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Digital Transformation Capabilities in Manufacturing SMEs: Gaining Agility through IT Capability Configurations

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Abstract

Adopting a capability-based view of digital transformation as a 2nd-order 'dynamic' capability, this paper investigates how 1st-order dynamic and operational IT capabilities are strategically configured and aligned by manufacturing SMEs in order to gain organizational agility. Resulting from a fuzzy-set qualitative comparative analysis (fsQCA) of 67 Canadian SMEs, our results show that a high level of organizational agility is concretized when these firms align at least three dynamic IT capabilities and one operational IT capability. Through three high-performing configurations composed of the sensing, learning, coordinating and integrating dynamic IT capabilities along with the IT management capability and e-business capability, we demonstrate which capabilities are present to achieve a high level of organizational agility, and under what environmental condition they manifest themselves. Providing a richer description and deeper understanding of the interrelationships between the IT capabilities required by manufacturing SMEs' digital transformation, our contributions are both practical and theoretical.

Keywords: Strategic IT alignment, Digital transformation; Organizational agility; Dynamic capabilities; Qualitative comparative analysis (QCA).

1. Introduction

Long before the actual post-pandemic world and its growing uncertainties, information technologies (IT) have been presented as a solution to multiple problems at both operational and organizational levels. Over time, their contribution to the development and support of "organizational agility", that is, the ability of a firm to respond to threats in its business ecosystem, were also highlighted by researchers (El Sawy et al., 2010; Sambamurthy et al., 2003). Adapted to the conditions posed by the digital age, these observations have been reiterated, especially when this environment is highly turbulent (Pinsonneault & Choi, 2022), and for small and medium-sized enterprises (SMEs) in particular (Ortiz de Guinea & Raymond, 2020). That said, digital transformation (DT) is recognized as a multidimensional and a multilevel concept within which strategic, managerial, technological, organizational as well as environmental building blocks are mobilized and articulated (Vial, 2019). According to this, some researchers posit that SMEs are "typically more agile and able to innovate more rapidly" compared to larger enterprises (Chan et al., 2019, p. 437). Paradoxically, other researchers have said that SMEs are still understudied, as well as their capabilities are limited and inadequate to carry out their DT (Li et al., 2018), especially during a major crisis such as the Covid-19 pandemic (Mandviwalla & Flanagan, 2021). However, there is a certain consensus regarding the need for researchers to better understand the nonlinear interplay of dynamic IT capabilities and operational IT capabilities, particularly in the face of competitive issues (Raymond et al., 2020).

For practitioners close to SMEs and their managers, DT whose fundamental objective is to provoke "major business improvements to augment customer experience, streamline operations, or create new business models" (Warner & Wäger, 2019, p. 326), becomes not only more important but also more complex. Highlighted by the Covid-19 pandemic, IT capabilities – be they 'dynamic' or not - are thus more than ever considered essential to business activities at both to operational and strategic levels (Helfat et al., 2007). Consequently, while DT is now considered as a 2nd-order 'dynamic' capability, other key elements and organizational mechanisms are represented by 1st-order 'dynamic' IT capabilities as well as 'operational' IT capabilities (Ortiz de Guinea & Raymond, 2020; Raymond et al., 2020). Nevertheless, it is not yet clear how these IT capabilities affect (or not) managerial practices and other organizational mechanisms that also support strategic business shifts (Mikalef & Pateli, 2017; Pelletier et al., 2021). In the same line of thought, there are also gaps concerning why, when and how IT capabilities become 'dynamic' (or not) (Li & Chan, 2019), and under what specific conditions they manifest themselves (Ozanne et al., 2022). This is why IT-enabled organizational agility now represents a top

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concern for all the actors involved in such a context (Werder et al., 2021), and constitutes a core mechanism for strategic renewal (Warner & Wäger, 2019).

