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THE INTERPLAY OF RESOURCES, DYNAMIC CAPABILITIES AND TECHNOLOGICAL UNCERTAINTY ON DIGITAL MATURITY

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Purpose: Based on the resource-based view theory, environmental uncertainty perspective, and causal complexity in firms, this study aims to identify the causal pathways of organizational resources, dynamic capabilities and technological uncertainty leading to digital transformation from a holistic perspective.
Design/methodology/approach: Considering the gap in the existing literature on the configuration of internal and external factors affecting digital transformation, this study conducts a set-theoretic analysis using fuzzy-set qualitative comparative analysis (fs/QCA). The fs/QCA focuses on the effects of causal conditions that allow for more detailed discovery and understanding of the causal mechanisms of digital transformation. Thirty-three manufacturing SMEs were selected and fs/QCA was used to explore how companies can engage resources and dynamic capabilities to achieve digital transformation in the face of a highly uncertain external environment.
Findings: As the research shows, both high and low levels of digital maturity can be achieved through various pathways of causal conditions. There is synergy between technological uncertainty and relational and portfolio technological resources or between technological uncertainty and sensing and seizing capabilities that can jointly promote digital transformation.
Research limitations/implications: The analysis is based on a limited number of cases. In order to generalize the results, a larger sample from multiple industries can be collected and analyzed, thus refining the findings and increasing the level of universality. Future research should also be extended to different levels and theoretical perspectives to analyze the different factors influencing digital transformation.
Practical implications: According to the research, managers should avoid "one size fits all" strategies and follow a pathway based on their resources and capabilities, especially dynamic to promote digital transformation or analyze environmental changes, as the digital era is inextricably linked to a high degree of technological uncertainty.
Originality/value: This research enhances understanding of the interdependence of causal conditions (i.e. organizational resources, dynamic capabilities and technological uncertainty) in established relationships with the outcome – the level of digital maturity. It also provides implications for the digital transformation of manufacturing SMEs.

Keywords: digital maturity, resources, dynamic capabilities, technological uncertainty, fs/QCA.

Category of the paper: research paper.

1. Introduction

The fourth industrial revolution, or Industry 4.0 pushed, among others, by COVID-19 and the increase in customer expectations for technological development and digital transformation, promotes business innovation, increases customer experience as well as improves performance (e.g. Ferreira et al, 2019; Martínez-Caro et al., 2020). The adaptation of enterprises to these new circumstances is critical to their survival. However, the low success rate (< 30%) of organizational transformation (e.g. La Boutetière et al., 2019) shows that there is still uncertainty about how companies can seize the opportunities of the digital transformation. An important challenge is to overcome the existing processes, routines and patterns.

We are currently witnessing an increasing proliferation of digital practices, and the emerging literature centers around the definition of digital transformation and the factors that influence its level of maturity. Digital maturity has been recognized, by both academia and industry, as the standard for assessing digital transformation performance. It is worth noting that the area of research related to digital maturity is complex and requires systematic and comprehensive research regarding the understanding of the factors involved in this process. It seems that the efforts are carried out in a narrowly focused perspective that limits the comprehensive and true interpretation of the mechanisms influencing digital transformation. Digital transformation and maturity are therefore a complex problem of systems engineering (Chen et al., 2021), for which the causal conditions can be both internal and external to enterprises. Therefore, more research is required to deepen our understanding of how interactions between internal and external factors influence the degree of digital maturity of enterprises.

In addition to internal modernization through digital technologies, companies may require external applications to overcome the limitations of time and space. The issue of leveraging existing resources and capabilities especially dynamic capabilities becomes important in this regard. Dynamic capabilities rooted in organizational routines and actions of managers and employees are well suited to explain successful digital transformation (Warner, and Wäger, 2019; Rowe et al., 2017). Companies should strive to integrate internal and external resources by constantly analyzing the external environment, balancing technology and business practices and developing their digital capabilities. Only with this approach can they achieve a high level of digital maturity and successful transformation.

