Information technology-enabled explorative learning and competitive performance in industrial service SMEs: a configurational analysis

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Abstract

Purpose As purveyors of knowledge-based and high value-added services to the manufacturing sector, industrial service SMEs must develop the information technology (IT) capabilities that, in combination with other non-IT capabilities, enable their capacity for organizational learning (OL), and for explorative learning in particular. In this context, we aim to identify the different causal configurations that account for the nonlinear complex interplay of IT capabilities for exploration and strategic capabilities for explorative learning as they affect competitive these firms' competitive performance.

Design/methodology/approach Survey data obtained from 92 industrial service SMEs were analysed with a configurational approach, using fuzzy set qualitative comparative analysis (fsQCA).

Findings As it allows for equifinality, the fsQCA analysis identified six causal configurations that characterize the sampled firms' explorative learning capability, two being equally associated with high innovation performance, and four being equally associated with high productivity.

Originality/value By viewing explorative learning as a dynamic capability that is enabled by the firm's IT and strategic capabilities, our study contributes to OL theory by providing a more concrete or 'operational' grounding which allows for a greater practical applicability of this theory. By taking both the configurational and capability-based views of the OL-IT-performance causal framework, we provide an empirical basis for unraveling, explaining and understanding the complex non-linear relationships embedded within this framework.

Keywords: Explorative learning, IT capabilities, Strategic capabilities, Capability configuration, Competitive performance, fsQCA, Industrial service, SME

Paper type Research paper

1. Introduction

In a digital world that has shifted from a product-based to a knowledge-based global economy, and where the frontier between product and service is now blurred, one of the most important issues for strategic management, small business, and information systems (IS) researchers and

practitioners lies in identifying the effects of the firm's information technology (IT) resources and competencies that, in combination with other non-IT resources and competencies, enable its capacity for *organizational learning* (OL) (Andreu and Ciborra, 1996; Janson, Cecez-Kecmanovic and Zupančič, 2007; Kane and Alavi, 2007; Real, Leal and Roldán, 2006). As purveyors of knowledge-based, high value-added services to the manufacturing sector (Bryson, Keeble and Wood, 1997), industrial service firms, most of whom are small and medium-sized enterprises (SMEs), must answer a dual management challenge. That is, they are challenged to respond to both the digitalization and the globalization of their business environment by formulating and implementing a digital transformation strategy (Bharadwaj, El Sawy, Pavlou and Venkatraman 2013; Setia, Venkatesh and Joglekar, 2013). The strategic management and use of IT by these firms is thus meant to enable their learning processes and support their learning mechanisms (Andreu and Ciborra, 1996; Kane and Alavi, 2007; Nguyen, Ngo, Northey and Siaw, 2019). In doing so, the aim of the management and use of IT is also to maintain or improve firms' competitive performance in terms of innovation and productivity (Aboal and Tacsir, 2018; Soto-Acosta, Popa and Martinez-Conesa, 2018).

Researchers have studied OL processes under two forms, namely exploration and exploitation (March, 1991; Pentland, 1995). From a functionalist perspective in which 'OL is a synonym of information processing within organizations' (Popova-Nowak and Cseh, 2015, p. 305), *explorative learning* essentially refers to the firm's acquisition of new knowledge or replacement of existing knowledge in its organizational memory, whereas *exploitative learning* refers to the firm's reuse, diffusion and refinement of its existing knowledge (Kane and Alavi, 2007; Li and Huang, 2013; Nielsen, Mathiassen and Hansen, 2018). We focus on the first form in this study, as being most conducive to achieve high levels of competitive performance in the highly dynamic, turbulent and uncertain environment in which most industrial service SMEs

operate (Bnner and Tushman, 2003; Dixon, Meyer and Day, 2007; Teece, Peterhaf and Leih, 2016).

The role and impact of IT with regards to OL processes and outcomes have been the object of some studies in the last twenty-five years (Robey, Boudreau and Rose, 2000). This includes, for instance, studies of IT-based OL support systems (Hine and Goul, 1998), of IT's role in the firm's organizational memory and learning (Croasdell, 2001), of IT-enabled explorative and exploitative learning mechanisms (Kane and Alavi, 2007), of IT-enabled OL in Web-based processes such as crowdsourcing (Schlagwein and Bjørn-Andersen, 2014), and of the impact of enterprise social media on OL (Qi and Chau, 2018). To-date, however, no attempts have been made to explain the complex interplay of the firm's IT capabilities with its other (non-IT) organizational capabilities in enabling its explorative learning process and thus improving its competitive performance, and especially in a SME context where the firm's IT resources and competencies have been found to play a strategic role in this regard (Raymond, Bergeron, Croteau and St-Pierre, 2016).

From a capability-based view of the firm's digital transformation (Easterby-Smith and Prieto, 2008), we focus here on its *explorative learning capability*, that is, on the firm's IT capabilities for exploration, on its strategic capabilities for explorative learning, and on the extent to which and manner by which these capabilities, in combination, enable firms to attain high levels of competitive performance (in terms of innovation and productivity). In characterizing, contextualizing and valuing the explorative learning capability, we take a 'configurational' approach that is grounded in contingency theory instead of the traditional universalistic or 'best practices' approach (Doty, Glick and Huber, 1993). Furthermore, by identifying the 'capability configurations' of industrial service enterprises (Miller, Eisenstat and Foote, 2002), we allow for complex and nonlinear relationships as well as for 'equifinality', or the possibility for industrial service firms to achieve high levels of competitive performance

through different explorative learning paths and from different starting positions in terms of their IT and non-IT resources and competencies (Gresov and Drazin, 1997). This approach also allows for 'causal asymmetry', that is, the possibility that the capability configurations associated to high levels of competitive performance differ from the configurations associated to the absence of such performance (Fiss, 2011).