For researchers, despite abundant theoretical and empirical foundations, the foregoing initially calls for taking a closer look at how IT capabilities, including their related processes, knowledge, and other factors contribute (or not) to organizational agility (Sambamurthy et al., 2003). Among other things, by opening its “black box” through the ‘sensing’ dimension (Pinsonneault & Choi, 2022). Second, by avoiding a recurring pitfall of past research, that is to say the investigation of each type of capability independently of the others (Steininger et al., 2022). Third, to better consider how the inherent uncertainty of the digital age affects (or not) the firm’s agility (Vial, 2019). This includes how manufacturing SMEs deal with complexity, as well as how they mobilize their dynamic and operational IT capabilities (Ortiz de Guinea & Raymond, 2020). Finally, by remembering that “IT-enabled transformation” and “digital transformation”, are not synonymous (Vial, 2019), neither for small nor for large firms.

In answer to these needs, the ‘capability-based’ theoretical lens (Teece, 2009) is useful to delve into the mechanisms that enable the firm to reconfigure and renew its IT and non-IT capabilities (Helfat et al., 2007). This includes a more complete investigation of DT in manufacturing SMEs (Li et al., 2018), and how these firms mobilized DT, as a 2nd-order dynamic capability, to respond to changing environmental contingencies and uncertainty (Ortiz de Guinea & Raymond, 2020). More specifically, this study seeks to describe and understand the different sets (i.e., configurations) through which 1st-order dynamic IT capabilities (i.e., sensing, learning, coordinating, and integrating); operational IT capabilities (i.e., IT infrastructure, e-business, and IT management), under a specific ecosystemic context (i.e., environmental uncertainty), interact and align for DT and organizational agility. Consistent with past research, we use strategic IT alignment - ‘fit as gestalts’- to refer to the interplay between these elements (Bergeron et al., 2001). To this end, our exploratory research questions are: *What are the configurations of dynamic and operational IT capabilities that manufacturing SMEs must develop to successfully align for digital transformation? And what are the configurations that lead these firms to high levels of organizational agility?*

Through a configurational-based approach, that is, a fuzzy-set qualitative comparative analysis (fsQCA) of 67 manufacturing SMEs, our main contributions aim to be both practical and theoretical. Specifically, concerning the complexity of DT, of its realization, as well as of its issues with regard of organizational agility. Conducted in an understudied context, that is, SMEs, we also aim to explore how organizations and technological-related capabilities influence each other.

2. Key Concepts for Studying Agile DT

Combined with the capability-based view (CBV*),* the *strategic IT alignment* literature provides us with robust theoretical and empirical foundations. This includes IT alignment’s usefulness for DT in SMEs and their preferred partners in innovation and IT implementation, i.e. industrial service SMEs (Pelletier et al., 2021; Raymond et al., 2020). Nevertheless, the intrinsic complexity of DT combined with IT managerial issues in the context of SMEs require further efforts from researchers (Li et al., 2018). First, to provide a more contextualized definition of DT’s key elements in manufacturing firms. Second, to support a better understanding of the specific capabilities that are to be ‘aligned’. Third, to understand under what forms these elements lead to valuable outcomes for the firms (Mattke et al., 2022).

As mobilized by IS researchers for decades (Li & Chan, 2019), the concept of *IT capabilities* has been studied from different perspectives. Just to name a few, these capabilities have been associated to business value and performance (Ortiz de Guinea & Raymond, 2020), the strategic IT alignment process (Pelletier et al., 2021), IT competencies and innovation capacity (Ravichandran, 2018), product innovation (Raymond et al., 2018), and human resources management (e-HRM) (L’Écuyer & Raymond, 2020). In line with this study’s research object, IT capabilities have also been observed to have complex relationships with other organizational capabilities. More specifically, those that help to understand how firms cope with the uncertainty or turbulence of its business environment (Mikalef & Pateli, 2017).

In a nutshell, based on sensing, seizing and transforming mechanisms, the *dynamic capabilities* (DCs) approach helps us to understand how firms acquire their resources and how they subsequently deploy them through various capabilities (Helfat et al., 2007; Teece, 2009). This includes the IS field wherein researchers became interested in this approach about 20 years ago (Steininger et al., 2022). Following El Sawy et al. (2010), when combined to environmental conditions and IT-based systems, DCs are meant to address complex phenomena such as strategic IT alignment (Pelletier et al., 2021), digital transformation (Warner & Wäger, 2019), organizational agility (Sambamurthy et al., 2003), as well as in very turbulent contexts such as in manufacturing SMEs during the recent Covid-19 pandemic (Ozanne et al., 2022).