Both environmental aspects and possessed organizational resources and dynamic capabilities are critical to successful digital transformation. However, these factors have rarely been considered together from a holistic perspective. Researchers relying on conventional methods tend to focus on the net effects of single factors rather than the interactions of multiple factors. To overcome these limitations, this paper employs a qualitative comparative analysis (QCA) that is appropriate for studies involving complexity and causality (Ragin, 2008; Rihoux, and Ragin, 2009; Kwiotkowska, 2018). The QCA method is focused on finding the common conditions implying the selected outcome and therefore allows discovering and understanding the causal mechanisms of digital transformation. More specifically, the method allows us to determine whether the resources and dynamic capabilities possessed, together with the technological uncertainties in the environment, are able to jointly or individually explain the results relating to the degree of digital maturity revealing the types and pathways of digital transformation.

The study was conducted among thirty-three manufacturing SMEs. QCA and more specifically fuzzy-set QCA (fs/QCA) was used to investigate how enterprises can engage resources and dynamic capabilities to achieve digital transformation in the face of a highly uncertain external environment. The following research question was posed: What are the possible combinations of factors that generate high and low levels of digital maturity? The research analyzed the combined impact of technological uncertainty, organizational resources and dynamic capabilities on the digital transformation of enterprises, and identified multiple pathways through which such effects are realized.

This study offers several contributions to the literature. First, the study proposes a framework for understanding the configurations of factors influencing different levels of digital maturity. The framework takes into account organizational resources, dynamic capabilities and environmental features – technological uncertainty, while analyzing the complex dynamics of these determinants. Second, the study reveals many equifinal pathways to high and low digital maturity, rather than the single best solution offered in most studies in the literature to date. The study provides a better understanding of the interdependence of causal conditions in established relationships with the studied outcome.

Following the aims of the research, the paper is structured as follows. Section 2 ("Literature review") presents and discusses the conceptual background of digital transformation, organizational resources, dynamic capabilities, environmental determinants and the interactions of these concepts. In Section 3 (“Data and method”) the research design is described, along with data and method. The main empirical results are displayed in Section 4 (“Results”). Section 5 ("Discussion and conclusions") discusses the research findings, their theoretical and practical implications, and conclusions, limitations, and tracing future research paths.

2. Literature review

Digital transformation is an interesting research area both from the perspective of theory and business practice. The literature offers a variety of definitions of digital transformation analyzing the phenomenon at the social (Kaplan, and Haenlein, 2019), meso (Gurbaxani, and Dunkle, 2019), and enterprise levels (Guinan et al., 2019). In the definition provided by

Vial (2019), digital transformation is described as a process that aims to improve an individual by inducing significant changes in its properties through a combination of information, computing, communication and connectivity technologies. Warner and Wäger (2019) indicate that digital transformation refers to the process of leveraging new digital technologies such as cloud technology, blockchain, mobile Internet, artificial intelligence and Internet of Things and is used to expand business opportunities, improve customer experience, streamline operational processes and develop innovative business models.

Importantly, research conducted in this area has contributed significantly to a better understanding of specific aspects of the digital transformation phenomenon. It has been found that technology itself is only part of the complex puzzle that needs to be solved for organizations to remain competitive in the digital world. Strategy (Bharadwaj et al., 2013) and changes in the organization including its structure (Selander, and Jarvenpaa, 2016), processes (Carlo et al., 2012) and culture (Karimi, and Walter, 2015) are required to ensure the ability to generate new value creation pathways (Svahn et al., 2017).

Research conducted at the organizational level mostly focuses on assessing the leading drivers of digital transformation and refers to digital culture (Martínez-Caro et al., 2020), digital skills (Kane et al., 2015), or the digital leadership model (Kwiotkowska et al., 2021; Jackson, and Dunn-Jensen, 2021), among others. It should also be noted that in addition to internal factors, external conditions are also very important for the adoption of digital transformation solutions. Changes in the external environment especially random events or technological uncertainty relating to the unpredictability of technological change have been identified as major drivers of digital transformation. In fact, internal change mechanism in the aspect of process reengineering based on the integration of resources and capabilities especially dynamic ones support digital transformation (Warner, Wäger, 2019; Amit, and Han, 2017). Thus, external – environmental factors and internal – organizational factors driving digital transformation are combined providing an important direction for further research.