As applied here, the configurational approach is based on the premise that there are specific combinations of the firm's IT and non-IT capabilities that enable its explorative learning processes and, in turn, positively influence its competitive performance (Fiss, 2011). Therefore, the first research question to be answered by this study is the following: *In the context of industrial service SMEs, what are the different explorative leaning capability configurations that lead to high levels of competitive performance?* And given that the configurational approach allows for causal asymmetry, the second question follows: *What are the capability configurations that prevent these firms from attaining high levels of competitive performance?*

In answering these questions through an empirical study of 92 Canadian SMEs operating in the industrial services sector, we hope to provide deeper understanding of the nature and effects of the complex interplay between the firm's explorative learning and IT capabilities in this context. We also hope to fill the gap in the OL, small business and IT literatures in this regard, as our study's research contribution is threefold. First, by focusing specifically on explorative learning rather than organizational learning in general, we bring greater explicitness, precision and applicability to OL theory. Second, by taking a configurational rather than a 'best practices' approach, we bring greater validity, explanatory power and generalizability to OL theory. Third, by focusing on the specificities of SMEs with regard to OL and IT, we bring greater contextualization and theoretical relevance to our findings and thus better delineate our contribution to OL, small business and IT research and practice from that of previous empirical studies.

2. Theoretical and empirical background,

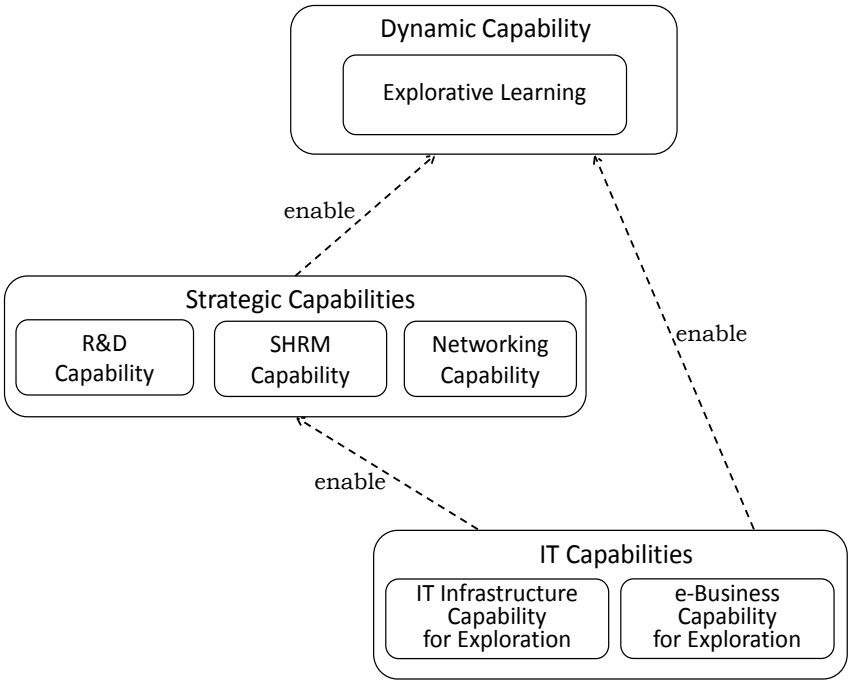
Strategic management researchers have looked extensively at the firm's strategic capabilities to explain its organizational performance. These capabilities are defined as skill sets and knowledge ensembles that enable the firm to deploy its assets and coordinate its activities (Desarbo, Di Benedetto, Song and Sinha, 2005). Thus, strategic capabilities have been found to determine critical organizational outcomes such as the firm's innovation performance (e.g. Di Benedetto, DeSarbo and Song, 2008) and productivity (e.g. Fabi, Lacoursière, Raymond and St-Pierre, 2010). In this regard however, most studies have taken a 'universalistic' perspective (Delery and Doty, 1996), assuming that the development of certain strategic capabilities constitute 'best practices' in such matters as R&D (e.g. Beise-Zee and Rammer, 2006), networking (e.g. Ulubasoglu, Akdis and Kök, 2009), HR management (e.g. Hassid and Fafaliou, 2006) and IT management (e.g. Liu, Ke, Wei and Hua, 2013).

The universalistic perspective is deemed however to be insufficient by those researchers who rather take a 'configurational' perspective (Raymond and St-Pierre, 2013). From a holistic view of the firm as an 'open system', these researchers focus on strategic capability profiles or patterns rather than individual capabilities, that is, considering ensembles of variables that determine an outcome interdependently rather than individual variables independently of one another (Fiss, 2007). The firm may thus both attain and sustain a competitive advantage by developing a unique *capability configuration*, that is, by creating a coherent combination of strategic capabilities that is difficult to imitate by its competitors (Miller, Eisenstat and Foote, 2002).

As presented in Figure 1, explorative learning is viewed in this study through the 'capability-based' theoretical lens (Grant, 1996; Teece, Pisano and Shuen, 1997), that is, as a 'dynamic capability' that enables the firm to reconfigure its IT and non-IT resources and competencies in response to changing environmental contingencies (Pavlou and El Sawy,

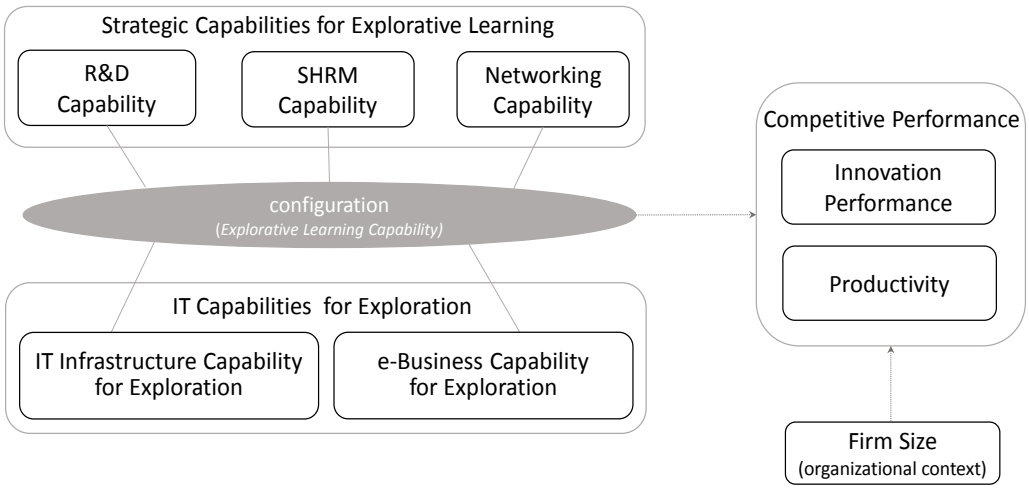
2011). We thus wish to contribute to OL theory by integrating concepts and insights obtained from the configurational approach, from the capability-based view (CBV), and from the strategic management, small business and IT literatures (Berta, Cranley, Dearing, Dogherty, Squires and Estabrooks, 2015). We also wish to contribute to OL practice as it is enabled by the strategic management and use of IT in an industrial service SME context.

