Operationalizing Digital Transformation: A Capability-Based Maturity Model

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Abstract: Digital transformation (DT) has become a strategic imperative for organizations navigating an era of rapid technological advancements. It deeply requires the development of capabilities that enable firms to continuously sense, seize, and reconfigure resources to sustain competitive advantage. However, despite this need, existing maturity models primarily focus on technological dimensions, often overlooking the organizational capabilities required for a systematic and effective transformation. This study addresses this shortcoming by proposing a capability-based maturity model that extends the Digital Transformation Dynamic Capability framework developed by Leso et al. (2023), operationalizing its thematic areas (designing and managing transformation, fostering digital value propositions, engaging in digital business ecosystems, systematizing structural changes, and leveraging enablers) into a structured assessment tool. By integrating dynamic capabilities theory with a maturity perspective, this model provides a comprehensive framework to evaluate an organization's ability to undergo and sustain DT. To test the model, we conducted expert content validation and empirical testing with 43 Italian companies embedded in a digital innovation ecosystem. The results indicate that while organizations exhibit moderate to high maturity in areas such as digital innovation management and technological infrastructure, they face challenges in transformation planning and business model adaptation. These findings underscore the necessity of a strategic and capability-oriented approach to digital maturity, moving beyond a purely technological focus. By providing an actionable framework, this research equips organizations with a strategic roadmap to enhance their digital capabilities, ensuring adaptability in an increasingly complex and evolving digital landscape

Keywords: Digital Transformation, Capability Maturity Model, Dynamic Capabilities, Organizational Adaptability

1. Introduction

Technological change disrupts industries and creates new business models in today's dynamic digital economy. Digital transformation (DT) is widely recognised as a critical factor for sustaining organisational competitiveness amid accelerating technological advancements and evolving consumer expectations (Verhoef et al., 2021). However, beyond its technological dimension, DT requires strategic renewal and organisational adaptability, involving changes in processes, structures, cultural paradigms, and mobilization of intangible assets (Gong and Ribiere, 2020; Warner and Wäger, 2019; Bharadwaj 2000).

Despite its strategic importance, organisations face considerable challenges when implementing DT initiatives, such as resistance to adoption, lack of digital skills among employees, and difficulties in aligning digital strategies with a rapidly evolving market (Chirumalla, 2021; Leso et al., 2022; Vasconcellos et al., 2022). Moreover, the complexity of DT calls for higher-order capabilities that support continuous adaptation in dynamic and uncertain environments. In this context, the dynamic capabilities (DC) perspective presents a valuable lens through which to understand the capabilities required for DT at the firm level (Teece, 2007; Vial, 2019). However, existing research suggests that such capabilities remain underexplored, particularly regarding how organisations can develop and operationalise them (Leso et al., 2023).

To address these challenges, maturity models have been widely used to assess progress, identify gaps, and prioritise strategic actions in DT (De Bruin et al., 2005). However, many of the DT models focus heavily on technological dimensions or are constrained to specific sectors, lacking the flexibility to address the broader

organisational implications of DT (Lin et al., 2020). This study advances the field by proposing a capability-oriented approach grounded in the Digital Transformation Dynamic Capability (DTDC) framework (Leso et al., 2023). The DTDC integrates a maturity-based assessment with the DC lens, identifying five thematic areas encapsulating microfoundations of sensing, seizing, and reconfiguring capabilities (see Table 1). It provides a structured yet adaptable foundation for understanding and managing DT at the organisational level.

Influenced by prior studies (e.g., Schumacher et al., 2019; North et al., 2020), the present research operationalises the DTDC into a robust and practical assessment tool designed for empirical application. This instrument aims to support strategic planning and capability development by offering organisations actionable and capability-oriented insights that bridge diagnostic evaluation and transformation strategy, beyond the limitations of technology or sector-specific models.

The proposed model was empirically tested in 43 Italian companies operating within a digital innovation ecosystem, demonstrating its relevance and applicability across varied organisational environments. This work contributes to both theory and practice by advancing the understanding of DC in DT and offering a validated instrument for capability assessment. It underscores the value of a structured yet adaptable approach to managing transformation, enabling organisations to align cultural, structural, and strategic elements with the demands of the digital age.