According to Resource-Based View (RBV) theory, a firm's competitive advantage is attributed to the possessed valuable and scarce resources. Firms maintain their competitive advantage as long as the resources are inalienable or imitated by other firms (Barney, 1991; Chadwick et al., 2015). Moreover, a bundle of complementary resources and capabilities is needed to achieve competitive advantage (Kauppila, 2015). Following this line, RBV-based resource orchestration theory argues that the causal complexity of competitive advantage comes from the configuration of organizational resources, capabilities, and management decisions possessed that respond simultaneously to internal and external competitive environments (Kauppila, 2015). This theory also echoes many previous studies in the information systems field that information technology (IT) resources alone do not uniquely provide strategic advantage (e.g., Zammuto et al., 2007). Thus, the relationship between resources and firm performance is likely to be complex in terms of multi-directional interactions between complementary organizational elements e.g., culture, resources, structure, capabilities, and environmental elements.

Digitalization requires firms to design and organize their resources and capabilities from a systemic and value creation perspective (Amit, and Han, 2017). This study examines two types of organizational resources, namely relational resources and portfolio technological resources, relevant to the research context, i.e. manufacturing firms. Manufacturing firms in emerging markets act as both exporters and suppliers, and their competitive advantage strongly depends on their relationships with global buyers (Fletcher-Chen et al., 2017). Building and maintaining long-term relationships with these global customers means having relational resources for manufacturing firms' markets and sales (Kingshott et al., 2018). Thus, relational resources are acquired by developing and maintaining positive relationships with business partners, while allowing firms and their partners to effectively leverage and synthesize capabilities to create competitive advantages (Wittmann et al., 2009). In turn, with the advent of Industry 4.0, developing a portfolio technological resources is a strategic roadmap for the future of manufacturing firms (Ghobakhloo, 2018). Mainly digital and smart technologies such as automation, cloud, 3D printing and Internet of Things (IoT) enable sustainable manufacturing and thus competitive advantage (Machado et al., 2020). Thus, based on previous studies (e.g. Zhang and Ozer, 2015), this study assumes that the portfolio technological resource will be defined as the portfolio of core technology assets owned by a manufacturing company that enable the company to digital transformation and maintain its competitive advantage.

Higher-order organizational capabilities that support firms in adapting their organizational structures, processes, and cultures are called dynamic capabilities (Teece, 2007). Dynamic capabilities are rooted in the routines of organizations and the actions of managers and employees and, unlike ordinary capabilities, represent the ability of organizations to transform (Winter, 2003) and positively influence performance (Jantunen et al., 2018). Dynamic capabilities are therefore seen as enablers of digital transformation (Warner, and Wäger, 2019). They can be categorized into three dimensions: sensing, seizing, and reconfiguring (Teece, 2007). Sensing capabilities help achieve superior performance in finding new and aligning from existing markets, correctly identifying customer needs, and recognizing innovation opportunities. Seizing capabilities enable new structures, policies, incentives, and value generation for organizations or service and product innovations. Reconfiguration capabilities refer to the alignment of organizational resources to meet new requirements in new circumstances.

It should also be emphasized that digital transformation is the result of the evolution of companies and the environment. The introduction and adaptation of new technologies certainly affects the change and specification of customers' needs, and thus intensifies uncertainty. Uncertainty in the environment may result from the lack of control over external resources but also the difficulty in understanding and obtaining external information. In the era of digital transformation, especially the focus is on technological uncertainty referring to the unpredictability of technological change in terms of the complexity and novelty of technology (Zhu et al., 2020), but also how people discover and exploit opportunities (Liu et al., 2020). These changes create uncertainty, but they also create new opportunities. Advanced digital technologies such as cloud computing, big data, artificial intelligence, and the Internet of Things can promote the creation of digital capabilities, opportunities, resources, and other factors, and thus lead to digital transformation (Zhu et al., 2020) by supporting enterprises in this regard. Thus, the high level of technological uncertainty means that enterprises need to make and adjust their business operations early to cope with more complex and novel technologies (Jiang, and Ma, 2018). In this way, the development and application of digital technologies can facilitate digital transformation.

In summary, despite the fact that digital transformation is the result of the interaction of various factors, both internal and external, studies conducted in the literature so far have mostly focused on factors at the organizational level, neglecting the important role of factors flowing from the environment, especially those related to technological uncertainty. In order to fill this research gap, this paper analyzes the simultaneous impact of various mechanisms influencing digital transformation, both relating to internal, organizational and external environmental aspects from a holistic perspective (Figure 1). In turn, due to their complex combination, as convincingly argued by Fiss (2011) or Ragin (2008), multiple pathways are available through which companies can realize digital transformation that are difficult to explore by traditional methods.