Figure 1: Dynamic capability-based view of explorative learning



In taking the CBV to tackle our research questions, we initially propose that competitive performance, that is, innovation performance and productivity depend on specific configurations of three elements that, together, compose the industrial service SMEs' explorative learning capability. We define a configuration as a specific combination of elements – in this case, IT capabilities for exploration, strategic capabilities for explorative learning, and organizational size as the contextual contingency – that together generate the outcome of interest – in this case, competitive performance. This proposition 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 industrial service SMEs' explorative learning capability



2.1 IT capabilities for exploration

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' (Bharadway, 2000, p. 171).

2.1.1 IT infrastructure capability for exploration

The firm's IT capabilities first include its IT assets such as the computing technologies and applications platform that constitute its 'IT infrastructure' (Ajamieh, Benitez, Braojos and Gelhard, 2016; Ross, 2003). Now, in view of the firm's strategic IT priorities with regard to developing its learning capability and absorptive capacity (Sun and Anderson, 2010; Zahra and George, 2002), certain IT infrastructure capabilities may be categorized as being either mainly explorative or exploitative through the notion of 'IT ambidexterity' (Lee, Sambamurthy, Lim and Wei, 2015), in line with Levinthal and March's (1993) conceptualization of how firms pursue either exploration or exploitation. For instance, certain technologies such as CAD/CAM mainly focus on product or service innovation, while others such as an ERP focus on improving efficiency within the firm (Aral and Weil, 2007). Therefore, CAD/CAM technologies are

essentially explorative IT in nature, while ERP systems qualify as mainly exploitative IT. In this study however, we exclude exploitative IT, concentrating instead on explorative IT as these last technologies are the ones that are specifically designed to enable the firm's explorative learning processes (Lee and Widener, 2016) and to provide it with greater agility (Park, El Sawy and Fiss, 2017) in the face of increased competitive pressures.

2.1.2 e-Business capability for exploration

Organizational IT capabilities also include the IT competencies that allow a firm to enable its business processes as well as its knowledge management through its use of IT (Joshi, Chi, Datta and Han, 2010), that is, through its 'e-business' capabilities (Zhu, 2004). Now, in similar fashion to its IT infrastructure capabilities and again referring to the IT ambidexterity notion (Lee et al., 2015), the firm's e-business capabilities may be categorized as being either explorative or exploitative. For instance, certain forms of e-business such as e-collaboration and e-business intelligence are mainly explorative in nature as they focus on rendering the firm more agile and more innovative (Hill and Scott, 2004; Prajogo and Olhager, 2012), while others such as e-commerce are mainly exploitative in that they focus on enabling the firm's business processes and operations (Raymond and Blili, 2000; Zhu, 2004).

2.2 Strategic capabilities for explorative learning

Recalling that the firm's strategic capabilities have been found to shape its competitive performance (e.g. Hutton and Eldridge, 2019; Uwizeyemungu, Raymond, Poba-Nzaou and St-Pierre, 2018), three such capabilities, namely research and development (R&D), strategic human resource management (SHRM) and networking capabilities were chosen on the basis of their being identified in the literature as enabling factors of explorative learning (Human and Naudé, 2009; Khatri, 2006; Martínez-Senra, Quintás, Sartal and Vázquez, 2015), and as being paramount for the competitive performance of SMEs in a globalized economy (Kroon, Van De Voorde and Timmers, 2013; Mu and Di Benedetto, 2012; Raymond and St-Pierre, 2013).

Moreover, these capabilities are envisioned here as 'lower-order' capabilities embedded in the 'higher-order' explorative learning capability, such capability embeddedness being 'created by the combination of resources across functions and hierarchical levels within the firm' (Grewal and Slotegraaf, 2007, p. 455).

2.2.1 R&D capability

In the industrial services sector, the R&D capability refers to the firm's ability to acquire, assimilate, transform and exploit new knowledge, in conjunction with its human and intellectual capital and knowledge management competencies, in order to develop new services (service R&D) or improve the process by which existing services are rendered to manufacturing firms (process R&D) (Koschatsky and Stahlecker, 2010; Nunes, Serrasqueiro, Mendes and Sequeira, 2010). Moreover, the firm's R&D capability may by itself constitute – or be part of – its service offering (Un and Rodríguez, 2018). Now, this capability may also be considered as a proxy for the 'learning' dimension of the firm's absorptive capacity (Lucena and Roper, 2016). In empirical research, the R&D capability has been observed to enable explorative learning processes (von Zedtwitz, 2002; Bresman, 2013; Un and Rodríguez, 2018). Likewise, researchers have found the R&D capability to be a determinant of explorative learning (Belderbos, 2003; Martínez-Senra et al., 2015; Khedhaouria, Montani and Thurik, 2017). Furthermore, the firm's R&D capability may be enabled by its IT capabilities, and especially by an e-business capability such as 'e-business intelligence' (Fink, Yogev and Even, 2017).

2.2.2 SHRM capability

The SHRM capability is defined as the firm's capacity to develop, motivate and empower human resources in order to meet strategic goals in a dynamic, turbulent and sometimes hostile environment (Khatri, Baveja, Agrawal and Brown, 2010). In empirical research, the OL capability has been found to interact with the SHRM capability in determining the performance

of the HR function (Bhatnagar, 2007; Camps, Oltra, Aldás-Manzano, Buenaventura-Vera and Torres-Carballo, 2016) and to be positively impacted by certain SHRM practices such as talent management (Oltra and Vivas-López, 2013; Hu, Wu and Shi, 2016). The SHRM capability is considered to be the most critical of the strategic capabilities with regard to OL and is enabled by the IT infrastructural capabilities of the firm (Uwizeyemungu et al., 2018), and especially by an e-business capability such as the 'e-recruitment' or 'e-training' of employees (Jayanti, 2012).