2. Digital Maturity Model

DT represents a significant organizational challenge, requiring continuous and systematic analysis of a company's positioning relative to digital competencies and resources. However, traditional approaches often fail to capture the complexity of this evolution, highlighting the need for sophisticated maturity models capable of continuously measuring and improving digital capabilities. In this sense, present research addresses this challenge by developing and testing a comprehensive digital maturity model through an iterative process based on the design research approach (Hevner et al. 2004). This methodology facilitated the creation of a flexible instrument capable of capturing the dynamic evolution of organizational capabilities in response to digital demands.

Starting from the DTDC framework configuration, the maturity model is strategically structured around five thematic action areas and employs DTDC's microfoundation patterns as core dimensional indicators. Through incremental maturity level assessments, it captures the complex, dynamic nature of organizational digital evolution, operationalizing dimensions into 23 evaluation items based on microfoundations representing the organizational capabilities (Table 1).

After the model was refined through an iterative development process that ensures methodological rigor, systematic development of assessment instruments, and validation against empirical observations. Unlike simplistic linear models, this approach acknowledges the intricate and evolving nature of digital capabilities in contemporary organizations. The research integrates theoretical depth with practical applicability, offering a sophisticated instrument for understanding and navigating digital transformation. Furthermore, five general maturity levels were established, inspired by Schumacher et al. (2019) (Table 1): Level 0 indicates the organization does not have any initiative in the matter; Level 1 is characterized by planning efforts, with some familiarity and reactive initiatives; Level 2 shows understanding of the subject's importance, and some proactive (yet irregular) activities occur without defined standards or relying on specific individuals; Level 3 includes recurring initiatives with noticeable contributions to company results, though still lacking full process structuring; and Level 4 indicates a proactive, structured process with systematic recurrence and defined responsibilities, validated and integrated into organizational results.

An assessment instrument was then proposed. To this end, a questionnaire was developed whereby each item reflected one of the previously identified patterns. To ensure respondents considered the underlying categories, the description of each question included details of its component categories. To improve response agility, the personalized maturity levels were replaced with a general description of the levels and applied uniformly. Figure 1 illustrates the final version of a question.

2.1 Data Collection

The instrument was tested with organisations within the Politecnico di Milano innovation ecosystem, specifically those associated with the Digital Innovation Observatory. This initiative is a central hub for digital innovation in Italy, combining research, communication, and continuous monitoring of technological trends. From a pool of 484 companies, the sample was narrowed based on an inclusion criterion: firms needed to exhibit a minimum

level of digital maturity, defined according to Verhoef et al. (2021), to ensure alignment with strategic use and management of digital resources.

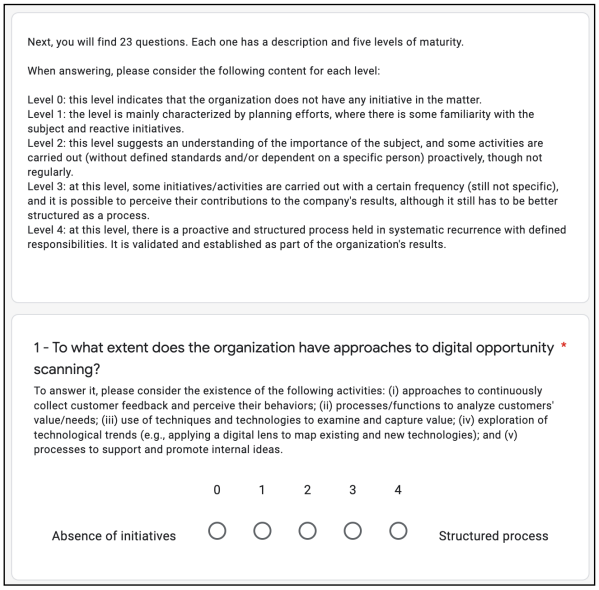
Table 1: Dimensions and evaluation items