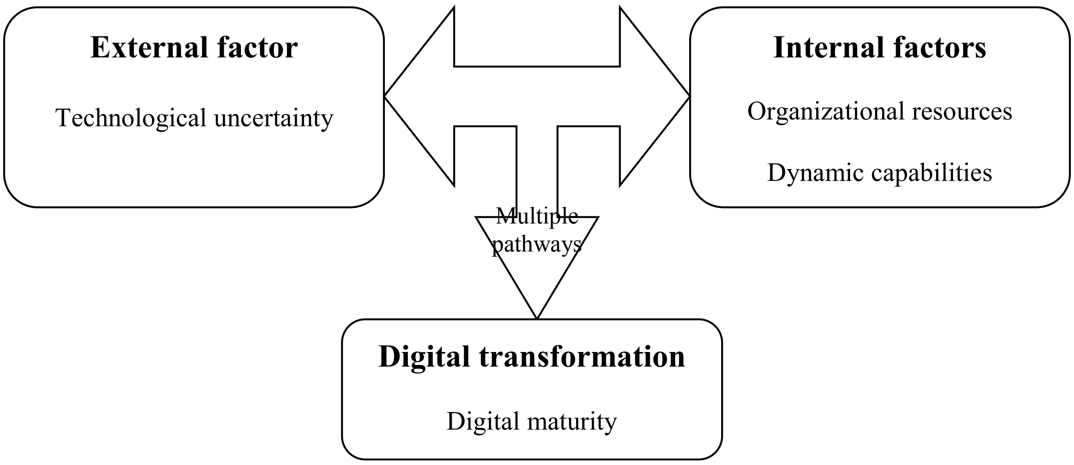

Figure 1. The research framework. Source: own study.

3. Data and method

The data was collected through a survey of high-level managers of Polish manufacturing SMEs. The sample was carefully selected to provide insights into the studied area of digital transformation based on the experience gained in manufacturing companies facing digital transformation. Based on the available data, a list of 86 potential subjects was created. All entities received an email with a description of the project and an invitation to collaborate. Thirty-three companies expressed their willingness to participate. Survey participants were top executives, including chief digital officers and CEOs at manufacturing SMEs. The survey was conducted between February 2021 and May 2021, with respondents taking an online survey. After confirming that the respondent is a relevant company representative and indicating company-level variables (company age, company size, industry sector), the respondent answered questions on relevant variables shown in random order. Finally, some personal information (e.g. gender, age) was asked after ensuring the anonymity of the answers. A set of descriptive categories is provided in Table 1.

Table 1.
Sample description

Variable and Category		Statistic
Firm level	Firm age	Mean: 39.6 years
	Industry sector	• Manufacture of computers, electronic and optical products:27.3% • Manufacture of motor vehicles, trailers and semi-trailers:18.2% • Manufacture of electrical equipment: 30.3% • Furniture manufacturing:24.2%
	Firm size (employees)	• Fewer than 50: 36.4% • 50-250: 63.6%
Respondent level	Gender	• Female: 73.3% • Male: 26.7%
	Age	Mean: 46.3 years
	Position	• CEOs: (41%) • chief digital executives, CDOs: (23%) • manufacturing directors (29%) • others (7%)

Source: own study.

The aim of this research is to find causal pathways that explain the digital transformation of enterprises. As a result, traditional quantitative approaches (e.g. linear regression) are inadequate as they analyze the main effect of independent variables on at least one dependent variable, the so-called "net effects" (Woodside, 2013). Therefore, the qualitative comparative analysis (QCA) was used, i.e. a fuzzy-set (fs/QCA) based on set theory and fuzzy algebra (Ragin, 2008), which is applicable to the study of complex causality and multiple interactions (Fiss, 2011). Fs/QCA produces a relationship that is the total number of alternative pathways that maximize the test score. These pathways consist of three different possibilities in which a variable may influence the outcome: (a) presence – which is a key requirement; (b) absent, illustrating the absence of a requirement; and (c) irrelevance, being a "don't care" variable or dispensable variable for the desired outcome. Fuzzy sets allow for the inclusion of continuous variables, which are much more common in management science research, and allow for the definition of different levels of membership (e.g. 0 for no membership, 1 for membership, 0.5 for cross-over membership). Importantly, membership can be understood as the presence of a variable in the outcome under study, which is iterated over all possible combinations of variables and outcomes to obtain a truth table. The Quine-McCluskey algorithm is then used to reduce the truth table to a subset of outcome-changing variables (presence or absence) and irrelevant variables ("don't care") via Boolean minimization. After minimization, each row of the reduced truth table consists of pathways that can be interpreted causally; that is, each variable alters the outcome either positively (presence) or negatively (absence), or is irrelevant (don't care). These pathways make up one or more solutions.