Organizational agility is defined as a firm's "ability to detect opportunities for innovation and seize those competitive market opportunities by assembling requisite assets, knowledge, and relationships with speed and surprise" (Sambamurthy et al., 2003, p. 245). Following Vial (2019), organizational agility is one of the four elements that enable the value creation process in the DT process. Nevertheless, while organizational agility has also long been a core concept of the IS research field, important questions remain concerning when, how and under what conditions IT can help firms to achieve and maintain such agility (Mikalef & Pateli, 2017), especially in more turbulent periods within which "economic, social, human, and organisational capital" is required (Mandviwalla & Flanagan, 2021, p. 59).

2.1. CBV approach to DT and organizational agility

Our research objectives are to offer a rich description and understanding of the key IT capabilities underlining the digital transformation of manufacturing SMEs, that is, how these capabilities interrelate to contribute to the organizational agility in such a context. Through different configurations of IT capabilities that align with each other as well as with other organizational capabilities, this study thus aims at "unfold the complexity associated with the interplay of multiple conditions that influence an outcome" (Mattke et al., 2022, p. 557).

As presented in Figure 1, DT is studied through the CBV theoretical lens (Helfat et al., 2007; Teece, 2009), that is, as a 2nd-order dynamic capability that enables the firm to reconfigure and renew itself through its 1st-order dynamic IT capabilities as well as its operational IT capabilities.

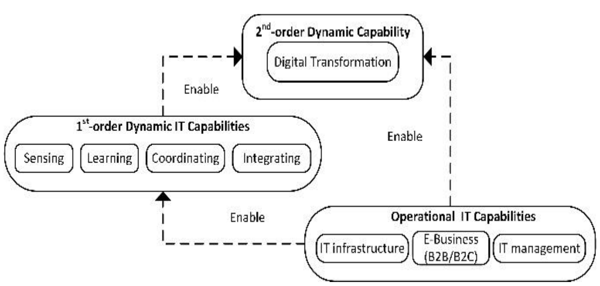

Figure 1. Capability-based view of digital transformation

In taking the CBV to tackle our research questions, we initially propose that organizational agility depends on specific configurations of these three elements that, together, compose the manufacturing SMEs' digital transformation capability. Following Ragin (2008), we define a configuration as a specific combination of elements – in this case, dynamic IT capabilities, operational IT capabilities, and environmental uncertainty as the contextual contingency – that together generate the outcome of interest – in this case, organizational agility. This definition leads us to empirically explore a research model that is based on the configurational approach, as presented in Figure 2, and as further explained below.

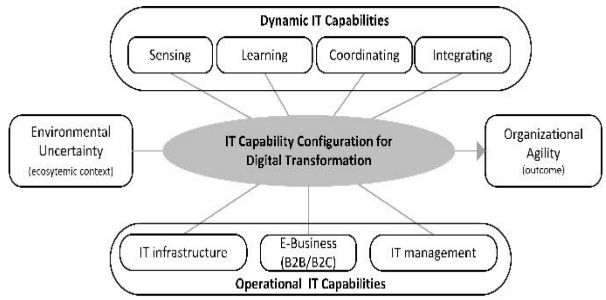

Figure 2. Research model on manufacturing SMEs' DT capability

More specifically, IT capabilities are defined herein as "the organization's ability to 'mobilize and deploy IT-based resources in combination or co-present with other resources and capabilities" (Bharadwaj, 2000, p. 171). Following this definition, one of the characteristics of the digital age is to combine "both newer and older IT" such as information, computing, communication and connectivity technologies (Li & Chan, 2019). Nevertheless, over time, IT capabilities have often been discussed by researchers without reference to their specific roles in the organization (Helfat et al., 2007). With regard to the present study's research object, the roles related to these capabilities are assumed to occur at two levels, that is at the organizational level through *dynamic* IT capabilities (i.e., sensing, learning, coordinating, and integrating) and IT functional level through *operational* IT capabilities (i.e., IT infrastructure, e-business practices and IT management). In doing so, when they 'align' and interact in a coherent way, these IT capabilities enable a 2d-order dynamic capability – in this case, digital transformation – to produce a "performance effect" for the firm such as a gain in organizational agility (Mikalef & Pateli, 2017, p. 3).