2.2.3 Networking capability

The networking capability is specific to the firm and indicates its ability to manage relationships with suppliers and other business partners (Human, and Naudé, 2009). In empirical research, the networking capability has been found to positively moderate the impact of explorative learning on competitive performance (Chung, Yang and Huang, 2015) and conversely, the networking capability has been found to positively mediate the impact of the learning capability on competitiveness (Husain, Dayan and Di Benedetto, 2016). As can be expected with the advent of Web-based technologies and Web 2.0 in particular, networking is a strategic capability that has been observed to gain most from a well-developed IT infrastructure (Barão, Braga de Vasconcelos, Rocha and Pereira, 2017), and in particular from an e-business capability such as the 'e-collaboration' between partners (Dong and Yang, 2015).

2.3 Organizational outcomes of explorative learning: competitive performance

Viewed as a dynamic capability, OL has been studied in the strategic management literature with regards to its direct and indirect effects on performance (Easterby-Smith and Prieto, 2008). Empirical studies have thus confirmed the positive impact of OL on the firm's organizational performance in general (López-Nicolás and Meroño-Cerdán, 2011; Ruiz-Jiménez and Fuentes-Fuentes, 2013). In particular, past research has found a positive influence of OL on the firm's innovation performance (Liao, Chang, Hu and Yueh, 2012; Onağ, Tepeci and Başalp, 2014;

Salunke, Weerawardena and McColl-Kennedy, 2019), and on its productivity (Deng, Doll and Cao, 2008). Furthermore, it has also been confirmed empirically that innovation in service enterprises has a positive effect on labour productivity (Deng et al., 2008; Peters, Riley, Siedschlag, Vahter and McQuinn, 2018). As a result, we focus in this study on innovation performance and productivity as being the two main dimensions of competitive performance.

2.4 Organizational context of explorative learning: firm size

In the services sector, firm size may be thought of as a proxy for certain aspects of the firm's organizational context, and for the abundance and availability of resources and competencies in particular, as smaller firms are generally found to be less endowed than larger firms in this regard (de Brentani, 1995; Nunes et al., 2010). Firm size constitutes a potentially important contingency for industrial service SMEs in developing their IT capabilities for exploration and their strategic capabilities for explorative learning (Hong and Oxley, 2016; Chikweche and Bressan, 2018). Thus, including firm size is important, even more so considering that the management literature has demonstrated the influence of organizational size differences on performance outcomes (Benito-Osorio, Colino, Guerras-Martín and Zúñiga-Vicente; Hong and Oxley, 2016; Hwang, Hwang and Dong, 2015).

3. Methods

3.1 Sample

This study's data were culled from a benchmarking database that contains information on 92 industrial service SMEs located in Quebec, Canada. These enterprises offer knowledge-based and high value-added services to the manufacturing industry, and in areas such as IT, human resources, R&D and logistics. The database was created by having the firms' top executives and IT manager answer a twenty-page questionnaire to gather wide-ranging data on the competitive performance and business practices of their firm. In exchange for providing this

data, the firms obtained a comparative diagnosis of their strategic situation and competitive position.

3.2 Measures

The sampled firms' IT and strategic capabilities were assessed with surrogate measures taken from the extant IS and strategic management literatures. The IT capability for exploration was assessed through the identification of the different organization's IT infrastructure and e-business capabilities. These two capabilities were measured with summative indices calculated from the number of IT-based and Web-based systems and applications such as rapid prototyping and e-business intelligence that are used by the firm mainly for explorative purposes (Zhu, 2004). The R&D capability was assessed by the most commonly used proxy, namely the R&D budget per employee (Barry, 2005). The SHRM capability was measured by assessing the mean level of development of ten high-performance HRM practices related to the recruitment, performance evaluation, remuneration, training, development, motivation and empowerment of employees (Uwizeyemungu et al., 2018). The networking capability was measured by the number of the firm's partnerships with other organizations in domains such as marketing, R&D and service delivery (Raymond and St-Pierre, 2013). Innovation performance was assessed by a commonly used measure, i.e. the proportion of sales ascribed to new or modified services (Garcia and Calantone, 2002), whereas labour productivity was assessed with the financial measure most used by researchers and practitioners, i.e. the firm's gross profit per employee (Bryan, 2007). The measures containing the questionnaire items may be found in Appendix A.

4. Results

The research questions were answered by using fuzzy set qualitative comparative analysis (fsQCA), a method appropriate for small sample size (Rihoux and Ragin, 2009). This method uses Boolean algebra to identify different configurations of elements or causal conditions that are associated to the same preferred outcome (high levels of competitive performance in our case) (Ragin, 2008). Thus, the principal contribution of fsQCA lies in its ability to evaluate the relation between a configuration of elements and an outcome. Analysis of our configurational framework was preceded by a direct fuzzy set 'calibration' of the research variables, as it is recommended when Likert-type scales and indexes are used for variable measurement (Liu, Mezei, Kostakos and Li, 2017). For each of our research variables, we thus identified the three points of fuzzy set membership by using percentiles, as recommended in the fsQCA literature (Dul, 2016; Glaesser and Cooper, 2014; Plewa, Ho, Conduit and Karpen, 2016)[1].

Presented in Table 1 are the descriptive statistics and fuzzy set calibration thresholds for causal variables or elements forming the configurations and for the outcome variables. We determined the threshold for being 'fully-in' to be the top quartile value across cases, the 'cross-over' to be at the median value, and the bottom quartile value as the threshold to be 'fully-out'. We used the same thresholds for the preferred outcomes, i.e. the top quartile value both for 'high' innovation performance and 'high' productivity. Following the identification of the three threshold values for all research variables, the fsQCA procedure uses a nonlinear logistic function that transforms all cases of a variable into a fuzzy set, thus allowing cases to take a value between 0 and 1 (Liu et al., 2017; Ragin, 2008).

[1] Some of the variables are skewed as a result of the nature of some of the measures, and thus, data calibration was done using percentiles (Dul, 2016) because calibrating based on survey scales or indexes is likely to offer less meaningful results (Plewa et al., 2016).

