'Regan, and Sarpong 2018
Mobile devices with apps	Technology for communication and sales	Eling and Lehmann 2017
Chatbots	Technology for communication and sales	Eling and Lehmann 2017
Robo-advisors	Technology for communication and sales	Eling and Lehmann 2017
Social networks and messengers	Facebook, WhatsApp, internet forum	Eling and Lehmann 2017
Video calls	Skype, Facetime	Eling and Lehmann 2017
Video platforms	YouTube, Vimeo	Eling and Lehmann 2017
Website	Technology for communication and sales	Eling and Lehmann 2017
Additive manufacturing	Also known as 3D printing	Troxler and Wolf 2017; Dornberger et al. 2018; Carcary, Doherty, and Conway 2016
Augmented and virtual reality	It comprises interactive experiences and sensory stimulation in computer-simulated environments, which can also be applied to making digital twins.	Berman 2012; Zheng, Yang and Cheng 2018

Source: elaborated by the author, inspired by Eling and Lehmann (2017)

However, it is crucial to remember that digital technologies provide little value to an organization alone (Kane 2019). It is their use within a specific context that allows a company to discover new ways to create value (Vial 2019). Thus, as the implementation of digital solutions is linked to a wide range of purposes, a major concern to consider is the proper formulation of the problem to be solved with technologies at all organizational levels and actors beyond the firm's boundaries (Zangiacomi et al. 2019).

2.5 Barriers and challenges

Engaging in the digital transformation process benefits companies but also brings numerous challenges (Soluk and Kammerlander 2021), which must be circumvented and overcome with structural changes (Vial 2019). The most prominent challenges are found in the overview set out in Table 2.3. The result presents eight (non-exhaustive) groups elaborated based on the extant literature that represent different sources of difficulties and will be explored next.

Table 2.3 - Digital transformation barriers and challenges

Barriers and challenges	Examples	References
Inconsistent understanding of the scope and substance of the change	Lack of clear vision	Chirumalla 2021; Saarikko et al. 2020
	Lack of strategy	Zangiacomi et al. 2019; Llopis-Albert et al. 2021; Saarikko et al. 2020
	Long-term project perception	Bouwman, Nikou, and de Reuver 2019; Soluk and Kammerlander 2021
	Merging the DT strategy with the company's strategy	Matt, Hess, and Benlian 2015
	Outcome measurement	Brunetti et al. 2020; Zangiacomi et al. 2019; Llopis-Albert et al. 2021; Chirumalla 2021; Saarikko et al. 2020
	Rigid strategic planning	Warner and Wäger 2019
	Scope of digital transformation	Bertola and Teunissen 2018; Zangiacomi et al. 2019; Tekic and Koroteev 2019; Chirumalla 2021; Saarikko et al. 2020; Soluk and Kammerlander 2021
	Transformation timing	Tekic and Koroteev 2019; Saarikko et al. 2020
Capacity and capabilities	Difficulties in building new capabilities	Bertola and Teunissen 2018; Zangiacomi et al. 2019; Chirumalla 2021; Saarikko et al. 2020
	Digital Incompetence	Caputo et al. 2021
	Lack of competence for digital exploitation	Tekic and Koroteev 2019; Brunetti et al. 2020; Zangiacomi et al. 2019; Eling and Lehmann 2017 ; Chirumalla 2021; Saarikko et al. 2020; Soluk and Kammerlander 2021
	Technology volatility	Brunetti et al. 2020; Zangiacomi et al. 2019; Saarikko et al. 2020
Leadership and top management	Aversion to losing authority and control	Soluk and Kammerlander 2021
	Lack of support for changes	Tekic and Koroteev 2019; Zangiacomi et al. 2019
	Lack of leadership competence	Zangiacomi et al. 2019; Warner and Wäger 2019
	Managers openness to change	Zangiacomi et al. 2019; Warner and Wäger 2019
Cultural and organizational factors	Cultural gaps	Chirumalla 2021
	Fear of losing the job	Soluk and Kammerlander 2021
	High level of hierarchy	Warner and Wäger 2019
	Path-dependence and cognitive inertia	Margiono 2020; Tekic and Koroteev 2019; Caputo et al. 2021; Chirumalla 2021; Vial 2019; Warner and Wäger 2019; Bouncken and Barwinski 2020; Saarikko et al. 2020
	Rigid culture	Chirumalla 2021
Transformation management	Change capacity management	Warner and Wäger 2019
	Constant alignment	Zangiacomi et al. 2019

	Knowledge management	Brunetti et al. 2020; Zangiacomi et al. 2019; Saarikko et al. 2020
Collaborations and partnership	Need to establish collaborations and partnership	Brunetti et al. 2020; Zangiacomi et al. 2019; Tekic and Koroteev 2019; Saarikko et al. 2020
External factors	Market challenges and threats	Brunetti et al. 2020; Saarikko et al. 2020; Chirumalla 2021
	Societal challenges	Brunetti et al. 2020
	Value-chain inertia	Saarikko et al. 2020
Resources	Financial investment limitation	Li et al. 2019; Zangiacomi et al. 2019; Soluk and Kammerlander 2021
	Technological Infrastructure	Eling and Lehmann 2017; Zangiacomi et al. 2019; Chirumalla 2021

Source: elaborated by the author

2.5.1 Inconsistent understanding of the scope and substance of the change

Any company that intends to take advantage of digital technologies must be willing to adapt its strategies and capabilities to accommodate new ways of perceiving and creating value. To do so, as an initial step, companies must understand what digital transformation means (Saariko et al. 2020). Similar to the problem of defining the boundaries of the digital transformation phenomenon that scientific research faces (especially regarding the difference between digitization, digitalization, and digital transformation), the empirical world of such transformation equally encounters difficulties related to the **inconsistent understanding of the scope and substance of change**. Hence, first of all, it is necessary to realize that the very exercise of understanding the digital transformation process is in itself a great challenge since it is a complex, multidisciplinary phenomenon with numerous implications.

Thus, we find difficulties that vary in scale and complexity. For example, from a broad perspective, there is a challenge linked to understanding and supporting that digital transformation is a long-term project with uncertain outcomes (Bouwman, Nikou, and de Reuver 2019; Soluk and Kammerlander 2021). Transformation may take time since, as Teece (2018) highlights, business models are more context-dependent than technology-dependent, and changes in the business model may take time to catch up with technological possibilities. Also, as Llopis-Albert et al. (2021) indicate, there is often no immediate payback, and the return on investment is uncertain, which carries capital risk.

However, the consequences of an inconsistent understanding unfold into other challenges. Such inconsistency results in a lack of or inappropriate transformation strategy, difficulty in merging the digital transformation strategy with the company's strategy, lack of vision and purpose for the transformation, and inability to quantify the results. All that makes the organization misperceive or misunderstand results and implications, such as interpreting the success of the transformation considering the only results of using new technology for a singular purpose (Tekic and Koroteev 2019). Thus, by not looking at a systematic approach and adopting digital business models (Chirumalla 2021), the organization take the risk of failing to realize innovation in its business model and may end up (i) assuming a reactive ad-hoc problem-solving kind of behavior, missing the chance to standardize change practices (Chirumalla 2021) or (ii) having to deal with digital initiatives as isolated projects (Soluk and Kammerlander 2021).

2.5.2 Capabilities and skills

Another considerable portion of the challenges the digital transformation process imposes resides in the realm of competencies to deal with the phenomenon (Khin and Ho 2019). First, the lack of competence in digital exploration is a limiting factor to any attempt to create or maintain a business model that creates, proposes, or captures value in a digital way. Even in simpler processes, such as digitizing analog parts of the company (Saariko et al. 2020), specific competencies are demanded, and their absence can generate severe consequences in the evolution of the company's digital business model. In a more sophisticated example, Eling and Lehmann (2017) and Tekic and Koroteev (2019) indicate the need for data analysis competence and the competence to know how to turn data into money since, according to, Saarikko et al. (2020), data is a permanent source for value generation.

Moreover, the characteristic technological volatility imposes challenges linked to the adoption of technologies. Companies must have the capacity to understand and evaluate which technologies best relate to the specific needs of organizations (Zangiacomi et al. 2019; Brunetti et al. 2020). According to Chesbrough (2010), a mediocre technology applied to a great business model can be more valuable than a great technology exploited by a mediocre business model. In other words, one must have the ability to understand the spectrum of technology offerings to adopt what makes the most sense. Moreover, it is known that a lack of digital competence tends to generate low applicability of technologies to current processes (Chirumalla 2021), in addition to possible legal and ethical implications linked to data (Eling and Lehmann 2017), for example. Therefore, companies must increase their digital knowledge base (Zangiacomi et al. 2019).

From the understanding that digital transformation demands new competencies from the organization, other sources of challenges unfold. The first one concerns the difficulties in building new capabilities. Following Lenka, Parida, and Wincent (2016), although the process of developing these competencies is still an open field for research, we find challenges at the organizational level, such as a lack of awareness about what the future skills are (Bertola and Teunissen 2018), or individual such as those related to people's own capability development (Chirumalla 2021). Second, employees who lack digital competence and have difficulties with technology hinder the digital transformation process, representing a challenge. Such digital incompetence generates resistance to the use of new technologies (Caputo et al. 2021) and possible sabotage to use. There is also a difficulty associated with the organizational capacity of the transformation, where the challenge is to balance exploiting existing competencies and building new ones (Svahn, Mathiassen, and Lindgren 2017).

2.5.3 Leadership and top management

The posture and behavior of people in top management and leadership positions also emerge as sources of challenges for the digital transformation process. The complexity of the transformation process demands leaders capable of sustaining collaborative organizational forms based on trust and guided by digital technologies. In the face of this, four difficulties unfold. The first is an aversion to the loss of authority and control. The second difficulty is resistance to experimentation with new business model possibilities, favoring models with higher gross margins through rules, norms, and metrics for maintaining the status quo (Warner and Wäger 2019). The

third is the need for commitment and sponsorship from the company's top executives to make the transformation happen (Tekic and Koroteev 2019). Finally, there is the challenge related to the leadership competencies themselves: companies need people who are prepared to carry out the transformation proactively rather than reactively (Zangiacomi et al. 2019).

2.5.4 Organizational and cultural factors

When organizations adopt new digital technologies, they interact with a complex context formed by organizational antecedents that encompass organizational strategy, the historical path of an organization, the resources, processes, values, culture, and managerial characteristics (Hanelt et al. 2020). Thus, due to the complexity inherent in the digital transformation process, scientific literature and experts highlight that the dependence created on what has already been established as a business model is a significant barrier that can erode the business if not overcome (Foss and Saebi 2018; Kim and Min 2015). Such path dependence arises as a major resistance culturally, structurally and individually (Vial 2019; Warner and Wäger 2019; Tekic and Koroteev 2019) and part of the challenge imposed by digital disruption is explained by the possibility of organizational inertia inhibiting fundamental change (Remane et al. 2017a) - even when the organization recognizes that change is necessary.

In this sense, one can first appreciate the organization's inertia broadly, considering, for example, the rigidity of the company's culture, its hierarchical structure, and the cultural gaps that arise from new digital paradigms. This first consideration includes, for example, the way people collaborate (Warner and Wäger 2019), cultural values (Warner and Wäger 2019), and governance structure (Chanias, Myers, and Hess 2019; Skog 2016). Consequently, for example, a culture heavily based on internal competition for career advancement will struggle to become a collaborative environment (Chirumalla 2021). On the other hand, at the individual level, the existence of a conservative mindset among employees and cognitive inertia makes it difficult to identify and implement new solutions (Tekic and Koroteev 2019; Bouncken and Barwinski 2020).

2.5.5 Transformation management

Due to the efforts to carry out and unfold the transformation, some difficulties emerge. In this regard, organizations must be aware of activities to overcome the difficulties, such as performance capability management and results demonstration. During digital transformation, it is necessary to manage and support the innovation process considering that the ability to make changes may be scarce due to limited resources to balance the innovation process and operational demands (Warner and Wager 2019). Furthermore, it is evident in the literature that it is necessary to keep all employees in the company aware of the goal (Chirumalla 2021; Saarikko et al. 2020), as well as keep the organization constantly aligned and demonstrate, when possible, that results are being achieved. Another difficulty is related to knowledge management, which unfolds in different challenges. The first is the need to adopt new approaches to knowledge transfer and storage (Zangiacomi et al. 2019). The second relates to the possibility of technological overlap and data governance. Moreover, the consequences of poor information management, such as rework, can be considered as a third challenge.

2.5.6 External Factors

Regarding external factors, organizations need to be aware of the contingencies of their context. Firstly, there are challenges due to the inertia of the value chain that can prevent the company from being able to innovate its business model. Many organizations operate in a traditional industry, where things have been done the same way for many years and with limiting digital contingencies (Saariko et al. 2020). Resistance from partners, suppliers, and consumers can limit digital transformation. The second point relates to market challenges and threats. In a completely different way from the industries in the first example, some digital business models take advantage of industries with low entry barriers (Saariko et al. 2020). This imposes a significant challenge on incumbent organizations: as these companies can make room for nascent companies to develop from (i) a potential customer frustration, (ii) lack of competence, or (iii) willingness to change. Third, societal challenges increasingly require organizations to address the impact of environmental sustainability, notably resource efficiency and energy consumption (Brunetti et al. 2020).

2.5.7 Partnerships and collaboration

In the digital transformation process, there is an understanding of the strong need to establish connections with external partners (e.g., Tekic and Koroteev 2019; Saarikko et al. 2020), and within the efforts required to compose external relationships, organizations may end up encountering difficulties. They may first be reluctant to engage in partnerships or seek new capabilities outside their own circle (Saarikko et al. 2020) or may not understand concepts linked to open innovation (Tekic and Koroteev 2019). In addition, there are challenges linked to developing and managing synergies and innovative technology solutions involving multiple stakeholders (Brunetti et al. 2020). It may require interacting and exploring relationships with different players in the local ecosystem, such as, for example, universities, innovation centers, policymakers, and new players (Zangiacomi et al. 2019).

2.5.8 Resources

Finally, to support digital transformation, it is necessary to count on an adequate technological infrastructure to ensure the delivery of the proposed value, guarantee agility, flexibility, and the decision-making process can be decentralized and data-driven. These facts can be a challenge since many organizations may have not updated their technological base in recent times, with resources that are often unable to support a digital logic, such as poor data readiness (Chirumalla 2021). In this sense, resources are needed that enable process automation, the storage of large amounts of data, and the integration of systems that enable the flow of information, among others (Eling and Lehmann 2017; Zangiacomi et al. 2019; Chirumalla 2021). Thus, infrastructure holds an important enabling role and cannot be overlooked. However, in the face of such a need, companies may face financial difficulties regarding the investments that need to be made. This can be linked to financial constraints (Zangiacomi et al. 2019) or even, in the case of SMEs, resistance due to a preference for self-financing (Soluk and Kammerlander 2021). In both cases, one can see the limitation of resources that such firms can invest in innovation.

2.6 Digital maturity

As cited earlier, the literature on digital transformation also relies on understanding the digital maturity of organizations and the possibility that the phenomenon can be better understood through the maturity perspective. According to Kane (2019), digital maturity refers to effectively aligning an organization's people, culture, structure, and tasks by taking advantage of the opportunities the technology infrastructure enables, both inside and outside the organization. Therefore, to navigate the complexity of contemporary business, companies must align their culture, people, structure, and tasks with each other and the digital environment to effectively meet the challenges of an ever-changing landscape. Mettler and Pinto (2018) indicate that digital maturity is the result of an ongoing process of adapting to a changing digital landscape - it can be viewed as a characteristic learned by an entity and represents its ability to respond to the environment appropriately (Kane et al. 2018).

Scaling digital maturity requires a company to engage in different job possibilities. It is primarily influenced, implicitly or explicitly, by two factors: the digital intensity and the organization's transformation management intensity (Westerman et al. 2012). Companies need to synchronize talent, organizational structure, and culture with the digital environments around them: digital is about educating people, not just technology (Kane 2019). However, this process can take time because, generally, incumbent (established) pre-digital organizations need to change their entire organization, business model, and processes as they adopt digital technologies (Bharadwaj et al. 2013; Sebastian et al. 2017; Tumbas, Berente, and vom Brocke 2017).

An important aspect of the distinction between digital transformation and digital maturity is that organizations mature in different ways, at different rates, and in different directions as they learn how to react properly and better exploit the emerging digital competitive environment. In other words, digital maturity embraces the understanding that the transformation process takes place in different parts of the enterprise and that different maturity levels can be achieved at any given time.

Moreover, as Remane et al. (2017a) indicate, digital maturity tends not to follow a linear course. It depends on various organizational characteristics, such as company size, business model, or industry, and such models may not provide sufficient guidelines for companies to support digital transformation. Mettler and Pinto (2018) indicate that there is no common definition for the 'digital maturity' concept. Maturity can generally be described as the "state of being complete, perfect, or ready" (Simpson and Weiner 1989). However, as technology continuously evolves and rarely reaches a stage of ultimate perfection, it may be valuable to understand digital maturity as a relative concept that, according to the authors, varies with the work environment and time: in their study in a hospital, they noticed that digital maturity generally evolves as a function of time (i.e., thanks to new hardware and software acquisitions and disassemblies) and location (i.e., from one unit to another). The time issue is also an argument raised by the consultancy PWC (Shahiduzzaman 2017), which indicates that digital maturity is not a static concept and, as such, an organization will need to assess its maturity over time.

In light of the need to understand the concept, the following points summarize some of the characteristics that make up digital maturity, according to Kane (2019):

- Maturity is a gradual and continuous process that unfolds over time. Companies can face different challenges at different stages of development and can always continue to grow and adapt to become even more digitally mature.
- Gradual maturation should not be confused with less significant changes. As the company becomes more digitally mature, it may find that it needs to do business in different ways.
- Organizations may not fully know what they will end up looking like when they begin to mature.
- Maturation is a natural process that does not happen automatically. Organizations, leaders, and employees may not instinctively know how to do this. Even digital-native millennials may not necessarily know how to apply their skills in an organizational context. Managers must develop practical knowledge of digital trends to lead their organization to adapt in the right way. Digital maturity is an evolutionary concept that requires constant, active monitoring and adaptation (Mettler and Pinto 2018).
- Maturity is never complete. One of the trends we have seen in recent years is the rise of large incumbent companies making the kinds of changes necessary to adapt to a digital world.

Digital maturity models

Since digital maturity is something that develops over time and with specific activities, in order to remain competitive, organizations must have a continuous improvement process that analyzes the company's positioning in relation to different requirements (competencies, resources, etc.). In this way, it is necessary to measure how an organization is progressing in its digital transformation, and for that, there are digital maturity models. According to De Bruin et al. (2005), maturity models are useful tools that aim to assist in these specific issues, where the concept of maturity is composed of levels of development that characterize a specific dimension (Andersen and Henriksen 2006). Shahiduzzaman (2017) indicates that a 'digital maturity model' would be the extent to which a digital transformation process is defined and digital technologies are managed, measured, and continuously improved.

The nature of a maturity model consists of levels that assess the maturity of an enterprise. Each level of the model includes selected dimensions, and that level of maturity is assessed through measurable values that can be achieved in incremental steps. The output of a maturity model reveals the current and desirable maturity levels, indicating an organization's current capabilities/skills and improvement measures respective to the levels. According to Poeppelbuss and Roeglinger (2011), there are three types of use for applying maturity models. The first is descriptive use, used as a diagnostic tool. It assesses the entity's current capabilities under investigation against certain criteria and reports maturity levels to internal and external stakeholders. The second application has a prescriptive purpose in order to identify desirable maturity levels and then provide guidelines for improvement. The third type of use is comparative, through internal or external benchmarking.

Regarding the efforts that have been made regarding the development of digital maturity models, it is worthwhile noting a few shortcomings. Chanias and Hess (2016) suggest that the generic approach that most maturity models take, based on standardized questionnaires, is a

problem. The rationale is that, as already stated, achieving digital maturity in a digital transformation scenario is very context-dependent. Second, some maturity models in the literature focus only on the technological side of the phenomenon, using indicators such as IT investments. Again, this approach only provides an incomplete picture since digital transformation has implications and demands both from a technological and organizational point of view. In this sense, it also seems inappropriate to assess digital maturity purely from an external perspective (e.g., by tracking data from websites). Finally, the use of complex mathematical-statistical calculation procedures for determining numerical scores and respective maturity levels can be questionable. These results are hardly reproducible due to the lack of transparency and are also difficult to communicate to managers and other stakeholders.

To illustrate, De Leon (2016) did a study in the telecommunications area and suggested important points for proposing a maturity model suitable for a specific industry:

- Provide a structured view of digital transformation.
- Comprehensive enough to cover all aspects of digital transformation.
- Be specific to the context and challenges that communications service providers are facing.
- Describe the current situation, and provide insight into what a more advanced digital communications service delivery looks like.
- Be able to be used as an industry standard to help communications service providers benchmark themselves against their peers.

Regarding practice-oriented digital maturity models, Remane et al. (2017b) indicate the existence of some drawbacks. For example, practice-oriented studies suggest that a fully digitized firm has reached a final condition and that all firms should thrive towards that same end state. Such approach neglects possible differences among firms in the face of the impact of digital transformation; and disagrees with the characteristics and arguments found earlier regarding the contingency aspects that must be taken into consideration. Among the practical studies is the study by Kane (2019), which presents a model with three levels of maturity (early, developing, and maturing) in which the maturity of organizations is established through employees' impression of how digitally mature their company is when compared to an ideal digitally mature company. Such a survey is very subjective, as employees may not be aware of what a digitally mature company is. The authors point this fact out as a model flaw: "we confess that our measures and groupings may not be perfect assessments of digital maturity."

In line with digital maturity, there are other concepts to which one must be attentive because of the proximity with which they are related. This is the case of digital readiness. In the literature, there is evidence that the terms are strongly related and relative. In addressing smart manufacturing, Jayasekara, Pawar, and Ratchev (2019) point out that readiness can be defined as the ability or maturity of a manufacturing company to deploy smart manufacturing concepts. De Carolis et al. (2017b) establish a relationship by indicating that manufacturing companies should perform a comprehensive digital maturity assessment in order to have a transparent view of their current level of digital readiness. For Gürdür, El-khoury, and Törngren (2019), technology readiness levels - readiness to adopt and use new technologies to achieve goals at work (Parasuraman 2000) - refer to the measurement system that supports the maturity assessment of a specific technology.

Some studies place digital readiness at a stage prior to maturity in the spectrum of the digital transformation. For Schumacher, Erol, and Sihn (2016), the difference between the concepts is that readiness is before the maturation process, evidencing whether an organization is ready to start a development process. According to the authors, a readiness assessment should be performed before the company begins the maturation process. After that, companies must look through the maturity understanding to assess the situation during the maturation process, evidencing the organization's level concerning the analyzed process. For example, De Carolis et al. (2017a) define *smart manufacturing readiness* as the ability or maturity of a company 'to' deploy smart manufacturing concepts, and the term *smart manufacturing maturity* as how well a company has employed smart manufacturing concepts or its smart manufacturing capability. Put another way: readiness can be viewed as the state in which an organization is ready to perform a task, while maturity would be the level of evolution that an organization has achieved with respect to a task.

However, even though one predates the other, the concept of digital readiness contains similar characteristics to digital maturity. The concept can be elaborated at the organizational and individual level, indicating skills and competencies (including technology and computing, information science, media, and communication) that enable companies to adopt and use new digital technologies (Kosmol, Reimann, and Kaufmann 2019). From an organizational perspective, the consulting firm Deloitte indicates the scope of different dimensions: organization, culture, employees, and digital environment (Deloitte 2018). On an individual level, digital readiness can be described as an interconnection of digital skills and confidence (people's beliefs about their ability). These two factors join into a third, usage. Usage is the degree to which people use digital tools in performing tasks.

Thus, while adequately addressing the differences between digital readiness and digital maturity models, it is reasonable that a search for a greater understanding of the characteristics of digital transformation can also be sought by exploring the concept of digital readiness. The identification and evaluation of digital readiness models comprise dimensions and characteristics that, besides being essential, allow one to ascertain the complexity and understanding of the phenomenon aspects of digital transformation.

2.7 *Dynamic Capabilities Theory*

One theoretical lens that can contribute greatly to understanding digital transformation's impacts is that of dynamic capabilities (DC). In particular, the convergence and generativity of digital technologies mean that developing dynamic capabilities is strategic for organizations to ensure their survival in the digital age. This theoretical perspective arises from the resource-based view (RBV) on how organizations achieve competitive advantage in a dynamic or changing context (Ambrosini and Bowman 2009) and is often described as the sophistication of RBV (Teece 2007, 2014), complementing it (Peteraf 1993; Teece, Pisano and Shuen 1997), and being understood as a performance enhancement of RBV (Eisenhardt and Martin 2000). Similarly, Barney (2001), revisiting his seminal study, recognizes the complementarity between the RBV and the Dynamic Capabilities theory. Thus, the DC can be described as the engine 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 the company's knowledge.

Dynamic capabilities theory deals with how organizations respond regarding resources and competencies when faced with changes, such as digital transformation (Loebbecke and Picot 2015; Henriette, Feki, and Boughzala 2015; Teece 2018). This theoretical approach proclaims that the success of firms in these environments depends substantially on their ability to adapt and respond quickly to change. Thus, dynamic capabilities theory can be defined as the firm's ability to integrate, build, and reconfigure internal and external competencies in rapidly changing environments. This theory adopts as its conceptual process a foundation involving competencies characterized by dynamism, accelerated environmental turbulence, and processes of continuous innovation and renewal (Teece, Pisano, and Shuen 1997). Helfat and Peteraf (2009) complement this definition by stating that the dynamic capabilities of an organization allow it to create, expand, and modify its resource base.

Dynamic capabilities are, in essence, meta-skills designed to integrate, create, and reconfigure internal and external resources into new or enhanced competencies needed to survive in dynamic environments (Teece 2014). Such an approach is seen as a potential integrator of the resources and competencies view in understanding the creation and sustainment of firms' competitive advantage (Lin and Wu 2014; Makadok 2001). Its focus is on the process by which the firm develops and renews its competencies, which is conditioned by both the firm's own past choices and the environment's dynamism. Thus, they are path-dependent, often embedded in the actions and behaviors of top management teams (Teece 2014), and can be expressed in specific organizational processes and competencies that access and manipulate resources to create new sets of competencies (Eisenhardt and Martin 2000). They are composed of rare and/or difficult skills to replicate and are essential for responding to opportunities, developing innovations, including business models (Teece 2018), or adjusting to new ecosystems (Teece 2007).

In the view of some authors, it is not enough just to change and/or innovate; the change must be systematic and repetitive, based on processes and/or routines (Eisenhardt and Martin 2000; Winter 2003; Zollo and Winter 2002). For a capability to be considered dynamic, the organization must be able to use it repeatedly and reliably: ad hoc solutions or the creative talent of people employed in an organization are not considered dynamic capabilities. Thus, a dynamic capability is "a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operational routines seeking to improve its effectiveness" (Zollo and Winter 2002).

Dynamic capabilities are made up of "micro-foundations", which can be understood as specific processes, routines, skills, and competencies at the individual and group level that lead to superior performance in the organization (Eisenhardt and Martin 2000). Thus, dynamic capabilities can be divided into ordinary and high-order (Teece 2018). The former determines how an organization survives, enabling some degree of sufficiency (and possibly excellence) in well-defined tasks, usually related to management, operations, and governance (Teece 2014). High-order dynamic capabilities represent organizational capabilities for (i) sensing - detecting new opportunities (change anticipation skills), (ii) seizing - leveraging resources and competencies to

develop opportunities (identifying, accessing, and resourcing appropriate resources), and (iii) reconfiguring - improving competitiveness through reconfiguring (reforming and building new competencies) organizational assets (Teece 2007, 2014).

According to Teece (2007), these capabilities can be represented, for example, by processes and routines for (i) scientific and technological development, (ii) identifying target market segments, (iii) research and development, (iv) developing customer solutions, (v) defining organizational boundaries, (vi) defining and routinely using decision-making protocols, (vii) decentralizing decisions by decomposing organizational structures, (viii) co-specializing assets, (ix) learning and knowledge governance, etc. Building sensing, seizing, and reconfiguring capabilities enable a company to craft future strategies for projecting, creating, and refining a defensible business model, as well as guiding organizational transformation and providing a durable source for gaining a competitive advantage (Teece 2018).

A dynamic capability cannot be confused with its result, nor the environment, since it is itself a result variable. In fact, the elements that determine the existence of dynamic capabilities are part of a set of behaviors, skills, routines, learning, and knowledge governance processes and mechanisms aimed at change and innovation. The articulation of these elements can result in varying degrees of innovation and dynamism, which can manifest themselves in environments of varying dynamism, whether in sectors where innovation is more intense or in more traditional sectors with consolidated technology. The result of this articulation ranges from the identification of needs or opportunities for change and the generation of ideas; the development of new products, services, and processes that are superior in relation to competitors; to the introduction of disruptions to create dynamism in the market (McKelvie and Davidsson 2009; Augier and Teece 2009).

In the literature on dynamic capabilities, some aspects pertinent to their formation have been discussed: antecedents, sources and aspects that relate to them as mechanisms and moderators. The view of where dynamic capabilities come from was limited for many years (Felin and Foss 2005), however, it is possible to observe in the more recent literature several antecedent sources of dynamic capabilities. Schilke, Hu, and Helfat (2018) consolidated such antecedents into three groups: organizational factors, individual/team factors, and environmental factors. The first contemplates elements of organizational experience, organizational structure and culture, resources, and information technology; the second integrates elements of human capital, leadership, and managerial capability; and the last is a set of factors from the external environment inter-organizational structure. Among the aspects that relate to dynamic capabilities, there are mechanisms and moderators. Mechanisms are intermediate variables through which dynamic capabilities influence their outcomes, while moderators are external variables that affect the strength of the relationship between dynamic capabilities and their outcomes (Schilke, Hu, and Helfat 2018).