The outcome in this research is digital maturity recognized as a standard for assessing the results of digital transformation (e.g. Pramanik et al., 2019). In this study, the digital maturity assessment model by Gill and Vanboskirk (2016) was used, based on four dimensions: culture, organization, technology and insight. Each dimension contained five items (e.g. “We have the right leaders to execute on our digital strategy day-to-day" or “We have digital skills embedded throughout our organization”).

Relational resources are measured reflectively by building relationships with external business partners (Wittmann et al., 2009). According to global commodity chain theory, external business partners are reliable and strong partnerships with global customers (Boyd et al., 2010) and reliable networks with suppliers (Shou et al., 2017). Portfolio technological resources are generated to cover the technologies required for digital transformation, i.e. manufacturing technology, digital marketing technology, design technology and IT. Based on existing literature (Wittmann et al., 2009; Boyd et al., 2010; Ghobakhloo, 2018; Castelo-Branco et al., 2019; Li et al., 2019), four items measuring relational resources (e.g. “We have successfully developed a strategic partnership relationship with our customers”) and four items measuring the portfolio technological resources (e.g. “We have developed the required information technologies for Industry 4.0”) were used.

For the three dimensions of dynamic capabilities, i.e., sensing, seizing, and reconfiguring, measures developed in the existing literature were used. The measurement items for the sensing dimension include activities related to acquiring knowledge and resources (Zahra and George, 2002) and identifying opportunities (Teece, 2007). This dimension contained five items (e.g. “We are looking for new opportunities in the operational environment”). Measurement items for the seizing dimension include patching (Teece, 2007), investing in research and development and competence building (Katkalo et al., 2010), and making changes (Eisenhardt and Martin, 2000). This dimension contained four items (e.g. “We actively develop new ways of doing business”). The reconfiguring aspect of dynamic capabilities represents activities related to knowledge, leadership, and human resource management (Jantunen et al., 2012), as well as the reallocation of resources and assets (Eisenhardt and Martin, 2000). This dimension included three items (e.g. “We use the existing know-how in new areas”).

Technological uncertainty was measured using the popular scale developed by Jaworski and Kohli (1993) and assessed using two elements, such as, for example, “Core technology in the industry is changing rapidly”. A five-point Likert scale was used for all scale items ranging from 1 (strongly disagree) to 5 (strongly agree). The individual reliability of each construct was greater than the minimum acceptable Cronbach's α of 0.7, indicating high reliability (Nunally, Bernstein 1994).

4. Results

First, before conducting the appropriate pathways analysis, it was checked whether any single condition is necessary for digital transformation. If the consistency coefficient is higher than 0.9, the causal condition can be considered a necessary condition for the outcome (Ragin, 2008). Table 2 shows the results of this analysis. For high and low levels of digital maturity, the consistency coefficients of all conditions were below 0.9, indicating that no single condition is necessary for digital transformation (Ragin, 2008; Schneider, and Wagemann, 2012).

Table 2.
Necessity analysis of single, causal conditions

Condition	High level of digital maturity		Low level of digital maturity	
	Consistency	Coverage	Consistency	Coverage
Relational Resource	0.71	0.72	0.64	0.57
~Relational Resource	0.54	0.65	0.63	0.71
Portfolio Technological Resource	0.55	0.43	0.71	0.54
~Portfolio Technological Resource	0.72	0.71	0.64	0..73
Sensing	0.53	0.65	0.68	0.59
~Sensing	0.71	0.75	0.73	0.69
Seizing	0.63	0.43	0.56	0.62
~Seizing	0.68	0.59	0.71	0.68
Reconfiguring	0.75	0.67	0.69	0.57
~Reconfiguring	0.64	0.65	0.66	0.67
Technological Uncertainty	0.71	0.73	0.67	0.58
~Technological Uncertainty	0.52	0.65	0.77	0.72

Note. ~ logical negation – the absence of conditions. Source: own study.