Table 1: Descriptive statistics and calibration of the research variables (n = 92)

Research Variable	Fuzzy Set Calibrations			mean	s.d.	min	max
	fully in	cross-over	fully out				
Strategic Cap. for Explorative Learning							
R&D Capability[a]	3000	500	0	4525	12352	0	69747
SHRM Capability[b]	0.40	-0.05	-0.40	0.04	0.45	-0.81	1.43
Networking Capability[c]	5	2	0	2.5	2.7	0	12
IT Capabilities for Exploration							
e-Business Capability for Exploration[d]	4	1	0	2.1	1.9	0	6
IT Infrastructure Cap. for Exploration[e]	4	1	0	2.7	1.5	0	4
Competitive Performance							
Innovation Performance[f]	0.30	0.05	0.00	0.18	0.30	0.00	1.00
Productivity[g]	0.67	0.33	0.10	0.41	0.44	-1.07	2.31
Organizational Context							
Firm Size[h]	40	25	10	31	27	4	146

[a] R&D budget / number of employees (CAN $)
[b] mean level of development of 10 high-performance HRM practices (standardized variables)
[c] number of formal collaborations with customers, suppliers, consultants, universities and research centres
[d] number of explorative activities that are realized by the firm through e-business applications and the Web
[e] number of technologies and systems that are used by the firm for explorative purposes
[f] sales of new or modified services / total sales
[g] gross profit / number of employees (x 100 000 CAN $)
[h] number of employees
Nota. Calibration thresholds: fully in = top quartile, crossover = median, fully out = bottom quartile.

The sampled firms' size varied from 4 to 146 employees with a mean of 31 and a median of 25. Most variables were not highly correlated except for e-business capability for exploring and IT infrastructure capability for exploring which presented the highest correlation (-0.57), as presented in Table 2.

The first step in fsQCA is the analysis of the configurational elements that are deemed 'necessary' for the outcome. As presented in Table 3, the necessity of an element or causal condition is assessed by its consistency, that is, by the extent to which members in this condition (e.g., firms having a strong SHRM capability), also show membership in the outcome (e.g., firms achieving a high level of productivity) (Ragin, 2006). Now, a causal condition is deemed to be necessary for an outcome when its consistency score is higher than 0.90 (Ragin,

2008). Thus, as indicated in Table 3, no configurational element was found to be individually necessary to achieve high innovation performance and high productivity.

Table 2: Inter-correlations of the research variables (n = 92)

Research Variable	inter-correlations						
	1.	2.	3.	4.	5.	6.	7.
1. Firm Size	-						
2. R&D Capability	-0.01	-					
3. SHRM Capability	0.11	0.26	-				
4. Networking Capability	0.07	0.07	0.30	-			
5. e-Business Capability for Exploration	-0.21	0.12	0.30	0.29	-		
6. IT Infrastructure Capability for Exploration	0.20	0.11	-0.20	-0.10	-0.57	-	
7. Innovation Performance	-0.06	0.44	0.17	0.07	0.23	-0.01	-
8. Productivity	0.00	0.28	0.22	-0.02	0.04	0.02	0.09
Nota. Correlations greater than 0.20 or less than -0.20 are significant ($p < 0.05$)							

Table 3: Necessity analysis of the configurational elements

Configurational element	**High Innovation Performance**		**High Productivity**	
	Consistency	**Coverage**	**Consistency**	**Coverage**
Strategic Cap. for Explorative Learning				
R&D Capability	0.542	0.627	0.391	0.532
SHRM Capability	0.643	0.531	0.637	0.618
Networking Capability	0.572	0.520	0.540	0.576
IT Capabilities for Exploration				
e-Business Capability for Exploration	0.761	0.602	0.601	0.558
IT Infrastructure Cap. for Exploration	0.775	0.452	0.820	0.561
Organizational Context				
Firm Size	0.575	0.489	0.554	0.552

4.1 Configurations for high innovation performance and high productivity

While fsQCA is first described with regard to the relationship between the desired outcome and the case sets built for each causal condition (or configurational variable), the main advantage of this technique lies in its capacity to analyze relationships between configurations, i.e. between combinations of causal conditions and the outcome case set (Ragin, 2008). As the

solution sets (or desired configurations) are built through Boolean addition of individual causal conditions, a condition's fuzzy set score indicates its degree of membership in the solution.

The fsQCA technique starts its configurational analysis by creating a truth table of 2^k rows, where each row represents a possible configuration combining k individual causal conditions. This table is sorted on the basis of the frequency and consistency of each configuration, where frequency represents the number of observations for each possible configuration (Pappas, Giannakos and Sampson, 2019) while consistency estimates the proportion of configurations "consistent with the outcome" (Fiss, 2011, p. 402).

The fsQCA method allows one to analyze the configurational elements that, together, are 'sufficient' to produce the chosen outcomes (Ragin, 2008). This analysis also distinguishes 'core' conditions, that is, those found to strongly influence the outcome, from 'peripheral' conditions, those found to have a lesser influence and thus may be exchangeable (with other peripheral conditions) or even expendable (Fiss, 2011). This method was thus applied to two sets of configurations: one for high innovation performance and another one for high productivity. In demonstrating equifinality and as presented in Table 4, the results of the fsQCA analysis identify six causal configurations, i.e. two sets of configurational elements (or causal conditions) equally associated to high levels of innovation performance (HI1 and HI2) and four sets equally associated to high levels of productivity (HP1, HP2, HP3 and HP4). The overall solution coverage indicates the proportion of cases that are covered by all reported configurations, whereas the overall solution consistency assesses the degree to which capability configurations are subsets of the outcome (Ragin, 2006). In this study, the consistency cut-off point was set at 0.75, a satisfactory level proposed by Ragin (2008) and the minimum frequency equal to 1, as recommended for small sample sizes (Ragin, 2006).

The high-innovation performance configurations, HI1 and HI2, highlight the primary importance of strong R&D and SHRM capabilities ('core' conditions)[2] and the secondary importance of a strong IT infrastructure for exploration capability ('peripheral' condition)[3]. Also, HI1 applies to small-sized enterprises (i.e. 24 employees or less) but not to medium-sized enterprise (i.e. 25 employees or more), whereas HI2 adds a strong explorative e-business capability as a core condition and is irrespective of firm size ('immaterial' condition)[4].