Area	Dimensions (*Pattern*)	Items
Fostering digital value propositions	Digital opportunity scanning	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	Analysis and refinement of digital opportunities; Digital assertiveness; Financial analysis of digital opportunities; Regular meetings for opportunity analysis and alignment
	Digital innovation management	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	Data acquisition; Data storage in the cloud; Process and operation automation/digitalization; Smart and autonomous processes
Designing and managing transformation	Transformation planning	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	Follow-up and review/adjustment of the transformation strategy; Management of performance capacity; Pacing the transformation; Data-driven decision
	Transformation promotion	Continuous follow-up alignment; Employees involvement; Market communication
	Knowledge and Learning Management	Data management; IT Security; Knowledge management
Acting in digital business ecosystems	External exploration	Competition monitoring; Interactions with ecosystem players; Partnership searching
	Ecosystem exploitation	Exploitation of the ecosystem capabilities; Integration of processes/systems with partners; Management of the ecosystem
	Significant collaborations and partnership	Establishment of collaboration and open innovation; Incorporation/incubation of digital businesses
Systematizing structural changes	Agile practices orientation	Exploration of agile practices in digital business management; Exploration of agile practices in tech projects
	Multidisciplinary teams and flexibility	Promotion of flexibility and autonomy in work; Support multidisciplinary teams
	Employee structure modification	Incorporation of new roles and functions; Redefinition of roles and positions; Offboarding of people misaligned with the company's purpose
	Knowledge and competence improvement	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	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

Area	Dimensions (*Pattern*)	Items
	Technological infrastructure	Data storage and processing; Hardware and devices; Information System
	Organizational management	Monitoring performance indicators; Organizational knowledge; Organizational management
	Process and operations mgmt	Data integration capability; Process and operation warranty; Process management

Source: Leso et al. (2023)

The questionnaire was administered in English between May and July 2022. It was designed to be completed anonymously by C-level executives or managers with sufficient knowledge of their firm's DT efforts.


Next, you will find 23 questions. Each one has a description and five levels of maturity.

When answering, please consider the following content for each level:

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.

1 - To what extent does the organization have approaches to digital opportunity scanning? *

To answer it, please consider the existence of the following activities: (i) approaches to continuously collect customer feedback and perceive their behaviors; (ii) processes/functions to analyze customers' value/needs; (iii) use of techniques and technologies to examine and capture value; (iv) exploration of technological trends (e.g., applying a digital lens to map existing and new technologies); and (v) processes to support and promote internal ideas.

0 1 2 3 4

Absence of initiatives ○ ○ ○ ○ ○ Structured process

Figure 1: example of the data collection instrument. Source: elaborated by the author

2.2 Data Analysis

Data analysis was conducted using the Statistical Package for Social Sciences version 18. Organizations were segmented by size, and a descriptive analysis of the maturity of the 23 dimensions was performed. Additionally, the incidence of maturity levels across the 23 dimensions was analyzed, grouped by thematic area.

3. Results

A sample of 43 valid responses were obtained, representing 8.88% of the potential sample. According to Hill (1998), samples ranging from 10 to 30 are considered adequate for pilot studies, validating the sufficiency of the sample for analyzing results, even if not for statistical extrapolations or generalizations. The results were analyzed through segmentation based on two criteria: (i) company size (SMEs and large enterprises) and (ii) industry sector (service and product). In terms of company size, companies with 1 to 50 employees accounting for 39.5% of the respondents (n = 17). Medium-sized companies (51 to 250) constituted 25.6% (n = 11), while large companies (more than 250) comprised 34.9% of the sample (n = 15). The subsequent analyses consider only two size categories: SMEs (companies with up to 250 employees, 28 firms) and large enterprises (companies with more than 250 employees, 15 firms) (European Commission, 2003).

The pilot application yielded valuable insights into the levels of digital maturity achieved by the organizations. The most prominent areas included “Fostering Digital Value Propositions” and “Technological Infrastructure,” with high maturity levels in “Digital Innovation Management” (mean: 2.93). Conversely, areas related to “Ecosystem Exploitation” and “Employee Structure Modification” showed lower maturity levels in most companies, highlighting cultural and structural challenges.