However, despite the recognition that agility is a 'response' to environment threats, there is still need for a more specific look at what influence this phenomenon (Pinsonneault & Choi, 2022). To do so, and as postulated by the configurational approach that has been adopted here, organizational agility, as an outcome, may arise from more than one configuration of these various IT capabilities – be they dynamic or operational. More specifically, such IT capability configurations may arise in SMEs where DT not only goes "far beyond changes to internal business processes" (Li et al., 2018, p. 1131), but also mobilizes external IT expertise, notably through orchestration mechanisms and collaborative relational capabilities (Pelletier et al., 2021).

2.2. DT in the context of SMEs

On the one hand, several recent and less recent events push firms, even the smallest ones, to accelerate their "digital shift" through the development of various organizational and IT capabilities (Pelletier & Cloutier, 2019). On the other hand, despite a growing interest in the past years, SMEs are still understudied by IS researchers in several respects (Li et al., 2018; Ozanne et al., 2022), and more specifically with respect to two important issues of the digital age. The first issue relates to identifying the internal and external determinants of SMEs' strategic orientation with regard to IT in general and DT in particular (Pelletier et al., 2021). The second issue relates to identifying the mechanisms by which SMEs develop appropriate strategic as well as operational IT capabilities (Raymond et al., 2018). This includes the incoherence of the decisions that are made, the actions that are carried out and the nature of the IT projects that are prioritized, particularly those of a more strategic nature. In other words, and despite their 'apparent' ability to innovate more rapidly than larger firms (Chan et al., 2019), SMEs tend to adopt IT without in-depth questioning of the challenges that their use of IT may represent concerning the operational IT capabilities, as well as other organizational capabilities (Pelletier & Cloutier, 2019). In such a context, the resulting situation can be qualified as a strategic IT misalignment (Fichman & Melville, 2014), and this is not good news in the digital era, and more specifically for manufacturing SMEs moving towards DT.

3. Research Method

A questionnaire-based Web survey methodology was employed to gather data on the constructs of interest among manufacturing SMEs in the province of Quebec, Canada. The questionnaire was answered by the manager who had the responsibility of the firm's DT in terms of IT applications and/or digital manufacturing operations projects, such as the firm's IT, operations, and general manager (cf. Appendix A for a further description of the respondents' profile). Given that our research questions are exploratory in nature and that the configurational approach is well-suited to samples of low to medium size, a convenience sampling procedure was deemed acceptable. Our Web-based survey questionnaire was thus fully completed by 67 manufacturing SMEs during the Fall of 2021. Moreover, the sampled firms are fairly representative, in terms of size and sector, of the population of manufacturing SMEs in Quebec (cf. Appendix A for a further description of the sampled firms).

The operationalization of the research constructs was based on the extant literature on IT capabilities, dynamic capabilities and IT-enabled business value. Environmental uncertainty, which represents the firms' ecosystemic context, was measured with 5-point Likert scales based on Ortiz de Guinea and Raymond's (2020) measure using five items. For dynamic IT capabilities, we used 5-point Likert scales based on Mikalef and Pateli's (2017) measures using four items each to capture sensing, learning, coordinating, and integrating capabilities. For IT operational capabilities, we followed Raymond et al's (2018) previous research and asked respondents whether IT infrastructure, e-Business (e.g. B2B and/or B2C) and IT management practices were present (or not) in their firm. Also note that the five "scale" variables were measured by averaging their respective scale items. Whereas the two "index" variables were measured by summing their respective dichotomous items (1=yes, 0=no) (Babbie, 2002). Finally, the outcome of interest (i.e. organizational agility) was measured with 5-point Likert scales based on Ravichandran's (2018) works, divided in two sections both containing five items. Following this researcher, the first section focusses on a comparison with industry leaders regarding the firm's IT-related practices with respect to their customers (i.e., needs, adaptation of products/services, segmentation, information). The second section, again a comparison with industry leaders, has asked for IT-related practices with respect to their markets (i.e., opportunities, prospecting, new niches, strategic responses to competitors' actions).