Table 4: Configurations for high innovation performance and productivity

	High Innovation Performance		**High Productivity**			
Configuration / *Configurational element*	**HI1**	**HI2**	**HP1**	**HP2**	**HP3**	**HP4**
Strategic Cap. for Explorative Learning						
R&D Capability	●	●				●
SHRM Capability	●	●	●	●	●	●
Networking Capability			●	●	⊗	⊗
IT Capabilities for Exploration						
e-Business Capability for Exploration		●	●	●	⊗	⊗
IT Infrastructure Cap. for Exploration	•	•	⊗	•	•	•
Organizational Context						
Firm Size	⊗		⊗	●	●	
Conditions tested						
Consistency	0.780	0.834	0.835	0.822	0.779	0.736
Raw coverage	0.255	0.314	0.152	0.215	0.179	0.120
Unique coverage	0.034	0.093	0.050	0.102	0.084	0.025
Overall solution consistency	0.779		0.800			
Overall solution coverage	0.348		0.402			

Legend. ● : presence of a core condition ⊗ : absence of a core condition
• : presence of a peripheral condition ⊗ : absence of a peripheral condition
blank: immaterial condition ("don't care")

[2] Core elements or conditions are those for which the evidence for a causal relationship with the outcome is strong (Fiss, 2011).
[3] Peripheral elements are those for which the evidence indicates a weak causal relationship with the outcome (Fiss, 2011).
[4] An immaterial condition represents a situation in which the element may be either present or absent without altering the causal relation between the configuration and the outcome (Ragin, 2008).

The first two high-productivity configurations, HP1 and HP2, highlight the primary importance of having strong SHRM, networking and e-business capabilities. Furthermore, HP1 is under the condition that the firm does not have a strong IT infrastructure capability and applies to small-sized enterprises, whereas HP2 adds a strong IT infrastructure capability as a peripheral condition and applies to medium-sized enterprises. The last two high productivity configurations, HP3 and HP4, are characterized by the presence of a strong SHRM capability and the absence of strong networking and e-business capabilities as core conditions, as well as by the presence of a strong IT infrastructure capability as a peripheral condition. Also, HP3 applies to medium-sized enterprises, whereas HP4 requires a strong R&D capability as a core condition and is irrespective of firm size.

4.2 Configurations for non-high innovation performance and non-high productivity

In addition to equifinality, the configurational approach taken here allows for causal asymmetry, i.e. the possibility that the causal conditions for the presence of the preferred outcome will differ from those for its absence (Fiss, 2011). As this approach allows for nonlinearity in causation, the same configurational element may thus have different causal roles within different configurations. In demonstrating causal asymmetry and as presented in Table 5, further results of the fsQCA analysis identify three causal configurations associated to non-high innovation performance and productivity, that is, to the absence – rather than the presence – of high levels of competitive performance. More precisely, results show two sets of causal configurations associated to non-high innovation performance (NHI1 and NHI2) and one set associated to non-high productivity (NHP1).

The two configurations associated to non-high innovation performance levels, NHI1 and NHI2, have two core conditions in common, i.e. firms in these configurations lack strong R&D and explorative e-business capabilities. Also, NHI1 is characterized by the absence of a strong SHRM capability and applies to small-sized enterprises as core conditions, whereas NHI2 is

characterized by the lack of a strong networking capability and applies to medium-sized firms as core conditions. The single configuration associated to the non-attainment of high productivity levels, NHP1, indicates the core conditions to be the absence of a strong SHRM capability as well as the presence of strong R&D, networking and e-business capabilities, with the added peripheral condition that the firm be small-sized.

Table 5: Configurations for non-high innovation performance and productivity

Configuration *Configurational element*	**Non-High Innovation Performance**		**Non-High Productivity**
	NHI1	**NHI2**	**NHP1**
Strategic Cap. for Explorative Learning			
R&D Capability	⊗	⊗	●
SHRM Capability	⊗		⊗
Networking Capability		⊗	●
IT Capabilities for Exploration			
e-Business Capability for Exploration *IT Infrastructure Cap. for Exploration*	⊗	⊗	●
Organizational Context			
Firm Size	⊗	●	⊗
Conditions tested			
Consistency	0.944	0.891	0.921
Raw coverage	0.226	0.224	0.109
Unique coverage	0.140	0.138	0.109
Overall solution consistency	0.909		0.921
Overall solution coverage	0.364		0.109

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")

5. Discussion

In answering the research question, a fsQCA analysis allowed us to unveil different capability configurations, that is, six causal 'recipes' that enable the explorative learning capability of industrial service enterprises to attain high levels of innovation performance and productivity. In line with the configurational approach, contingency theory and the CBV, these equifinal

configurations manifest a 'gestalts' type of alignment or 'fit' between the firms' IT capabilities for exploration and strategic capabilities for explorative learning (Raymond and St-Pierre, 2013). Hence, competitive performance was associate here to different capability configurations rather than being linearly predicted by each of its individual components, as it would be in the more traditional causal or 'path' analyses based on regression analysis or structural equation modelling (SEM) (Fiss, 2011).

With regard to the capability configurations unveiled, one first notes that the SHRM capability is present in all configurations of both high innovation performance and high productivity, and may thus be deemed as a 'necessary' condition (Dul, 2016), notwithstanding the results of the prior necessity analysis (Table 3).[5] This means that explorative learning benefits the firm in terms of its competitive performance to the extent that employees are strongly motivated and empowered to undertake exploration activities. Another strategic capability that appears to be necessary to achieve high innovation performance is the R&D capability. However, this capability appears in only one of the four high productivity configurations. This points to the industrial service firms' difficulty in being both highly innovative and highly productive at the same time, as these two outcomes are shown here to be achieved through very different capability configurations. One might also surmise that productivity, as opposed to innovation, would benefit more from exploitative rather than explorative learning, and in particular from IT capabilities for exploitation such as enterprise resource planning (ERP) systems and e-commerce applications.

