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 small- and medium-sized enterprises (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, this study aims 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 these firms' competitive performance.*

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

Findings – *As it allows for equifinality, the fsQCA analysis identified two sets of causal configurations that characterize the sampled firms' explorative learning capability as it relates to competitive performance. In the first set, two configurations were equally associated with high innovation performance, whereas in the second set, four configurations were 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, the 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, the authors 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*

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Erratum: It has come to the attention of the publisher that the article, "Raymond, L., Bergeron, F., Croteau, A.-M., Ortiz de Guinea, A. and Uwizeyemungu, S. (2020), "Information technology-enabled explorative learning and competitive performance in industrial service SMEs: a configurational analysis", *Journal of Knowledge Management*, contained an error in the affiliation for Dr. Ana Ortiz de Guinea, which should now read as "Associate Professor at Deusto Business School, Universidad de Deusto, Bilbao, Spain; Distinguished Research Professor at the University of Exeter Business School, University of Exeter, Exeter, United Kingdom, and Associate Professor at HEC Montréal, Montréal, Canada". This error was introduced in the production process and have now been corrected online.

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 knowledge 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 *et al.*, 2007; Kane and Alavi, 2007; Real *et al.*, 2006). As purveyors of knowledge-based, high value-added services to the manufacturing sector (Bryson *et al.*, 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 *et al.*, 2013; Setia *et al.*, 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 *et al.*, 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 *et al.*, 2018).

Developing their IT capabilities has become especially critical for SMEs, as these firms face greater environmental uncertainty and usually dispose of less IT resources and competencies than large firms to face the managerial challenges arising from the globalization and digitization of their business environment (Limaj *et al.*, 2016). In this context, SMEs have both more to learn and more to gain when they seek to improve their competitive performance by reengineering their OL processes with the support of IT (Raymond *et al.*, 2016). Now, SMEs have specific characteristics – less financial resources and expertize, less formalization and delegation of managerial decision-making, but greater flexibility and lower turnover rates – that influence the efficacy of these processes (Chikweche and Bressan, 2018; Durst and Edvardsson, 2012; Wee and Chua, 2013). Thus, this research and its findings apply to SMEs.

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 *et al.*, 2018). We focus on the first form in this study because it is the most conducive to achieve high levels of competitive performance in the highly dynamic, turbulent and uncertain environment in which most industrial service SMEs operate (Benner and Tushman, 2003; Dixon *et al.*, 2007; Teece *et al.*, 2016).

After reviewing and assessing the research literature on the emerging role and impact of IT with regards to OL processes and outcomes, Robey *et al.* (2000) concluded that future studies should acknowledge and integrate the literatures from both fields – the IT and OL research streams – and in so doing recognize "the situated nature" of OL within the context of IT-enabled work practices. As then, for instance, researchers have studied IT-based OL support systems (Hine and Goul, 1998), IT's role in the firm's organizational memory and learning (Croasdell, 2001), IT-enabled explorative and exploitative learning mechanisms (Kane and Alavi, 2007), IT-enabled OL in web-based processes such as crowdsourcing (Schlagwein and Bjørn-Andersen, 2014) and 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. In addition, this is especially true in the SME context where the complementarity of the firm's IT and non-IT resources and competencies has been found to play a strategic role with regards to OL and performance (Martinho *et al.*, 2016; Raymond *et al.*, 2016).

From a capability-based view (CBV) 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 and manner by which these capabilities, in (multiple) combination(s), 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 the contingency and configurational theories instead of the traditional universalistic or “best practices” approach (Doty *et al.*, 1993; Bergeron *et al.*, 2004; Fiss, 2011). Furthermore, by identifying the “explorative learning capability configurations” (i.e. IT and strategic capabilities) capable of producing high innovation performance and productivity (Miller *et al.*, 2002), we allow for complex and nonlinear relationships and for “equifinality.” Now, equifinality is 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). That is, equifinality allows system elements (i.e. the elements forming the firm’s explorative learning capability configurations) to be combined in multiple ways to equally produce the outcome, which means that the same element might be present in one successful configuration but might be absent in another. In other words, the same specific capability could enable in one configuration or inhibit in another, the firm’s attainment of competitive performance, depending on how it is configured with the other elements forming the overall explorative learning capability. 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:

> *RQ1*. 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:

> *RQ2*. 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 aim to provide a deeper understanding of the nature and effects of the complex interplay between the firm’s explorative learning capabilities (i.e. IT and strategic capabilities for explorative learning) in this context. We, thus, contribute to the OL, small business and IT literatures by filling the knowledge gap in this regard, as our study’s research contribution is threefold. First, by focusing specifically on explorative learning rather than OL in general, we bring greater explicitness, precision and applicability to OL theory. Second, by taking a configurational rather than a universalistic approach, we also provide a methodological contribution by bringing added validity, explanatory power and generalizability to OL theory. Finally, by focusing on the specificities of SMEs with regard to OL and IT, we contribute to OL practice by filling the theory-practice gap that characterizes IT-enabled explorative learning, in other words, by bringing greater contextualization and theoretical relevance to our findings, and thus, better delineating our contribution to OL, small business and IT research and practice from that of previous empirical studies.

2. Theoretical and empirical background

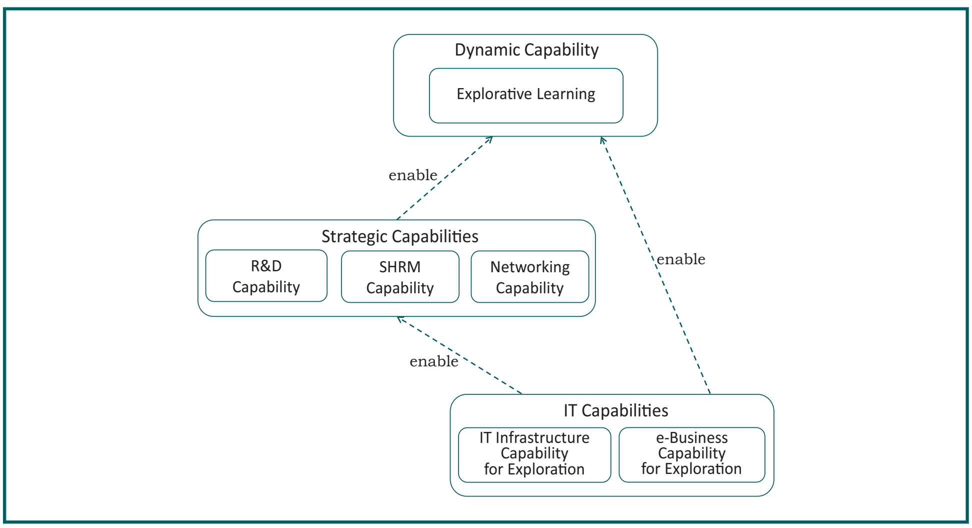
Strategic management researchers have looked extensively at the firm’s strategic capabilities to explain its organizational performance. These capabilities are defined as skill sets and knowledge ensembles that enable the firm to deploy its assets and coordinate its activities (Desarbo *et al.*, 2005). Thus, strategic capabilities have been found to determine critical organizational outcomes such as the firm’s innovation performance (Di Benedetto *et al.*, 2008) and productivity (Fabi *et al.*, 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 research and development (R&D) (Beise-Zee and Rammer, 2006), networking (Ulubasoglu *et al.*, 2009), HR management (Hassid and Fafaliou, 2006) and IT management (Liu *et al.*, 2013).

The universalistic perspective is deemed, however, to be insufficient by those researchers who rather take a “configurational” perspective (Fiss, 2007; 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 *et al.*, 2002).

As presented in Figure 1, explorative learning is viewed in this study through the “capability-based” theoretical lens (Grant, 1996; Teece *et al.*, 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). One may note in this regard that this view differs somewhat from the “knowledge management” view of OL (Castaneda *et al.*, 2018). We, thus, wish to contribute to OL theory by integrating concepts and insights obtained from the configurational approach, from the CBV and from the strategic management, small business and IT literatures (Berta *et al.*, 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.

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

Figure 1 Dynamic CBV of explorative learning



empirically explore a research model that is based on the configurational approach, as presented in Figure 2 and as further explained below.