Long associated with the innovation capability of firms in its more traditional sense (i.e., the technological innovation of products and processes) (Breznik and Hisrich 2014), there is a discussion on the use of dynamic capabilities in understanding other organizational innovation dynamics. For example, innovation in services (Bharadwaj et al. 2013; Henriette, Feki and Boughzala 2015) and business model innovation itself (Reis et al. 2018; Martín-Peña, Díaz-Garrido,

Chapter 4 - Developing the Capability-Based Maturity Model

Unlike chapters 3 and 5, this chapter has a reduced structure because its results will not be published in any journal. Thus, the chapter does not have a literature section, having its theoretical background based on the contents developed in chapters 2 and 3.

4.1 Introduction

The *Digital Transformation Dynamic Capability* framework developed in the previous chapter fills significant gaps pointed out by scientific works (e.g., Annarelli et al.; 2021, Vial 2019) on what are and how it is possible to develop high-order capabilities to deal with the digital transformation phenomenon. Given its comprehensive and detailed nature derived from an applied perspective, such a framework is strongly linked to holistically understanding the phenomenon of the required capabilities, being a robust tool at the disposal of organizations. It serves as an essential basis for strategy formulation, circumventing numerous problems linked to the phenomenon, such as, for example, inconsistent understanding of the scope of digital transformation or transformation management (indicated by Zangiacomi et al 2019; Tekic and Koroteev 2019; Chirumalla 2021; Saarikko et al. 2020; Warner and Wäger 2019).

In order to deepen the knowledge developed in Chapter 3, making it more practical and tangible to organizations, assisting them in developing the ability to become digitally mature, this article aims to unfold the *Digital Transformation Dynamic Capability* into a maturity model. Despite the difficulty of operationalizing the framework due to its complexity and breadth - indicated in the conclusion of Chapter 3, such a development seems pressing and necessary, given the apparent scarcity of digital maturity models that explore the issue of developing a transformation capability (Appendix 3B). Many maturity models seek the understanding of numerous (often sector-specific) details of organizations, for example, industry (interest consolidated by the strong appeal to Industry 4.0 characteristics), SMEs (interest justified by the essential role in maintaining and growing economies, according to Hamidi et al. 2018), among other examples such as agile services (Kampker et al. 2018), healthcare (Williams et al. 2019), and IT department (Isaev, Korovkina, and Tabakova 2018). However, few studies look at capability diagnostics, for example, in the case of Lin, Sheng, and Jeng Wang (2020). They developed a capabilities-based maturity assessment; however, their findings are restricted to the industrial sector and face the problem of generalizability of the results obtained.

Thus, the present chapter aims to make the *Digital Transformation Dynamic Capability* framework a practical tool by proposing and testing a maturity model based on the five thematic areas of action, allowing access to the maturity level of the capabilities previously elaborated. This chapter involves the development of a *Digital Transformation Dynamic Capability* assessment instrument that, after the content and face validation procedures, was applied (in a test phase) in 43 Italian companies belonging to a digital innovation ecosystem, whose results were analyzed using descriptive statistics. As the main results, we have a validated instrument whose results reflect the innovative behavior of a particular ecosystem, highlighting moderate and advanced maturity levels

for categories linked to *digital opportunities scanning*, *digital innovation management*, and *technological infrastructure*. The chapter is developed in three other sections: the method used, results and discussion, and conclusion.

4.2 Methodological procedure

Through the systematic review performed in Chapter 3 (Appendix 3B), it was possible to notice that only nine articles of the 23 that propose a maturity model follow some approach. On the one hand, it highlights a possible lack of rigor in the composition of the models, validating the impression of Kohli and Melville (2018) about the lack of theoretical support in the composition of maturity models. However, on the other hand, it provides direction and guidance on the approaches used among the 33 papers revised: the use of the Design science research framework proposed by Hevner et al. (2004) and the Manual for the theoretically founded development and evaluation of maturity models by Becker et al. (2009) stand out.

Thus, in order to constitute a robust capability-based maturity model, the design science approach of Hevner et al. (2004) was used as foundation. Based on real problems in the information systems field, the authors guide the creation of research instruments through seven guidelines. Furthermore, the present chapter is inspired by the procedures of Becker et al. (2009), which proposed a framework for developing maturity models based on the Hevner et al. (2004) guidelines and the design science research approach. Therefore, this chapter followed the next steps (from Becker et al. 2009) for the development of the maturity model: (i) problem definition, (ii) comparison of existing maturity models, (iii) determination of development strategy, and (iv) iterative maturity model development and development of the assessment instrument (which unfolds in four sub-steps). Those steps are mainly contemplated in the development of Chapter 3, and will be detailed next.

Problem Definition. The problem that guides the development of the proposed model is the same problem elaborated in Chapter 3 and can be summarized in its research question: *what are the capabilities underlying the ability to become a digitally mature organization?* The domain is characterized by companies facing the process of digitally transforming their business model - with no distinction on the size. Also, it is important to point out this problem's relevance, as few studies look at capability diagnostics in the digital context.

Comparison of existing maturity models. Following Becker et al. (2009), the need for developing a new maturity model must be substantiated by a comparison with existing models. Hence, this step has been contemplated in Appendix 3B, which presents the main results obtained from the systematic review exploring the main existing models published in scientific journals or significant conferences. Table 3B.1 summarizes their main characteristics.

Determination of development strategy. The model development strategy aims at the completely new model design, so it is partially included in the research approach elaborated in Chapter 3, the flexible pattern-matching (Bouncken et al. 2021). Following Becker et al. (2009), we have made the combination of several models into a new one, using and analyzing their content under a new perspective and application domain. Hence, in the present approach, we have identified the maturity models in the systematic review were used as a starting point for the constitution of the

developed model's conceptual patterns. Subsequently, the final framework was conceived through the confrontation with observed patterns obtained from the cases studied. Such a framework is the basis for developing the maturity model.

Regarding the structure, the model levels were inspired by the models reviewed, having as the principal foundation the work of Schumacher, Nemeth, and Sihn (2019).

Iterative maturity model development and development of the assessment instrument. This is the central phase of the procedure model is (Becker et al. 2009). It has four sub-steps that will be iterated: *selecting the design level*, *selecting the approach*, *designing the model section*, *and testing the results*. Therefore, it was first defined that (i) the model architecture would be a multi-dimensional maturity assessment, where (i) it would be divided into the five thematic areas of action of the *Digital Transformation Dynamic Capability* and (ii) that the instrument's dimensions would be its 23 microfoundation patterns (demonstrated in Table 4.1).

The maturity model was conceived via numerous iterations transforming the microfoundation patterns from the framework into an instrument. Therefore, the main effort for further development of the model concerns adapting the patterns as dimensions of an instrument and creating its maturity levels.

Thus, it was first defined that (i) the model would be divided into the five thematic areas of action of the *Digital Transformation Dynamic Capability* and (ii) that the instrument's dimensions would be its 23 microfoundation patterns (demonstrated in Table 4.1).

Table 4.1 - Dimensions and evaluation items

Area	**Dimensions (*pattern*)**	**Items (*categories*)**
Fostering digital value propositions	Digital opportunity scanning (5 itens)	Continuous collection of customer feedback and evidence; Analysis of customers' value/needs; Exploration and analysis of data; Exploration of technological trends; Internal sensing
	Digital opportunity evaluation (4 itens)	Analysis and refinement of digital opportunities; Digital assertiveness; Financial analysis of digital opportunities; Regular meetings for opportunity analysis and alignment
	Digital innovation management (6 itens)	Fostering digital innovation; Development of MVP and tests; Usage of a digital innovation lab; Development/improvement of digital solutions; Development of individualized and segmented solutions; Development of hybridized solutions (digital + physical)
	Business Model reconfiguration/ digitalization (4 itens)	Data acquisition; Data storage in the cloud; Process and operation automation/digitalization; Smart and autonomous processes
Designing and managing transformation	Transformation planning (6 itens)	Analysis of challenges and risks; Analysis of growth possibilities; Comprehension of digital transformation; Definition of the transformation strategy; Development of an implementation roadmap; Establishing objectives and metrics
	Transformation management (4 itens)	Follow-up and review/adjustment of the transformation strategy; Management of performance capacity; Pacing the transformation; Data-driven decision
	Transformation promotion (3 itens)	Continuous follow-up alignment; Employees involvement; Market communication
	Knowledge and Learning Management (3 itens)	Data management; IT Security; Knowledge management
Acting in digital business ecosystems	External exploration (3 itens)	Competition monitoring; Interactions with ecosystem players; Partnership searching
	Ecosystem exploitation (3 itens)	Exploitation of the ecosystem capabilities; Integration of processes/systems with partners; Management of the ecosystem
	Significant collaborations and partnership (2 itens)	Establishment of collaboration and open innovation; Incorporation/incubation of digital businesses
Systematizing structural changes	Agile practices orientation (2 itens)	Exploration of agile practices in digital business management; Exploration of agile practices in tech projects
	Multidisciplinary teams and flexibility (2 itens)	Promotion of flexibility and autonomy in work; Support multidisciplinary teams
	Employee structure modification (3 itens)	Incorporation of new roles and functions; Redefinition of roles and positions; Offboarding of people misaligned with the company's purpose
	Knowledge and competence improvement (4 itens)	Leveraging digital and product/service design competence; Recruitment of/access to digital knowledge; Recruitment of/access to product and design competence; Recruitment of/access to strategic knowledge

	Organizational structure redesign (2 itens)	Change of the organizational structure; Systematic structure reviews
Supporters and enablers of a DTDC	Financial resources	Financial resources
	Human capital	Digital competence; Interpersonal skills; Technical skills
	Leadership competence and attitude	Leadership competence; Top management and leadership informed and updated; Top management and leadership presence and support
	Organizational culture	Digital and entrepreneurial awareness
	Technological infrastructure	Data storage and processing; Hardware and devices; Information System
	Organizational management	Monitoring performance indicators; Organizational knowledge; Organizational management
	Process and operations management	Data integration capability; Process and operation warranty; Process management

Source: elaborated by the author

Furthermore, five general maturity levels have been established, inspired by Schumacher, Nemeth, and Sihn (2019) (Table 4.2).

Table 4.2 - General maturity levels established

Level	**Description**
Level 0	this level indicates that the organization does not have any initiative in the matter
Level 1	the level is mainly characterized by planning efforts, where there is some familiarity with the subject and reactive initiatives
Level 2	this level suggests an understanding of the importance of the subject, and some activities are carried out (without defined standards and/or dependent on a specific person) proactively, though not regularly
Level 3	at this level, some initiatives/activities are carried out with a certain frequency (still not specific), and it is possible to perceive their contributions to the company's results, although it still has to be better structured as a process
Level 4	at this level, there is a proactive and structured process held in systematic recurrence with defined responsibilities. It is validated and established as part of the organization's results

Source: elaborated by the author

An assessment instrument was then proposed, divided first into the five thematic areas of action of the *Digital Transformation Dynamic Capability*, which are assessed through their identified patterns (Table 4.1).

To transform the patterns into an evaluation instrument, we initially developed a questionnaire in which each pattern would be evaluated as a construct of its component categories. That is: each category within the different patterns would be an item to be evaluated in the instrument. As a result, a questionnaire with a total of 73 questions (one for each category) was generated. Inspired by Schumacher, Nemeth, and Sihn (2019), each of the 73 item questions contemplates a practical example and the description of personalized five levels of maturity (inspired by the general levels mentioned earlier, each of the 73 maturity items had personalized characteristics of each level to facilitate the answer). Figure 4.1 exemplifies an assessed item.

Prior to data collection, a pre-study was conducted for the content and face validation of the instrument. For this purpose, a group of three academic experts (two Ph.D. students and the coordinator of the digital innovation ecosystem) and an industry expert tested the instrument. They were asked to give their opinions on the content of the questions, the content of the items in relation to the study context and the wording (literary editing and fluency of terms and words), the structure, and the scale (Rudner 2001). As a main result, there was an understanding that the questionnaire application was inadequate. The 73 questions, with personalized maturity levels, required significant understanding and response time (the total response time to the questionnaire was around 30 minutes).

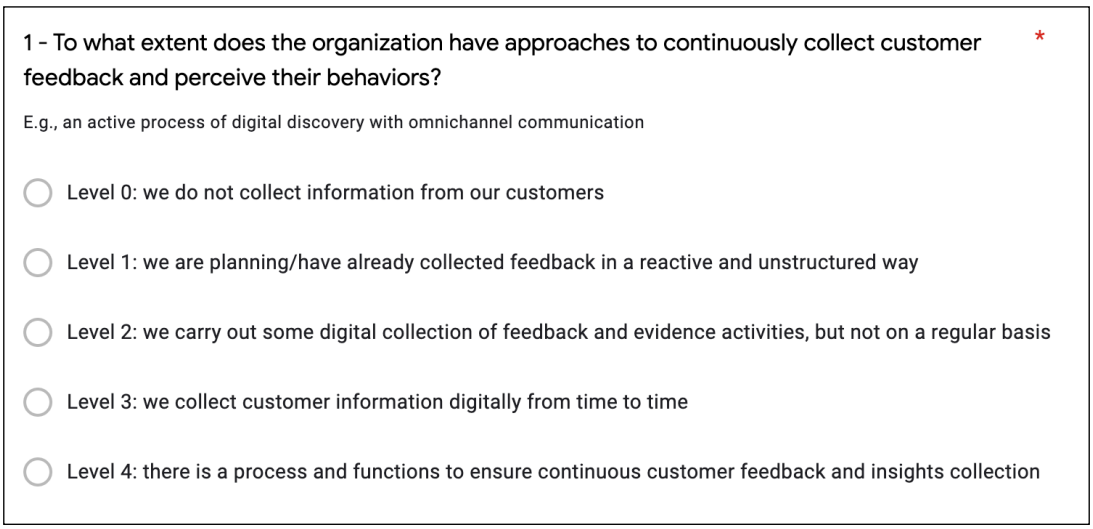

Figure 4.1 - Question regarding the item *Continuous collection of customer feedback and evidence*

Source: elaborated by the author

As a result, a smaller version of the questionnaire was developed and retested. In its smaller version, instead of having 73 questions, where each question represented a pattern category, there were 23 questions, where each question reflected a pattern. To ensure that the content of the categories was reflected upon by the respondent, the description of each of the 23 questions included the details of its component categories. Furthermore, in order to gain agility of response, it was decided that the questions would not have their maturity levels customized but would be answered assuming the levels previously explained in a general way. Figure 4.2 shows what the final version of a question looks like.

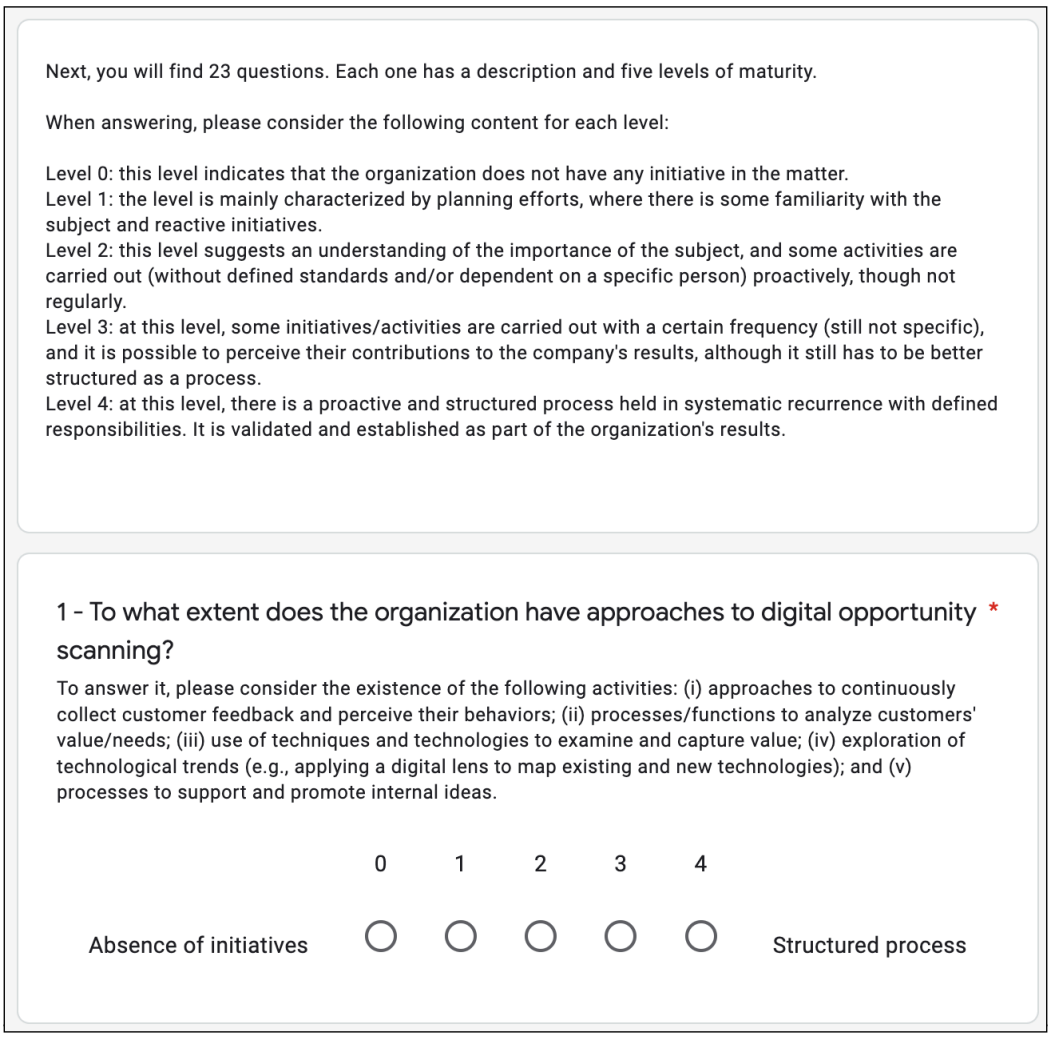

Figure 4.2 - Readjustment of the data collection instrument

Source: elaborated by the author

4.2.1 Data collection

In order to test the instrument, data collection was carried out with organizations that are part of the innovation ecosystem of Politecnico di Milano, belonging to the Digital Innovation Observatory, a qualified reference point in Digital Innovation in Italy, integrating research, communication, and continuous updating activities. In addition to being an ecosystem aligned with the goals of instrument development and testing, it is a convenient environment for data collection due to the proximity of the researchers. Then, the potential sample contained 484 companies.

Besides, we added a section in the questionnaire with four items, based on the work of Verhoef et al. (2021), that seek to ascertain some of the characteristics to compose a sample in which companies had at least some digital maturity in relation to strategic imperatives in the organization. To ensure that we objectively consider only organizations with a particular digital maturity level, the organizations should indicate mature strategic imperatives in digital resources and digital management (through metrics and goals), presenting at least a digital transformation level in one of them.

The questionnaire was administered via online survey in English between May and July 2022 and was designed to be completed anonymously by C-level positions or managers with

sufficient knowledge of the firm's efforts. Following Solarino and Aguinis (2021), elite informants maintain an understanding of decision-making processes and organizational narratives, offering a chance to explore the micro-foundations of companies' strategies (Foss and Pedersen 2016).

4.2.2 Data analysis

Data analysis was conducted using the Statistical Package for Social Science Software (SPSS) version 18. Having the organizations segmented by sector and size, we carried out the descriptive analysis of (i) the maturity of the 23 dimensions and (ii) the incidence of the maturity levels of the 23 dimensions divided by each thematic area.

4.3 Results

From a database of 484 companies, 43 valid responses were obtained, representing 8.88% of the potential sample. According to Hill (1998) and Isaac and Michael (1995), samples between 10 and 30 can be considered adequate for pilot research, thus having a sufficient and adequate sample for a pilot survey and for the analysis of the validation results, although not for any kind of statistical extrapolation or generalization. In order to analyze the results, the data was divided in two ways: (i) company size (SMEs and large) and (ii) sector (service and industry). The demographic and sector characteristics can be seen in tables 4.3 and 4.4.

Table 4.3 - Demographic characteristics

Size	n (43)	%
1 a 50	17	39,53%
51 a 250	11	25,58%
More than 250	15	34,88%

Source: elaborated by the author

In order to increase the level of description of the companies, Table 4.3 provides three extracts. However, the following analyses consider only two sizes where one concerns SMEs, firms with up to 250 employees (27 firms), and the other, large firms with more than 250 employees (15 firms) (European Commission 2003).

Table 4.4 - Organizations industry

Type	Sector	n (43)	%	Total
Service	Financial Services	7	16,28%	26
	IT & Services	6	13,95%	
	Health Care	5	11,63%	
	E-learning	3	6,98%	
	Food Services	2	4,65%	
	Logistics & Supply Chain	1	2,33%	
	Public Sector	1	2,33%	
	Publishing, Marketing & Entertainment	1	2,33%	
	Staffing & Recruiting	1	2,33%	

Industry	Automotive Manufacturing	4	9,30%	16
	Semiconductor Manufacturing	4	9,30%	
	Fashion	3	6,98%	
	Industrial Manufacturing	3	6,98%	
	Made in Italy	1	2,33%	
	Packaging	1	2,33%	

Source: elaborated by the author

Next, the results were divided into the analyses mentioned above in the methodological procedures.

4.3.1 Maturity level of the dimensions

Table 4.5 shows the general average maturity of the 23 dimensions in relation to the five thematic areas of action of the *Digital Transformation Dynamic Capability* and segmented according to sector and size. Table 4.5 also reports data regarding the dimensions' standard deviation, minimum level, and maximum level.

In the overall analysis, no dimension had an average above maturity level 3; however, there are cases close to maturity level 3. In the meantime, the dimensions of *Digital innovation management* (average 2.930, standard deviation 1.033) and *Digital opportunity scanning* (average 2.907, standard deviation 0.971), both components of the area of *Fostering digital value propositions*, and *Technological infrastructure* (average 2.907, standard deviation 1.109), from the area *Supporters and enablers of a DTDC*, stand out positively. Similarly, none of the dimensions fell below maturity level 2. Even so, some dimensions were close to level 1, for example, *Employee structure modification* (mean 2.140, standard deviation 1.355), *Ecosystem exploitation* (mean 2.163, standard deviation 1.174), and *Transformation management* (mean 2.209, standard deviation 1.264).

Analyzing the proposed segments, one notices that the positive highlights echo the general behavior. The two dimensions linked to the *Fostering digital value propositions* area remain close to level 3. Technological infrastructure also remains significant, especially in the large companies segment (mean 3.2, standard deviation 1.014 and minimum 1) and in the product segment (mean 3.053, standard deviation 1.026 and minimum 1). In the SME and service segments, *Technological infrastructure* averages equally close to level 3 (mean 2.750, standard deviation 1.143 and minimum 1) but falls below the *Organizational culture* dimension (mean 2.857, standard deviation 0.970).

Table 4.5 - Maturity of the 23 dimensions

		General				SMEs				Large				Service				Product			
Area	**Dimension (*pattern*)**	**Ave**	**Std dev**	**Mín**	**Max**	**Ave**	**Std dev**	**Mín**	**Max**	**Ave**	**Std dev**	**Mín**	**Max**	**Ave**	**Std dev**	**Mín**	**Max**	**Ave**	**Std dev**	**Mín**	**Max**
Fostering digital value propositions	Digital opportunity scanning	**2,907**	**0,971**	**0**	**4**	**2,929**	**1,016**	**0**	**4**	**2,867**	**0,915**	**1**	**4**	**2,917**	**0,974**	**1**	**4**	**2,895**	**0,994**	**0**	**4**
	Digital opportunity evaluation	2,628	1,001	1	4	2,786	0,957	1	4	2,333	1,047	1	4	2,833	0,963	1	4	2,368	1,012	1	4
	Digital innovation management	**2,930**	**1,033**	**1**	**4**	**2,929**	**1,016**	**1**	**4**	**2,933**	**1,100**	**1**	**4**	**2,917**	**1,100**	**1**	**4**	**2,947**	**0,970**	**1**	**4**
	Business Model reconfiguration/ digitalization	2,721	0,934	1	4	2,714	0,897	1	4	2,733	1,033	1	4	2,708	0,955	1	4	2,737	0,933	1	4
Designing and managing transformation	Transformation planning	2,558	1,119	0	4	2,536	1,138	0	4	2,600	1,121	0	4	2,583	1,176	0	4	2,526	1,073	0	4
	Transformation management	2,209	1,264	0	4	2,286	1,329	0	4	2,067	1,163	0	4	2,333	1,341	0	4	2,053	1,177	0	4
	Transformation promotion	2,581	1,159	0	4	2,607	1,100	1	4	2,533	1,302	0	4	2,500	1,319	0	4	2,684	0,946	1	4
	Knowledge and Learning Management	2,535	1,222	0	4	2,429	1,260	0	4	2,733	1,163	0	4	2,500	1,445	0	4	2,579	0,902	1	4
Acting in digital business ecosystems	External exploration	2,349	1,173	0	4	2,286	1,213	0	4	2,467	1,125	0	4	2,333	1,167	0	4	2,368	1,212	0	4
	Ecosystem exploitation	2,163	1,174	0	4	2,214	1,258	0	4	2,067	1,033	0	4	2,083	1,213	0	4	2,263	1,147	0	4
	Significant collaborations and partnership	2,535	1,162	0	4	2,571	1,200	0	4	2,467	1,125	0	4	2,708	1,233	0	4	2,316	1,057	0	4
Systematizing structural changes	Agile practices orientation	2,256	1,482	0	4	2,250	1,669	0	4	2,267	1,100	0	3	2,292	1,488	0	4	2,211	1,512	0	4
	Multidisciplinary teams and flexibility	2,767	1,212	0	4	2,821	1,249	1	4	2,667	1,175	0	4	2,875	1,227	1	4	2,632	1,212	0	4
	Employee structure modification	2,140	1,355	0	4	2,393	2,393	0	4	1,667	1,047	0	4	2,167	1,435	0	4	2,105	1,286	0	4
	Knowledge and competence improvement	2,512	1,099	0	4	2,571	1,200	0	4	2,400	0,910	1	4	2,417	1,139	0	4	2,632	1,065	0	4
	Organizational structure redesign	2,326	1,169	0	4	2,429	1,200	0	4	2,133	1,125	0	4	2,333	1,204	0	4	2,316	1,157	0	4
Supporters and enablers of a DTDC	Financial resources	2,674	1,229	0	4	2,607	1,257	0	4	2,800	1,207	0	4	2,667	1,308	0	4	2,684	1,157	0	4
	Human capital	2,651	1,044	1	4	**2,821**	**1,056**	**1**	**4**	2,333	0,976	1	4	2,667	1,090	1	4	2,632	1,012	1	4
	Leadership competence and attitude	**2,814**	**1,097**	**0**	**4**	**2,821**	**1,249**	**0**	**4**	2,800	0,775	2	4	2,792	1,215	0	4	**2,842**	**0,958**	**1**	**4**
	Organizational culture	2,628	1,024	0	4	**2,857**	**0,970**	**0**	**4**	2,200	1,014	0	4	**2,875**	**0,797**	**1**	**4**	2,316	1,204	0	4
	Technological infrastructure	**2,907**	**1,109**	**1**	**4**	2,750	1,143	1	4	**3,200**	**1,014**	**1**	**4**	2,792	1,179	1	4	**3,053**	**1,026**	**1**	**4**
	Organizational management	2,442	1,098	0	4	2,393	2,393	0	4	2,533	0,743	2	4	2,375	1,245	0	4	2,526	0,905	1	4
	Process and operations management	2,488	1,121	0	4	2,286	1,213	0	4	**2,867**	**0,834**	**1**	**4**	2,500	1,180	0	4	2,474	1,073	0	4

Regarding dimensions with lower maturity levels in the segments, we observe a behavior close to the general average but with some important modifications. *Employee structure modification* shows level 1 in large companies (average 1.667, standard deviation 1.047) and is almost unanimous as one of the lowest. However, it is not valid in the SME segment: the dimension is close to level 1 (mean 2.393, standard deviation 1.449) but not lower than *Agile practices orientation* (mean 2.250, standard deviation 1.669), *Process and operations management* (mean 2.286, standard deviation 1.213) and *Ecosystem exploitation* (mean 2.214, standard deviation 1.258). In this sense, *Agile practices orientation* has a level close to 1 in the other segments, as does Ecosystem exploitation and Transformation management.

4.3.2 Incidence of maturity levels according to thematic areas

More specifically, in relation to the thematic areas, it is possible to see in tables 4.6 to 4.10 the incidence of the number of companies according to the maturity level in each dimension of the area.

In relation to *Fostering digital value propositions* area, Table 4.6 shows that in all four dimensions, more than 50% of the companies present maturity above level 3. In this line, the Digital innovation management dimension stands out, in which 34.15% of the companies present level 4, as well as the coherence of maturity between *Digital opportunity scanning*, *Digital opportunity evaluation*, and *Digital innovation management*, which present higher incidence in level 3. Within segments, among large companies and service companies, the substantial incidence at level 4 in Digital innovation management stands out; and the cohesive maturity line of product companies in relation to level 3.

In general, it is possible to indicate that companies manifest proactive efforts to generate digital innovations. Both concerning sensing (opportunity scanning and evaluation) and seizing activities, organizations move their efforts toward the composition of digital values. Above all, this is an expected result, taking into account the sample's nature and the companies' participation in an innovation ecosystem, which indicates a strong interest in being close to news about opportunities, threats, and potential partnerships for development. Furthermore, it is noted that the *Business Model reconfiguration/digitalization* dimension presents a higher incidence at level 2 (in the overall result; and in SME and service segments) and low incidence at level 1, which may indicate a possible transition and consolidation phase of the capability.