Table 2: Organizations sector

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%	
Product	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%	

3.1 Maturity Level of the Dimensions

Regarding the dimensions' standard deviation, no dimension achieved an average above maturity level 3 in the overall analysis. However, some dimensions approached level 3. For instance, "Digital Innovation Management" (mean: 2.930, SD: 1.033), "Digital Opportunity Scanning" (mean: 2.907, SD: 0.971), and "Technological Infrastructure" (mean: 2.907, SD: 1.109) were notably high. Conversely, no dimensions fell below level 2, although some were close to level 1, such as "Employee Structure Modification" (mean: 2.140, SD: 1.355), "Ecosystem Exploitation" (mean: 2.163, SD: 1.174), and "Transformation Management" (mean: 2.209, SD: 1.264).

Analyzing the segmented data, the positive highlights mirrored the general behavior. Dimensions linked to "Fostering Digital Value Propositions" remained near level 3. "Technological Infrastructure" was also significant, particularly in the large enterprises segment (mean: 3.2, SD: 1.014) and the product segment (mean: 3.053, SD: 1.026). In SMEs and the service sector, "Technological Infrastructure" averaged close to level 3 (mean: 2.750, SD: 1.143) but was surpassed by the "Organizational Culture" dimension (mean: 2.857, SD: 0.970).

Dimensions with lower maturity levels revealed patterns consistent with the overall average but with notable differences. For example, "Employee Structure Modification" showed level 1 in large companies (mean: 1.667, SD: 1.047) and was nearly unanimous as one of the lowest. However, in SMEs, while the dimension approached level 1 (mean: 2.393, SDD: 1.449), it was surpassed by "Agile Practices Orientation" (mean: 2.250, SD: 1.669), "Process and Operations Management" (mean: 2.286, SD: 1.213), and "Ecosystem Exploitation" (mean: 2.214, SD: 1.258).

3.2 Incidence of Maturity Levels According to Thematic Areas

Regarding the thematic areas, Tables 3 to 6 provide the distribution of companies across maturity levels for each dimension. In the "Fostering Digital Value Propositions" area (Table 3), more than 50% of companies reached maturity levels above 3 in all four dimensions. "Digital Innovation Management" stood out, with 34.15% of companies achieving level 4. Additionally, there was strong coherence across the dimensions "Digital Opportunity Scanning," "Digital Opportunity Evaluation," and "Digital Innovation Management," which predominantly reached level 3. Notably, large companies and service companies demonstrated a significant

incidence of level 4 in "Digital Innovation Management," while product companies exhibited consistent maturity at level 3.

Table 3: Fostering digital value propositions

Maturity Level	Digital op. Scanning	Digital op. Evaluation	Digital Innovation Mgmt	BM Reconfiguration/ Digitalization
General				
0	2,33%	0,00%	0,00%	0,00%
1	6,98%	18,60%	13,95%	9,30%
2	16,28%	18,60%	13,95%	**32,56%**
3	**46,51%**	**44,19%**	**37,21%**	**34,88%**
4	27,91%	18,60%	34,88%	23,26%
SMEs				
0	3,57%	0,00%	0,00%	0,00%
1	3,57%	10,71%	14,29%	7,14%
2	21,43%	25,00%	10,71%	**35,71%**
3	**39,29%**	**39,29%**	**42,86%**	35,71%
4	32,14%	25,00%	32,14%	21,43%
Large				
0	0,00%	0,00%	0,00%	0,00%
1	13,33%	33,33%	13,33%	13,33%
2	6,67%	6,67%	20,00%	26,67%
3	**60%**	**53,33%**	26,67%	**33,33%**
4	20,00%	6,67%	**40%**	26,67%

In general, it is possible to indicate that companies manifest proactive efforts to generate digital innovations - which is an expected result, taking into account the nature of the sample. 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.