The fs/QCA3.0 software was used in this analysis. Following the fs/QCA steps, a sufficiency analysis was performed using a minimum case frequency benchmark greater than or equal to 1 (e.g. Schneider, and Wagemann, 2012; De Crescenzo et al., 2020) and a raw consistency benchmark of greater than or equal to 0.8 (e.g. Fiss, 2011; Du, and Kim, 2021). Consistency and coverage are two metrics to measure the strength and importance of the relationship between condition(s) and the outcome (Ragin, 2008).

This study refers to the suggested principle of coverage, according to which selected configurations should capture at least 75-80% of cases (Ragin, 2008). The results are shown in Table 3. The study identifies three pathways that can lead to a high level of digital maturity. The overall solution consistency is 0.88, which explains the significance level of all configurations as a whole. The results show that the three pathways capture 75% of high-level digital maturity. Next, two pathways were identified that may lead to low level of digital maturity. The overall consistency of the solution is 0.85, with coverage of 0.75.

Table 3.
Causal pathways leading to digital maturity

Causal condition	High level of digital maturity			Low level of digital maturity	
	1a	1b	2	3a	3b
Relational Resource(RR)	●		●	⊖	
Portfolio Technological Resource(PTR)	●		●	⊖	
Sensing (SEN)		●	⬤		⊖
Seizing (SIZ)		●	⬤		⊖
Reconfiguring (R)			⬤		⊖
Technological Uncertainty (TU)	⬤	⬤		⊝	⊝
Raw coverage	0.48	0.43	0.47	0.37	0.41
Unique coverage	0.07	0.02	0.10	0.07	0.05
Consistency	0.82	0.80	0.79	0.94	0.86
Overall solution coverage	0.75			0.75	
Overall solution consistency	0.88			0.85	

Note. ⬤ – core causal conditions (present); ● - peripheral casual condition (present); ⊝ - core casual condition (absent); ⊖ - peripheral casual condition (absent); blank spaces indicate "do not care".

Source: own study.

As indicated by the first two pathways (1a and 1b), digital transformation is achieved under high technological uncertainty. This type of maturity therefore includes two pathways, configuration 1a and configuration 1b, and the sum of coverage is 0.09. The core condition for both of them is technological uncertainty. Thus, the technological uncertainty of the environment is an important extrinsic motivation to achieve a high level of digital maturity, which is also confirmed by previous studies (Zhu et al., 2020). As the first pathway indicates: RR * PTR * **TU**, enterprises use their relational and portfolio technological resources to cope with environmental changes, and thus achieve a high level of digital maturity. On the other hand, as indicated by pathway 1b: SEN*SIZ***TU**, in an uncertain technological environment, firms use dynamic capabilities, more specifically sensing and seizing capabilities, to achieve high digital maturity. As the research shows, in an uncertain technological environment, firms can alternatively rely on their relational and portfolio technological resources or use sensing and seizing capabilities to achieve high digital maturity. In the two paths dominated by the technological uncertainty of environment, there is an effect of mutual substitution between resource (relational and portfolio technological resources) and dynamic capabilities (sensing and seizing capabilities).

Interestingly, configuration 2 also leads to high digital maturity, in which both analyzed resources (i.e. relational and portfolio technological resources), and dynamic capabilities (sensing, seizing and reconfiguring resources) are combined. In this configuration, dynamic capabilities are core causal conditions. The coverage is 0.1, which is much higher than the other two types, indicating good versatility of this solution. As indicated by pathway 2: RR*PTR***SEN*SIZ*R** dynamic capabilities are an important internal motivation for achieving a high level of digital maturity.

The core condition leading to low digital maturity, as indicated by the analyses conducted, is insufficient awareness of technical uncertainty in the environment. This type includes two pathways, configurations 3a and 3b, and the sum of the coverage is 0.12. Pathway 3a: ~RR*~PTR*~**TU** indicates that enterprises with low relational resource and portfolio technological resource, have difficulties in seizing the opportunities that arise to successfully implement the digital transformation. Pathway 3b: ~RR*~PTR*~**TU**, on the other hand, indicates that low dynamic capabilities that not support companies in adapting their organizational structures, processes, and cultures to transformation also lead to the fact that, companies cannot take advantage of technological breakthroughs and find it difficult to achieve high levels of digital maturity.