Table 4.6 - *Fostering digital value propositions*

Maturity level	Digital opportunity scanning		Digital opportunity evaluation		Digital innovation management		Business Model reconfiguration/ digitalization	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
General								
0	1	2,33%	0	0,00%	0	0,00%	0	0,00%
1	3	6,98%	8	18,60%	6	13,95%	4	9,30%
2	7	16,28%	8	18,60%	6	13,95%	**14**	**32,56%**
3	**20**	**46,51%**	**19**	**44,19%**	**16**	**37,21%**	**15**	**34,88%**
4	12	27,91%	8	18,60%	15	34,88%	10	23,26%
Total	43	100,00%	43	100,00%	43	100,00%	43	100,00%
SMEs								
0	1	3,57%	0	0,00%	0	0,00%	0	0,00%

1	1	3,57%	3	10,71%	4	14,29%	2	7,14%
2	6	21,43%	7	25,00%	3	10,71%	**10**	**35,71%**
3	**11**	**39,29%**	**11**	**39,29%**	**12**	**42,86%**	10	35,71%
4	9	32,14%	7	25,00%	9	32,14%	6	21,43%
Total	28	100,00%	28	100,00%	28	100,00%	28	100,00%
Large								
0	0	0,00%	0	0,00%	0	0,00%	0	0,00%
1	2	13,33%	5	33,33%	2	13,33%	2	13,33%
2	1	6,67%	1	6,67%	3	20,00%	4	26,67%
3	**9**	**60%**	**8**	**53,33%**	4	26,67%	**5**	**33,33%**
4	3	20,00%	1	6,67%	**6**	**40%**	4	26,67%
Total	15	100,00%	15	100,00%	15	100,00%	15	100,00%
Service								
0	0	0,00%	0	0,00%	0	0,00%	0	0,00%
1	2	8,33%	3	12,50%	4	16,67%	2	8,33%
2	6	25,00%	4	16,67%	3	12,50%	**9**	**37,50%**
3	**8**	**33,33%**	**11**	**45,83%**	8	33,33%	7	29,17%
4	8	33,33%	6	25,00%	**9**	**37,50%**	6	25,00%
Total	24	100,00%	24	100,00%	24	100,00%	24	100,00%
Produt								
0	1	5,26%	0	0,00%	0	0,00%	0	0,00%
1	1	5,26%	5	26,32%	2	10,53%	2	10,53%
2	1	5,26%	4	21,05%	3	15,79%	5	26,32%
3	**12**	**63,16%**	**8**	**42,11%**	**8**	**42,11%**	**8**	**42,11%**
4	4	21,05%	2	10,53%	6	31,58%	4	21,05%
Total	19	100,00%	19	100,00%	19	100,00%	19	100,00%

Source: elaborated by the author

Regarding the Designing and managing transformation area (Table 4.7), all four dimensions have more than 50% of the companies with maturity above level 3. The *Transformation management* dimension presents a significant volume of companies at level 1, for example - which is greatly influenced by the SME segment (in which level 1 is the most prevalent, representing one-third of the 27 companies). Moreover, it is interesting to indicate that the *Transformation promotion* dimension has a high and consolidated maturity level, with the highest percentage among companies linked to the service sector (33.33%).

In general, one can say that there is a significant concern with the Transformation plan and development within organizations, but that the Change and knowledge management capabilities still need to gain more attention and maturity within SMEs.

Table 4.7 - *Designing and managing transformation*

Maturity level	Transformation planning		Transformation management		Transformation promotion		Knowledge and Learning Management	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%
General								
0	2	4,65%	4	9,30%	1	2,33%	3	6,98%
1	6	13,95%	11	25,58%	9	20,93%	6	13,95%
2	10	23,26%	7	16,28%	8	18,60%	10	23,26%
3	**16**	**37,21%**	**14**	**32,56%**	**14**	**32,56%**	**13**	**30,23%**
4	9	20,93%	7	16,28%	11	25,58%	11	25,58%
Total	43	100,00%	43	100,00%	43	100,00%	43	100,00%
SMEs								
0	1	3,57%	2	7,14%	0	0,00%	2	7,14%

1	5	17,86%	**9**	**32,14%**	6	21,43%	5	17,86%
2	6	21,43%	2	7,14%	6	21,43%	**7**	**25,00%**
3	**10**	**35,71%**	9	32,14%	**9**	**32,14%**	**7**	**25,00%**
4	6	21,43%	6	21,43%	7	25,00%	7	25,00%
Total	28	100,00%	28	100,00%	28	100,00%	28	100,00%
Large								
0	1	6,67%	2	13,33%	1	6,67%	1	6,67%
1	1	6,67%	2	13,33%	3	20,00%	1	6,67%
2	4	26,67%	**5**	**33,33%**	2	13,33%	3	20,00%
3	**6**	**40,00%**	**5**	**33,33%**	**5**	**33,33%**	**6**	**40,00%**
4	3	20,00%	1	6,67%	4	26,67%	4	26,67%
Total	15	100,00%	15	100,00%	15	100,00%	15	100,00%
Service								
0	1	4,17%	2	8,33%	1	4,17%	3	12,50%
1	4	16,67%	7	29,17%	6	25,00%	3	12,50%
2	5	20,83%	1	4,17%	5	20,83%	6	25,00%
3	**8**	**33,33%**	**9**	**37,50%**	4	16,67%	3	12,50%
4	6	25,00%	5	20,83%	**8**	**33,33%**	**9**	**37,50%**
Total	24	100,00%	24	100,00%	24	100,00%	24	100,00%
Produt								
0	1	5,26%	2	10,53%	0	0,00%	0	0,00%
1	2	10,53%	4	21,05%	3	15,79%	3	15,79%
2	5	26,32%	**6**	**31,58%**	3	15,79%	4	21,05%
3	**8**	**42,11%**	5	26,32%	**10**	**52,63%**	**10**	**52,63%**
4	3	15,79%	2	10,53%	3	15,79%	2	10,53%
Total	19	100,00%	19	100,00%	19	100,00%	19	100,00%

Fonte: elaborada pelo autor

The area of *Acting in digital business ecosystems* (Table 4.8) has one of the dimensions with the lowest average - *Ecosystem exploitation* (Table 4.5), which is reflected in the incidence of responses regarding the maturity levels indicated by companies: 39.53% of companies indicated level 2. Moreover, in this area, only the dimension *Significant collaborations and partnership* has more than 50% of the companies in levels 3 or 4; the other two dimensions are below this percentage, with almost 10% of the companies in level 0 (in which the vast majority are SMEs). In relation to the dimension of *Significant collaborations and partnership*, a strong maturity in the capacity of companies in the service sector to develop partnerships can be perceived. This trend is not followed by the product companies, in which this dimension is more mature at level 2. Based on these results, it is possible to indicate that there is a growing maturity in the capacity for external recognition, although there is a maturity to be reached for greater use of the capabilities that exist within the ecosystem.

Table 4.8 - *Acting in digital business ecosystems*

Maturity level	External exploration		Ecosystem exploitation		Significant collaborations and partnership	
	Frequency	%	Frequency	%	Frequency	%
General						
0	4	9,30%	4	9,30%	3	6,98%
1	5	11,63%	7	16,28%	4	9,30%
2	13	30,23%	**17**	**39,53%**	**13**	**30,23%**
3	**14**	**32,56%**	8	18,60%	**13**	**30,23%**
4	7	16,28%	7	16,28%	10	23,26%

Total	43	100,00%	43	100,00%	43	100,00%
SMEs						
0	3	10,71%	3	10,71%	2	7,14%
1	4	14,29%	5	17,86%	3	10,71%
2	7	25,00%	**8**	**28,57%**	7	25,00%
3	**10**	**35,71%**	7	25,00%	**9**	**32,14%**
4	4	14,29%	5	17,86%	7	25,00%
Total	28	100,00%	28	100,00%	28	100,00%
Large						
0	1	6,67%	1	6,67%	1	6,67%
1	1	6,67%	2	13,33%	1	6,67%
2	**6**	**40,00%**	**9**	**60,00%**	**6**	**40,00%**
3	4	26,67%	1	6,67%	4	26,67%
4	3	20,00%	2	13,33%	3	20,00%
Total	15	100,00%	15	100,00%	15	100,00%
Service						
0	2	8,33%	2	8,33%	1	4,17%
1	4	16,67%	6	25,00%	4	16,67%
2	5	20,83%	**8**	**33,33%**	4	16,67%
3	**10**	**41,67%**	4	16,67%	**7**	**29,17%**
4	3	12,50%	4	16,67%	**8**	**33,33%**
Total	24	100,00%	24	100,00%	24	100,00%
Produt						
0	2	10,53%	2	10,53%	2	10,53%
1	1	5,26%	1	5,26%	0	0,00%
2	**8**	**42,11%**	**9**	**47,37%**	**9**	**47,37%**
3	4	21,05%	4	21,05%	6	31,58%
4	4	21,05%	3	15,79%	2	10,53%
Total	19	100,00%	19	100,00%	19	100,00%

Source: elaborated by the author

The results of the *Systematizing structural changes* area (Table 4.9) show a more significant variation and diffusion than the previous areas, evidencing that the ability to deal with the necessary changes of DT still needs to be better established within the spectrum of organizations. This area, for example, has three dimensions in which more than 50% of the companies indicated levels 3 or 4 of maturity: *Agile practices orientation*, *Multidisciplinary teams and flexibility*, and *Knowledge and competence improvement*. However, in relation to the first dimension, it is important to note that its general average (2.256), previously presented, is strongly influenced by the rate of companies that do not possess this capability (present level 0), 20.93%. This dimension was the one that received the most level 0 responses among all 23 dimensions, but, at the same time, it presents a strong incidence in levels 3 and 4 in general and in the segments (although no large company indicated level 4). This contrasting scenario may indicate difficulty in adopting agile approaches or translating the pillars of agility (as seen in the following chapter).

In addition, the *Employee structure modification* dimension, which has the lowest overall average (2.140), has the incidence of dispersed maturity levels, with more conciseness in level 2 and more than 30% of the companies in level 0 or 1. Finally, we point out that the *Knowledge and competence improvement* dimension represents a capability that receives attention from the companies that responded to the survey, showing interesting results in the segments, with large

companies or companies from the product sector showing greater maturity than in the SMEs and service companies.

Table 4.9 - *Systematizing structural changes*

Maturity level	Agile practices orientation		Multidisciplinary teams and flexibility		Employee structure modification		Knowledge and competence improvement		Organizational structure redesign	
	Frequency	%	Frequency	%	Frequency	%	Frequency	%	Frequency	%
General										
0	9	20,93%	1	2,33%	6	13,95%	2	4,65%	3	6,98%
1	5	11,63%	8	18,60%	8	18,60%	6	13,95%	8	18,60%
2	5	11,63%	7	16,28%	**13**	**30,23%**	11	25,58%	11	25,58%
3	**14**	**32,56%**	11	25,58%	6	13,95%	**16**	**37,21%**	**14**	**32,56%**
4	10	23,26%	**16**	**37,21%**	10	23,26%	8	18,60%	7	16,28%
Total	43	100,00%	43	100,00%	43	100,00%	43	100,00%	43	100,00%
SMEs										
0	7	25,00%	0	0,00%	4	14,29%	2	7,14%	2	7,14%
1	4	14,29%	6	21,43%	4	14,29%	3	10,71%	5	17,86%
2	2	7,14%	6	21,43%	6	21,43%	7	25,00%	5	17,86%
3	5	17,86%	3	10,71%	5	17,86%	**9**	**32,14%**	**11**	**39,29%**
4	**10**	**35,71%**	**13**	**46,43%**	**9**	**32,14%**	7	25,00%	5	17,86%
Total	28	100,00%	28	100,00%	28	100,00%	28	100,00%	28	100,00%
Large										
0	2	13,33%	1	6,67%	2	13,33%	0	0,00%	1	6,67%
1	1	6,67%	2	13,33%	4	26,67%	3	20,00%	3	20,00%
2	3	20,00%	1	6,67%	**7**	**46,67%**	4	26,67%	**6**	**40,00%**
3	**9**	**60,00%**	**8**	**53,33%**	1	6,67%	**7**	**46,67%**	3	20,00%
4	0	0,00%	3	20,00%	1	6,67%	1	6,67%	2	13,33%
Total	15	100,00%	15	100,00%	15	100,00%	15	100,00%	15	100,00%
Service										
0	4	16,67%	0	0,00%	4	16,67%	1	4,17%	1	4,17%
1	4	16,67%	5	20,83%	4	16,67%	4	16,67%	**6**	**25,00%**
2	4	16,67%	4	16,67%	**6**	**25,00%**	**8**	**33,33%**	**6**	**25,00%**
3	5	20,83%	4	16,67%	4	16,67%	6	25,00%	6	25,00%
4	**7**	**29,17%**	**11**	**45,83%**	6	25,00%	5	20,83%	5	20,83%
Total	24	100,00%	24	100,00%	24	100,00%	24	100,00%	24	100,00%
Produt										
0	5	26,32%	1	5,26%	2	10,53%	1	5,26%	2	10,53%
1	1	5,26%	3	15,79%	4	21,05%	2	10,53%	2	10,53%
2	1	5,26%	3	15,79%	**7**	**36,84%**	3	15,79%	5	26,32%
3	**9**	**47,37%**	**7**	**36,84%**	2	10,53%	**10**	**52,63%**	**8**	**42,11%**
4	3	15,79%	5	26,32%	4	21,05%	3	15,79%	2	10,53%
Total	19	100,00%	19	100,00%	19	100,00%	19	100,00%	19	100,00%

Source: elaborated by the author

Regarding the area of *Supporters and enablers of a DTDC* (Table 4.10), more than 50% of the companies present maturity above level 3 in all its dimensions. This result highlights the maturity of the companies connected to the Observatory and, thus, evidences the positive and significant relationship between these dimensions and the ability to innovate digitally. In this context, the *Technological infrastructure* dimension stands out, whose overall average is 2.907, and almost 40% of the companies indicate maturity level 4, ratifying this dimension's significant role as an enabler in companies that promote digital innovations. Furthermore, it can be seen that the

maturity level of leadership in the companies, through the *Leadership competence and attitude* dimension, is also expressive, with 32.56% of the companies indicating a maturity level 4. This is a significant result, as it helps to confirm recent scientific production results regarding leadership posture in a digital transformation context, such as He et al. (2022) and AlNuaimi et al. (2022).

Table 4.10 - *Supporters and enablers of a DTDC*

Maturity level	Financial resources		Human capital		Leadership competence and attitude		Organizational culture		Technological infrastructure		Organizational management		Process and operations management	
	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%	Freq.	%
General														
0	3	6,98%	0	0,00%	2	4,65%	2	4,65%	0	0,00%	3	6,98%	3	6,98%
1	5	11,63%	6	13,95%	2	4,65%	3	6,98%	7	16,28%	4	9,30%	6	13,95%
2	8	18,60%	**15**	**34,88%**	12	27,91%	12	27,91%	7	16,28%	14	32,56%	7	16,28%
3	**14**	**32,56%**	10	23,26%	13	30,23%	**18**	**41,86%**	12	27,91%	**15**	**34,88%**	**21**	**48,84%**
4	13	30,23%	12	27,91%	**14**	**32,56%**	8	18,60%	**17**	**39,53%**	7	16,28%	6	13,95%
Total	43	100,00%	43	100,00%	43	100,00%	43	100,00%	43	100,00%	43	100,00%	43	100,00%
SMEs														
0	2	7,14%	0	0,00%	2	7,14%	1	3,57%	0	0,00%	3	10,71%	3	10,71%
1	4	14,29%	3	10,71%	2	7,14%	2	7,14%	6	21,43%	4	14,29%	5	17,86%
2	5	17,86%	9	32,14%	6	21,43%	3	10,71%	4	14,29%	5	17,86%	4	14,29%
3	**9**	**32,14%**	6	21,43%	7	25,00%	**16**	**57,14%**	9	32,14%	**11**	**39,29%**	**13**	**46,43%**
4	8	28,57%	**10**	**35,71%**	**11**	**39,29%**	6	21,43%	**9**	**32,14%**	5	17,86%	3	10,71%
Total	28	100,00%	28	100,00%	28	100,00%	28	100,00%	28	100,00%	28	100,00%	28	100,00%
Large														
0	1	6,67%	0	0,00%	0	0,00%	1	6,67%	0	0,00%	0	0,00%	0	0,00%
1	1	6,67%	3	20,00%	0	0,00%	1	6,67%	1	6,67%	0	0,00%	1	6,67%
2	3	20,00%	**6**	**40,00%**	**6**	**40,00%**	**9**	**60,00%**	3	20,00%	**9**	**60,00%**	3	20,00%
3	**5**	**33,33%**	4	26,67%	**6**	**40,00%**	2	13,33%	3	20,00%	4	26,67%	**8**	**53,33%**
4	**5**	**33,33%**	2	13,33%	3	20,00%	2	13,33%	**8**	**53,33%**	2	13,33%	3	20,00%
Total	15	100,00%	15	100,00%	15	100,00%	15	100,00%	15	100,00%	15	100,00%	15	100,00%
Service														
0	2	8,33%	0	0,00%	2	8,33%	0	0,00%	0	0,00%	3	12,50%	2	8,33%
1	3	12,50%	3	12,50%	1	4,17%	1	4,17%	5	20,83%	2	8,33%	3	12,50%
2	4	16,67%	**10**	**41,67%**	5	20,83%	6	25,00%	4	16,67%	6	25,00%	4	16,67%
3	**7**	**29,17%**	3	12,50%	**8**	**33,33%**	**12**	**50,00%**	6	25,00%	**9**	**37,50%**	**11**	**45,83%**
4	**8**	**33,33%**	8	33,33%	8	33,33%	5	20,83%	**9**	**37,50%**	4	16,67%	4	16,67%
Total	24	100,00%	24	100,00%	24	100,00%	24	100,00%	24	100,00%	24	100,00%	24	100,00%
Produt														
0	1	5,26%	0	0,00%	0	0,00%	2	10,53%	0	0,00%	0	0,00%	1	5,26%
1	2	10,53%	3	15,79%	1	5,26%	2	10,53%	2	10,53%	2	10,53%	3	15,79%
2	4	21,05%	5	26,32%	**7**	**36,84%**	**6**	**31,58%**	3	15,79%	**8**	**42,11%**	3	15,79%
3	**7**	**36,84%**	**7**	**36,84%**	5	26,32%	**6**	**31,58%**	6	31,58%	6	31,58%	**10**	**52,63%**
4	5	26,32%	4	21,05%	6	31,58%	3	15,79%	**8**	**42,11%**	3	15,79%	2	10,53%
Total	19	100,00%	19	100,00%	19	100,00%	19	100,00%	19	100,00%	19	100,00%	19	100,00%

Source: elaborated by the author

4.4 Discussion

From the systematic review of maturity models (Chapter 3), it was found that the models reviewed did not address a view of maturity based on the ability of companies to keep modifying their business models in order to remain meaningful in a digital and continuously changing context.

Moreover, it was also found that efforts to capture the capabilities required for an organization to keep changing (e.g., Warner and Wäger 2019; Matarazzo et al. 2021; Soluk and Kammerlander 2021) do not explore in-depth the practical application of their compelling results. Thus, at the interface of these two findings lies the importance of making the framework developed in Chapter 3 tangible through a maturity model, which holistically contemplates the opportunity to verify the maturity of companies to scale their digital maturity levels. In relation to this, after considering the results obtained, at least two avenues of discussion are necessary. The first concerns the development and test of the model as a capability-based instrument for analyzing the maturity of organizations; the second concerns its possible practical and theoretical implications.

First, given the complexity of the previously developed framework, the effort to transform it into a maturity model needs to be highlighted. It was necessary to perform the development and validity testing of two versions in order to be able to ensure greater answerability. The initial, more detailed version sought to ensure a more sophisticated appreciation of the presence of patterns (influenced mainly by the work of Schumacher, Nemeth, and Sihn 2019). Such a version, which contained 73 variables - one for each category, was discarded in favor of a 'leaner' version in which the categories were condensed into the description of the pattern being investigated. The change strategy was successful as 43 responses were obtained, a sufficient and adequate sample for a pilot survey, according to Hill (1998) and Isaac and Michael (1995).

Furthermore, regarding the content of the results, it is important to emphasize that they were collected within a 'controlled' scope, in which the test-application of the instrument was carried out in a sample of organizations (i) partners of a digital innovation observatory and (ii) that met inclusion criteria (based on Verhoef et al. 2021). In such a way, it was possible to guarantee the condition of validating the results obtained by the instrument in the light of possible expected results. For example, it was reasonable to predict at least a particular outcome for some patterns (such as moderate and/or advanced level of maturity in *Digital innovation management*).

Regarding the results, even though this is a sample from which statistical implications cannot be drawn, it is interesting to analyze that there is an orientation (even if initial) in some categories. For example, companies present a good level of maturity in the area of *Fostering digital value propositions*, emphasizing the ability to recognize opportunities (*digital opportunity scanning*) and explore them (*digital innovation management*). It was also evident the maturity of the companies concerning the *technological infrastructure* of the *Supporters and enablers of a DTDC* area.

Finally, the condition of pilot application in a known scope also conferred the chance of possible improvements in the instrument and future implications. Regarding theoretical implications, the instrument advances the theory in relation to the maturity models verified in the systematic review of Chapter 3. It satisfies the need to be able to analyze the digital transformation process of companies from a capability perspective, a possibility that Lin, Sheng, and Jeng Wang (2020) had previously developed, although their findings were restricted to the industrial sector. In turn, the present pilot application of the questionnaire was carried out in companies linked to a digital innovation observatory (of different service or product sector sizes).

Regarding practical implications, two lines of analysis can be perceived. The first, at the organizational level, is the potential to use the instrument as a guiding mechanism for companies'

strategy formulation. From the content developed and the descriptive nature of the maturity model (Poeppelbuss and Roeglinger 2011), the model can be used as a diagnostic tool, guiding decision-making on resource allocation and the development of capabilities so that the organization reaches a dynamic capacity for change.

At a second level, from the application of the questionnaire in larger samples (or specific samples), the results obtained can inspire the creation of public policies to guide and encourage the development of companies toward TD. By applying the instrument to an ecosystem or a set of companies, it is possible to understand the macro needs, which would lead to creating and promoting activities that would allow these gaps to be filled. According to Cazeri et al. (2021), it is important to note that many Brazilian companies do not even know the basic definitions related to "Industry 4.0", "Digital Revolution" and their associated technologies. It demonstrates the urgency and the need to support the development of knowledge and capabilities in the national scenario. Still, according to the authors, while world-class companies will continue with their projects and organizational changes, the COVID-19 crisis has significantly affected the transition of most companies (especially SMEs). Such a scenario increases the importance of the model developed in Chapters 3 and 4: by helping to identify the elements and factors that would help companies succeed in DT, which is an open field for practical implications and further research (Scuotto et al. 2021; Soluk and Kammerlander 2021; Priyono et al. 2020), it serves as a basis for structuring government actions.

4.5 Conclusion

The present paper presented the development and pilot application of a maturity model based on the *Digital Transformation Dynamic Capability* framework developed in Chapter 3. Following the design science approach, this paper presented the proposition of two versions of the instrument, where the leaner version was tested with 43 Italian companies that are partners of the Digital Innovation Observatory linked to Politecnico di Milano. Hence, the main results are (i) the presentation of a tested maturity model with potential practical implications. It can be used for further exploration to verify ecosystems and sectors, and to create public policies or diagnose organizational capacity for developing *Digital Transformation Dynamic Capability*. Furthermore, from the analysis of the collected data, it was verified that (ii) there is significant maturity in the area of *Fostering digital value propositions,* which points out the importance that the Italian companies linked to the Innovation Observatory are giving to a such urgent topic as the digital transformation.

The main limitations are, first, the sample size. Although the present database supports pilot study testing, a larger base would allow for a more qualified understanding of the subject areas. Second, the developed model can be classified (following Poeppelbuss and Roeglinger 2011) as descriptive. Thus, a limitation is the non-assignment of guidelines according to the levels of maturity evidenced in the diagnosis. In this way, companies can check their capabilities level and proceed in search of developing them. As the instrument and framework are comprehensive and detailed, such an effort is well supported. However, it is evident that if there were practical guidelines for developing such capabilities, companies would benefit more and faster. Therefore,

both limitations may guide future queues of work. The first, at the organizational level, is the potential to use the instrument as a guiding mechanism for companies' strategy formulation, but it is necessary to create action plans attributed to the levels and the micro-foundations. Moreover, at a second level, the application of the questionnaire in larger samples (or specific samples) may suggest paths of joint development: public policies may be based on the results obtained in order to finance the promotion and development of capabilities in companies.

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Chapter 5 - Modeling the antecedent factors of the *Digital Transformation Dynamic Capability* framework

This chapter is a version of the article The contribution of organizational culture, structure, and leadership factors in the digital transformation of SMEs: a mixed-methods approach. The first part of the article, the qualitative effort, was presented at the international event RND 2022 in Trento (Italy). Moreover, the entire paper was published in Cognition, Technology & Work (Qualis A1, impact factor 2.818 - 2021).

Abstract: Contributing to the scarce literature on how companies deal with business model digital transition, this work explores the digital transformation (DT) process in small and medium enterprises (SME), investigating how organizational culture, structure, and leadership influence it. While such three factors are deemed essential components to facilitate DT, how they operate and how they relate to each other are still not very well-defined issues in need of in-depth investigation. This study employed a mixed-methods approach, following an exploratory sequential design. First, a conceptual model was developed based on qualitative data collected from expert interviews and analyzed through grounded theory. This stage uncovered 25 first-order concepts about culture, structure, and leadership, further organized into six constructs and hypotheses paths. Then, with a sample of 192 SMEs, the structural model was measured and validated using Exploratory Factor Analysis and PLS-SEM. As a result, our study offers robust and timely research whose conceptual model condenses a knowledge corpus that future research can benefit from, and it provides statistical extrapolations about how and how much those factors relate to each other in SMEs context; moreover, given the traditional scarce resources and lack of flexibility in SMEs, it provides orientation and guidelines to managers facing DT and needing to understand the organizational factors they should be aware of, where to focus energy, and what to expect as results. From a large-scale perspective, this study carries an impactful contribution to the many countries where SMEs play a major economic and social role.

Keywords: digital transformation; organizational culture; organizational structure; leadership; small and medium enterprises; mixed-methods; business model.

5.1 Introduction

The current competitive environment is characterized by a number of major and intertwined phenomena that contribute to reshaping its strategic and organizational landscape. These phenomena include (i) the rise of digital competitors that renew industries (e.g., Spotify, UBER, Airbnb); (ii) increasingly informed and demanding consumers (Fernández-Rovira et al. 2021; Shakina et al. 2021; Warner and Wäger 2019); (iii) the constant emergence of disruptive digital technologies (e.g., Internet of Things, artificial intelligence, big data, blockchain) that, among other things, create new business opportunities (Müller, Buliga, and Voigt 2018), enable the more accurate insights and information of the needs and requests of consumers (Rialti et al. 2019), and encourages the creation of flexible and interconnected firm systems (Magni et al. 2021); and (iv) a

global crisis caused by the coronavirus outbreak (COVID-19) which accelerated the conditions of development and adoption of technologies and capabilities (Fregnan et al. 2022). The result is a scenario that challenges companies' business models and pushes them to remain successful (or to survive) through ways to deliver their products and services digitally (Seetharaman 2020; Scuotto et al. 2022). In these conditions, one of the most prominent issues involves understanding *digital transformation* (DT), which can be defined as a change in how a firm employs digital technologies to develop a digital business model that helps create and appropriate more value (Verhoef et al. 2021). Rather than being merely about technology, DT is an effort of strategic renewal and holistic change that takes advantage of digital technologies to generate greater value for customers by creating or updating business models, processes, structures, and cultural approaches (Gong and Ribiere 2020; Chanias, Myers, and Hess 2019; Vial 2019; Warner and Wäger 2019).

Research on DT is multidisciplinary and still developing, with growing interest from researchers (Vaska et al. 2021; Verhoef et al. 2021). However, with little conceptual or empirical research examining how organizations are digitally transformed, scientific literature seems to lag behind the practical world (Fernández-Rovira et al. 2021; Warner and Wager 2019; Li 2018). In such a context, Vial (2019) pointed out that firms' ability to design mechanisms that enable repeatable and continuous adaptation is a significant issue, and some researchers endeavored to comprehend DT through the lens of dynamic capabilities theory (e.g., Warner and Wäger 2019; Matarazzo et al. 2021; Soluk and Kammerlander 2021). In this inspiring venue, understanding the organizational antecedents *par rapport* with the adaptability of companies represents a significant theme for contributions (e.g., Dhir et al. 2016), with particular attention to the understanding and further theorizing about organizational factors such as culture and structure and individual factors such as leadership (Schilke, Hu, and Helfat 2018; Verhoef et al. 2021), how they interact with each other and their interrelationship with digital technologies.