4. Results

Studying organizational phenomenon such as DT through the 'universalist' variable-oriented approach does not allow us to understand the complex interplay between the core elements of the phenomenon (Ragin, 2008). Whereas a 'configurational' case-oriented approach allows us to better understand these elements as well as their interplay. More specifically, through the evaluation of different combinations of elements that lead to an equivalent outcome, as the configurational approach allows for equifinality (Gresov & Drazin, 1997; Meyer et al., 1993). Founded on a quite recent set-theory analytic approach using Boolean algebra, the results were obtained through the use of quantitative comparative analysis (QCA). QCA seeks to identify "causal recipes" using both theory and method (Ragin, 1987). Following Mattke et al. (2022), such an approach also aims to identify whether certain specific conditions are necessary for an outcome to occur as well as for specific configurations to prove sufficient to enable that outcome.

4.1. Calibration

Calibration is a fundamental operation in QCA that allows transforming raw numerical data into set membership scores (Duşa, 2019). In QCA, each variable can be calibrated into crisp (cs) or fuzzy set (fs) following a half-conceptual, half empirical process to identify thresholds that meaningfully represent the differences in degree among cases (Greckhamer et al., 2018). In this study, we used the indirect method combined with percentiles to determine the thresholds for every condition and the outcome. This way of doing is well adapted for Likert-scale questionnaire (Rubinson et al., 2019). For each condition, we thus set the three points of fuzzy set membership through percentiles ('fully in' = top quartile; 'crossover' = median; 'fully out' = bottom quartile) presented with the variables' descriptive statistics in Table 1.

Table 1. Reliability, descriptive statistics and fuzzy set calibration of the research variables

Research Variable	α[a]	mean	stdev	min	max	fuzzy set calibrations		
						fully in	crossover	fully out
Environmental Uncertainty	0,62	2,26	0,51	1.00	3,60	2,60	2,20	2,00
Sensing Capability	0,90	3,36	0,92	1,00	5,00	4,00	3,50	2,75
Learning Capability	0,92	3,43	0,81	1,25	5,00	4,00	3,50	3,00
Coordination Capability	0,86	3,40	0,80	1,00	5,00	4,00	3,50	3,00
Integration Capability	0,92	3,07	1,00	1,00	5,00	3,88	3,25	2,25
IT Management Capability	0,91	3,20	0,89	1,50	5,00	4,00	3,13	2,56
IT Infrastructure Capability	-	0,26	0,14	0,07	0,73	0,33	0,20	0,13
e-Business Capability	-	0,56	0,17	0,00	1,00	0,71	0,57	0,43
Organizational Agility	0,86	3.92	0,51	2,70	5,00	4,20	3,90	3,55

[a] Cronbach's alpha coefficient of reliability [inappropriate for index variables]

4.2. Necessity analysis

We then conducted a necessity test for the presence of high organizational agility. This procedure indicates whether each causal condition, by itself, is necessary for the outcome (Ragin, 2006). A condition is necessary when its consistency score exceeds 0.90 (Schneider & Wagemann, 2012). In our study, the eight consistency scors ranged from 0.573 to 0.755. Following Dul (2016), with the 0.90 threshold, it is likely that fsQCA fails to identify single necessary conditions and thus a false negative error may occur. As relaxing this threshold may produce false positive errors, we chose another approach that may produce fewer false negatives and false positives, that is, identifying single necessary conditions by selecting the conditions that are present in all sufficient configurations (Dul, 2016).