In the "Designing and Managing Transformation" area (Table 4), not all dimensions exceeded 50% maturity at levels 3 or 4. For instance, "Transformation Management" had a significant portion of companies at level 1, influenced largely by SMEs (where level 1 accounted for one-third of the 27 companies). However, "Transformation Promotion" showed high maturity, particularly among service companies (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: Designing and managing transformation

Maturity Level	Transf. Planning	Transf. Management	Transf. Promotion	Knowledge and Learning Management
General				
0	4,65%	9,30%	2,33%	6,98%
1	13,95%	25,58%	20,93%	13,95%

Maturity Level	Transf. Planning	Transf. Management	Transf. Promotion	Knowledge and Learning Management
2	23,26%	16,28%	18,60%	23,26%
3	**37,21%**	**32,56%**	**32,56%**	**30,23%**
4	20,93%	16,28%	25,58%	25,58%
SMEs				
0	3,57%	7,14%	0,00%	7,14%
1	17,86%	**32,14%**	21,43%	17,86%
2	21,43%	7,14%	21,43%	**25,00%**
3	**35,71%**	32,14%	**32,14%**	**25,00%**
4	21,43%	21,43%	25,00%	25,00%
Large				
0	6,67%	13,33%	6,67%	6,67%
1	6,67%	13,33%	20,00%	6,67%
2	26,67%	**33,33%**	13,33%	20,00%
3	**40,00%**	**33,33%**	**33,33%**	**40,00%**
4	20,00%	6,67%	26,67%	26,67%

The area of "Acting in digital business ecosystems" (Table 5) has one of the dimensions with the lowest average - Ecosystem exploitation, which is reflected in the incidence of responses regarding the maturity levels indicated by companies: 39.53% of companies indicated level 2.

Table 5: Acting in digital business ecosystems

Maturity Level	External Exploration	Ecosystem Exploitation	Significant Collaborations and Partnership
General			
0	9,30%	9,30%	6,98%
1	11,63%	16,28%	9,30%
2	30,23%	**39,53%**	**30,23%**
3	**32,56%**	18,60%	**30,23%**
4	16,28%	16,28%	23,26%
SMEs			
0	10,71%	10,71%	7,14%
1	14,29%	17,86%	10,71%
2	25,00%	**28,57%**	25,00%
3	**35,71%**	25,00%	**32,14%**
4	14,29%	17,86%	25,00%
Large			
0	6,67%	6,67%	6,67%
1	6,67%	13,33%	6,67%

Maturity Level	External Exploration	Ecosystem Exploitation	Significant Collaborations and Partnership
2	**40,00%**	**60,00%**	**40,00%**
3	26,67%	6,67%	26,67%
4	20,00%	13,33%	20,00%

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 conquered for greater use of the capabilities that exist within the ecosystem.

The results of the "Systematizing structural changes" area (Table 6) 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, about 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.

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 6: Systematizing structural changes

Maturity Level	Agile Practices Orientation	Multidisciplinary Teams and Flexibility	Employee Structure Modification	Knowledge and Competence Improvement	Organizational Structure Redesign
General					
0	20,93%	2,33%	13,95%	4,65%	6,98%
1	11,63%	18,60%	18,60%	13,95%	18,60%
2	11,63%	16,28%	**30,23%**	25,58%	25,58%
3	**32,56%**	25,58%	13,95%	**37,21%**	**32,56%**
4	23,26%	**37,21%**	23,26%	18,60%	16,28%
SMEs					
0	25,00%	0,00%	14,29%	7,14%	7,14%
1	14,29%	21,43%	14,29%	10,71%	17,86%
2	7,14%	21,43%	21,43%	25,00%	17,86%
3	17,86%	10,71%	17,86%	**32,14%**	**39,29%**
4	**35,71%**	**46,43%**	**32,14%**	25,00%	17,86%

Maturity Level	Agile Practices Orientation	Multidisciplinary Teams and Flexibility	Employee Structure Modification	Knowledge and Competence Improvement	Organizational Structure Redesign
Large					
0	13,33%	6,67%	13,33%	0,00%	6,67%
1	6,67%	13,33%	26,67%	20,00%	20,00%
2	20,00%	6,67%	**46,67%**	26,67%	**40,00%**
3	**60,00%**	**53,33%**	6,67%	**46,67%**	20,00%
4	0,00%	20,00%	6,67%	6,67%	13,33%

Regarding the area of "Supporters and enablers of a DTDC", 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).