Organizational culture contemplates values, beliefs, principles, and the way people work (Chanias, Myers, and Hess 2019; Warner and Wäger 2019), and, in line with Peter Drucker, according to whom 'culture eats strategy for breakfast,' it can determine a company's fate on the DT journey. For instance, it can affect employee commitment to change (Holbeche 2018), can enable crucial dynamic capabilities to deal with DT (Warner and Wäger 2019), and represents a key driver of organizational change (Hogan and Coote 2014) as, according to Hock, Clauss, and Schulz (2015), it relates to firms' ability to innovate their business models. Nevertheless, although DT represents mostly a cultural change that has to happen within the company (Mergel, Edelmann, and Haug 2019), cultural factors such as values, beliefs, principles, and mentalities have been associated with few practical and scientific exploitations concerning business performance and innovative results (Holbeche 2018) or organizational capabilities in dynamic conditions (Narayanan et al. 2009). Similarly, the organizational structure also represents an essential role in comprehending firm success in uncertain, complex, and dynamic environments (Seetharaman 2020). For example, cross-functional collaboration has been indicated as a critical element of agility and ambidexterity, both crucial to advance in the DT, as agile structures are arguably more capable of detecting business opportunities and threats early and implementing changes since their flexible structures can be quickly modified (Chan et al. 2019; Holbeche 2018; Teece, Peteraf and Leih 2016). However, research on organizational structures that allow firms to execute DT requires further

investigation (Verhoef et al. 2021). Concerning the role of leadership, it is deemed that DT requires superior change management capabilities (Sousa and Rocha 2019) and, according to Elbanna and Newman (2022), the positive role of top management support has become a mantra in information systems (IS) research. For instance, He et al. (2022) highlight the role of leadership that drives digitalization in empowering capable individuals and providing systematic support against crises. Also, AlNuaimi et al. (2022) confirmed that digital transformational leadership significantly influences DT. However, following Elbanna and Newman (2022), there is also a negative side of top management support in IS implementation that has been largely unrecognized by previous research. Hence, their role in stimulating a digital culture and how they support the organization in DT are still open questions (Singh et al. 2019; Uhl-Bien and Arena 2018; Vial 2019). Furthermore, we know that culture, leadership, and organizational change have significant positive associations with organizational performance (Dalvi et al. 2013), so how they operate and relate to each other (or not relate) is also an attractive gap inside the DT discussion (Vaska et al. 2021; Priyono et al. 2020). While some capabilities grew in importance during the pandemic suggesting a *new work culture* (Fregnan et al. 2022), according to Vaska et al. (2021), the culture shift in companies that transitioned to digital requires more research. Also, Ko et al. (2021) conclude that decision-makers are the drivers of DT in organizations, and for Vial (2019), leaders can ensure that companies develop digital orientation and the necessary agility to respond to digital technology's context. However, to what extent leadership influences those and other matters (Singh et al. 2019), and the importance of the company's mission of mobilizing people to develop DT (Porfírio et al. 2021) are still open for examination.

Those concerns can be particularly challenging for small and medium-sized organizations (SMEs) (Verhoef et al. 2021; Müller, Buliga, and Voigt 2018). According to Scuotto et al. (2021), to evolve, SMEs must have their business model digitalized; however, reality confronts them with several difficulties. For example, they often lack leadership guidance and prioritization, bringing uncertainty about DT's potential gains and implications (PWC 2018; Mittal et al. 2018; Gruber 2019; Rafael et al. 2020). They also tend to have limited investment capacity and lack adequate resources, digital awareness, experience, competencies, and confidence to handle data management and security (Giotopoulos et al. 2017; Gruber 2019; Rafael et al. 2020), along with resistance to change (Soluk and Kammerlander 2021). SMEs are frequently hindered by rigid organizational structures and cultures that do not experiment with cutting-edge technologies and lack networking opportunities (Matarazzo et al. 2021; Rafael et al. 2020; Machado et al. 2019). Also, Cazeri et al. (2021) indicate that, while world-class companies will continue their projects and organizational changes, the COVID-19 crisis significantly impacts most companies' transition (mainly SMEs). So, identifying elements and factors that may help SMEs succeed in DT represents an open field to practical implications and more in-depth research (Scuotto et al. 2021; Soluk and Kammerlander 2021; Priyono et al. 2020; Bouwman et al. 2019; North et al. 2019).

This chapter main objectives are to identify the cultural, structural, and leadership factors influencing DT and depict how they relate to it and each other. The research combines qualitative and quantitative research. First, a conceptual model of six constructs and hypotheses paths was developed based on data collected from thirteen expert interviews and analyzed using grounded theory. Then, in the quantitative part, an instrument for measuring the model was developed and

validated with a sample of 192 organizations. Its reliability and validity were tested using Exploratory Factors Analysis (EFA), and the model paths were examined using Partial Least Squares Structural Equation Model (PLS-SEM).

Therefore, this study provides a necessary socio-technical perspective of different DT factors linked to the organizational behavior and information technology fields. Its main contribution is the proposal and test of a conceptual model composed of six different cultural, organizational, and leadership factors in the DT context: (i) promoting an innovation culture, (ii) cultivating a digital and entrepreneurial awareness, (iii) nurturing an experimental environment, (iv) encouraging an agile structure, (v) setting a cultural alignment, and (vi) leading the transformation. Such a model advances knowledge on the interface between technology, work, and people in SMEs, inspiring theoretical advances in how organizations deal with the DT. Moreover, this study contributes to the literature on companies transitioning to digitalized business models (Matarazzo et al. 2021; Seetharaman 2020), helping to structure the foundation for further exploration - a need highlighted by Kadir and Broberg (2020). For instance, it demonstrates *how* and *how much* organizations can ensure the development of necessary cognitive aspects (such as tolerance to failures, trust, the propensity to take risks, and openness to change - Roblek et al. 2021) to respond to modern digital technology's context through the understanding of the constructs *digital and entrepreneurial awareness* and *nurturing an experimental environment*. In the same way, it explains the impact of agile structures in supporting the creation of an innovation culture to advance DT and confirms a dual (negative and positive) influence on leaders' behavior in such a context (Weber et al. 2022). Furthermore, this study elaborates how those factors relate to dynamic capabilities (Teece 2007), helping SMEs to set the ability to design and maintain high-order mechanisms that enable repeatable, continuous adaptation in a dynamic environment as the DTs - answering a call by Vial (2019). Also, from a practical perspective, such contributions can be associated with a potential economic contribution (Keen and Williams 2013) as SMEs constitute an essential part of the economy in many countries (Gruber 2019) and, following OECD (2017), are lagging behind in the digital transition. Following the introduction, the article has five sections: a theoretical background (addressing DT and aspects related to culture, organizational structure, and leadership), method, results, and discussion and conclusion.

5.2 Theoretical background

5.2.1 Digital Transformation

In recent years, academia and practitioners have shown an increasing interest in DT (Vaska et al. 2021), a field that is still structuring its best definition. Recent studies have made efforts to address it (Gong and Ribiere 2020; Vial 2019; Warner and Wäger 2019), and, in this study, we follow Verhoef et al. (2021, p.1): DT is the way in which "*a firm employs digital technologies to develop a new digital business model that helps to create and appropriate more value for the firm*". This definition allows us to comprehend the phenomenon in a holistic instance and removes the confusion in the literature about the terms *digital transformation*, *digitization*, and *digitalization* (Mergel, Edelmann, and Haug 2019). Those three concepts (often used interchangeably by management scholars) can be understood as phases (Soluk and Kammerlander

2021; Verhoef et al. 2021) or domains (Saarikko et al. 2020) characterized by specific kinds of technology use and have their own layers of complexity amid their implications for value creation, technology management, business strategy, and organizational culture (Saarikko et al. 2020). To Verhoef et al. (2021), *digitization* describes the action of converting analog information into digital information; and *digitalization* describes how IT or digital technologies can be used to alter existing business processes.

Mergel, Edelmann, and Haug (2019) stated that DT might be accused of being "old wine in new bottles" with topics such as ERP (Enterprise Resource Planning) implementation. About it, it is essential to direct our attention to two points. The first is that DT' frequently involve advanced digital technologies like the Internet of Things, big data, cloud solutions, blockchain, and artificial intelligence, among others (Fernández-Rovira et al. 2021, Hinings, Gegenhuber, and Greenwood 2018; Shakina et al. 2021). The second point concerns the term *transformation* itself: as Gong and Ribiere (2020, p.9) pointed out, while all transformation is a change, not all change is a transformation. Research on DT has so far shown that it requires not just technological implementation but a redefinition of crucial business model elements (Caputo et al. 2021). So, to increase customer satisfaction, expand customer base, and improve value delivery (Li 2018, Mergel, Edelmann, and Haug 2019; Warner and Wäger 2019), the central structure of the value proposition must be reassessed, encompassing value creation and appropriation, value network articulation, orchestration, and governance (Latilla et al. 2020). DT may also involve the development of new organizational forms (Hinings, Gegenhuber, and Greenwood 2018), team decentralization, and space for new places, new relationships, and new knowledge to deal with and support new digital processes (Heinze et al. 2018). In other words, DT comprises an overall evolving process that requires adopting and using new technologies in a strategic change perspective (Warner and Wäger 2019).

We perceive some interesting streams among the works trying to comprehend DT in SMEs. In particular, research efforts have been made toward comprehending the necessary capabilities for DT through the dynamic capabilities lens (Teece 2007). For instance, Matarazzo et al. (2021), a multi-case study with six SMEs operating in the Made in Italy context, examines the impact of DT on customer value creation. Although the authors could not provide static generalizations, they indicate that *learning* is crucial for SMEs, and it requires effective capabilities to integrate technology, business, and learning strategies. Besides, Soluk and Kammerlander (2021) explored fifteen SMEs and proposed three stages to understanding the DT journey - process digitalization, product and service digitalization, and business model digitalization. Again, the authors could not provide statistical generalizability but pointed out the dynamic capabilities needed for each stage. Supported by the micro-foundations lens, Scuotto et al. (2021) and Scuotto et al. (2022) explore different SMEs' capabilities to deal with DT. The former highlights SMEs' need for internal digital capabilities to respond rapidly to market changes and how individual digital capabilities play a crucial role in growth and innovation. The latter explores SMEs' technology absorptive capacity (TAC) and the relevant role of Chief Information Officers (CIOs). Furthermore, recent research explored the capabilities that grew in importance during the COVID pandemic (Roblek et al. 2021).

In another stream, authors highlight the possibility of analyzing DT through a maturity perspective as it softens the magical and instant idea that the word *transformation* carries. As

Remane et al. (2017) indicated, the maturity perspective removes the linear perception of the transformation. Organizations mature in different ways, at different rates, and in different directions, depending on several organizational characteristics (company size, business model, and industry sector). Also, it presumes that a stage of maximum perfection is rarely reached as technology continuously evolves (Mettler and Pinto 2018), so it is better to understand DT continuously varying according to the work environment and time. Finally, digital maturity considers the company as a whole and requires synchronizing talent, organizational structure, and culture with the digital environments around them to take advantage of opportunities made possible by technological infrastructure (Kane 2019; Kane et al. 2018).

Moreover, the digital maturity perspective represents a significant source of inspiration for DT analysis due to its model propositions, and, regarding the scientific corpus with a focus on SMEs, we can highlight digital maturity models (e.g., Axmann and Harmoko 2020; Chonsawat and Sopadang 2020; Colli et al. 2019, Heinze et al. 2018; Pirola, Cimini and Pinto 2019; Rafael et al. 2020; Ramantoko et al. 2018). By exploring such models, it is possible to perceive the main variables that characterize what a digital maturity SME company looks like. For instance, it is possible to perceive the importance given to competencies, activities, and resources, such as the adoption of information systems and forward-looking digital technology (Axmann and Harmoko 2020), data integration capability (Pirola, Cimini and Pinto 2019), product and service digitalization (Axmann and Harmoko 2020; Chonsawat and Sopadang 2020), innovation management (Rafael et al. 2020), financial resources (Chonsawat and Sopadang 2020), and digital competence and experience (mainly by Pirola, Cimini and Pinto 2019). However, although some models highlight aspects such as customer experience (Heinze et al. 2018; Ramantoko et al. 2018) and leadership competencies and attitudes (Chonsawat and Sopadang 2020), little attention has been given to variables associated with organizational structure, culture, and leadership, which we explored further in the sequence.

5.2.2 Organizational culture, structure, and leadership

Considering that the dynamics of the DT process are based on an organization's ability to establish appropriate routines to operate digitally, it strongly relates to organizational culture (Martínez-Caro, Cegarra-Navarro, and Alfonso-Ruiz 2020). As organizational culture contemplates collective values, beliefs, principles, mentalities, how people work, historical values, and technological and governance structure (Chanias, Myers, and Hess 2019; Warner and Wäger 2019), such aspects can mainly affect the process of DT. For example, following Hock, Clauss, and Schulz (2015), firms' capability to innovate the business model depends on the workforce's collective organizational values. In this vein, according to Holbeche (2018), leading organizations recognize culture as a critical enabler of innovation because it tends to create the conditions to have the 'right' people who 'fit' the company and ensure that people with the right skills can thrive within the culture - creating commitment to change. Reinforcing this argument, Verdu-Jover, Alos-Simo, and Gomez-Gras (2018) indicate that organizations that have internalized the need for a reflective cognitive level (the capacity to reconsider internal values according to new demands) tend to be more comfortable in achieving changes. Finally, organizational culture enables crucial dynamic capabilities to deal with the DT process (following Warner and Wäger 2019), being a critical driver

of organizational change (Hogan and Coote 2014). In a general sense, thus, organizations should support values and political guidelines such as experiment orientation, customer-centered thinking, and cultivating an open and creative mind (Chanias, Myers, and Hess 2019).

Concerning such cultural factors, a particular mentality (sometimes referred to as 'digital awareness') can be perceived in digitalized organizations (Colli et al. 2019; Imgrund et al. 2018). It tends to encompass a particular attitude toward new technologies, general trust in technology (Kampker et al. 2018), and a continuous focus on digital prioritization, assuming digital technologies as the primary source of development and improvements (Crittenden, Crittenden, and Crittenden 2019). Besides, this distinct mentality tends to contribute to DT success as it favors the process of rethinking a competitive advantage (Verdu-Jover, Alos-Simo, and Gomez-Gras 2018), the development of detection routines for new technologies (Warner and Wäger 2019), and supports companies to remain competitive in the face of digital disruptions (Crittenden, Crittenden, and Crittenden 2019).

Moreover, Mergel, Edelmann, and Haug (2019) suggest the cultural importance of supporting a change-oriented disposition towards the DT process. Such a disposition, present in some digital maturity models (e.g., Imgrund et al. 2018), is a characteristic feature of entrepreneurial spirit and engagement among employees (Tekic and Koroteev 2019), which, according to Heinze et al. (2018), is essential to a digital organization's continued success, as it provides the energy necessary for constant evolution. It seems crucial to promote and nurture it at the employee and management levels, as it supports organizations' capacity to transform in rapidly changing environments and holds the comprehension that the DT makes sense for the organization (Colli et al. 2019; Kampker et al. 2018; Schumacher, Nemeth, and Sihn 2019).

In the sequence, the organizational structure concerns how activities are orchestrated to achieve the company's objectives, and they represent a fundamental issue to be considered in the DT (Eggers and Park 2018; Latilla et al. 2020; Warner and Wäger 2019). According to Mergel, Edelmann, and Haug (2019), organizational changes resulting from the DT are considered the most critical overall result of the process, and there are still open questions about which organizational structures allow companies to better execute DT strategies (Verhoef et al. 2021). So far, hierarchical organizational schemes with multiple layers of management and a robust top-down approach, very particular in SMEs (Matarazzo et al. 2021), tend not to be the most effective for rapidly changing digital environments, as the bureaucracy involved in such schemes reduces response speed and innovation (Verhoef et al. 2021). According to Matarazzo et al. (2021), developing cross-functional teams and flexible organizations represents a fundamental instrument for integrating and coordinating digital knowledge throughout an SME organization. Besides, structural flexibility helps anchor the importance of change (Verdu-Jover, Alos-Simo, and Gomez-Gras 2018), and several aspects must be considered, such as, e.g., internal collaboration and cooperation, the capacity to operate in agile and flexible organizational forms (Stich, Gudergan, and Zeller 2018).

Specifically, agility and collaboration allow organizations to successfully navigate the uncertainty and unpredictability of environments dominated by digital disruptions (Troise et al. 2022; Roblek et al. 2021; Chan et al. 2019) and respond quickly to multiple heterogeneous and external environmental changes (Shams et al. 2020). *Agility* can be defined as "the ability of an organization to efficiently and effectively redistribute/redirect its resources to create value and

protect (and capture) higher-performing activities as justified by internal and external circumstances" (Teece, Peteraf, and Leih 2016, p. 17). In SMEs, agility is an emergent topic of organizational structures linked to understanding how to respond to changing environments by mitigating organizational rigidity and developing innovative capability (Chan et al. 2019).

For Tronvoll et al. (2020), the absence of rigidity in procedures is an essential component of organizational agility and facilitates DT. Although how this relationship takes place is still not very well defined, agile organizations tend to perform better in explorative activities to detect and exploit market opportunities, promoting the recombination and development of new products, services, and business models that increase value for the client (Karimi and Walter 2015). Also, agile organizations recognize each employee's importance and autonomy and exalt collaborative and decentralized work. However, for this to happen it is necessary to flexibilize work arrangements to create a change-oriented environment (Schumacher, Nemeth, and Sihn 2019) and value different ways of working (Kampker et al. 2018). Finally, from a maturity perspective, according to Kane (2019), digitally mature organizations are less hierarchical, increasingly organized around multifunctional teams, and drive decision-making to the company's lowest levels, where they can be done quickly and in a more informed way.

Finally, leadership is strategic to advance in DT (Chanias, Myers, and Hess 2019; Yeow, Soh, and Hansen 2018). The literature on the role of leadership in DT is still nascent (Porfírio et al. 2021), with a little exploration of how it stimulates a digital culture and supports the organization in DT (Singh et al. 2019; Uhl-Bien and Arena 2018; Vial 2019). However, recent research indicates that digital transformational leadership significantly influences DT (AlNuaimi et al. 2022). The leadership role in DT may be associated with the function of recognizing the importance of executing DT and providing commitment and support to employees (Arkhipova and Vaia 2019; Imgrund et al. 2018; Porfírio et al. 2021). Following Ko et al. (2021), management commitment positively affects strategic goals as strong management commitment creates a coherent environment of ambitions and directions. For Hinings, Gegenhuber, and Greenwood (2018), top management supports new digital values and shifts the organizational belief system towards organizational change, fostering employee understanding of the digital strategy. In this vein, digitally mature organizations presumably have competent and digital-oriented leadership (Chirumalla 2021; Warner and Wäger 2019) that nourish the objective importance and is supportive and committed to employees' needs (Pirola, Cimini and Pinto 2019; Stoianova, Lezina, and Ivanova 2020) and, among other things, be able to deal with resistance to change and manage the tensions generated by change. Also, it is associated with the development and support of a mentality towards being capable of responding to the disruptions related to using digital technologies (Porfírio et al. 2021; Sousa and Rocha 2019) and a fundamental role in triggering disruptive technology absorptive capacity within SMEs (Scuotto et al. 2022). Korherr et al. (2022) identified six factors that play a critical role in fostering analytics and establishing analytics-based decision-making, such as management behavior, top management and strategy, analytics infrastructure, organization and governance, HR management and development, and culture.

However, although leadership has been connected with positive functions by the research mentioned earlier, recent results highlight a possible negative impact of top management. Elbanna and Newman (2022) bring to attention the possibility of top management overconfidence and

excessive backing and support of systems implementation. Also, Weber et al. (2022, p 233) suggest that digital transformation–oriented behavior, characterized by a continuously "emphasizing the digital vision, showing the need for change, and staying abreast of new digital technologies, may intimidate employees who already have high levels of uncertainty due to an organization's DT". Hence, agreeing with Elbanna and Newman (2022), there is an interesting dialectic relationship between top management support's positive and negative sides, whose efforts, for instance, can create ambivalent change responses (Weber et al. 2022), promoting intimidation and increasing resistance to change instead of reducing it and fostering involvement.

5.3 Method

This study employed mixed-methods research whose *developmental* purpose (following Venkatesh, Brown, and Sullivan 2016) was to explore the prevalence of cultural, organizational, and leadership factors in the DT process by developing and testing a conceptual model. Several researchers indicate the advantages of the simultaneous application of qualitative and quantitative research, as it could offer more accurate information, support interpretations, and indicate the direction of potential causalities (Mayring 2001). This study was undertaken using a sequential mixed methods design, specifically a *sequential exploratory research design*. It is characterized by an initial phase of qualitative data collection and analysis followed by a phase of quantitative data collection and analysis (Creswell and Plano Clark 2018). We choose this approach because it allows the discovery and testing of variables and dimensions that are unknown or still not established in theory and the possibility of generalizing the qualitative results of a small sample (Creswell, Plano Clark, et al. 2003; Morse 1991; Creswell and Plano Clark 2018). Since the theoretical development around the DT phenomenon is still at an emerging stage, exploratory research was deemed particularly appropriate.

Details will follow in explaining each phase, but it is necessary to indicate beforehand some characteristics related to the mixed-methods research design (Figure 5.1). The sampling design strategy is a multi-level type, which involves using two sets of samples obtained from different levels of the study (Collins et al. 2007). Regarding the data collection strategy, according to Venkatesh, Brown, and Sullivan (2016), we used two techniques: a qualitative approach established on interviews with specialists; and a quantitative approach with data collected through a web-based instrument applied via an online survey. For data analysis, we used a sequential qualitative-quantitative strategy, where qualitative data analysis is followed by quantitative data analysis. Thus, we used inductive theoretical reasoning in the first phase, defining emergent patterns from interview data (validated through design and analytical validity), and, after, we performed data transformation, converting those concepts into numerical codes that could be examined quantitatively and described statistically (Teddlie and Tashakkori 2009). To avoid problems with multicollinearity, we ensured a sufficient sample size for accurate estimation and used available statistical tests such as Variance Inflation Factors (VIF). Moreover, to provide rigor for quantitative procedures, we evaluated data using reliability and validity tests (e.g., internal validity, construct validity).

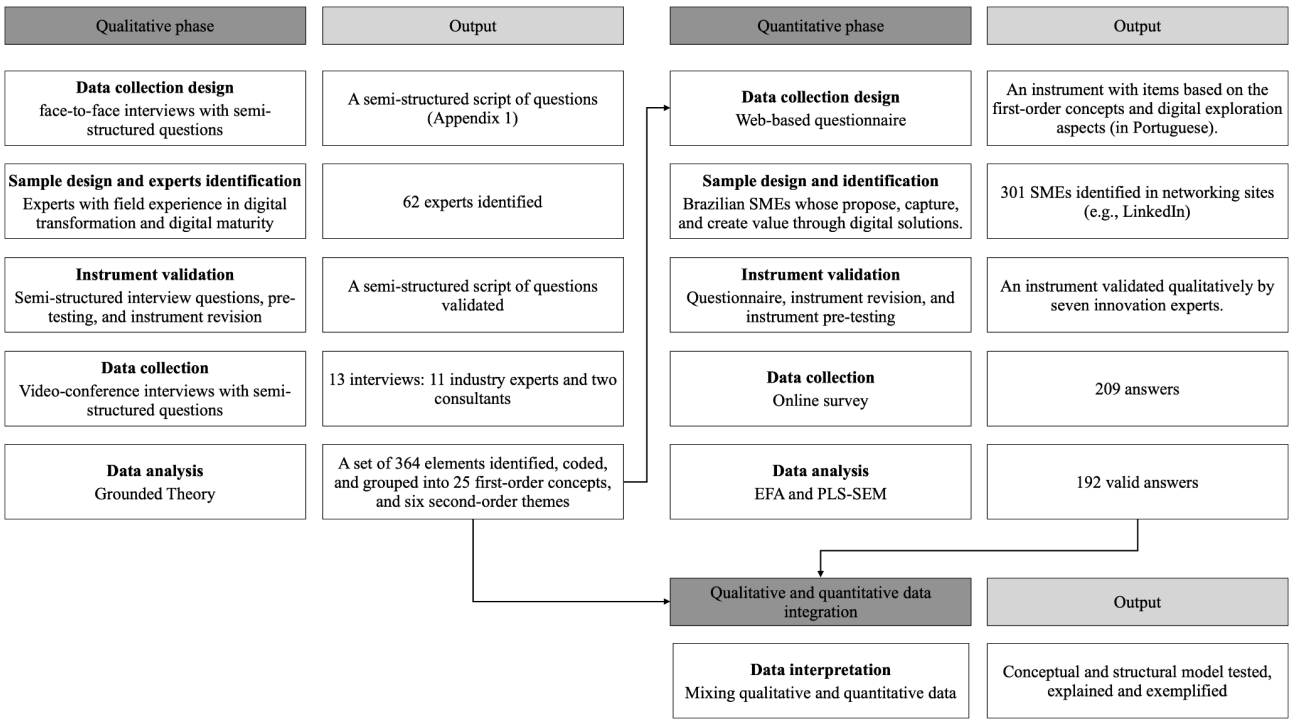

Figure 5.1 - Mixed method flow

Source: elaborated by the authors

5.3.1 Qualitative phase

In the qualitative phase, we conducted exploratory qualitative research collecting data from interviews with field experts. First, we created a semi-structured script of questions (Appendix 5A) and analytically validated it. After, we composed the sample, ensuring its design validity by providing accurate pieces of descriptive information (following Maxwell 1992) and ensuring credibility through a diverse sample selected with the following criteria. We screened experts who work on SMEs (up to 250 employees - European Commission 2003) digitally transformed, founded before 2010 (to ensure a background of organizations with experience and maturity enough to provide valuable inputs) and present certain digital maturity. To be aligned with our DTs' definition, we checked this latter point through a questionnaire based on the five strategic imperatives areas according to three phases of DT in Verhoef et al.'s (2021) model (Table 5.1). We interviewed eleven industry specialists (Table 5.2) from Brazilian companies that are in the DT context by presenting at least a digitalization level in 'Organizational Structure' and having components at the DT level in Digital Resources and Metrics.

Table 5.1 - DT strategic imperatives

Area\phase	Digitization	Digitalization	Digital transformation
Digital Resources	Digital assets	+ Digital agility, Digital networking capability	+ Big data analytics capability
Organizational Structure	Standard top-down hierarchy	Separate, agile units	Separate units with flexible organizational forms, internalization of IT and analytical functional areas
Metrics	Traditional KPIs: Cost-to-serve, ROI, ROA	Traditional and Digital KPIs: User experience, Unique customers/users, active customers/users	Digital KPIs: Digital share, magnitude and momentum, co-creator sentiment

Source: Verhoef et al. (2021)

Four experts work on traditional real estate companies that digitalized their business models (RealB, RealE, RealG, and RealI). The real estate market is an attractive DT scenario because of the emergence of digital intermediaries (Gong and Ribiere 2020), whose exclusively digital activity has made renting and selling processes less bureaucratic and forced incumbents to react. Three other experts work in system development companies (SysC, SysJ, and SysK), a peculiar sector for DT due to its numerous changing organizations (Brown and Eisenhardt 1997) and because it is where agile methodologies were first introduced. About the other experts, two works in companies were winners of the National Innovation Award in Brazil in 2019: LingH in the linguistic consultancy and PubA in the publishing house. Given the DT initiated before the 2020 pandemic, both organizations maintained their staff and acted remotely, delivering their service digitally. Furthermore, one works in a recruitment firm (RecD), and the last one works in an entertainment company (EntF) with international performance that organizes itself internally to carry out the events and recreate experiences in digital formats - a sector where resides a critical change because no one can attend to physical events during the COVID outbreak. In addition, we interviewed two innovation and service provider specialists in the DT context with field experience in SMEs - a significant role whose capabilities are crucial to helping organizations deliver digital value propositions (Mazumder and Garg 2021). Consultant ConsL has worked with small companies in Italy for more than six years, and consultant ConsM has a distinct role in the small real estate sector with more than seven years of experience in the systems development market.

Table 5.2 - Interviewee's characteristics

Expert	Position	Company size	Company foundation	Company Area	Company capital	Professional education and resume
PubA	CEO/ founder	7	2008	Publishing company	Between R$500,000 and R$1,000,000	Journalist, MBA in management, and member of TEDx organization
RealB	CEO/ founder	10	2002	Real Estate	Between R$100,000 and R$500,000	Manager with 15 years of relevant professional experience in the field
SysC	CEO/ founder	13	2008	Systems development	Up to R$ 100.000	Computer scientist, Data Privacy Solutions Engineer, investor
RecD	CEO/ founder	16	2010	Recruitment and selection	Between R$100,000 and R$500,000	Civil engineer, MBA in economics and management, 13 years of relevant professional experience in the field
RealE	CEO/ founder	20	2003	Real Estate	Above R$ 1,000,000	Manager with 11 years of relevant professional experience in the field
EntF	CEO/ founder	35	2009	Entertainment	Between R$100,000 and R$500,000	Bachelor in advertising with a specialization in cultural marketing, 13 years of relevant professional experience in the field
RealG	CEO/ founder	40	2002	Real Estate	Up to R$ 100.000	Bachelor of Laws, entrepreneur, 19 years of relevant professional experience in the field
LingH	CEO/ founder	42	2003	Linguistic consultancy	Up to R$ 100.000	MsC, MBA, Bachelor of Arts, 19 years of relevant professional experience in the field
RealI	Commercial director	60	1981	Real Estate	Above R$ 1,000,000	Manager with 11 years of relevant professional experience in the field
SysJ	CEO/ founder	100	1981	Systems development	Above R$ 1,000,000	Business Administration and Management, MsC
SysK	CEO/ founder	120	1997	Systems development	Between R$500,000 and R$1,000,000	MsC, Bachelor of Accountancy, 29 years of relevant professional experience in information technology

ConsL	NA	NA	2014	Service provider consultant	NA	MsC, 6 years of relevant professional experience in the field
ConsM	NA	NA	2013	Service provider consultant	NA	MsC, 7 years of relevant professional experience in the field

Source: elaborated by the authors

Using video-conference, we collected data through thirteen interviews that lasted one hour and twenty minutes (average). All the interviews followed the same script, and to ensure data reliability and credibility (Judd, Smith, and Kidder 1991), questions were asked in the prescribed order. The interviews were recorded, transcribed, and validated by the respondents to avoid errors and misunderstandings (Gibbert, Nair, and Ruigrok 2016), and after we analyzed the data corpus with the grounded theory method (Gioia et al. 2012). This examination method relies heavily on constant comparison of data collection and its analysis, allowing inductive theory development by coding, categorizing, and connecting data. In such a process, researchers looked for similarities and differences between the interview data and literature on organizational structure, culture, and leadership in the DT context (Timonen et al. 2018). This constant comparison included two processes: *open coding* and *axial coding*. In the former, data content was fragmented into key concepts or small sentences (*elements*); then, in the latter, they were grouped inductively based on their associations. This process permitted the creation of the initial concepts (*first-order concepts*) of the emerging conceptual model, and procedures were carried out by the three researchers independently, who routinely came together to compare their results. The main discrepancies were discussed to reach a consensual understanding and obtain reliability between coders (enhancing the theoretical validity and reliability). Through numerous iterations in fine-tuning the analytical structure and revisiting the data to seek confirmation and validation, the first-order concepts were further compared with each other to find out about any existing associations. Finally, they were arranged on *second-order themes* that compose the conceptual model, where interactional hypotheses paths were proposed based on the literature and interview data's content.