4.3. Sufficiency analysis

The next step in QCA is to convert calibrated data set into a truth table which, in turn, is reduced to a set of Boolean expressions (Rubinson, 2019). A truth table entails all logically possible configurations of conditions included in a study and contains 2^k rows (k = the number of conditions), each representing a specific configuration (Greckhamer et al., 2018). Following this, we need to specify the frequency and the consistency in the truth table. Frequency represents the number of each possible configuration observed in the truth table. Here, the frequency threshold was set to 1. Consistency indicates to what degree the empirical data are in line with a postulated subset relation (Schneider & Wagemann, 2012). Ragin (2008) suggests that the consistency threshold should not be less than 0.75.

Using the fs/QCA Software version 3.1b (Ragin & Davey, 2017), three solutions (complex, parsimonious and intermediate) arise from the simplification of the different combinations of causal conditions in the truth table. The core conditions are those that are part of the parsimonious and the intermediate solutions while the peripherical conditions only appear in the intermediate solution (Fiss, 2011).

Table 2 shows the results of the analysis indicating that three configurations deemed to be sufficient and equifinal for achieving high organizational agility (HOA). Black circles ("●") indicate the presence of a condition, and circles with a cross-out ("⊗") indicate its absence. Large circles indicate core conditions, and small circles refer to peripheral conditions. Blank spaces in a solution indicate a “don’t care” situation in which the causal condition may be either present or absent (Ragin & Fiss, 2008).

The consistency for each configuration indicates the degree to which a configuration consistently results in the outcome (Park & Mithas, 2020). One can see in Table 2 that consistency is between 0.909 and 0.955 which is over the recommended threshold of 0.75 (Ragin, 2008). Following Park and Mithas (2020), the overall solution consistency indicates the degree to which all configurations together consistently result in high organizational agility. Again, the consistency must be above 0.75 to be acceptable, which is the case here with 0.924. Finally, the overall solution coverage is the total coverage by all configurations together (Park & Mithas, 2020). Coverage is a measure of how trivial a condition is for an outcome, in the sufficiency relation the coverage is used as a measure to calculate how much of the entire outcome Y is “explained” by a causal condition X (Dușa, 2019). There is no specific rule for an acceptable overall solution coverage, but a low solution coverage indicates that there are many instances of the outcome that are not explained by the model (Rubinson et al., 2019). This is not the case here where the solution overall coverage is 0.448.

Table 2. Causal configurations for the presence of organizational agility

Configuration / *Configurational element*	**High Organizational Agility (HOA)**			
	HOA1a	**HOA1b**	**HOA2**	**HOA3**
Ecosystemic Context				
Environmental Uncertainty	⊗		⊗	•
Dynamic IT Capabilities				
Sensing	●	●	●	
Learning	●	●	●	●
Coordination	●	●	●	●
Integration	●	●	●	●
Operational IT Capabilities				
IT Management	●	●		●
IT Infrastructure		•	•	
e-Business			●	●
Conditions tested				
Consistency	0.931	0.913	0.909	0.955
Raw coverage	0.264	0.330	0.169	0.186
Unique coverage	0.047	0.030	0.026	0.024
Overall solution consistency	0.924			
Overall solution coverage	0.448			

Legend: ● presence of a core condition; • presence of a peripheral condition; ⨂ absence of a core condition; ⊗ absence of a peripheral condition; Blank immaterial condition (“don’t care”)

The interpretation of Table 2 can be done horizontally by comparing the presence or the absence of conditions between them or vertically by comparing the conditions that differentiate the configurations. We can see vertically that environmental uncertainty does not have a core effect for high organizational agility. Moreover, dynamic IT capabilities are always present as core conditions to reach high organizational agility except for sensing which is not present in configuration HOA3.