The robustness analysis of the fs/QCA results was then performed, which used standard methods including adjusting the calibration threshold, adding or removing cases, changing the frequency threshold, changing the consistency threshold, and adding other conditions (Zhang, and Du, 2019). Referring to this method, the consistency threshold was reduced from 0.8 to 0.75, which, however, did not affect the still five supported pathways. Overall consistency slightly decreased and overall coverage increased slightly. Three new cases were added consecutively, but the solutions remained similar, indicating the robustness of the research results obtained.

5. Discussion and contributions

As the research shows, neither external factors: technological uncertainty in the environment, nor internal factors: organizational resources, dynamic capabilities alone create the necessary conditions for digital maturity. The results show that both high and low levels of digital maturity can be achieved through different causal pathways. Based on the combination of resources, dynamic capabilities, and technological uncertainty, three high digital maturity level pathways were identified, technological uncertainty-oriented (pathways 1a and 1b) and dynamic capability-oriented (pathway 2). The study also identified two low digital maturity pathways (3a and 3b) based on insufficient awareness of environmental uncertainty, which have an asymmetric relationship with high levels of digital maturity.

The study observed that there is a substitution between resources and dynamic capabilities along two pathways dominated by environmental uncertainty leading to high levels of digital maturity. These alternative solutions indicate that under certain conditions, a high level of digital maturity can be achieved through different pathways that nevertheless lead simultaneously to the same outcome. Based on the resource-based view and the environmental uncertainty perspective, a theoretical model of digital transformation was proposed and an analysis was conducted revealing the mechanisms that influence the level of digital maturity.

Unlike most studies focused on organizational factors (e.g., such as skills (Kane et al., 2015) and digital culture (Martínez-Caro et al., 2020), this study considers internal and external factors together thus extending the research. As the analyses conducted show, digital maturity is determined by the interaction between external technological uncertainty and internal dynamic resources and capabilities, rather than by any single condition.

Importantly by focusing on dynamic capabilities in the digital age, it contributed to the theory of higher-order organizational capability. How dynamic capabilities affect innovation (Li et al., 2016), or firm performance (Jantunen et al., 2018) is a popular way for exploration. However, this research analyzes how the three dimensions of dynamic capabilities, namely sensing, seizing, and reconfiguring (Teece, 2007), affect digital transformation, and thus reveals an interactive mechanism between dynamic capabilities and digital maturity. This finding supports the thesis of Warner and Wäger (2019), who suggest extending the dynamic capabilities theory to the current digital context.

In addition, fs/QCA was used for the study which significantly broadens the choice of research methods conducted around the issues of digital maturity. This procedure furthermore allowed, on the one hand, overcoming the difficulties of classical research methods and, on the other hand, to reveal the causal pathways and conditional substitution relations of high and low levels of digital maturity from a causal asymmetry perspective. In summary, fs/QCA expands the choice of research methods and provides a new approach to study small and medium samples in the field of digital transformation.

This research also provides some practical recommendations. An organization's capability to proactively respond to technological uncertainty in the environment is an important indicator of a high level of digital maturity (see pathway 1a and pathway 1b). This indicates that business managers should especially analyze environmental changes because the digital era is inextricably linked to a high degree of technological complexity. Managers need to develop the relational and portfolio technology resource (see pathway 1a) and the sensing capabilities that help achieve superior performance as well as the seizing capabilities that enable new structures, policies, incentives, and value generation (see pathway 1b), thus quickly adapting their transformation strategy to environmental change. Alternatively, managers should develop dynamic capabilities with the support of the relational and portfolio technological resources (see pathway 2) to achieve high digital maturity. Managers should avoid a "one-size-fits-all" strategy and follow a pathway appropriate to their resources and dynamic capabilities (see pathway 2) and market factors (see pathways 1a and 1b) to promote digital transformation.

Certain limitations and concerns arising from this study indicate further research opportunities. The analysis is based on a limited number of cases, Polish manufacturing SMEs. In order to generalize the results, a larger sample from multiple industries can be collected and analyzed, thus refining the findings and increasing the level of universality. Also including entities from other countries in the sample could further enrich the findings. Furthermore, the research focused only on the impact of selected resources, dynamic capabilities and technological uncertainty on digital transformation. Future research should therefore be extended to different levels and theoretical perspectives to analyze the different factors affecting digital transformation.

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