5.3.2 Quantitative phase

In the quantitative phase, we tested the structure of the conceptual model developed. Therefore, we assumed the second-order themes to be the model constructs and developed a questionnaire drawing on the insights generated from the qualitative phase. The questionnaire items were defined based on the qualitative first-order concepts to verify the respondent's level of agreement with affirmative sentences about the existence of each concept in the organization through a ten-point Likert scale (one equals "strongly disagree" and ten equals "strongly agree"). We chose this type of scale following the recommendation of Wittink and Bayer (2003): it offers a higher degree of the measurement precision of variance, can improve measurement reliability, and provides a better opportunity to detect changes. The questionnaire was developed to be completed anonymously by C-level positions and managers with sufficient knowledge of the firm's DT efforts. Following Solarino and Aguinis (2020), such elite informants retain the understanding of decision-making processes and organizational narratives, and it offers a chance to explore the micro-foundations of companies' strategies (Foss and Pedersen 2016).

To test the structure of the developed conceptual model, we organized a sample of mature digital organizations. We screened organizations that propose, capture, and create value through digital solutions due to their digital maturity, size, and declared service/product offer. We first searched online career networking sites (e.g., LinkedIn) for SMEs that offer their products or services through a digital solution or describe their activities considering the use of digital technology (a procedure carried out before and validated in recent studies such as Gong and Ribiere 2020; and Haarhaus and Liening 2020). We confirmed information on companies' websites and contacted managers to check their willingness to answer the questionnaire. To guarantee a sample adherent to the digital maturity research scope, we added a section in the questionnaire with four items that seek to ascertain some of the characteristics of strategic imperatives in the organization based on the Verhoef et al.'s (2021) model (Table 5.1). The indicators of digital resources, organizational structure, metrics, and goals were organized in multiple-choice questions, and the respondent should inform if they were present in the organization. Hence, to ensure that we objectively consider only organizations with a particular digital maturity level, the organizations should indicate mature strategic imperatives in digital resources and digital management (through metrics and goals), presenting at least a *digital transformation* level in one of them. After that, we also verified the respondent's perception of the DT performance by adding two ten-point Likert scale items. The first concerns (i) the perception of the extent the *firm employs digital technologies to develop a new digital business model that helps create and appropriate more value for the firm;* and the second (ii) the perception of the organization's position compared to competitors. Data collection was done through a web-based questionnaire. We asked the sample previously set to answer the survey using several media (in particular email and direct message LinkedIn). Following Couper (2017), the online channel is appropriate for collecting survey data.

Psychometric properties of the instrument were assessed using a variety of techniques. Because scales were developed for this study, we applied robust procedures for instrument validation to avoid major concerns regarding the derived measurement model. First, a pre-study was conducted to evaluate the face and content validity. Researchers reviewed items several times, and a group of five academic specialists (PhD students linked to a university research group of technology and innovation) and two industry specialists (RealG and SysJ) tested the items' content regarding the context of the study and wording (literary editing and fluency of terms and words), the structure, and the scale (Rudner 2005). The scale validity was assessed using exploratory factor analysis (EFA). As almost everything measured in the social sciences is correlated to some degree (Meehl 1990), we performed the procedures most aligned and consistent with social science concerning factors extraction and rotation (Fabrigar and Wegener 2012, Kahn 2006, and Worthington and Whittaker 2006). We used Principal Axis Factoring (PAF) to perform factors extraction and chose oblique rotation to be applied to allow factor intercorrelations, performing Promax.

To ensure EFA was capable of factoring, we performed Kaiser-Meyer Olkin (KMO) - considering excellent the values greater than 0.8 and 0.9 (Field 2005), Bartlett's tests of sphericity between items ($p < 0.05$), and verification of the diagonal in the anti-image matrix. As the proposed conceptual model is reflective (following Hair et al. 2017; Obonyo, Okeyo, and Kambona 2018; Sarstedt et al. 2014), it was evaluated and validated by considering the internal consistency

(composite reliability), factor reliability, convergent and discriminant validity (Hair et al. 2014a). Composite reliability (CR) was analyzed based on the suggested level of 0.7 (Fornell and Larcker 1981), and items loadings were checked based on the cut-off value of 0.5 (Hair et al. 2009; Comrey and Lee 1992; Tabachnick and Fidell 2007) with no significant cross-loadings (Maskey et al. 2018). The reliability was assessed by Cronbach's alpha, considering 0.7 as acceptable (Hair et al. 2014a, Park et al. 2014), the convergent validity was estimated by examining the average variance extracted (AVE), considering a cut-off value of 0.5 (Hair et al. 2019), and, finally, the discriminant validity was assessed through Heterotrait–Monotrait ratio (HTMT), considering the conservative cut-off value of 0.85 (Hair et al. 2019). As mentioned before, multicollinearity among the latent variables was checked by calculating the Variance Inflation Factors (VIF), considering the threshold value of 5.0. We also examined the outer loadings of the indicators - which should exceed 0.708 for satisfactory convergent validity (Henseler et al. 2009), but, in exploratory cases, this cut-off can be 0.6 (Garson 2016; Cordiglia and Van Belle 2017; Lazar, Feng, and Hochheiser 2017).

Finally, to test the structural model and its hypotheses, we conducted a partial least squares structural equation modeling (PLS-SEM), an approach that employs ordinary least squares commonly utilized in information systems research (Hair et al. 2017). We choose PLS-SEM because it provides a proper statistical approach for testing hypotheses in a generalizable way for explorative research (Hair et al. 2017; Lowry and Gaskin 2014). Hence, the model's predictive power was assessed by the amount of variance attributed to the latent variables (i.e., R2), in which Hair et al. (2019) points out that the effect size for R2 of 0.75, 0.50, and 0.25 are considered substantial, moderate, and weak, while Wetzels et al. (2009) suggest that in IT-related research the effect size for R2 of 0.36, 0.25, and 0.1 are considered large, medium, and small. The levels of significance were estimated using a bootstrap technique (5000 samples), following Hair et al. (2014b). For a significant relationship, we considered t-values should be at least 1.96 (Revythi and Tselios 2017). All data processes were conducted and analyzed using Statistical Package for Social Science software (SPSS) version 18 and Smart PLS software.

5.4 Results

The results are divided into two distinct parts: the development of the conceptual model and hypotheses paths, followed by the test of the structural model of the quantitative phase.

5.4.1 Development of conceptual model and hypotheses

Data content obtained from the thirteen interviews and analyzed with grounded theory generated 364 elements, coded and grouped into 25 first-order concepts and six second-order themes (Figure 5.2 and Table 5.5). Below, we analyze the six second-order cultural, organizational, and leadership themes and propose hypotheses paths.

5.4.1.1 Promoting an innovation culture (INN)

This theme, with five first-order concepts, points out how to conceive and maintain an organizational structure that generates business model innovations and grows digitally. We know

from Verhoef et al. (2021) that, in fast-changing digital environments, it is required to avoid aspects that decrease response speed and innovativeness. Agreeing with the authors, experts RealB, SysC, and SysK, reinforce that highly hierarchical structures and relations do not favor innovation or transformation; however, they are still a challenge to be modified because of their top-to-bottom nature. So, an innovation culture may impact the structure and make the organization '*consider a flatter organizational structure*'. As mentioned by the expert RealB, it is best suited to companies that search for a scalable and expansion-oriented business model, which agrees with Kane (2019). Having horizontal and boundary-less structures tends to increase the company's shared vision (expert RealE), the organization's malleability, permeability, and adaptability, collaboration among employees, and support for co-creating transformation. In this context, we also perceive an orientation to '*multifunctional and self-managed team organization*', which favors DT (following Matarazzo et al. 2021) and, according to Fregnan et al. (2022), promotes the integration of different kinds of knowledge which help to broaden perspectives and solutions. Likewise, *promoting an innovation culture* helps 'cut bureaucracies' (expert SysC) and ensure quality and agility in decision-making (experts EntF and SysJ). Finally, improving the communication (Roblek et al. 2021) and the organizational vision for employees (experts SysC, RecD, and SysK) also helps to get processes improved, technology adopted (experts EntF and SysJ), reduces resistance to change (expert RealI), and fosters employee training and development (expert SysC). In such a context, in RealB, an organizational form known as *holacracy* has been implemented.

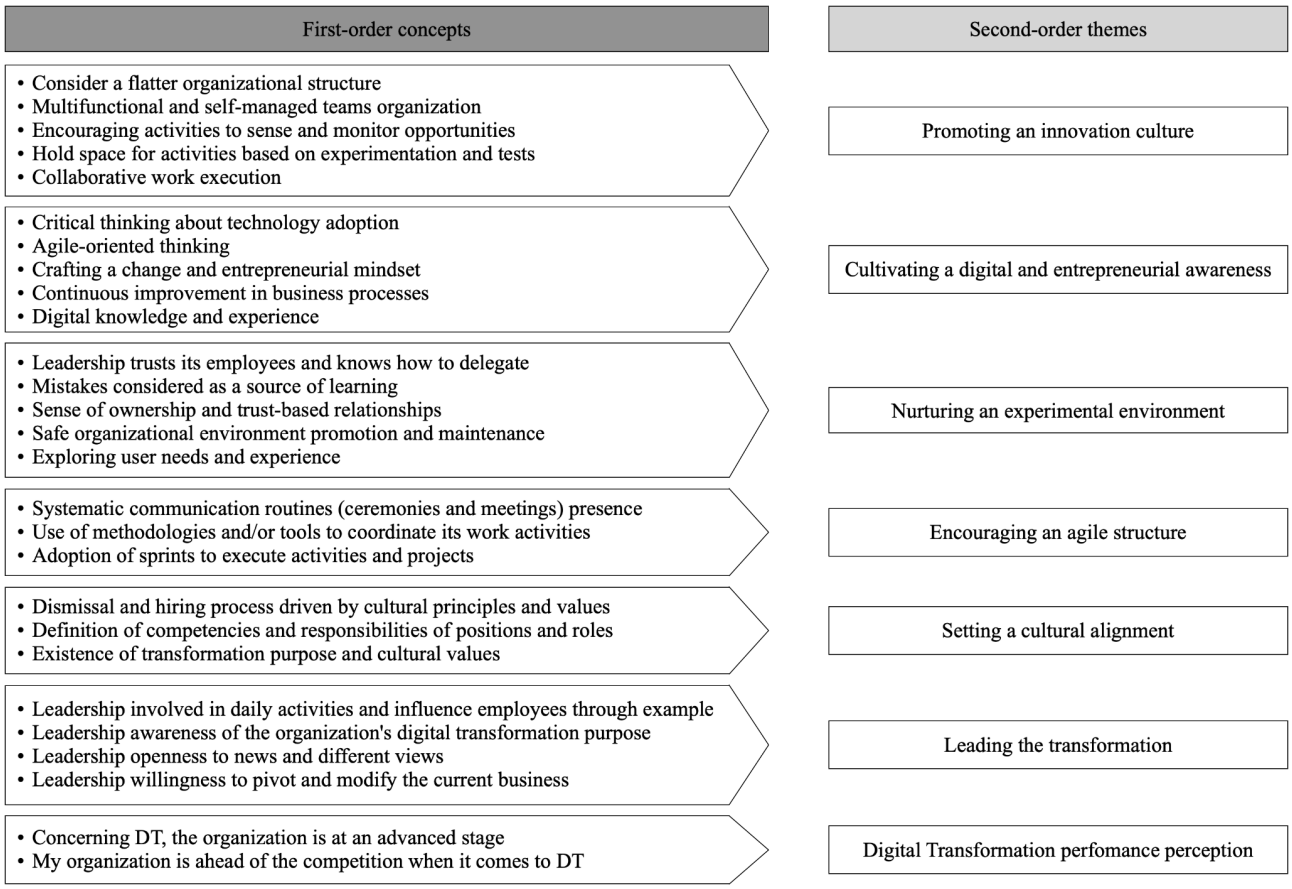

Figure 5.2 - Results of qualitative phase

Source: elaborated by the authors

Besides, internal organizational collaboration and cooperation have been highlighted and explored as essential elements of DT (Fregnan et al. 2022; Roblek et al. 2021; Vial 2019; Li, Abel, and Negre 2021). In this respect, all experts indicated that '*collaborative work execution*' supports DT success. It facilitates reaching a common purpose (experts SysC, RealI, SysJ, and EntF) and represents the possibility of increasing the effectiveness of performance: 'DT demands complex and intertwined activities, in which the activity of one depends on each other's, so, without collaboration, the development of new solutions and the necessary result is not achieved' (expert EntF).

Moreover, *par rapport* the development of valuable digital deliveries, Roblek et al. (2021) indicates the importance of ensuring that the natural curiosity of employees is maintained, and, in this sense, interviewees have widely cited that an innovation culture comprises and impact the fact of '*hold space for activities based on experimentation and tests*', like supporting activities of MVPs, tests, and adjustments. Following Fregnan et al. (2022), it is crucial to be open to the introduction of something new and to promote activities of developing new solutions and functionalities experimentally, combining data and information, and comprehend that making the customer pay for a solution 'requires a lot of trial and error and observation of other primary sources of success' (expert SysK). Finally, we highlight that an innovation culture enhances the need to keep up with and get used to new technologies, creating room to maintain a structure that '*encourages activities to sense and monitor opportunities*' in the market and the ecosystem.

Based on the arguments above and inspired by the results of Scuotto et al. (2021), where innovation thus has a positive influence on SMEs' growth, we hypothesized that *promoting an experiment-driven culture*

H1. *has a positive and significant effect on DT performance perception.*

5.4.1.2 Cultivating a digital and entrepreneurial awareness (DIGE)

This theme includes five first-order concepts and is directly linked to the DT process, highlighting the importance of promoting and maintaining a digital and changing awareness culture. It represents the organization's capacity to frame how technology will impact the business: for example, which technologies would suit better the company's' needs; which parts of the company are those that must be digitalized, and which would be better not to be digitalized or, perhaps, to be outsourced in partnerships (RealG). In such a sense, organizations generate a '*critical thinking about technology adoption*' (almost all interviewees corroborate this idea, which is also praised by Roblek et al. 2021) and an orientation to a '*continuous improvement in business processes*' (specialist consM; Yeow, Soh, and Hansen 2018). Consequently, companies reduce technology adoption based on intuition and improve the criteria for it: technologies then may only be adopted according to improvement priorities and according to the possibility of innovating in performance and processes, facilitating communication, increasing collaboration, supporting decision-making (increasing employee autonomy), and delivering more value to the client. Furthermore, this theme involves the factor of '*digital knowledge and experience*'. Following Fregnan et al. (2022), it is essential to be familiar with technology to take advantage of the opportunities they offer, as there is no transformation without people who know how to deal with technologies (experts LingH and SysK). Although *digital knowledge* can be a particular limitation

in SMEs (Machado et al. 2019), according to Scuotto et al. (2021), the ability of SMEs to innovate depends on employees with appropriate digital capabilities to maximize the use of digital technologies. The availability of highly digitally skilled employees is positively related to their ability to absorb technology (Scuotto et al. 2022), so top management must comprehend that considerable benefits can derive from qualified employees, so they must be willing to acquire new knowledge (following Roblek et al. 2021).

'*Change and entrepreneurial mindset*', as mentioned in the reviewed literature (e.g., Roblek et al. 2021), was largely supported by interviewees as essential for DT, and it comprises the following characteristics: individual openness to novelty, curiosity, flexibility, appreciation for challenges, restlessness, and nonconformity. As argued by the expert SysK, digital and entrepreneurial awareness relates 'to be open and embrace changes in an absolute way because conformed people do not promote changes' (agreeing with Roblek et al. 2021). Then, a way to fine-tune an organization's mentality for change is to increase employee autonomy (experts PubA and SysK), their ability to make decisions (expert SysJ), and the ability to 'learn how to learn', which tends to enhance collaboration among people (expert SysK). Besides, a change-oriented mentality is linked to '*agile-oriented thinking*' (alluding to a cognitive alignment with the agile manifesto principles inspired by software development practices), which according to experts SysC, SysJ, SysK, and ConsM, is decisive for DT. In accordance with Crittenden, Crittenden, and Crittenden (2019), and Vial (2019), experts argue such a mentality facilitates DT because it tends to foster a more automated and technological mentality, conceiving innovation through a lean thinking, small, incremental, and iterative changes in short cycles, and a continual value delivery.

From those elaborations and in line with previous works, such as Scuotto et al. (2021), whose results indicate that SME innovation depends on digitally skilled employees, we formulated that *cultivating a digital and entrepreneurial awareness*

H2A. *has a positive and significant effect on DT performance perception;*

H2B. *has a positive and significant effect on promoting an innovation culture.*

5.4.1.3 Nurturing an experimental environment (EXP)

This theme comprises five first-order concepts that symbolize values and practices that provoke an experiment-driven atmosphere, leveraging the conditions to establish transformation routines (Warner and Wäger 2019) and, consequently, progress in the DT. SMEs usually have hierarchical structures (Matarazzo et al. 2021) in which behaviors and routines are biased by a command-and-control logic (as evidenced by experts RealG, RealI, and ConsM), where people in management/leadership positions are convinced that they can and must control everything (experts SysK and ConsL). This dynamic perpetuates a space of risk aversion that is difficult to disrupt, making the proposition of an experiment-driven atmosphere challenging. 'One of the things that I had the most difficulty in the transformation process was to create an environment in which people could suggest changes and talk about what was not going well' (expert SysC). So, to overcome it, organizations should nurture an experimental environment, which will '*promote and maintain a safe organizational environment'* that values a '*sense of ownership and trust-based relationships*'. The expert SysJ illustrates this point with the following quote: 'in a small business, it is essential to foment the feeling of being the 'owner of the organization' because it is a driving force: it makes the

employee feel that his job is more than performing tasks and solving problems'. Another consequence is a feeling of being highly involved (Fregnan et al. 2022), which (i) allows employees to add something personal to each activity, and (ii) represents a mechanism for generating psychological inclination in people facing changes and ensuring commitment (Leso et al. 2021; Leso and Cortimiglia 2021).

Moreover, this theme also values that '*mistakes are considered a source of learning*' and that the '*leadership trusts employees and knows how to delegate*'. Following Roblek et al. (2021), mistakes occur in developing and implementing disruptive innovations, and intolerance of errors is the biggest obstacle to disruptive innovation. So leaders must know that 'maturing in the DT is full of mistakes,' (SysK) and must nurture autonomy and decentralized work conditions, where employees know that making errors will not penalize them, and they can take risks without fear (founders of companies RecD RealE, and RealG). Furthermore, according to Vial (2019), a common theme points to the need for firms to cultivate a willingness to take risks and according to experts RecD, LingH, and SysK, companies that do not tolerate errors tend to struggle with DT. That resonates in the results of Roblek et al. (2021, p 12) about the propensity to take risks: 'risk-taking is evident in new technology projects and companies in which the culture discourages risk-taking become moribund'. Also, it is interesting to combine the results by Weber et al. (2022) and Roblek et al. (2021), where the former emphasizes that leaders nurture cognitive trust and that the latter indicates a positive relationship between trust and security. So it is straightforward to assume that the leader has a fundamental role in helping establish an experimental environment.

Finally, '*exploring user needs and experience*', found in previous literature (e.g., Mergel, Edelmann, and Haug 2019; North et al. 2019; Saarikko et al. 2020; Warner and Wäger 2019; Roblek et al. 2021), was widely mentioned in the interviews. A shared understanding of capturing the customer's perspective implies the capacity to innovate in a digital and changing market, fitting the customer's exigencies and needs through an attitude of more curiosity and less certainty to fine-tune the value proposition (RealG; Kane 2019). 'A culture of innovation and change begins when the company recognizes the importance of listening to the customer and stops assuming what he/she wants' (expert RealG), which is in line with Roblek et al. (2021), about the awareness of empathy and listening to the customers. According to consultant ConsM, this capacity helps differentiates the DT process from an action plan. Companies, especially SMEs, normally seek a step-by-step practical course instead of profoundly creating the capacity to evaluate innovations and whether they make sense for their customers. In such a way, it may trigger a necessary awareness to sustain an experimental environment with the search for more efficient processes, more valuable deliveries, and transformation (experts RealI, SysK) along with the customer needs at the center (Fregnan et al. 2022).

Based on the aforementioned arguments, we firmly believe that such concepts aid in constructing a more collaborative and innovative place where people can become digitally aware through their daily routine and activities. Therefore, we hypothesized that *nurturing an experimental environment*

H3A. *has a positive and significant effect on promoting an innovation culture;*

H3B. *has a positive and significant effect on digital and entrepreneurial awareness.*

5.4.1.4 Encouraging an agile structure (AGL)

According to Fregnan et al. (2022), a new work culture implies flexibility, where it is essential to have the agility to react quickly. In this way, three first-order concepts compose this theme, and interviewees have cited agile approaches adoption as a way to help carry out a DT process. 'It is impossible to go through a DT without organization. If this organization comes from agile methodologies, this can surely help create the conditions for it' (expert RecD). However, a crucial point is to 'understand that *agile* is an approach and not just a method' (consultant ConsL). So, as the founder of company RealG pointed out, 'it provides pillars (e.g., inspection, adaptation, and transparency) that companies have to translate to their reality'. Once it is done, the organization enables an efficient arrangement that helps manage activities (e.g., deadline specifications, responsibility, prioritization), boost projects and activities execution, and anchor the importance of change.

In this context, by encouraging an agile structure, the company will promote '*the use of methodologies and/or tools to coordinate its work activities*' and '*the adoption of sprints to execute activities and projects*' - as reported in all interviews. For instance, KANBAN was widely cited as a method for organizing activity flow management. Monitoring activities and registering all tasks being developed 'ensures that the activities will continue to occur, even if the personnel changes within a team' (expert SysK). Beyond that, interviewees claimed that KANBAN is very useful, as it enables a complete vision of the whole and what is being performed by each collaborator (bringing predictability and shared knowledge). Similarly, encouraging the existence of *sprints* to execute activities and projects has been pointed out as crucial for DT. Interviewees, however, firmly believe there is no one-fit-all solution, and companies should try to adopt the logic to their reality. The adoption of SCRUM as an approach, for instance, can vary in (i) the development cycles realization and duration, (ii) the team formation and role assignment (e.g., scrum master, product owner), and (iii) ceremonies carried out (daily, planning, review, and weekly meetings). Results suggest that such adaptations and variations of agile methodologies are important in developing an agile-oriented culture. Interviewees claimed that 'it takes time for everything to work, and often the company is not prepared to work with an agile team, and there may be failures in the first sprints and frustration' (expert SysK). The practical advice is that 'firms must not rush when adapting and implementing agile methodologies' (expert RealG).

'S*ystematic communication routines (ceremonies and meetings)*' is a remarkably insightful result from the interviews. A significant consequence of an agile structure is its discipline which greatly benefits the DT journey. SMEs that were successfully transformed credit much of their success to creating a daily habit toward change. In this context, SCRUM ceremonies and meetings seem crucial to that disciplinary dynamic: planning meetings allow activities backlog definition and responsibilities assignment; review meeting enables continuous learning and improvements; daily meetings provoke tasks' execution; weekly meetings indicate what will be accomplished in the week and what was performed. Also, daily meetings are considered an evangelization mechanism by the interviewees. The expert RealG organized in his company daily half-hour meetings with all employees in which, before the start, he reminded everyone of DT's importance and the reason for its need.

Based on the above results and the fact that agility is deemed to allow organizations to successfully navigate the uncertainty and unpredictability of an environment dominated by digital disruptions (Troise et al. 2022; Roblek et al. 2021; Chan et al. 2019), we consider that an agile structure might promote a fine-tuning ambiance toward experimentation, with more narrowed practices of collaboration and dissemination of organizational matters. Then, we formulated the hypotheses that *encouraging an agile structure*

H4A. *has a positive and significant effect on nurturing an experimental environment;*

H4B. *has a positive and significant effect on promoting an innovation culture;*

H4C. *has a positive and significant effect on cultivating a digital and entrepreneurial awareness.*

5.4.1.5 Setting a cultural alignment (CULT)

This theme refers to practices and behaviors that allow organizations to internalize transformation purpose and cultural values. The lack of purpose and certainty about DT's potential gains and implications is prevalent in SMEs (Gruber 2019). However, having positive and new values, and a transformation goal is decisive for maturing in the DT, according to Levy et al. (2022), Mergel, Edelmann, and Haug (2019) and experts SysC, RecD, RealE, EntF, RealG, LingH, SysJ, and ConsL. Referencing Simon Sinek, expert ConsL said that any transformation must start with the *why* and only then goes on *how* to make the changes. Setting a cultural alignment implies first the '*existence of transformation purpose and cultural values*' towards DT. DT is very complex, so a clear vision and an elaborated strategy allow the organization to move on, as it gives a north, a common language, creating a sense of unity that contributes to decision-making, trust-building, and feeling of belonging (expert LingH; Stefanova and Kabakchieva 2019). According to previous research, companies that internalize the need for reconsidering its cultural values tend to be more comfortable in achieving changes (Verdu-Jover, Alos-Simo, and Gomez-Gras 2018), and strategic goals facilitate the implementation of new ideas (Ko et al. 2021). However, to Roblek et al. (2021), it is required to ensure that the natural curiosity of employees is preserved as a component of conceiving cultural values for developing an innovative company.

Furthermore, this theme promotes necessary efforts to translate and incorporate new values and purpose into the company's daily life. For instance, the '*definition of competencies and responsibilities of positions and roles*': a mechanism for alignment and implementing changes as it impacts several organizational aspects. For example, it permits (i) balancing team formations and (ii) identifying necessary skills for a given position/function. Also, it favors competence-based employee promotion (experts PubA, RealB, and SysJ) and supports the development of change-oriented training programs, which involve collaborators in a continuous process of small changes to get used to and internalize the value of change (expert LingH). Furthermore, this practice makes it possible to manage performance based on each employee's goals and responsibilities, which has twofold consequences. First, it fosters internalizing purpose and cultural values and guidelines since they can be deployed as responsibilities and can be monitored. Second, it increases employee and team autonomy based on an explicit declaration of responsibilities - which resonates with Fregnan et al. (2022) concerning the awareness employees must have of their roles. For instance, experts PubA and LingH use OKRs' methodology to organize collaborators' and teams' goals.

Another cultural alignment practice identified involves the '*dismissal and hiring process driven by cultural principles and values*'. Lack of cultural alignment can result in resignations, resistance, boycotts of change efforts, and, as described in literature (e.g., Caputo et al. 2021; Chirumalla 2021; Vial 2019), inertia and resistance are the most significant barriers to DT. So '*dismissal and hiring process driven by cultural principles and values*' seem appropriate when employees struggle to align with a new digital culture. As the founder of company RealG puts it, 'if the organization is confident in its purpose and values, has given a chance to people to adapt, but people are resisting, the best thing to do is to dismiss them'. Companies RealB and LingH are two organizations where a new purpose and cultural values were proposed, deployed in people's competencies and responsibilities, and collaborators had time to adapt to it. In the consultancy LingH, seven employees had to be fired after nine months. After two years of insisting on new rules and alternative ways for people to change, expert RealB decided to change the whole team. Otherwise, the hiring process ends up being facilitated because if organizations know what skills they are looking for, it is easier to hire people who share the same values (consultant ConsL).

Given the above arguments, we hypothesized that *setting a cultural alignment* through its values and mechanisms is a central pillar in DT and

H5A. *has a positive and significant effect on nurturing an experimental environment;*

H5B. *has a positive and significant effect on promoting an innovation culture;*

H5C. *has a positive and significant effect on cultivating a digital and entrepreneurial awareness;*

H5D. *has a positive and significant effect on encouraging an agile structure.*

5.4.1.6 Leading the transformation (LEAD)

DT is a journey that begins with the purpose, but it will only happen when top managers and leaders understand why the organization has to transform (experts RealB, RealG, and RealI, Imgrund et al. 2018; Arkhipova and Vaia 2019; and Singh et al. 2019). The results obtained set how leadership can stimulate a digital culture and how it can support the organization in DT (Singh et al. 2019; Uhl-Bien and Arena 2018; Vial 2019), pointing out, first, the leader's role to guide the organization in DT and sustain the change dynamically. So, in this vein, '*leadership awareness of the organization's DT purpose*' and '*willingness to pivot and modify the current business*' whenever necessary (experts PubA and RealG) are two expected behaviors of managers leading the DT.

Leading the transformation requires being aware of what happens in the market (agreeing with Swift and Lange 2018), seeking knowledge to understand the transformation benefits, and bringing innovation to the company via new digital technologies. Then, it is essential to have the sensitivity to make changes (expert EntF) and know why it is happening because being aware of the significance of implementing DT is the basis for elaborating the direction and values that will guide the organization - highly in consonance with previous research (e.g., Porfírio et al. 2021; Swift and Lange 2018) in respect to determining the direction of the transformation. Following Ko et al. (2021), management commitment positively affects strategic goals as it develops an environment of ambitions and directions. Therefore, it may imply being open to evolution and '*open to change*', flexible to engage different people in discussions (Singh et al. 2019), and humble to accept different views (SysK) to make innovation happen. Roblek et al. (2021) claim that openness to

change is one important internal factor contributing to disruptive innovations in a changing environment.