Assessed through managerial practices in IT project planning, IT architecture design, system updates, IT personnel management, the IT management capability is quite present in the configurations as a core condition except for configuration HOA2. Whereas the e-Business capability is only present in configurations

HOA2 and HOA3. For its part, the IT infrastructure capability is absent as a core condition in all configurations even though it is present as a peripherical condition in configurations HOA1b and HOA2. We can also observe differences between the configurations. More specifically, configuration HOA1 is divided into two sub-configurations where the absence of environmental uncertainty as a peripherical condition is compensated by the presence of the IT infrastructure as a peripherical condition. The HOA2 configuration differs from the HOA1 configuration by the presence of e-Business capability at the expense of IT management capability which becomes absent by maintaining the IT infrastructure capability present and adding environmental uncertainty as a peripheral condition. HOA3 differs from the other two configuration by replacing sensing capability with the e-Business capabilities in HOA1 and the IT management capability in configuration HOA2.

5. Discussion and Contributions

The purpose of this exploratory research was to, first, offer a rich description of what constitutes manufacturing SMEs' organizational agility. Second, to provide a better understanding of what constitutes and enables a crucial 2^d-order dynamic capability for manufacturing SMEs in the digital age, that is, digital transformation. More specifically, through three configurations of 1^st-order dynamic and operational IT capabilities that allow a firm to attain a high level of organizational agility, our results have empirically demonstrated that there is no 'one best way' to support DT in manufacturing SMEs. Well demonstrated in times of crisis, our results also highlight the need as well as the complexity of developing agility through DT. To do so, SMEs may combine dynamic IT capabilities, namely sensing, learning, coordinating and integrating practices, with other operational IT solutions as well as their related practices, namely IT management, IT infrastructure, and e-business. As illustrated in Table 2, they do so by taking two different paths. Specifically, and depending on whether there is environmental uncertainty in the firms' business ecosystem, our results suggest that sensing activities can be compensated by the combination of adequate IT management and e-business practices. For instance, when SME managers collect and analyze data concerning customers, products and competitors, or when they interact with employees and business partners, through social media, intranet and B2B/B2C applications.

By means of a fsQCA analysis and through a configurational approach that takes a "fit as gestalts" perspective of strategic IT alignment, this study has responded to a long-standing call concerning complexity of the adoption and use of IT (Raymond et al., 2020; Raymond et al., 2018). At the same time, we have highlighted the IT capabilities that enable the firm's digital transformation to produce the outcome of interest in this study, that is, organizational agility. Overall, these results contribute to a better appropriation of IT by SMEs', their actors and their business ecosystems in the digital age (Pelletier & Cloutier, 2019). Consistent with past research concerning the CBV lens (Helfat et al., 2007; Teece, 2009), this study has also highlighted that different IT dynamic capabilities serve different purposes in SMEs, and do so at the organizational and managerial action levels.

For researchers, these results reinforce the idea that a 'universalist' approach to IT and related IT management practices, including those for DT, does not promote the understanding of the adaptation mechanisms that are required in many situations. For instance, to respond to the growing uncertainty of changing business environment – be it digitally driven or not - as well as to cope with unexpected effects that emanate from crises such as the Covid-19 pandemic or the war in Ukraine. Moreover, our results bring to light that the notion of 'equifinality' as well as the holistic view proposed by the configurational approach is not only an effective but also a rigorous means of producing IT knowledge that better suits the true needs of SMEs and their managers. Finally, in line with past research, these results support the 'processual' view of a core IS concept, that is, strategic IT alignment. All identified as core causal conditions in this study, the sensing, learning, coordinating and integrating 1^st-order dynamic IT capabilities are here central to a process-based view of DT in manufacturing SMEs. Following Arvidsson and Holmström (2017), our three high-performing configurations also represent different arrangements of IT capabilities – be they dynamic or not -, organizational structures, and practitioner roles. More specifically, through three different alignment 'patterns', our results suggest three 'enactable' processes to guide SMEs' DT activities. In doing so, our study also indicates that 'alignment', understood in terms of the 'coherence' between IT investments and business objectives, is still an object of interest (Fichman & Melville, 2014; Pelletier et al., 2021).