4. Discussion

Leso et al. (2023) found that existing models fail to address a maturity perspective based on companies' ability to continuously adapt their business models to remain relevant in a dynamic and ever-changing digital context. Furthermore, previous efforts to capture the capabilities required for organizational change (e.g., Warner and Wäger, 2019; Soluk and Kammerlander, 2021) often lack depth regarding the practical application of their compelling findings. At the intersection of these two gaps lies the importance of operationalizing the DTDC framework into a tangible maturity model, offering organizations a holistic tool to assess and scale their digital maturity levels. Based on the results obtained, two key areas of discussion emerge: (i) the development and test of the model as a capability-based instrument for assessing organizational maturity and (ii) its theoretical and practical implications.

First, the results, collected within a controlled scope targeting organisations affiliated with a digital innovation observatory and meeting inclusion criteria based on Verhoef et al. (2021), enabled the testing of the instrument against expected outcomes, thereby supporting its validity and contextual alignment with digitally engaged organisations. For instance, the presence of moderate to advanced maturity levels in dimensions such as "Digital Innovation Management" was anticipated and observed, reinforcing the model's empirical coherence

The pilot study's controlled scope also facilitated identifying opportunities for future applications. Theoretically, the model advances the maturity model literature by enabling the assessment of DT through a capability-based lens. While Lin et al. (2020) previously developed a capability-based framework, their findings were limited to the industrial sector. By contrast, the present study tested the model across a diverse sample of organizations from the service and product sectors, contributing to its flexibility and potential generalization. Moreover, by translating DC microfoundations into measurable maturity levels, the model refines the theoretical lens by providing empirical access to the distributed nature and uneven development of capabilities across organisations. This perspective contributes to bridging the gap between DC as an abstract construct and their concrete manifestations within the organisational routines of DT.

Compared to earlier frameworks such as Schumacher et al. (2019), the DTDC model offers advantages by exploring microfoundations (e.g., knowledge management and external exploitation), providing more granular and actionable diagnostics. Unlike North et al. (2020), which emphasizes a linear and internally focused process, the DTDC framework promotes an iterative and holistic approach, encompassing the planning and execution of digital strategies aligned with organizational objectives. Furthermore, testing the model within a diverse innovation ecosystem enhances its adaptability and relevance.

On practical implications, the model offers strategic guidance for organizations by helping them assess current capabilities and prioritize investment in transformation. For policymakers, it may inform digital development strategies, particularly in emerging economies where capability-building is a persistent challenge (Scuotto et al., 2021). As SMEs continue facing digitalization barriers, the DTDC model highlights key capability areas to foster resilience and competitiveness. Even for organisations with low digital maturity, the model can serve as a structured starting point, enabling phased improvements and prioritised capability development aligned with strategic goals. Its modular structure also allows gradual adoption, making it particularly suitable for organisations with constrained resources or limited prior experience in DT initiatives.

5. Conclusion

This study advances the DTDC framework by proposing a maturity model grounded in DC and microfoundational logic. It moves beyond linear assumptions by capturing DT's distributed and evolving nature. The model bridges theory and practice, offering diagnostic and strategic value, particularly for organisations with low capability maturity.

However, the sample, limited to Italian firms within a digital innovation observatory, may constrain generalisability due to cultural or sectoral factors. Future research should test the model across broader contexts and integrate performance-oriented indicators. Applying it in developing ecosystems or under institutional fragility may further validate its robustness. Ultimately, the model offers a flexible foundation to assess, scale, and govern digital transformation beyond technology adoption.

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Ethics Declaration

Ethical approval was not required for this study. The questionnaire used included an introductory section informing participants about the purpose of the research, assuring anonymity, and requesting their informed consent prior to participation.

AI Declaration

OpenAI's ChatGPT was used to support language refinement and word count adjustments; all content was reviewed and validated by the authors.

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