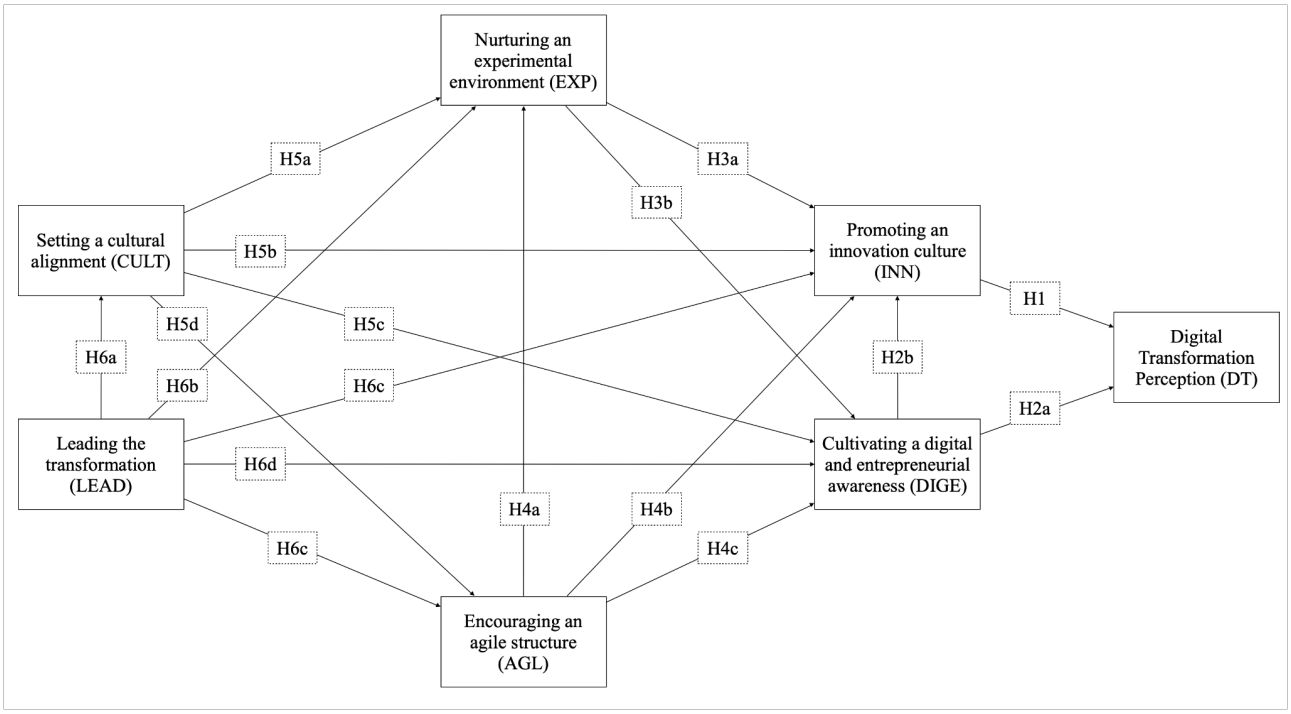

Figure 5.3 - Conceptual model and hypotheses paths
Source: elaborated by the authors

Once leaders are aware of all this, they must be deeply committed to it, as it is a necessary anchor for DT's success concerning the process's long-term nature. Among the experts, it is undeniable that leadership must strongly embrace change and sponsor it by being committed not only to the *idea of change* but also *financially* - thinking of it as a long-term investment with no immediate payoff. Besides, interviewees argued that 'understanding and internalizing DT in culture takes time and energy' (experts RealG and SysK). Then, consistent with Ko et al. (2021), it is crucial to create a change-oriented culture by inspiring employees, sustaining energy, and remaining resilient during the process. However, one must be aware of the dual influence that leadership can have (Elbanna and Newman 2022; Weber et al. 2022). Inspired by the interviews and following Singh et al. (2019), a way to fine-tune supports actions and balance the possible dialectic results can be done through the concept of '*leadership needs to be involved in daily activities and influence employees through example*'. Understanding and internalizing DT strategy in culture cannot depend only on discourse. 'The transformation is not a cancer cell that proliferates in the company and changes the status quo' (expert RecD). The leader must 'walk the talk': disseminating it throughout the company, motivating employees, and integrating and coordinating the digital knowledge throughout the organization - which agrees with Matarazzo et al. (2021). Operational daily activities generate a force against any transformation because it consumes employee time, so the leader must be obstinate, evangelize the employees daily, and continuously communicate the reason for the transformation (experts EntF, RealG, and RealI). In Singh et al. (2019), we also note the use of webinars as an informal mechanism to inform and educate employees about current topics, while

Weber et al. (2022) claim leader supports employees by supporting their skills development and providing individual feedback.

Then, based on the above assertions and inspired by previous results (e.g., Scuotto et al. (2022), whose findings support the role of CIOs in triggering disruptive technology abortive capacity within SMEs; AlNuaimi et al.'s (2022) association between digital transformational leadership and organizational agility; Ko et al. (2021) whose results point that management commitment has a positive effect on digital innovation) we formulated the hypotheses that *leading the transformation*

H6A. *has a positive and significant on setting a cultural alignment;*

H6B. *has a positive and significant on nurturing an experimental environment;*

H6C. *has a positive and significant on promoting an innovation culture;*

H6D. *has a positive and significant on cultivating a digital and entrepreneurial awareness;*

H6E. *has a positive and significant on encouraging an agile structure.*

5.4.2 Measurement and structural model

To test the structural model, the instrument, based on the first-order concepts, was administrated through a web-based questionnaire sent to people in a management position of 301 Brazilian SMEs. We collected two hundred nine responses, of which 17 had to be discarded as they did not meet the digital maturity selection criteria. The final sample comprises 192 valid responses (64% of the companies contacted), and the respondents' profiles can be seen in Table 5.3 and Table 5.4. Regarding the sample size, we took the perspective of building an adequate model, so as the maximum number of arrows pointing at a construct in the structural model is four, to detect a minimum R2 value of 0.10 in any of the constructs at a significance level of 1%, the smallest sample size required was 191 (Hair et al. 2014b). Since we obtained 192 usable responses, we met the sample size requirement.

Table 5.3 - Demographic Characteristics

Size	**n (192)**	**%**	**Position**	**n (192)**	**%**
2 to 10	23	11.98	General manager	77	40.1
11 to 50	76	39.58	Director	51	26.15
51 to 249	93	48.44	Manager/Manager assistant	39	20.31
			Head	25	13.02

Source: elaborated by the authors

Concerning EFA results, the KMO index test for each item was higher than 0.5 and an overall value of 0.901 for the whole questionnaire, indicating that the sample size and factorability were met for conducting EFA. Besides, Bartlett's test of sphericity was significant (approximate Chi-square = 2970.257; $p < 0.001$) and indicates an adequate amount of collinearity between items. The diagonal in the anti-image matrix was also inspected for values smaller than 0.5.

Table 5.4 - Organizations industry

Industry	**n (192)**	**%**	**Industry**	**n (192)**	**%**

IT & Services	72	37.50	Farming	7	3.65
Financial Services	47	24.48	Logistics & Supply Chain	4	2.08
Real Estate	19	9.90	Staffing & Recruiting	4	2.08
E-learning	12	6.25	Health care & Wellness	4	1.56
Internet	12	6.25	Renewables & Environment	3	1.56
Publishing, Marketing & Entertainment	8	4.17			

Source: elaborated by the author

Table 5.5 summarizes the main results about items and constructs. Regarding item loadings and constructs, EFA pointed out that all items were over the cut-off value of 0.5 with no significant cross-loadings, except two items (*continuous improvement in business processes* and *digital knowledge and experience*) that presented loadings smaller than 0.5. However, we retained them because (i) of their theoretical importance (interviewees highlighted that only by knowing technologies is it possible to generate critical thinking about them and establish a trusting relationship with technology) and (ii) the AVE for the construct was over 0.5. Regarding constructs reliability and validity, the model satisfied the criteria (Table 5.5). The AVE ratings are between 0.539 and 0.813, meaning that all indicators were above the cut-off value of 0.5. All composite reliability values were also above the required cut-off value of 0.70, ranging between 0.854 and 0.911. Cronbach's alpha values for each factor were higher than 0.70, and discriminant validity values - assessed through HTMT, were all over 0.85. All VIF values are below 5.0, so multicollinearity is not an issue. Finally, outer loadings of the indicators were all above 0.708, except for the variable *considering a flatter organizational structure*, which presented 0.686 - acceptable for exploratory purposes.

Regarding the model's predictive power, R^2 values indicate that the full model explains 26% of the variance in DT performance perception, 47.8% in INN, 51.1% in DIGE, 62.0% in EXP, 33.5% in AGL, and 33.9% in CULT. Regarding Hair et al. (2019), all results (except DT) indicate moderate effect, while regarding Wetzels et al. (2009), results can be considered medium (INN, DIGE, and EXP) and large (AGL, CULT, and DT).

Table 5.5 - Results descriptive statistics and EFA

Construct and Item	**Mean**	**SD**	**Loading**	**Cr. Alpha**	**CR**	**AVE**
Promoting an innovation culture (INN)				0.786	0.854	0.539
Encouraging activities to sense and monitor opportunities	8.4	1.569	0.627			
Hold space for activities based on experimentation and tests	8.72	1.477	0.537			
Collaborative work execution	8.86	1.405	0.608			
Consider a flatter organizational structure	7.92	1.76	0.559			
Multifunctional and self-managed teams organization	8.2	1.864	0.565			
Cultivating a digital and entrepreneurial awareness (DIGE)				0.821	0.874	0.583
Critical thinking about technology adoption	8.32	1.698	0.735			
Agile-oriented thinking	8.39	1.558	0.631			
Crafting a change and entrepreneurial mindset	8.11	1.594	0.59			
Continuous improvement in business processes	8.57	1.598	0.469			

Digital knowledge and experience	8.77	1.405	0.315			
Nurturing an experimental environment (EXP)				0.877	0.911	0.671
Exploring user needs and experience	8.62	1.557	0.792			
Leadership trusts its employees and knows how to delegate	8.64	1.35	0.684			
Mistakes considered as a source of learning	8.69	1.471	0.602			
Sense of ownership and trust-based relationships	8.78	1.351	0.611			
Safe organizational environment promotion and maintenance	8.93	1.485	0.56			
Encouraging an agile structure (AGL)				0.789	0.877	0.704
Systematic communication routines (ceremonies and meetings) presence	8.46	1.746	0.69			
Use of methodologies and/or tools to coordinate its work activities	8.37	1.827	0.635			
Adoption of sprints to execute activities and projects	8.03	2.366	0.548			
Setting a cultural alignment (CULT)				0.780	0.871	0.693
Dismissal and hiring process driven by cultural principles and values	8.64	1.606	0.772			
Definition of competencies and responsibilities of positions and roles	8.03	1.873	0.575			
Existence of transformation purpose and cultural values	8.77	1.596	0.531			
Leading the transformation (LEAD)				0.856	0.903	0.700
Leadership involved in daily activities and influence employees through example	9.12	1.138	0.87			
Leadership awareness of the organization's digital transformation purpose	9.18	1.183	0.897			
Leadership openness to news and different views	8.92	1.404	0.585			
Leadership willingness to pivot and modify the current business	8.84	1.367	0.503			
Digital Transformation performance perception (DT)				0.770	0.896	0.812
Concerning DT, the organization is at an advanced stage	8.37	1.49	0.867			
Organization is ahead of competitors when it comes to DT	8.14	1.79	0.737			

Source: elaborated by the authors. Mean scores are based on a ten-point Likert scale (1 = strongly disagree, 10 strongly agree)

5.4.2.1 Hypotheses testing

Figure 5.4 and Table 5.6 show the results of the latent variable path model. Fourteen paths out of seventeen reached statistical significance. H1 is supported and proposes that INN is positively associated with DT (0.254, $p < .05$). Similarly, both H2a and H2b are statistically significant, supporting that DIGE positively influences DT and INN with effects of 0.321 ($p < .001$) and 0.188 ($p < .05$), respectively. Regarding nurturing an experimental environment (EXP) hypothesis, the analysis indicated that it has positive effects on INN (0.335, $p < .01$) and DIGE (0.357, $p < .001$). Also, the results confirmed that encouraging an agile structure (AGL) does have a positive effect on EXP (0.191, $p<0.01$), INN (0.267, $p<0.01$), and DIGE (0.196, $p<0.01$). Although, the same is not true concerning the hypotheses about CULT. No statistical significance was observed for H5b and H5c, although CULT was positively related to EXP (0.391, $p<0.001$) and to AGL (0.340, $p<0.01$), supporting H5a and H5d.

Table 5.6 - Hypotheses testing

Hypothesis	Hypothesized Path	T Statistics	Effect	P Values	Empirical evidence

H1	INN - DT	2.764	0.254	0.006**	Yes
H2a	DIGE - DT	3.614	0.321	0.000***	Yes
H2b	DIGE - INN	2.282	0.188	0.023**	Yes
H3a	EXP - INN	2.627	0.335	0.009**	Yes
H3b	EXP - DIGE	3.485	0.357	0.000***	Yes
H4a	AGL - EXP	2.647	0.191	0.008**	Yes
H4b	AGL - INN	2.919	0.267	0.004**	Yes
H4c	AGL - DIGE	2.656	0.196	0.008**	Yes
H5a	CULT - EXP	3.904	0.391	0.000***	Yes
H5b	CULT - INN	0.380	0.044	0.704	No
H5c	CULT - DIGE	1.492	0.136	0.136	No
H5d	CULT - AGL	3.034	0.340	0.002**	Yes
H6a	LEAD - CULT	8.813	0.582	0.000***	Yes
H6b	LEAD - EXP	3.721	0.351	0.000***	Yes
H6c	LEAD - INN	0.288	-0.028	0.773	No
H6d	LEAD - DIGE	2.256	0.153	0.024*	Yes
H6e	LEAD - AGL	3.465	0.311	0.001***	Yes

(*p < 0.05, **p < 0.01, ***p<0,001)

Source: elaborated by the authors

Finally, the supporting role of leadership was confirmed in four out of the five hypotheses. The analysis suggested that it has a positive effect on CULT (0.582, p<0.001), EXP (0.351, p<0.001), DIGE (0.152, p<0.05), and AGL (0.311, p<0.001), but no statistically related to INN.

5.5 Discussion and conclusions

5.5.1 Discussion

First of all, we highlight that the development and validation of the conceptual framework were done by considering established and robust procedures. During the qualitative phase, it comprised the selection of experts from a representative DT context - who represent companies that made efforts to transform their activities to offer services/products digitally, mainly by introducing platform-based offers (e.g., the case of the real estate companies) and new digital product and services development (e.g., the entertainment sector and recruitment). Then, data were analyzed with grounded theory to develop the conceptual themes. In the quantitative phase, we screened companies due to a digital maturity selection criterion, ensuring that, objectively, they were aligned with our definition of DT (Verhoef et al. 2021) and presented a minimum level of digital maturity. Finally, we carried out robust procedures to validate the instrument and analyze the data (e.g., EFA with PAF to perform factors extraction and Promax oblique rotation; reliability and validity tests with conservative cut-off values) with a proper data sample.

This article describes DT following Verhoef et al.'s (2021) perspective (a sociocultural process that employs digital technologies to create and appropriate more value for the firm), and it also uses the author's framework as a prerequisite to explore how organizational culture, structure, and leadership factors contribute to SME's DT process. Our results ensure that this perspective is valid and that such factors represent an intertwined and holistic way to support organizational changes, being significant and essential for DT. Statistically, model constructs help explain 26% of the variance in DT performance perception, a significant result since we address human behavior modeling (which has a high inherent variability), and it is considered a moderate result following Wetzels et al. (2009). Next, we discuss the constructs and their associations.

We first highlight the direct and positive effect of *promoting an innovation culture* (INN) and *cultivating a digital and entrepreneurial awareness* (DIGE) on explaining 26% of the variance in DT performance perception. The positive results on *promoting an innovation culture* support previous research in respect, for instance, to the fact that innovation thus has a positive influence on SMEs' growth (Scuotto et al. 2021) or that organizations that encourage innovative culture and new ways of thinking are most likely to succeed in executing DT plans and initiatives (Alshehab et al. 2022). It also stands as a powerful argument for SMEs to believe and invest more in innovation culture in order to scale digital business models. Following Roblek et al. (2021), approximately only 1–3% of company staff dedicates SME time to innovation, which may be due a posture to minimize risks of the numerous challenges SMEs face in DT (Verhoef et al. 2021; Müller, Buliga, and Voigt 2018; Scuotto et al. 2021). However, it also seems too risky not to adapt to the possibilities that digital brings (Carcary, Doherty, and Conway 2016), besides the fact that an innovative culture reduces the rate of cultural resistance. In this vein, it is worth diving deeper and exploring such a result concerning the five first-order concepts. In relation to the question proposed by Verhoef et al. (2021) about if digital transforming firms should adopt self-organizing teams instilled with autonomy and flexibility, our results directly contribute to it (and to the literature associated with it, e.g., according to Fregnan et al. 2022) by stressing the significance of some organizational factors for *promoting an innovation culture* as, for example, multifunctional teams arrangement with less hierarchical organizations, and activities of experimentation and sensing. Another important point is that internal organizational collaboration and cooperation between people are essential elements of DT (Fregnan et al. 2022; Roblek et al. 2021; Vial 2019). Although it can be challenging for SMEs - whose organizational structure is often not flexible enough (Rafael et al. 2020), a collaborative and innovative approach benefits transformation by establishing a change-oriented environment identified with a constant search for better customer deliveries, less bureaucratic practices, quick decision-making, and employees more committed to deliveries. After all, it enables, for example, operations to run without depending on physical spaces.

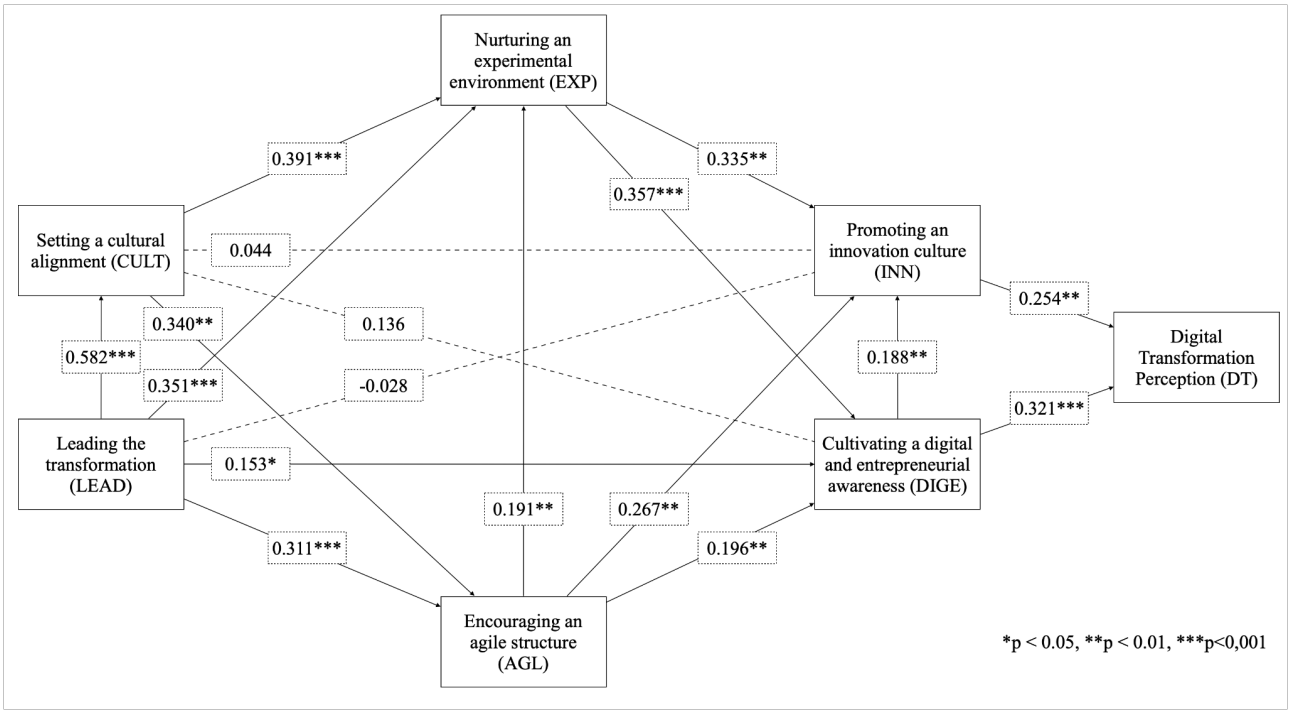

Figure 5.4 - Conceptual model and hypotheses

Source: elaborated by the authors

Besides it, the results strongly supported change-oriented values and principles regarding digital and entrepreneurial awareness (DIGE). From literature, we know that a particular mentality could be perceived in digitalized organizations (Colli et al. 2019), but from interviews and the structural model, we captured how much this can be related to DT (0.321, $p < .001$) and an innovative structure (0.188, $p < .05$). Improving the understanding of what a 'digital culture looks like' (Kane et al. 2016), we echo Korherr et al. (2022) and Levy et al. (2022), arguing that a company that transforms is one that, among several things, has a culture that transited to data collection, analysis, and evidence-based decision making, despite making decisions based on intuition (about what customers want and or which technology is best) - a widespread behavior in SMEs. Besides resonating with the results of previous works as Fregnan et al. (2022) and Roblek et al. (2021), it is an organization connected to what is happening, and that cultivates critical thinking about technology, knowing how to choose and use the most appropriate technology that may improve its value proposition. In this line, according to interviewees, a way to fine-tune it is by promoting incremental change circumstances through continuous training and development, confirming that learning is crucial for DT in SMEs (Matarazzo et al. 2021). As expert SysK says, 'new technologies will be launched continuously, and one cannot stop learning nor dealing with technology'. Furthermore, the results also confirm that the ability to innovate depends on appropriate digital capabilities to maximize the use of digital technologies (Scuotto et al. 2021). Those who understand digital technologies are the ones who make the changes; therefore, there is no transformation without such knowledge and capability to deal with technologies (experts LingH and SysK). In order to enhance employee learning experience and performance, recent literature point to gamification (Adhiatma, Sari, and Fachrunnisa 2021), and experts SysC, EntF, and RealI indicate that a way to increase digital experience is to invest in young and digital native professionals and mix them with people who might represent different generational and

technological paradigms. Although Roblek et al. (2021) point out a potential difference among cultural values, following the interviewees, it permits merging specialized technological expertise with management experience while disseminating a digital culture and training *old* employees.

Moreover, we found exciting results regarding *nurturing an experimental environment* (EXP) and *encouraging an agile structure* (AGL). First, they are both significantly and positively related to INN and DIGE, so we can imply they indirectly support the DT journey by helping craft and structure the organization. According to Vial (2019), a common theme across DT studies points to firms' need to cultivate a willingness to take risks and experiment. In this line, our results confirm that nurturing an experimental environment is crucial to developing a change-oriented attitude and enhancing innovations (agreeing with Alshehab et al. (2022), whose results show that a risk-taking culture also encourages new ways of thinking and solutions from diverse perspectives). From the experience of expert RealG, 'no meeting or transformation will run if people do not talk and participate. However, if they feel in a safe and trustworthy environment, they start talking and helping each other more.' Following experts LingH and RealI, celebration routines can help create such a safe space, making people feel involved (as indicated by Fregnan et al. 2022) and breaking their potential resistance.

Concerning *agile structure* (AGL), Tronvoll et al. (2020) argued that agility facilitates DT, but how this relationship takes place was not very well defined. So, a significant contribution of this study is the comprehension that agility enables companies to establish an organizational dynamic focused on discipline, a success factor in DT because it allows companies to acquire malleability, organized activities, and improve communication. Also, inspired by Verhoef et al. (2021), we know that stimulating digital agility requires flexible organization forms that allow fast responses to constant digital change. However, while it was not tested in the developed model, we can infer implications the other way around. Agility significantly increases a digital *innovation culture* (e.g., to detect and exploit market opportunities and have a flatter organizational structure with collaborative work execution), a crafted *digital and entrepreneurial awareness*, and a safe *experimental environment*. Hence, combined results may suggest that those relations can be mutually reinforcing. Another important result is that SMEs must understand that agility has a philosophical basis and that its pillars can be translated into countless realities. So, if companies manage to adapt them, the agile approach can benefit work progress and problem resolution and help anchor changes. In RealG, for example, the founder organized the SCRUM daily meeting as a half-hour encounter with all employees in which, before the start, he reminded everyone of DT's importance and the reason for it. The case of RealI is also interesting in this sense. SCRUM daily meetings were used to overcome a real estate company's usual problem in the proper use of CRM: not entering data. At the meetings, everyone had to talk about their sales funnel registered in CRM, and people who did not use the system began to feel uncomfortable as they did not have anything to manifest, and this was the ignite to use the system. So, from the structural model, we argue that SMEs that manage to reconcile agile with a horizontal and collaborative structure tends to create greater autonomy and, consequently, greater agility in decision making and in proposing more valuable deliveries.

Hypotheses that linked *setting a cultural alignment* (CULT) to INN and DIGE were not supported. This interesting result suggests at least two important considerations with practical

implications. First, *setting a cultural alignment* alone does not guarantee an *innovation culture* or *digital and entrepreneurial awareness*. From the proposed model, the construct CULT has a guiding quality that needs a structure that "embodies" its orientation - which happens through the enhancement of a *safe and experimental environment* (EXP) and a functional and rhythmic structural approach (in this case an *agile structure* - AGL). The second consideration supports the importance of contemplating the model holistically and intricately. The attempt to model cultural and organizational factors involved in DT involves a high level of complexity, and the fact that these hypotheses have not been supported extols the complex nature of mediation and indirect effects of the other constructs (e.g., EXP and AGL). This strengthens the understanding that DT takes place through a set of different factors intertwined in a complex manner. In a practical way, this is a significant result because it points out that once the company has its values and uses them to craft roles and functions, the organization can be on track to the DT process. Furthermore, the positive link between CULT and EXP confirms that cultural values that aim to develop an innovative company have to ensure that employees' natural curiosity is maintained (Roblek et al. 2021).

Finally, our results about the theme *leading the transformation* confirm that leadership plays an essential role in DT in many ways. As Singh et al. (2019) reported, a cultural shift can be particularly challenging, and leaders need to make people be willing to take the risk and embrace digital topics and DT. Our results point out that leadership directly affects CULT, EXP, AGL, and DIGE, and so our results confirm AlNuaimi et al. (2022), Ko et al. (2021), and Alshehab et al. (2022) concerning that leadership is significant in defining strategic DT goals and influencing DT. Equally, through its capacity to propose and live the company's purpose and values (confirming Porfírio et al. 2021), its presence help to create the conditions for a safe and experimental environment and reduces resistance to change (e.g., fear of losing the job), inspires behaviors, and convince employees.

Nevertheless, it is necessary to indicate that the direct relationship with INN (H6d) was not supported, which is a counterintuitive though significant result. As aforementioned, recent literature discussed a possible dual influence leadership might hold while supporting DT. In this context, Weber et al. (2022) suggest that a digital transformation–oriented behavior may intimidate employees who already have high levels of uncertainty due to an organization's DT, which could reflect in resistance to change. Our results confirm (and extrapolate) it. Despite the negative result between LEAD and INN, we notice that leadership plays a significant and positive role in helping promote and maintain EXP, CULT, AGL, and DIGE factors that, afterward, will help promote a culture of innovation. From that, we first suggest that it plays a role mediated to INN, which might not result in resistance to change. However, when analyzed alone, it has a negative influence on INN, and that may be due to a negative side linked to the behavior of overconfidence and excessive backing and support (Elbanna and Newman 2022) or characterized by emphasizing the digital vision, showing the need for change, and staying abreast of new digital technologies (Weber et al. (2022). In any case, we confirm Elbanna and Newman (2022) regarding a dialectic relationship between the positive and negative sides of top management support in DT. In this vein, expert Sysk has stated an interesting practical implication: "*leaders must be aware that employees are specialist workers that usually know more about their work than leadership does, so it is better not interfere"*.

5.5.2 Conceptual model and dynamic capabilities

Another source of discussion relates to the potential association among the model developed *par rapport* the ability for firms to design and maintain high-order mechanisms (dynamic capabilities) that enable repeatable, continuous adaptation in a dynamic environment as the DTs - a question pointed out by Vial (2019) and in line with similar works that investigate dynamic capabilities, such as Daronco et al. (2022). So, by analyzing recent literature that explores the interface between DT and dynamic capabilities, we suggest how the factors that compose the model may serve as a basis (antecedents) for firms to design and maintain high-order mechanisms of sensing, seizing, and reconfiguring (following Teece 2007). Table 5.7 summarizes the potential associations among the model factors and micro-foundation of dynamic capabilities mechanisms.