With regards to the IT for exploration capabilities, a strong IT infrastructure is a peripheral rather than a core condition in the attainment of high innovation performance and high

[5] The necessity analyses reported in Table 3, indicate that the SHRM capability is not a necessary condition as its consistency is below the recommended threshold of 0.90 (Schneider and Wagemann, 2012). However, with such recommended threshold, false negatives or type II errors may occur (Dul, 2016). As a result, a second approach that might produce fewer false negatives (and positives) is to identify necessary conditions by selecting the conditions that are present in all configurations (Dul, 2016).

productivity, that is, it must be present but is not 'determinant'. A strong e-business capability for exploration is also present in one of the two high innovation performance configurations and in two of four high productivity configurations as a core condition. In the high productivity case, the e-business capability appear to work in tandem with the networking capability, that is, when one is present the other is present as well (HP1 and HP2) and, conversely, when one is absent the other is also absent (HP3 and HP4). This would be an indication that a 'mismatch' between these two capabilities for explorative learning (i.e. a strong networking capability with a lack of e-business capability or vice-versa) would be detrimental to achieving high levels of productivity. This again points to the fact that by presuming IT capabilities to directly enable the firm's learning processes and to linearly assess their performance independently of other non-IT capabilities, as the traditional variance approach does, one is bound to have a more limited understanding of the true role and impact of these capabilities (Woodside, 2013). That is, our configurational approach and analytical technique (i.e. fsQCA) do not estimate the unique contribution of each condition for every resulting configuration; moreover, the configurational approach is not centered on estimating the 'net effects' of 'independent variables' on outcomes like the variance approach does. In contrast, fsQCA and the configurational approach view conditions (or 'independent variables') in combination, thus identifying the "connections of causally relevant conditions and outcomes" (Ragin, 2006, p. 8). As a result, the relation between organizational (IT and non-IT) capabilities and performance is viewed as being 'complex' and unexplainable by the simple direct effects afforded by the variance approach (Wang and Ahmed, 2007; Wilden, Devinney and Dowling, 2016). Thus, our study answers the calls for research on organizational capabilities and performance to take a configurational approach (Wilden et al., 2016).

5.1 Contribution

By viewing explorative learning as a dynamic capability that is enabled by the firm's IT and strategic capabilities, our study first contributes to OL theory by providing a more concrete or 'operational' grounding which allows for a greater practical applicability of this theory. By taking both the configurational view and the CBV of the OL-IT-performance causal framework, we were able to provide an empirical basis for unraveling, explaining and understanding the complex non-linear relationships embedded within this framework. This same approach may thus be used in future research to simultaneously investigate both explorative and exploitative IT and learning capabilities, that is, to focus on OL and IT 'ambidexterity' (Benner and Tushman, 2015; Lee et al., 2015; March, 1991).

This study's results demonstrate that a fsQCA-based configurational approach is better-suited theoretically to capture the complex, non-linear interplay between IT resources and non-IT resources (human resources most importantly) that supports the explorative learning process and thus, results in the competitive performance of industrial service firms (Wilden et al., 2016). Moreover, the strategic alignment of IT and strategic capabilities (such as SHRM capabilities) applied in this study provides us with a more powerful theoretical lens that may be used in future research on the antecedents and contingencies of these firms' learning and competitive behaviours (such as their strategic orientation and environmental uncertainty). This lens is also likely to provide a better understanding of the specific IT and organizational learning capabilities to be embedded into the digital transformation strategy of industrial service enterprises in facing new competitive challenges.

Our study also contributes to the OL, small business and IT literatures by emphasizing the learning aspects of the industrial service SME's capabilities development and the manner through which IT may contribute to this development (Andreu and Ciborra, 1996). By conceptually and operationally embedding IT and strategic capabilities for exploration into explorative learning capability configurations, we demonstrate how IT can become an active

component of the firm's learning process and of its ensuing competitiveness (Kane and Alavi, 2007). Moreover, by conceptualizing and analyzing IT capabilities for exploration with two distinct constructs, we answer calls for studying such capabilities by capturing their ontological dimension (Ortiz de Guinea and Webster, 2013), that is, by uncovering their underlying 'IT artifact' (Robey et al., 2000). Our operationalization of IT capabilities for exploration captures specific and concrete IT infrastructure and e-business capabilities and thus constitutes a departure from prior operationalisations of IT capabilities that have generally utilized perceptual measures that do not identify the specific technologies nor the specific activities they enable such as sensing, learning and innovating (Lee et al., 2015). In so doing, we are also able to provide industrial service enterprises with actionable options for developing a capability configuration that, in coherence with their strategic posture, further enables their explorative learning processes and thus improves their competitive performance.

As another contribution, this study combines IT related capabilities (i.e., e-business and IT infrastructure capabilities for exploration) with other strategic capabilities (i.e., R&D, networking, and SHRM capabilities) together and analyzes their joint effect on competitive performance. This contributes to the IT literature since most studies have explored the IT capability-performance link without including other organizational capabilities, while the reverse is true of most management studies with regard to the IT capabilities-performance link (Orlikowski, 2010; Zammuto, Griffith, Majchrzak, Dougherty and Faraj, 2007). Thus, our study answers the calls for further investigation of the interplay between OL, IT and other organizational capabilities as they affect the firm's performance (El Sawy, Malhotra, Park and Pavlou, 2010; Wilden et al., 2016).

In addition to its contribution to OL theory, our study also contributes to OL, small business and IT management practice. That is, our findings may provide managers of industrial service SMEs (and those who counsel and assist them) with different explorative learning capability

configurations that may be emulated with the aim of enabling their explorative learning processes and improving in turn their competitive performance. Given the IT and non-IT resources at their disposal, these firms may envisage the learning capability configuration that best fits their specific business environment and organizational context, and best meets their aim for either improved innovation performance or improved productivity. And if the aim is to achieve overall competitive performance, that is, to achieve high-performance both in terms of innovation and productivity, industrial service SMEs should definitely invest in developing their e-business capability for exploration (HI2, HP1 and HP2), and do so in conjunction with the development of their SHRM capability, their networking capability and their R&D capability.