For practitioners, IT-enabled organizational agility now represents a top concern (Werder et al., 2021). Meanwhile, researchers as well as some experts close to SMEs are increasingly inclined to question whether all SMEs' IT projects are true digital transformation projects. In this regard, our results concerning the peripheral role of the firms' IT infrastructure have demonstrated that organizational agility cannot be achieved if DT projects are limited to the adoption and assimilation at the operational level, regardless of what happens at the organizational and managerial levels of the firm. In other words, if the intrinsic nature of a true DT process in manufacturing SMEs is above all strategic, why do we still observe such uncertainty and ambiguity concerning the levels of change that are expected in such a context (Pelletier & Cloutier, 2019; Vial, 2019). Finally, returning to Table 2, this study reinforces our contribution to the 'praxis' of DT which corresponds to the sequence by which activities are organized, aligned and coherently unfolded *in situ* (Arvidsson & Holmström, 2017).

To summarize, this study contributes to IT capability and DT theory by integrating concepts and insights obtained from the configurational approach, from the CBV, and from the strategic management, the SME/entrepreneurship and the IT capability literatures. Our results also contribute to DT practice as it is enabled by the strategic management and use of IT in manufacturing SMEs.

6. Future Research and Limitations

If there is one thing in the past few years that has been well demonstrated, particularly for SMEs, it is that DT is definitely more a journey than a series of projects aimed at implementing "trendy" technologies (Warner & Wäger, 2019). Moreover, the organizational transformation and renewal that is required of manufacturing SMEs for such implementations also begets the need for a holistic/systems approach to DT in such a context (El Sawy et al., 2010; Vial, 2019). Following other researchers (Fichman & Melville, 2014; Fiss, 2011), our results open doors not only on cause-effect relationships between functional IT tools (i.e. IT infrastructure), managerial practices (i.e. IT management) and organizational internal/external interactions (i.e. e-business for B2B/B2C), but also concerning SME managers' cognitive modes of reasoning when they engaged in DT.

Thus, notwithstanding the exploratory nature of our study, the results of our configurational analysis allow us to anticipate other causal relationships as well as looking for other configurations of 1st and 2d order dynamic capabilities in such a context (e.g. organizational learning capability and business model renewal capability). Another limitation lies in the use of proxies to measure IT capabilities, as such measures may not operationalize these capabilities with sufficient breadth and depth. Moreover, our use of the fsQCA analytical method implies that choices made with regard to the research measures' calibration may affect the study's results (Glaesser & Cooper, 2014). Finally, although the number of responding firms was sufficient to carry out our analyses, we will have to ensure the robustness of our results by increasing the size of the sample.

7. Conclusion

In summary, our results show that high organizational agility is enacted when SMEs align at least three 1st-order dynamic IT capabilities and one operational IT capability. Through three high-performing configurations composed of the sensing, learning, coordinating and integrating dynamic IT capabilities, along with IT management capability and e-business capability, we demonstrate which ones are present to achieve greater organizational agility as well as under what environmental condition they manifest themselves.

Through theoretical and methodological foundations that have earned their rightful place within the IS research community, this study has first investigated how manufacturing SMEs deal with the complexity generated by the management challenges generated by DT. Through the identification of 1st and 2d-order dynamic and operational IT capabilities that interact at different levels simultaneously, this study has also built theory integrating four major issues for IS research in the digital era, that is, strategic IT alignment, digital transformation, organizational agility and dynamic IT capabilities.

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Appendix A. Description of the sample

Doing business in the 17 regions of Quebec, Canada, the survey population consisted of 67 manufacturing SMEs whose number of employees ranged from 20 to 499. They belong to manufacturing sectors of varying levels of technological intensity (low-tech, medium to low tech, medium to high-tech, high-tech). These firms ere selected from a database provides by a provincial paragovernmental agency that offers support and services to manufacturing firms and their innovation partners.

Characterization of Sampled SMEs and Respondents'	
Number of employees	
mean	85
median	60
Business sectors	
Wood products (8)	12%
Metal products (18)	27%
Machinery and industrial equipments (7)	10%
Computer and electronic products (6)	9%
Other manufacturing activities (28)	42%
Education level	
College degree	35%
University diploma (undergraduate)	40%
University diploma (graduate)	24%
Other	1%
Responsability for the firm's IT and DT	
Yes	42%
No	58%
Member of the firm's management committee	
Yes	87%
No	13%