According to Teece (2007), sensing refers to identifying and shaping opportunities and threats through new information about, for example, customer needs and the market. In DT, sensing capabilities may involve detecting digital evolution, users' emerging behaviors (Warner and Wäger 2019; Nylén and Holmström 2015), and competitor-based trends. In Matarazzo et al. (2021), sensing was perceived as the most important driver of SME firm's competitiveness and DT, while Soluk and Kammerlander (2021) proposed that sensing is essential for technological opportunity identification and development at the initial DT stage in SMEs. From that, we notice a great connection with the model factors in mainly two orientations. One considers digital scanning and trends monitoring efforts, which can be greatly influenced by first-order concepts of INN (e.g., *encouraging activities to sense and monitor opportunities)*, DIGE (e.g., *critical thinking about technology adoption*), EXP (e.g., *exploring user needs and experience*), and LEAD (e.g., *leadership openness to news and different views*). We claim this is an interesting point because it can orient SMES to deal with challenges and threats related to market and societal and value-chain inertia, as pointed out by Brunetti et al. (2020) and Saarikko et al. (2020). The second orientation is linked to digital scenario planning, what will be affected by CULT (e.g., the *existence of transformation purpose and cultural values*) and LEAD (e.g., *leadership awareness of the organization's digital transformation purpose*), which may assist companies in avoiding a possible inconsistent understanding of transformation scope and substance (e.g., absence of clear vision or strategy, inaccurate outcome measurement) as suggested elsewhere (e.g., Chirumalla 2021; Saarikko et al. 2020).

Seizing refers to an organization's ability to take advantage of resources and skills to develop opportunities (Teece 2007). Regarding DT, we witness an orientation to the development of digital solutions (e.g., Warner and Wäger 2019; Cao et al. 2019), which may be enabled and strengthened by some of the model constructs. For example, we highlight the presence of INN (e.g., *hold space for activities based on experimentation and tests),* DIGE (e.g., *change and entrepreneurial mindset*, and *digital knowledge and experience*), EXP as a whole, AGL (*use of methodologies to coordinate its work activities,* and *adoption of sprints*) and LEAD (*leadership willingness to pivot and modify the current business*).

Finally, reconfiguring is the capacity to carry out transformations, e.g., improving competitiveness through the reconfiguration of organizational assets (Teece 2007). In the DT context, management processes such as continuous redesigning and combining resources and acquiring and integrating knowledge are deemed critical. In this respect, DC micro-foundations are

somehow influenced and supported by all the model factors. For instance, we indicate a significant link between redesign efforts (Warner and Wäger 2019; Soluk and Kammerlander 2021; Chirumalla 2021) and INN (via *considering a flatter organizational structure*). Also, DIGE (through *agile-oriented thinking*) and EXP (through *safe organizational environment promotion and maintenance*) help to set the company for a continuous digital improvement strategy (Chirumalla 2021). AGL's three first-order concepts enable balancing digital portfolios (Warner and Wäger 2019), while we notice a high supportive connection between CULT aligning function with improving digital maturing (Warner and Wäger 2019) and the process of hiring new human resources (Matarazzo et al. 2021) that may help to overcome potential path dependence inertia and cognitive inertia, a huge challenge indicated by literature (e.g., Margiono 2020; Caputo et al. 2021; Chirumalla 2021; Saarikko et al. 2020). Finally, LEAD is arguably characterized as an antecedent of such reconfiguring mechanisms.

Table 5.7 - Relations among factors and DC mechanisms

Antecedents	Sensing	Seizing	Reconfiguriing
Promoting an innovative culture (INN)	Use of marketing analytics (Cao et al. 2019); Digital scouting (Warner and Wäger 2019); Trend Monitoring (Soluk and Kammerlander 2021; Matarazzo et al. 2021; Tortora et al. 2021); Internal sensing (Torres et al. 2018);	Product development management (Cao et al. 2019); Recognising, assimilating, and commercialising new information (Soluk and Kammerlander 2021); Rapid prototyping (Warner and Wäger 2019); Agile cross-functional teams (Chirumalla 2021);	Redesigning internal structures (Warner and Wäger 2019); Reorganisation of routines (Soluk and Kammerlander 2021); Integration of process and IT know-how (Chirumalla 2021);
Cultivating a digital and entrepreneurial awareness (DIGE)	Use of marketing analytics (Cao et al. 2019); Digital scouting (Warner and Wäger 2019); Trend Monitoring (Soluk and Kammerlander 2021; Matarazzo et al. 2021; Tortora et al. 2021); Internal sensing (Torres et al. 2018);	Product development management (Cao et al. 2019); Recognising, assimilating, and commercialising new information (Soluk and Kammerlander 2021); Rapid prototyping (Warner and Wäger 2019); Knowledge generation, Knowledge acquisition (Tortora et al. 2021); Agile cross-functional teams (Chirumalla 2021);	Continuous digital improvement strategy (Chirumalla 2021);
Nurturing an experimental environment (EXP)	Use of marketing analytics (Cao et al. 2019); Internal sensing (Torres et al. 2018);	Product development management (Cao et al. 2019); Recognising, assimilating, and commercialising new information (Soluk and Kammerlander 2021); Rapid prototyping (Warner and Wäger 2019); Engaging in strategic partnerships (Soluk and Kammerlander 2021); Agile cross-functional teams (Chirumalla 2021);	Continuous digital improvement strategy (Chirumalla 2021);
Encouraging an agile structure (AGL)		Product development management (Cao et al. 2019); Recognising, assimilating, and commercialising new information (Soluk and Kammerlander 2021); Rapid prototyping (Warner and Wäger 2019); Agile cross-functional teams (Chirumalla 2021);	Balancing digital portfolios (Warner and Wäger 2019); Management vision and a giraffe's view (Chirumalla 2021)
Setting a cultural alignment (CULT)	Digital scenario planning (Warner and Wäger 2019); Support scenario-planning practices (Chirumalla 2021)		Improving digital maturing (Warner and Wäger 2019); Quick learning by employees (Soluk and Kammerlander 2021); Process of hiring new human resources (Matarazzo et al. 2021)

Leading the transformation (LEAD)	Use of marketing analytics (Cao et al. 2019); Use of marketing analytics (Cao et al. 2019); Digital scouting (Warner and Wäger 2019); Trend Monitoring (Soluk and Kammerlander 2021; Matarazzo et al. 2021; Tortora et al. 2021); Internal sensing (Torres et al. 2018); Digital scenario planning (Warner and Wäger 2019); Support scenario-planning practices (Chirumalla 2021)	Product development management (Cao et al. 2019); Recognising, assimilating, and commercialising new information (Soluk and Kammerlander 2021); Rapid prototyping (Warner and Wäger 2019); Knowledge generation, Knowledge acquisition (Tortora et al. 2021); Engaging in strategic partnerships (Soluk and Kammerlander 2021); Agile cross-functional teams (Chirumalla 2021);	Continuous digital improvement strategy (Chirumalla 2021); Balancing digital portfolios (Warner and Wäger 2019); Management vision and a giraffe's view (Chirumalla 2021); Redesigning internal structures (Warner and Wäger 2019); Reorganisation of routines (Soluk and Kammerlander 2021); Integration of process and IT know-how (Chirumalla 2021);

Source: elaborated by the authors

5.5.3 Theoretical contributions

Research on DT is growing in numbers (Vaska et al. 2021; Verhoef et al. 2021), and there is a strong call for more research on the different aspects of DT in SMEs. Our findings contribute to the scarce literature on companies transitioning to digitalized business models (Matarazzo et al. 2021; Seetharaman 2020), helping to structure the foundation for further exploration - a need highlighted by Kadir and Broberg (2020). The conceptual model developed and tested in this study represents original research, in which we adopted a mixed-method approach and carried rigorous analysis (grounded theory, EFA, and PLS-SEM) on the data collected to ensure substantial implications. Thus, we present a number of theoretical and scientific implications of this study.

The main contribution is the proposition and test of a conceptual model, including the relation between (i) promoting an innovation culture, (ii) cultivating a digital and entrepreneurial awareness, (iii) nurturing an experimental environment, (iv) encouraging an agile structure, (v) setting a cultural alignment, and (vi) leading the transformation the DT context. First, the 364 elements inductively grouped in 25 first-order concepts and six second-order themes in the qualitative phase are, *per se*, an intense and condensed corpus of knowledge based on literature and practical instance that future research can take into consideration. Then, by testing the model, we provide statistical extrapolation of how they relate to each other, and it represents a significant contribution because it reveals the magnitude of their effects and their significance in relation to each other. Therefore, such a result confirmed our qualitative and quantitative choices for the analysis to answer the research question, dealing with the complexity it entails and the significant data volume.

Second, it contributes to the scarce research on DT by framing and exploring a scientific discussion about cultural, organizational, and leadership factors in this context. DT is an emerging topic (Caputo et al. 2021; Vaska et al. 2021) with a great interest in capturing the capabilities and the challenges of dealing with the DT (Chirumalla 2021; Warner and Wäger 2019), but few studies have approached how such antecedents relate to each other and DT. The present research contributes to advancing discussions, for example, of Vial's (2019) DT framework about how structural changes affect how organizations change their value proposition.

Third, this study helps establish and advance knowledge of the interface between technology, work, and people in SMEs. For instance, it becomes possible to understand how and how much organizations can generate and ensure the development of necessary cognitive aspects suggested by the literature (such as tolerance to failures, trust, the propensity to take risks, openness to change - Roblek et al. 2021), to respond to modern digital technology through the understanding

of the constructs digital and entrepreneurial awareness and nurturing an experimental environment. Equally, the model contributes to understanding the impact of agile structures and the dual influence of leaders in managing and supporting the creation of an innovation culture to advance DT. Finally, this study confirms the dialectic relationship between the positive and negative sides of top management support in DT.

Four, the relations inferred with respect to DC contribute to crafting the ability to design and maintain high-order mechanisms that enable repeatable, continuous adaptation in DTs. Although we did not conduct any test in this matter, we firmly believe this is a significant theoretical contribution as it sets the link between our results with a compelling and timely theory.

5.5.4 Managerial implications

The managerial implications mainly concern how SMEs can employ their efforts to deal with DT, and this study can contribute to practice in three ways. First, by using the developed model, managers can comprehend the big picture of the factors they should be aware of when deciding how to manage DT. Second, given the usual scarce resources (companies' time and effort) and lack of flexibility in SMEs, managers have the knowledge to guide their decisions about where to look first, how they should focus their energy, and what to expect as a result. Third, this study also provides information to create favorable conditions for the growth of SMEs by supporting, for instance, governmental actions. According to OECD (2017), SMEs are lagging behind in the digital transition, and, for instance, following Cazeri et al. (2021), a large number of Brazilian companies do not even know the basic definition of "Digital revolution". So those contributions can be associated with a potential economic contribution (Keen and Williams 2013), as SMEs constitute an essential part of the economy in most countries (Gruber 2019).

5.5.5 Limitations and future research

Any conclusions drawn from this study should be considered in light of its limitations, which provide avenues for future research. Firstly, the present study focused on understanding DT's cultural, organizational, and leadership factors, and it was done through interviews with industry and consultant experts. Thus, it probably does not capture all the factors that may exist, and, as a limitation, the present study could have benefited from more interviews drawn from varied industries, which would allow richer data and an opportunity for more details for the first-order concepts and second-order themes. Future works could (i) include additional variables to test further the validity and usefulness of this research model and (ii) test potential relations with DC mechanisms.

Second, we used a prerequisite to have an adherent sample on both qualitative and quantitative methods, based on Verhoef et al.'s (2021) model (Table 1). From that, we objectively consider organizations with a specific digital maturity, and we captured the performance of DT based on respondents' perception, which can be biased, although we tried to control it through rigorous analysis and such a prerequisite exam. Future works can work on better ways to understand DT performance and further modify the proposed model.

5.5.6 Conclusion

Through a six constructs model, this study explored, presented, and discussed how cultural, organizational, and leadership contribute to the DT process in SMEs. This study answered a theoretical call (Matarazzo et al. 2021, Scuotto et al. 2021, Seetharaman 2020, Soluk and Kammerlander 2021, Vaska et al. 2021) and represents a timely and robust orientation to SMEs' efforts in the DT context. Also, it helps advance the practice and theory by discussing essential aspects of the organizational behavior and information technology fields, such as the development of an innovative culture and the role of leadership in supporting DT.

Appendix 5A

1. How do you relate organizational culture and the DT process?
2. What cultural aspects are relevant to the success of the DT process?
3. What makes up an environment where change happens (change-oriented environment)?
4. Which organizational structures are most effective for the DT process?
5. Does your company employ/promote agile aspects in its organizational structure? Which are?
6. From this, how does the agile organization relate to the DT process?
7. Specifically, about the process of diluting the decision-making power in teams/ collaborators, how does it relate to the DT process?
8. What can be said about the collaboration between people? How does this relate to DT? How to create a collaborative culture to foster DT?

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Chapter 6 - Conclusion

Most of the results were discussed in the body of the developed articles. However, a discussion, albeit brief, is needed regarding how the findings of this thesis assist organizations in creating strategies and facilitating conditions to carry out the digital transformation or scaling digital maturity. Hence, it is worthwhile to position the findings of the thesis in relation to the literature review and further elaborate on the relationship between the antecedent factors in chapter 3 and the framework in chapter 5 in relation to the structure of the literature review illustrated in Figure 2.1.

6.1 Positioning the results

To further establish the position of the thesis results in light of the literature, it is deemed necessary that the first part of the concluding remarks addresses the enrichment of the barriers and challenges encountered by the organizations. Table 6.1 presents the table of barriers and challenges updated with the results obtained during the exploration of the cases in Chapter 3, the interviews with experts in Appendix 3C, and the results obtained in the development of Chapter 5.

The supported challenges and new findings in Table 6.1 are presented next. For better understanding, the results obtained in the cases studied in Chapter 3 are indicated in the Experts column as **RealStateA**, **EduB**, **AIC**, and **EduD**; the content that refers to the results obtained with the experts in Appendix 3C is indicated according to the codes used in Table 3C.1, and the content that refers to the results obtained during Chapter 5 is in accordance with Table 5.2 (Table 5.2 - Interviewee's characteristics).

Table 6.1 - Updated digital transformation barriers and challenges

Barriers/challenges	Examples	References	Experts
Inconsistent understanding of the scope and substance of the change	Customer value comprehension		AIC; ConsE
	Lack of clear vision	Chirumalla 2021; Saarikko et al. 2020	RealB; ConsB; LingH; RealStateA; ConsG; ConsE
	Lack of strategy	Zangiacomi et al. 2019; Llopis-Albert et al. 2021; Saarikko et al. 2020	
	Long-term project perception	Bouwman, Nikou, and de Reuver 2019; Soluk and Kammerlander 2021	RealG; ConsI; ConsE; ConsJ
	Merging the DT strategy with the company's strategy	Matt, Hess, and Benlian 2015	ConsH; ConsI
	Outcome measurement	Brunetti et al. 2020; Zangiacomi et al. 2019; Llopis-Albert et al. 2021; Chirumalla 2021; Saarikko et al. 2020	ConsH; RealG; AIC
	Rigid strategic planning	Warner and Wäger 2019	
	Scope of digital transformation	Bertola and Teunissen 2018; Zangiacomi et al. 2019; Tekic and Koroteev 2019; Chirumalla 2021; Saarikko et al. 2020; Soluk and Kammerlander 2021	SysK; LingH; RealB; ConsD; ConsB; SysC; RecD; ConsG; ConsJ
	Transformation timing	Tekic and Koroteev 2019; Saarikko et al. 2020	
	Difficulties in building new capabilities	Bertola and Teunissen 2018; Zangiacomi et al. 2019; Chirumalla 2021; Saarikko et al. 2020	ConsB
	Digital incompetence	Caputo et al. 2021	RealB; ConsG; RealI; RealG

Capacity and capabilities	Lack of competence for digital exploitation	Tekic and Koroteev 2019; Brunetti et al. 2020; Zangiacomi et al. 2019; Eling and Lehmann 2017 ; Chirumalla 2021; Saarikko et al. 2020; Soluk and Kammerlander 2021	EduD_1; LingH; SysK; AIC; ConsI; ConsE; ConsF; ConsJ
	Process reconfiguration		ConsH; ConsF
	Technology volatility	Brunetti et al. 2020; Zangiacomi et al. 2019; Saarikko et al. 2020	SysK
	Turnover and lack of people		ConsE; EduB_B; EduB_A
Leadership and top management	Aversion to losing authority and control	Soluk and Kammerlander 2021	RealG; SysJ; ConsD; SysC; SysK; ConsC; RealStateA; ConsD
	Lack of support for changes	Tekic and Koroteev 2019; Zangiacomi et al. 2019	RealStateA; RecD; ConsB; RealG; RealI; ConsI
	Lack of leadership competence	Zangiacomi et al. 2019; Warner and Wäger 2019	RecD; ConsB; SysJ; ConsI; ConsE
	Managers openness to change	Zangiacomi et al. 2019; Warner and Wäger 2019	SysK; ConsA
Cultural and organizational factors	Cultural gaps	Chirumalla 2021	RecD; ConsG; ConsJ; SysC; SysJ
	Fear of losing the job	Soluk and Kammerlander 2021	RealI; ConsJ
	High level of hierarchy	Warner and Wäger 2019	SysK
	Lack of autonomy / self-management		RecD; RealB; PubA; SysC; SysJ; ConsD
	Low error tolerance		RecD; LingH; SysC; SysK; RealB
	Path-dependence and cognitive inertia	Margiono 2020; Tekic and Koroteev 2019; Caputo et al. 2021; Chirumalla 2021; Vial 2019; Warner and Wäger 2019; Bouncken and Barwinski 2020; Saarikko et al. 2020	ConsB; AIC; EduD_1; ConsC; EntF; RealStateA; ConsI; ConsE; ConsJ
	Rigid culture	Chirumalla 2021	RecD; ConsD; RealStateA; ConsI
Transformation management	Investment (budget allocation/mgmt)		ConsH; ConsI
	Change capacity management	Warner and Wäger 2019	ConsH; SysK; AIC; EduB_B; ConsH; ConsE
	Constant alignment	Zangiacomi et al. 2019	RecD; AIC
	DT integration with the current business model		ConsI; ConsH
	Knowledge management	Brunetti et al. 2020; Zangiacomi et al. 2019; Saarikko et al. 2020	EduD_2; EduB_A
	Marketing communication challenge		AIC
Collaborations and partnership	Need to establish collaborations and partnership	Brunetti et al. 2020; Zangiacomi et al. 2019; Tekic and Koroteev 2019; Saarikko et al. 2020	
External factors	External ecosystem management		ConsH; ConsI
	Market challenges and threats	Brunetti et al. 2020; Saarikko et al. 2020; Chirumalla 2021	EduB_B; SysC
	Societal challenges	Brunetti et al. 2020	
	Value-chain inertia	Saarikko et al. 2020	Edit (BR)
Resources	Financial investment limitation	Li et al. 2019; Zangiacomi et al. 2019; Soluk and Kammerlander 2021	ConsB
	Technological Infrastructure	Eling and Lehmann 2017; Zangiacomi et al. 2019; Chirumalla 2021	EduD_1; EduB_A; EduD_1; EduB_B; ConsF

Source: elaborated by the author

In general, there is a strong adherence to the reality found in the results of the thesis with what was initially developed in theory and new sources of challenges. Not exhaustively, these results will be briefly discussed since they were, in some way, already discussed in the previous chapters.

First, regarding the **inconsistent understanding of the scope and substance of change**, as indicated by Llopis-Albert et al. (2021), there is no immediate return and the return on investment is uncertain, which leads to capital risk. This, for example, was evident in the thought of the CEO of RealStateA, which indicates the need to assume an investor mindset. In addition, in a more

sophisticated perspective, it was counted as an example of inconsistent understanding of the difficulty in perceiving and comprehending what the customer actually wants and how they perceive value when seeking to assume a digital posture. In the words of AIC's head of innovation, it is not always easy, even for an IT engineer, to *understand that the value delivered to the customer is the value that he/she perceives*. "There is a great difference between what the customer perceives as value and what you want to build as an AI expert into an algorithm for music, for example."

Following, there is a misperception or misunderstanding of the outcomes and implications of the process. As an example, there is the case of interpreting success about transformation from the results of using only one new technology for a specific purpose (Tekic and Koroteev 2019). Among the results, it is perceived that from an inconsistent understanding, the transformation process is susceptible to being *reduced to the adoption of technologies or the digitization* of an isolated process without contemplating the organization broadly, aligning people, culture, and technologies (SysK; LingH).

Regarding challenges related to **capabilities and competencies**, in agreement with Eling and Lehmann (2017) and Tekic and Koroteev (2019), one finds in AIC, for example, the need for data analysis competence and the competence to know how to turn data into money. Concerning the challenges encountered in the literature (Chapter 2), according to ConsH and ConsF, process reconfiguration carries significant difficulty because it is the realistic representation of new ways of designing and producing. In the words of ConsF, "it is necessary to completely revise the course of developing activities from a digital perspective. Finally, the challenge related to the loss of intellectual capacity and turnover became evident since the market is highly volatile and eager for digital skills (EduB).

The challenges and difficulties related to **leadership and top management roles** were confirmed. Regarding the aversion to the loss of authority and control, it can be noticed that due to the need to move from an environment based on the concept of "command and control" to one made of sharing and clarity of objectives, delegation, and verification of results (ConsC), people in leadership or management positions may have difficulties in understanding that they will not be able to do the digital transformation process alone (ConsD) and that they need to assume a posture of greater confidence and to know how to delegate. This, in the words of RealStateA's CEO, "is quite complicated because there is the impulse to control decisions, which are usually different."

The challenges linked to **organizational and cultural factors** were deeply discussed in Chapter 5 and enriched the knowledge of what was proposed in Chapter 2. For example, faced with the existence of a conservative mindset among employees and, consequently, cognitive inertia, the results highlighted numerous challenges to be overcomed. Since it is necessary to radically change employees' decision-making process (according to ConsC), it is necessary to consider the possibility that the employee may be unprepared to face a new economy based on collaboration, experimentation, and self-management. That is, it is necessary to understand (i) that the employee may be afraid of losing his job because of technological advances, (ii) that he is not (never has been) prepared to have autonomy and self-management without the need for micromanagement, or, simply, (iii) that he does not feel confident to understand that he is in an error-tolerant environment (SysK; RecD).

Regarding the challenges of **transformation management**, there was empirical adherence to the need to manage and support the innovation process and new challenges. About the challenge of managing the ability to make changes indicated earlier (Warner and Wager 2019), it was verified the possible existence of sources of tension that bring significant difficulties to companies. First, the tension generated from the integration of a new business model with the current business model, which was extolled in the case of EduB and unfolds in the challenge of understanding the organizational ability to make changes while continuing to deliver value (EduB; AIC; and SysK). Furthermore, according to the expert ConsI, if the budget for innovation comes from well-established functions or business units, there may be organizational tension if these units believe they are 'giving away' their money. This problem can, moreover, create burnout in people in the innovation function and generate a potential sense of lack of authority for budget resources.

About the challenge of maintaining constant alignment within the organization, as evidenced in the case of AIC, one of the major concerns of the innovation process is the measurement of impact to the company. This can be challenging in many ways, such as, for example, in how it is communicated internally. According to the commercial manager of RealStateA, "if for some reason the message doesn't arrive clean and evident to everyone, you lock a gear, which can be traumatic". Regarding the difficulty related to knowledge management, a problem of technological overlap and data governance was verified. In the words of EduD, some situations are tricky: "when there is more than one software to deal with certain data, sometimes they work in a complementary way, but sometimes they end up being redundant, which generates a data governance problem". Furthermore, there are the consequences of poor information management, such as rework: "unfortunately, it is normal to spend time on problems that have already been solved at some point that surface again in other years" (CTO of EduB). Finally, it was also found a difficulty related to external communication. As the organization is changing its business model, its communication proposal may also change, which will impose a challenge, as seen in AIC. "It is difficult to merge two very different objectives/goals to integrate everything in an identity/brand, while it is necessary to distinguish what you want to bring to the market in a more standardized way within a company that is trying to communicate art and data science together" (CEO of AIC).

When considering the challenges related to **partnerships and collaborations**, the specialists ConsH and ConsI indicate a difficulty regarding the interaction and exploration of relationships with different players in the local ecosystem. According to them, it is necessary to operate with new suppliers, compete with companies that, up to two years ago, did not even exist and; and, at the same time, open the frontiers of new markets and new demands. So there is a kind of industry convergence triggered by digital innovation and digital transformation.

Finally, it was evident in the EduB and EduD cases the difficulties related to (i) the **infrastructure** needed to support the digital transformation and ensure different ways of proposing value, (ii) as well as in relation to the investments that need to be made. Which, as already seen, may be linked to financial limitations (endorsed by ConsB) or, as seen in the case of RealStateA, to the need to make personal investments.

6.2 Relationship between antecedents and the Digital Transformation Dynamic Capability

After updating the challenges and barriers companies face, it is important to emphasize that the results that allowed producing the *Digital Transformation Dynamic Capability* framework and its antecedents give organizations, above all, the possibility of continuing to modify their structures in the face of such challenges. Bypassing them, establishing new ways of proposing and capturing value, and ensuring a capacity for change in an increasingly digital and volatile context (Fletcher and Griffiths 2020).

Thus, it is proposed to update Figure 2.1, in which both the framework developed in Chapter 3 and the model developed in Chapter 5 make up the frame involving the capabilities needed for organizations to create the conditions necessary to succeed during the scaling of the digital maturity of their business.

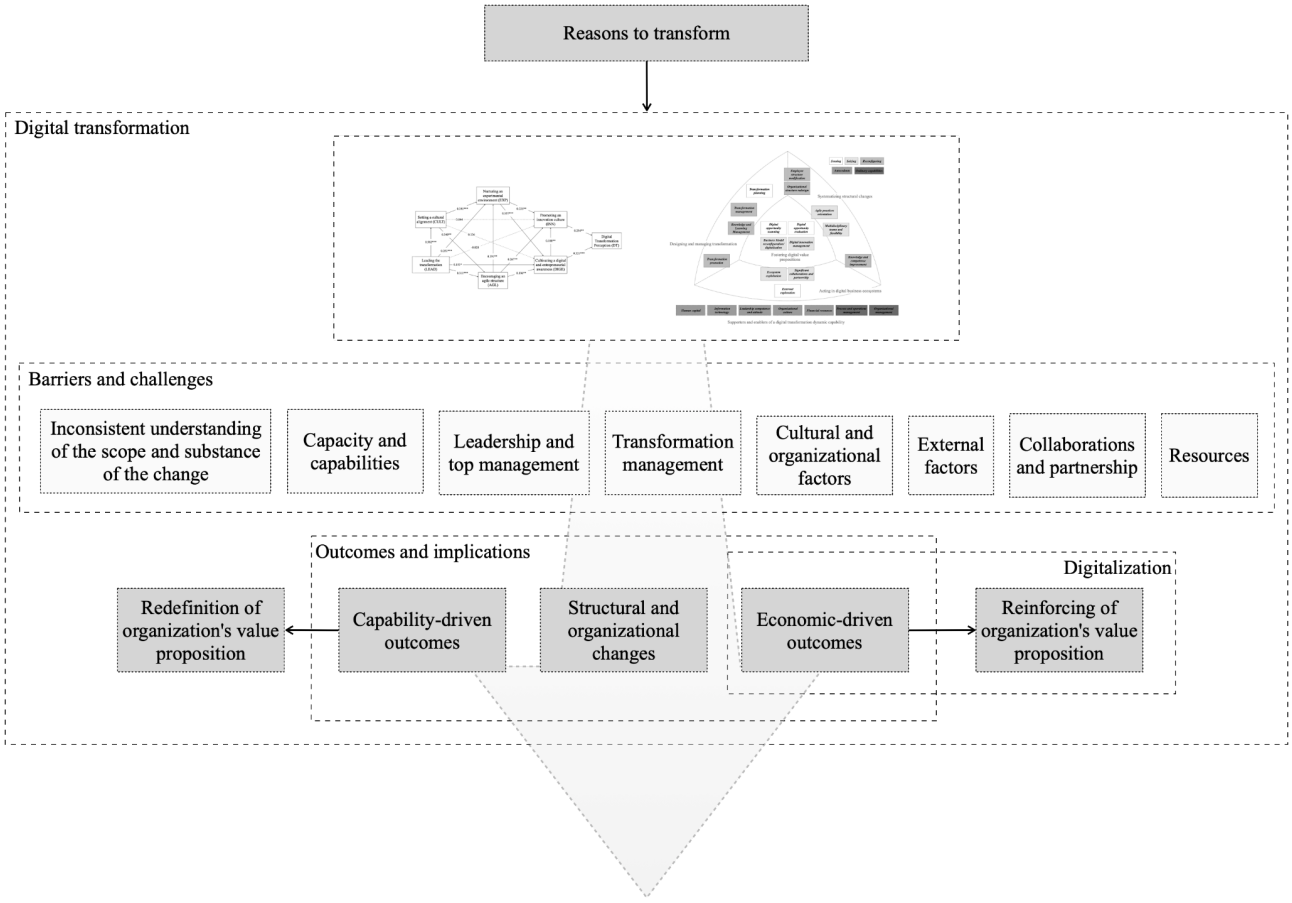

Figure 6.1 - Structure of the literature review (modified)

Source: elaborated by the author

Thus, a point of interest is to further the discussion between antecedents and the components of the framework in order to guide organizational strategies. As done in the discussion of Chapter 5, an important source of analysis is to establish potential links between the antecedent factors of the Chapter 5 model with firms' abilities to develop and maintain high-order capabilities. However, whereas in the discussion section of the previous chapter relationships were established between the developed model and recent literature, this section will elaborate on the potential relationships

between the cultural and organizational factors of the Chapter 5 model with the patterns of dynamic capabilities elaborated in Chapter 3. Although the model in Chapter 5 is focused on SMEs, it is still appropriate to establish such relationships since it can serve as inspiration for other organizations. Table 6.2 summarizes the potential associations between the factors of the model and the patterns of micro-foundations of the mechanisms of dynamic capabilities. Table 6.3 provides more detail on the relationships from the perspective of the thematic areas of the framework of Chapter 3.