As a further contribution to practice and in view of the causal asymmetry demonstrated in this study, our results indicate to managers the capability configurations that should be avoided, that is, those associated to the absence of either high service innovation performance or high productivity, or the absence of both. For instance, for small service enterprises, the lack of a strong SHRM capability would prevent them from attaining high levels of competitive performance, whatever the investment and the efforts made to develop their IT capabilities for exploration. Furthermore, as its explorative learning processes and mechanisms may be assessed by the firm in order to improve its competitive performance, the basis of its IT strategy would be to emulate those high-performing configurations that are coherent with its strategic objectives. Consequently, from an IT 'strategy-as-practice' perspective (Whittington, 2014), the configurational approach based on fsQCA analysis generates knowledge that is immediately and directly transferable, as opposed to the universalistic approach based on regression or SEM analyses, because the former analytical approach provides managers with equally-effective strategic options for the digital transformation of their firm whereas the latter approach cannot do so.

5.2 Limitations

Our research has intrinsic limitations with regards to the generalization of its results, related to the survey method employed and to the nature and size of the sample. For instance, causality, as understood in the variance-based tradition, cannot be inferred as our study is cross-sectional and thus, the time-lagged effect of the firm's capability configuration upon its competitive performance is unascertainable. Moreover, the industrial service SMEs sampled here operate in sectors where knowledge requirements and technological intensity are rather high, whereas SMEs in all other service sectors are much more heterogeneous in this regard. Another limitation lies in the use of proxies to measure organizational capabilities, as such measures may not operationalize these capabilities with sufficient breadth and depth. Finally, our use of the fsQCA analytical method implies that choices made with regard to the research measures' calibration and other aspects (e.g. choosing the consistency threshold) may affect the study's results (Glaesser and Cooper, 2014). We nonetheless guarded as best we could against such potential arbitrariness in our results by conducting a sensitivity analysis that confirmed the stability of our configurational solutions across different calibrations (Fiss, 2011) and by using the fsQCA thresholds most recommended in the literature (e.g. consistency threshold of 0.75) (Dul, 2016).

5.3 Conclusion

A configurational approach allowed us to identify causal configurations that associate the explorative learning capabilities of industrial service firms to high levels of innovation performance and productivity. These configurations were characterized in terms of the firms' IT capabilities for exploration, strategic capabilities for explorative learning and firm size. In further empirical investigations of the organizational learning capability, future research could rather focus on exploitative learning in order to better help industrial service firms in dealing with the increasing complexity of their business environment. And by using a configurational

approach to do so, future studies may add to our comprehension of how IT enables OL processes and mechanisms by further characterising the complex nature and impacts of the explorative and exploitative learning capability configurations developed by these firms in their pursuit of competitive performance.

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Appendix A: Elements of the questionnaire designed to measure the research variables

SHRM capability – Integration and Remuneration

Indicate which human resource management practices you use for each category of employees.

	Managers	Professionals/ Technicians	Operations personnel	Sales personnel	Clerical personnel
Integration					
Recruitment policy	☐	☐	☐	☐	☐
Performance appraisal	☐	☐	☐	☐	☐
Health insurance program	☐	☐	☐	☐	☐
Employee health program	☐	☐	☐	☐	☐
Pension fund	☐	☐	☐	☐	☐
Remuneration					
Stock ownership plan	☐	☐	☐	☐	☐
Profit sharing plan	☐	☐	☐	☐	☐
Individual compensation (e.g. bonuses)	☐	☐	☐	☐	☐

SHRM capability – Information

Indicate the categories of employees to which the following types of information are diffused.

Level of diffusion	CEO/Board of directors	Managers/ Dept. heads	Professionals/ Sales personnel	Technicians/ Clerical
Types of information diffused				
Owners' vision of the firm's development	☐	☐	☐	☐
Firm's mission and strategic objectives	☐	☐	☐	☐
Financial results of the firm	☐	☐	☐	☐
Objectives in matters of innovation	☐	☐	☐	☐
Organizational and technological changes	☐	☐	☐	☐
Evolution of customer base	☐	☐	☐	☐
Customers' present and future needs	☐	☐	☐	☐
Competitors' threats and strategies	☐	☐	☐	☐
Market situation and its impact on the firm	☐	☐	☐	☐
Supervisors' expectations	☐	☐	☐	☐

SHRM capability – Participation

When a decision is taken concerning the organization and the realization of strategic activities (e.g. the adoption of a new technology, the improvement of product/service quality), employees are generally: (check a single box per line)

Level of participation	Informed of the decision taken	Informed prior to the decision	Consulted to obtain their advice	Copartners in the decision	Mandated to take the decision
Categories of employees					
Managers	☐	☐	☐	☐	☐
Professionals/Technicians	☐	☐	☐	☐	☐
Operations personnel	☐	☐	☐	☐	☐
Sales personnel	☐	☐	☐	☐	☐
Clerical personnel	☐	☐	☐	☐	☐

Networking Capability

Please indicate the extent of your firm's formal collaborations with various organizations in terms of the domains of collaboration and the type of partners.

Partners	Manufacturing customers	Non-manufact. customers	Universities/ colleges	Consultants	Suppliers	Research centers
Collaboration domains						
Personnel training	☐	☐	☐	☐	☐	☐
Service delivery	☐	☐	☐	☐	☐	☐
Purchasing/procurement	☐	☐	☐	☐	☐	☐
Design/R&D	☐	☐	☐	☐	☐	☐
Marketing/sales	☐	☐	☐	☐	☐	☐
Improvements in service and delivery process	☐	☐	☐	☐	☐	☐

IT Infrastructure Capability for Exploration

Please check if your firm uses any of the following technologies and systems.

CAD / CAM (computer-aided drafting, design and manufacturing)	☐
Modeling / Simulation	☐
Rapid Prototyping	☐
Customer Relationship Management (CRM)	☐
Mobile Communication (e.g. mobile computing, smartphone)	☐

e-Business Capability for Exploration

Among the following activities, indicate those realized by your firm through e-business applications, the Internet and the Web.

e-Business intelligence	
Prospecting for new customers in Canada	☐
Prospecting for new customers abroad	☐
Developing business intelligence	☐
e-Collaboration	
Interacting with customers to improve products/services	☐
Interacting with business partners to design new products/services	☐
e-HRM	
Recruiting personnel	☐