Table 6.2 - Relations among factors and DTDC mechanisms

Antecedents	**Micro-foundations**		
	Sensing	**Seizing**	**Reconfiguriing**
Promoting an innovative culture (INN)	Digital opportunity scanning; External exploration	Digital innovation management; Ecosystem exploitation; Agile practices orientation; Multidisciplinary teams and flexibility	Employee structure modification; Organizational structure redesign
Cultivating a digital and entrepreneurial awareness (DIGE)	Digital opportunity scanning; Digital opportunity evaluation; External exploration	Digital innovation management; Business Model reconfiguration/digitalization; Ecosystem exploitation; Agile practices orientation; Multidisciplinary teams and flexibility	Transformation management; Transformation promotion; Knowledge and competence improvement
Nurturing an experimental environment (EXP)	Digital opportunity scanning; Digital opportunity evaluation	Digital innovation management; Significant collaborations and partnerships; Agile practices orientation; Multidisciplinary teams and flexibility	Transformation management; Transformation promotion; Employee structure modification
Encouraging an agile structure (AGL)	Digital opportunity evaluation; Transformation planning	Digital innovation management; Agile practices orientation; Multidisciplinary teams and flexibility	Transformation management; Transformation promotion
Setting a cultural alignment (CULT)	Transformation planning	-	Employee structure modification; Knowledge and competence improvement
Leading the transformation (LEAD)	Digital opportunity scanning; Digital opportunity evaluation; Transformation planning; External exploration	Digital innovation management; Business Model reconfiguration/digitalization; Ecosystem exploitation; Significant collaborations and partnerships; Agile practices orientation; Multidisciplinary teams and flexibility	Transformation management; Transformation promotion; Employee structure modification; Knowledge and competence improvement; Organizational structure redesign

Source: elaborated by the author

Since the results of the elaboration of the framework in Chapter 3 served as an initial basis for the deeper exploration of cultural and organizational background in Chapter 5, it is evident that the relationships to be discussed seem, first of all, explicit or obvious. It is even possible to see that in the fifth thematic area established in the framework are the contents discussed in Chapter 5 about leadership and organizational culture. However, it is important to highlight and elaborate on the details of the enabling character of antecedents. Thus, some of the relationships that can be appreciated in Tables 6.3 and 6.4 (Appendix 6) are discussed in the sequence divided into the six factors of the model in Chapter 5. Table 6.5 helps in the interpretation of the previous Tables.

Tabela 6.5 - Codes and Abbreviations

Factor	First-order concept	Code
Promoting an innovation culture (INN)	Hold space for activities based on experimentation and tests	INN1
	Encouraging activities to sense and monitor opportunities	INN2
	Multifunctional and self-managed team organization	INN3
	Collaborative work execution	INN4
	Consider a flatter organizational structure	INN5
Cultivating a digital and entrepreneurial awareness (DIGE)	Change and entrepreneurial mindset	DIGE1
	Agile-oriented thinking	DIGE2
	Continuous improvement in business processes	DIGE3
	Critical thinking about technology adoption	DIGE4
	Digital knowledge and experience	DIGE5
Nurturing an experimental space (EXP)	Safe organizational environment promotion and maintenance	EXP1
	Sense of ownership and trust-based relationships	EXP2
	Exploring user needs and experience	EXP3
	Mistakes considered as a source of learning	EXP4
	Leadership trusts its employees and knows how to delegate	EXP5
Encouraging an agile structure (AGL)	Promoting the use of methodologies and/or tools to coordinate its work	AGL1
	Encouraging the adoption of sprints to execute activities and projects	AGL2
	Systematic communication routines (ceremonies and meetings) presence	AGL3
Setting a cultural alignment (CULT)	Dismissal and hiring process driven by cultural principles and values	CULT1
	Definition of competencies and responsibilities of positions and roles	CULT2
	Existence of transformation purpose and cultural values	CULT3
Leading to transformation (LEAD)	Leadership openness to news and different views	LEAD1
	Leadership awareness of the organization's digital transformation purpose	LEAD2
	Leadership willingness to pivot and modify the current business	LEAD3
	Leadership involved in daily activities and influence employees through	LEAD4

Source: elaborated by the author.

Promoting an innovation culture. Firstly, it can be seen that organizations can benefit from an atmosphere concerned with fostering a culture of innovation to boost their ability to become digitally mature organizations. Through the effects understood within this cultural factor, the organization tends to facilitate the exploration and development of innovations by carrying out (not only, but mainly) ***sensing*** activities related to the areas *Acting in digital business ecosystems* and *Fostering digital value propositions*, as well as ***seizing*** activities related to *Fostering digital value propositions* and *Systematizing structural changes*.

For example, *promoting an innovation culture* has great adherence to practices related to sensing because, as seen in Chapter 5, a culture of innovation reinforces the routine of following and getting used to new technologies, creating space to maintain a structure that "*encourages activities to sense and monitor opportunities*". In this way, we perceive potential improvement in routines related to the micro-foundation *digital opportunity scanning* micro (such as *analysis of customers' value/needs, exploration and analysis of data*, *exploration of technological trends* and *internal sensing*) and external exploration (in interactions with ecosystem players and partnership searching).

About ***seizing*** activities, not only does the literature highlight collaboration as an essential element of DT (Vial 2019), but all experts in Chapter 5 indicated that performing collaborative work supports DT success and "without collaboration, the development of new solutions and the required outcome is not achieved" (expert EntF). Added to the strong orientation that an innovation

culture confers with the maintenance of a "*space for activities based on experimentation and tests*", these elements are crucial to promote the development of new solutions and functionalities, evidencing strong adherence to seizing practices linked to *digital innovation management* (through the *development of MVP and tests* or *usage of a digital innovation lab*) and orientation to agile practices (*exploration of agile practices in digital business management*).

Moreover, it is perceived that such cultural factor equally affects the reconfiguring mechanisms in the area *Systematizing structural changes* through, for example, *considering a flatter organizational structure*. According to the expert RealE, horizontal structures tend to increase the shared vision of the company, increasing the malleability, permeability, and adaptability of the organization supporting transformation. Improvement in employee communication and organizational vision is also perceived (according to experts SysC, RecD, and SysK). It is important because it aids in the technology adoption process (experts EntF and SysJ), reduces resistance to change (expert RealI), and fosters employee training and development (expert SysC). Thus, given this set of arguments, it can be established that the organization nurtures the necessary conditions to conduct organizational redefinition activities, such as *incorporation of new roles and functions, redefinition of roles and positions* and o*ff-boarding of people misaligned with the company's purpose.*

Cultivating a digital and entrepreneurial awareness. Such a factor tends to function as an important enabler of a digitally oriented organization, which will consequently enable the organization to better design, for example, *fostering digital value propositions* and *designing and managing transformation.*

First, both *change and entrepreneurial mindset* and *critical thinking about technology adoption* (expected effects of such cultural factor) tend to increase the sensing capability associated with the *digital opportunity evaluation* through better *digital assertiveness* of the organization. As analyzed in the previous chapter, this consequently reduces intuition-based technology adoption and increases the organization's ability to frame how technology will impact business and the *fostering digital value propositions*. In this same sense, such factor also presents strong adherence with the seizing activities of *business model reconfiguration/digitalization*. It is expected that a company whose culture is oriented to the *continuous improvement in business processes*, as indicated by the expert ConsM and authors Yeow, Soh, and Hansen (2018), and that values *digital knowledge and experience* will seek and achieve digital innovations.

Regarding ***reconfiguring*** activities in *designing and managing transformation*, it can be expected a substantial influence on the micro-foundations patterns of *transformation management* and *transformation promotion*. The presence of *agile-oriented thinking* is one drive of this influence. This mindset predicts a cognitive alignment according to the agile manifesto principles and has great adherence to *follow-up and review/adjustment of the transformation strategy* and *pacing the transformation* routines. Recalling Chapter 5, according to Crittenden, Crittenden, and Crittenden (2019), Vial (2019), and the experts SysC, SysJ, SysK, and ConsM, *agile-oriented thinking* tends to promote an automated and technological mindset based on lean thinking and continuous value delivery through small, incremental and iterative changes in short cycles. Therefore, an organization that aims at continuous value delivery (first principle of the manifesto), with estimated deliveries in short periods (third principle), that can maintain constant development

steps (eighth principle), and that looks for ways to be effective at regular intervals (twelfth principle) tends to be able to circumvent difficulties related to keeping all employees in the same direction and pace.

Nurturing an experimental space. Like the first factor discussed, nurturing an experimentation-oriented environment tends to enable the necessary behavior of further exploration and elaboration of new ideas within a company, strongly influencing activities in the areas of *fostering digital value propositions* and *systematizing structural changes*.

Picking up on Vial (2019), a common issue in digital transformation is the need for companies to cultivate a willingness to take risks. To do so, as pointed out by the experts RecD, LingH, and SysK, companies must create the conditions that will allow them to first increase their tolerance for errors and failures. Thus, it seems evident that an organization where there (i) is the *safe environment promotion and maintenance*, (ii) a *sense of ownership and trust-based relationships*, and (iii) where *mistakes considered as a source of learning* will find its ways to promote and generate digital innovations and increase the *fostering digital value propositions*. Similarly, the argument is valid for *exploring user needs and experience*. As seen before, comprehending the importance of capturing from the customer's perspective implies seeking to embrace their demands and needs through an attitude of more curiosity and less certainty to fine-tune the value proposition (RealG; Kane 2019) and consequently having more ability to innovate in a digital and changing marketplace.

Moreover, it is possible to establish that such cultural factors tend to create the necessary conditions for the *systematizing structural changes* through the safe space for experimentation and the emergence of organizational formats with more *flexibility and autonomy in work* and *multidisciplinary*. It is also possible to note a significant relationship with the maintenance of *employees' involvement* - which generates an important pro-change psychological orientation in employees (Leso et al. 2021) and is an important ***reconfiguring*** activity.

Encouraging an agile structure. The fourth factor contemplates organizational inclinations that tend and aim at the generation and delivery of value in a continuous manner. In this way, it is possible to see that through (i) *promoting the use of methodologies and/or tools to coordinate its work activities*, (ii) *encouraging the adoption of sprints to execute activities and projects*, and (iii) s*ystematic communication routines (ceremonies and meetings) presence*, the organization will create a dynamic in which it will be systematically talking, tracing measurable goals and evolving in a controlled and assisted way. Thus, it is possible to establish that this factor has influence, for example, in the ***sensing*** and ***reconfiguring*** activities of the *designing and managing transformation* area, and in the ***seizing*** activities of the *fostering digital value propositions* and *systematizing structural changes* areas.

This set tends to support innovation development activities (digital *innovation management*) by promoting an agile framework. For example, as seen earlier, *the use of methodologies and/or tools to coordinate its work activities*, such as KANBAN, allows organizing the management of the flow of activities, monitoring the activities, and recording all the tasks that are being developed. It also allows to "ensure that activities will continue to occur, even if the personnel change within a team" (SysK expert), and allows a complete view of the whole and of what is being done by each employee (bringing predictability and shared knowledge). Coupled with the resultant routine from

the *adoption of sprints to execute activities and projects*, the organization tends to orient itself towards continuous development and value proposition.

Similarly, it can be seen that ***encouraging an agile structure*** tends to support activities linked to the *systematizing structural changes* - such as *agile practices orientation* and *multidisciplinary teams and flexibility*. As seen in Chapter 5, they enable a type of user-centric organization and continuous value development, which is not limited to the development of digital solutions, but equally to the managerial practices of the company. According to the expert RealG, once companies translate the pillars of agility (namely, inspection, adaptation, and transparency) into their reality, they create the conditions for an efficient arrangement that facilitates the management of activities and processes (e.g., time specifications, accountability, prioritization), drives the execution of projects and activities, and anchors the importance of change. This is opposed to a bureaucratic or command-and-control logic, as seen in Chapter 5 (where people in management/leadership positions are convinced that they can and should control everything), and creates the conditions for a more fluid organization based on trust and the work to be done.

Finally, it is possible to highlight that *designing and managing transformation* area will be equally influenced by this antecedent factor - in the concerns of the *transformation planning* elaboration and the *transformation promotion*. Firstly, a company with the ability to organize its design by projects (an essential aspect of an agile framework) tends to have an easier time when designing the transformation planning (via, for example, the activities of *development of an implementation roadmap* and *establishing objectives and metrics*). Secondly, among the benefits contributed by organizational dynamics based on *systematic communication routines (ceremonies and meetings)* of the SCRUM approach, it is expected that companies will also find it easier to promote internally the efforts undertaken in the transformation process. Inspired by chapter 5, for example, the interviewees consider the daily meeting an evangelization mechanism. The expert RealG organized in his company daily thirty-minute meetings with all employees in which, before the beginning, he reminded them of the importance of DT and why it was necessary. Finally, by creating the conditions to have a company that communicates systematically, it is possible to verify that activities, such as opportunity assessment, should also benefit greatly (*digital opportunity evaluation*).

Setting a cultural alignment. As seen in Chapter 5, *setting a cultural alignment* has significant importance in organizational redefinition, and it is reasonable to expect its adherence to the ***sensing*** activities in *designing and managing transformation* and the ***reconfiguring*** activities of the *systematizing structural changes*.

First, it seems crucial that in order to compose the *definition of the transformation strategy*, the organization relies on the existence of *transformation purpose and cultural values*. According to Verdu-Jover, Alos-Simo, and Gomez-Gras (2018), organizations that have internalized the need to reconsider internal values tend to be more comfortable achieving change. Hence, by having established a cultural alignment that unfolds in the "existence of transformation purpose and cultural values," an organization can more easily envision its direction to success in the DT through a common language, and the creation of a sense of unity that contributes to decision making, trust building, and sense of belonging (LingH expert).

Furthermore, an organization that has a *definition of competencies and responsibilities of positions and roles* and maintains a *dismissal and hiring process driven by cultural principles and values* will be able to enable the required means to overcome some of the potential obstacles related to *employee structure modification* activities, as well as *knowledge and competence improvement*. In this sense, for example, the "definition of competencies and responsibilities of positions and roles" is a robust mechanism for alignment and implementation of change and has the potential to impact *employee structure modification* through the possibility to (i) balance team formations, (ii) identify the skills needed for a given position/function, and (iii) favor competency-driven employee promotion (PubA, RealB and SysJ experts). In another way, it also assists the *knowledge and competence improvement* as it supports the development of change-oriented training programs by involving employees in a continuous process of small changes (LingH expert). Moreover, this practice makes it possible to manage the performance based on each employee's goals and responsibilities, which has dual consequences: (i) internalizing the purpose and cultural values and guidelines because they can be deployed as responsibilities and can be monitored; and (ii) increasing employee and team autonomy based on an explicit statement of responsibilities.

On *dismissal and hiring process driven by cultural principles and values*, it can be seen that employee structure modification activities are widely supported as it allows the organization to deal with challenges such as resistance and boycotts to change efforts. As indicated in the literature (e.g., Caputo et al. 2021; Chirumalla 2021; Vial 2019), inertia and resistance are the most significant barriers to DT. Therefore, according to the expert RealG, "if the organization is confident in its purpose and values," employee structure modifications end up being facilitated, as this brings more certainty about what is expected from new positions and roles, aiding in the on-boarding of new employees and *off-boarding of people misaligned*. Likewise, *knowledge and competence improvement* is facilitated because the knowledge and clarity about what skills are being sought facilitate the hiring of people who share the same values (consultant ConsL).

Leading the transformation. Finally, there is the factor that holds the potential to impact various activities and maintain an organization's ability to change. Practically all of the thematic areas of the framework have some kind of potential association with *leading the transformation*.

Regarding, for example, *designing and managing transformation*, as seen earlier, digital transformation starts with a purpose. Still, it will only happen when top management and leaders understand why the organization has to transform (experts RealB, RealG, and RealI, Imgrund et al. 2018; Arkhipova and Vaia 2019; and Singh et al. 2019). Thus, it can be seen that *leadership awareness of the organization's DT purpose* and *willingness to pivot and modify the current business* tend to pave the organization's course and significantly influence sensing activities that concern transformation planning and ***reconfiguring*** regarding transformation management and promotion. Furthermore, it can be inferred that activities to promote the transformation tend to be favored by a *leadership involved in daily activities and that influence employees through example*. The understanding and internalization of the DT strategy in the culture cannot depend only on discourse, and the leader needs to 'walk the talk': disseminate it throughout the company, motivate employees, integrate and coordinate digital knowledge throughout the organization - which agrees with Matarazzo et al. (2021). The daily operational activities produce a force against any transformation because it consumes the employees' time. So the leader needs to be obstinate and

evangelize the employees daily, continuously communicating the reason for the transformation (experts EntF, RealG, and RealI).

However, as discussed earlier, one must consider the possible dual influence of leadership. According to Weber et al. (2022), it can intimidate employees with high levels of uncertainty due to an organization's DT, which could turn into resistance to change. The results in Chapter 5 confirm this possibility, where leadership was found to play a significant and positive role in helping to promote and maintain some of the factors while having a negative influence on *promoting an innovation culture* (possibly due to overconfident and overly supportive behavior). Thus, we confirm Elbanna and Newman (2022) regarding a dialectical relationship linked to top management support in DT, which has implications for *fostering digital value propositions*. Leadership is expected to recognize and promote innovation development activities in the organization, implying both internal efforts and *business model reconfiguration/digitalization* and *digital innovation management*. However, one must be aware of the negative consequences linked to excessive leadership behavior.

Similarly, *leading the transformation* tends to strongly influence the area *acting in digital business ecosystems*. For example, it involves being aware of what is happening in the market, seeking knowledge to understand the benefits of transformation, and bringing innovation to the company through the use of new digital technologies. Thus, it is expected that ideas associated with acting in ecosystems through *external exploration* and establishing *significant collaborations and partnerships* will gain space and recognition within the organization.

Finally, it can be seen that the performance of transformation-oriented leadership will facilitate the conditions for the *systematizing structural changes*. Specifically, it will impact ***seizing*** routines to elaborate different organizational forms (agile and flexible structure) and ***reconfiguring*** routines to consolidate the *employee structure modification* and in the *knowledge and competence improvement* process.

6.3 Developing Strategies

Finally, the overall appreciation of the results (Figure 6.1) has practical implications that can significantly impact the organizational and ecosystem levels. Among the practical implications of the findings of the previous chapters are the orientation of corporate strategies and the establishment and creation of public policies for the development of sectors and ecosystems. This is based on the digital scalability of companies.

Since the results obtained in this thesis are grounded on the concept of digital maturity, they are not intended to be definitive but rather to help establish the conditions under which the transformation process takes place. Moreover, the format of how the organization will confront the challenge of digitally transforming or scaling its digital maturity can be established in countless ways, varying according to its objectives and imperative contingency issues. As seen in Verhoef et al. (2021), a company may, for example, explore strategic directions that vary with product or service proposition or with market and industries. However, according to the previous chapters, faced with the need to transform in a digital context, firms will need specific capabilities and meta-capabilities that allow them to mature and thrive regardless of strategy. Thus, understanding the

Digital Transformation Dynamic Capability framework and its antecedents in conjunction with the maturity instrument can serve as guides for designing effective strategic efforts.

Such elaboration can be considered according to different (i) interests and (ii) scope dimensions. Regarding the interests, it is noted that the present results can serve to (i) inform about and verify the capabilities, as well as (ii) diagnostic tool of the companies. In relation to the dimensions of scope, it can be seen, for example, that the use of the instrument developed to evaluate the digital maturity of capabilities can be used to evaluate (i) one of the five areas of activity of an organization, (ii) an organization considering the five areas, and (iii) an ecosystem of organizations. Its use presents flexibility to support such interests and dimensions and, knowing that the level of digital maturity and misinformation in Brazilian companies is significant (Cazeri et al. 2021), the models of this thesis represent a powerful mechanism to support the development of knowledge and capabilities in the national scenario within organizations and in public policies for ecosystem development.

6.4 Conclusion

We conclude this thesis by praising a scientific journey that evolved as its object of study, the digital transformation phenomenon, also evolved and grew. By way of example, at the beginning of this thesis, in 2018, there was still a lack of articles with a precise definition of the topic (an issue addressed in chapter 2). Hence, in a preliminary version of chapter 3, the first systematic review covered more than 70 articles because, in order to increase knowledge on the topic, it also encompassed materials published in event proceedings. As time passed, which included the extraordinary event of the pandemic caused by the outbreak of COVID-19, the research around the theme evolved enormously, which allowed extensively initial ambiguity related to the phenomenon to be framed, but also required significant efforts to keep the thesis up to date. From this perspective, the findings of this thesis are part of a complex context and add to a substantial corpus of knowledge production with potential courses of an empirical impact.

Finally, it is emphasized that robust and varied research methods were employed to ensure results adherent to such a context. The research efforts of the thesis are qualitative (theoretical and exploratory) and quantitative (EFA and SEM), resulting in theoretical and practical implications that can be extrapolated (in the context of SMEs) and that ensure significant opportunities for future work indicated in the chapter.

Appendix 6

Table 6.3 - Relations between factors and patterns divided by thematic areas

				INN					DIGE					EXP					AGL			CULT			LEAD			
Thematic Area	DC	Micro-foundations	Categories	INN1	INN2	INN3	INN4	INN5	DIGE1	DIGE2	DIGE3	DIGE4	DIGE5	EXP1	EXP2	EXP3	EXP4	EXP5	AGL1	AGL2	AGL3	CULT1	CULT2	CULT3	LEAD1	LEAD2	LEAD3	LEAD4
Acting in digital business ecosystems	Sensing	External exploration	Competition monitoring		x																				x	x		
			Interactions with ecosystem players	x	x				x		x														x	x		
			Partnership searching	x	x				x			x													x	x		
	Seizing	Ecosystem exploitation	Management of the ecosystem	x					x																	x	x	
			Integration of processes/systems with external partners								x															x	x	
			Exploitation of the ecosystem capabilities				x		x		x															x	x	
		Significant collaborations and partnerships	Establishment of collaboration and open innovation											x											x		x	
			Incorporation/incubation of digital business																						x		x	
Designing and managing transformation	Sensing	Transformation planning	Analysis of challenges and risks																							x		
			Analysis of growth possibilities																							x		
			Comprehension of digital transformation																		x					x		
			Development of an implementation roadmap																x	x						x		
			Establishing objectives and metrics																x	x						x		
			Definition of the transformation strategy																					x		x		
	Reconfiguring	Learning and Knowledge Management	Data management																									
			IT Security																									
			Knowledge management																									
		Transformation management	Pacing the transformation							x																x	x	
			Management of performance capacity	x																						x	x	
			Data-driven decision										x													x	x	
			Follow-up and review/adjustment of the transformation strategy							x				x											x	x	x	
		Transformation promotion	Continuous follow-up alignment							x											x				x	x	x	x
			Employees involvement											x	x		x	x			x				x	x	x	x
			Market communication																								x	x
Fostering digital value propositions	Sensing	Digital opportunity evaluation	Digital assertiveness						x			x	x															
			Financial analysis of digital opportunities										x															
			Regular meetings for opportunity analysis and alignment													x					x							x
			Analysis and refinement of digital opportunities						x			x	x								x							
		Digital opportunity scanning	Continuous collection of customer feedback and evaluation		x									x		x									x			
			Analysis of customers' value/needs	x	x											x									x			
			Exploration and analysis of data	x	x				x	x		x				x									x			
			Internal sensing	x	x				x					x											x			
			Exploration of technological trends	x	x				x			x													x			
	Seizing	Business Model reconfiguration/ digitalization	Data acquisition						x		x	x	x												x		x	
			Process and operation automation/digitalization						x		x	x	x												x		x	
			Smart and autonomous processes						x		x	x	x												x		x	
			Data storage in the cloud						x		x	x	x												x		x	
		Digital innovation management	Fostering digital innovation	x					x					x	x	x	x		x	x					x		x	
			Development of MVP and tests	x					x				x	x	x	x	x		x	x					x		x	
			Development of individualized and segmented solutions	x					x				x	x	x	x	x		x	x					x		x	
			Development/improvement of digital solutions	x					x				x	x	x	x	x		x	x					x		x	
			Development of hybridized solutions (digital + physical)	x					x				x	x	x	x	x		x	x					x		x	

			Usage of a digital innovation lab	x					x				x	x	x	x	x		x	x					x		x	
Systematizing structural changes	Seizing	Agile practices orientation	Exploration of agile practices in business	x		x	x	x		x								x	x	x	x	x				x			
			Exploration of agile practices in tech projects	x		x	x	x		x								x	x	x	x	x				x			
		Multidisciplinary teams and flexibility	Promotion of flexibility and autonomy in work	x		x	x	x		x				x	x			x	x	x	x					x			
			Support multidisciplinary teams	x		x	x	x		x				x	x			x	x	x	x					x			
	Reconfiguring	Employee structure modification	Offboarding of people misaligned with the company's					x															x	x		x		x	
			Incorporation of new roles and functions					x						x									x	x		x		x	
			Redefinition of roles and positions					x															x	x		x		x	
		Knowledge and competence improvement	Recruitment of/access to product and design																				x	x		x			
			Recruitment of/access to digital knowledge																				x	x		x			
			Recruitment of/access to strategic knowledge																				x	x		x			
			Leveraging digital and product/service design										x											x		x			
		Organizational structure redesign	Change of the organizational structure					x																		x		x	
			Systematic structure reviews					x																		x		x	

Source: elaborated by the author. For the sake of formatting, the cultural, organizational, and leadership factors in Chapter 5 have been abbreviated. Thus, they follow the codes elaborated in auxiliary table 6.5

Table 6.4 - Relations between factors and split patterns in the mechanisms of DC

			INN					DIGE					EXP					AGL			CULT			LEAD			
DC	Micro-foundations patterns	Categories	INN1	INN2	INN3	INN4	INN5	DIGE1	DIGE2	DIGE3	DIGE4	DIGE5	EXP1	EXP2	EXP3	EXP4	EXP5	AGL1	AGL2	AGL3	CULT 1	CULT 2	CULT 3	LEAD 1	LEAD 2	LEAD 3	LEAD 4
Sensing	Digital opportunity scanning	Continuous collection of customer feedback and evidence		x									x		x									x			
		Analysis of customers' value/needs	x	x											x									x			
		Exploration and analysis of data	x	x				x	x		x				x									x			
		Internal sensing	x	x				x					x											x			
		Exploration of technological trends	x	x				x			x													x			
	External exploration	Competition monitoring		x																				x	x		
		Interactions with ecosystem players	x	x				x		x														x	x		
		Partnership searching	x	x				x			x													x	x		
	Digital opportunity evaluation	Digital assertiveness						x			x	x															
		Financial analysis of digital opportunities										x															
		Regular meetings for opportunity analysis and alignment													x					x							x
		Analysis and refinement of digital opportunities						x			x	x								x							
	Transformation planning	Analysis of challenges and risks																							x		
		Analysis of growth possibilities																							x		
		Comprehension of digital transformation																		x					x		
		Development of an implementation roadmap																x	x						x		
		Establishing objectives and metrics																x	x						x		
		Definition of the transformation strategy																					x		x		
	Agile practices orientation	Exploration of agile practices in business management	x		x	x	x		x							x	x	x	x	x				x			
		Exploration of agile practices in tech projects	x		x	x	x		x							x	x	x	x	x				x			
	Multidisciplinary teams and flexibility	Promotion of flexibility and autonomy in work	x		x	x	x		x				x	x		x	x	x	x					x			
		Support multidisciplinary teams	x		x	x	x		x				x	x		x	x	x	x					x			
	Significant collaborations and	Establishment of collaboration and open innovation											x											x		x	

	collaborations and partnerships	Incorporation/incubation of digital business																					x		x	
Seizing	Ecosystem exploitation	Management of the ecosystem	x					x																x	x	
		Integration of processes/systems with external partners							x															x	x	
		Exploitation of the ecosystem capabilities				x		x		x														x	x	
	Digital innovation management	Fostering digital innovation	x					x				x	x	x	x		x	x					x		x	
		Development of MVP and tests	x					x			x	x	x	x	x		x	x					x		x	
		Development of individualized and segmented solutions	x					x			x	x	x	x	x		x	x					x		x	
		Development/improvement of digital solutions	x					x			x	x	x	x	x		x	x					x		x	
		Development of hybridized solutions (digital + physical)	x					x			x	x	x	x	x		x	x					x		x	
		Usage of a digital innovation lab	x					x			x	x	x	x	x		x	x					x		x	
	Business Model reconfiguration/ digitalization	Data acquisition						x		x	x	x												x		x	
		Process and operation automation/digitalization						x		x	x	x												x		x	
		Smart and autonomous processes						x		x	x	x												x		x	
		Data storage in the cloud						x		x	x	x												x		x	
Reconfiguring	Employee structure modification	Offboarding of people misaligned with the company's purpose					x														x	x		x		x	
		Incorporation of new roles and functions					x					x									x	x		x		x	
		Redefinition of roles and positions					x														x	x		x		x	
	Knowledge and competence improvement	Recruitment of/access to product and design competence																			x	x		x			
		Recruitment of/access to digital knowledge																			x	x		x			
		Recruitment of/access to strategic knowledge																			x	x		x			
		Leveraging digital and product/service design competence									x											x		x			
	Learning and Knowledge Management	Data management																									
		IT Security																									
		Knowledge management																									
	Organizational structure redesign	Change of the organizational structure					x																	x		x	
		Systematic structure reviews					x																	x		x	
	Transformation promotion	Continuous follow-up alignment						x											x					x	x	x	x
		Employees involvement										X	x		x	x			x					x	x	x	x
		Market communication																								x	x
	Transformation management	Pacing the transformation						x																	x	x	
		Management of performance capacity	x																						x	x	
		Data-driven decision									x														x	x	
		Follow-up and review/adjustment of the transformation strategy						x				x												x	x	x	

Source: elaborated by the author. For the sake of formatting, the cultural, organizational, and leadership factors in Chapter 5 have been abbreviated. Thus, they follow the codes elaborated in auxiliary table 6.5

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