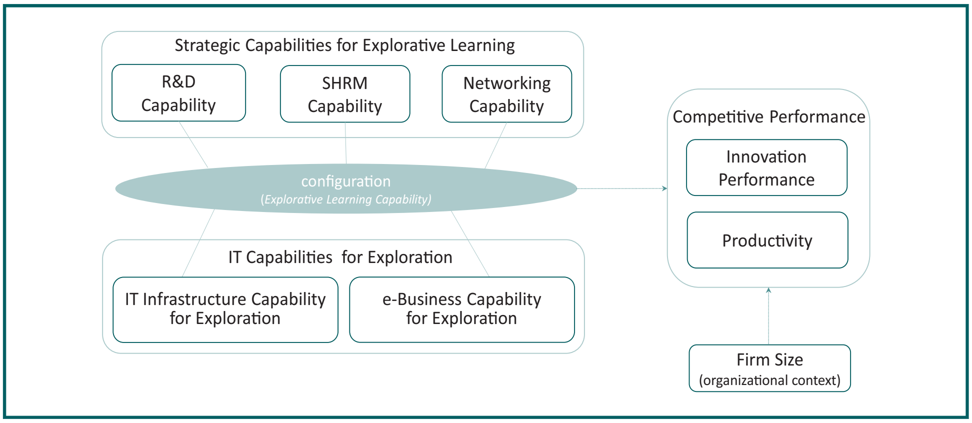
2.1 Information and technology capabilities for exploration

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" (Bharadwaj, 2000, p. 171).

2.1.1 Information and technology 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 *et al.*, 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 *et al.*, 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 enterprise resource planning (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 *et al.*, 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 and its knowledge management through its use of IT (Joshi *et al.*, 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).

Figure 2 Research model on industrial service SMEs' explorative learning capability



2.2 Strategic capabilities for explorative learning

Recalling that the firm's strategic capabilities have been found to shape its competitive performance (Hutton and Eldridge, 2019; Uwizeyemungu *et al.*, 2018), three such capabilities, namely 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 *et al.*, 2015) and as being paramount for the competitive performance of SMEs in a globalized economy (Kroon *et al.*, 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 Research and development 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, 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 *et al.*, 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; Khedaouria *et al.*, 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 *et al.*, 2017).

2.2.2 Strategic human resource management capability. The SHRM capability is defined as the firm's capacity to develop, motivate and empower human resources to meet strategic goals in a dynamic, turbulent and sometimes hostile environment (Khatri *et al.*, 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 *et al.*, 2016) and to be positively impacted by certain SHRM practices such as talent management (Oltra and Vivas-López, 2013; Hu *et al.*, 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 *et al.*, 2015) and conversely, the networking capability has been found to positively mediate the impact of the learning capability on competitiveness (Husain *et al.*, 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 *et al.*, 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 *et al.*, 2012; Onağ *et al.*, 2014; Salunke *et al.*, 2019) and on its productivity (Deng *et al.*, 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 *et al.*, 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 *et al.*, 2016; Hong and Oxley, 2016; Hwang *et al.*, 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 usual proxy, namely the R&D budget per employee (Barry, 2005). The SHRM capability was measured by assessing the mean level of development of 10 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.

4. Results

The research questions were answered by using fuzzy set qualitative comparative analysis (fsQCA), a 2nd-generation configurational analysis technique originally developed in political science for small sample sizes (Ragin, 2000). It has, as evolved, however, to deal with intermediate sample sizes (15 to 99 cases) such as ours and with large samples (Ragin, 2008). Succinctly described, fsQCA is an analytical technique that uses Boolean algebra for determining the different configurations of elements (variables) that generate the same outcome (Rihoux and Ragin, 2009). Consistent with configurational theory (Fiss *et al.*, 2013) and as opposed to covariance-based or component-based structural equation modeling (SEM) techniques such as EQS or PLS, the fsQCA technique assumes complex, nonlinear causality (Fiss, 2011) and allows for equifinality and causal asymmetry (Liu *et al.*, 2017).

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 *et al.*, 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; Plewa *et al.*, 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).

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

Research variable	Fuzzy set calibrations: Fully in	Cross-over	Fully out	Mean	SD	Minimum	Maximum
Strategic cap. for explorative learning							
R&D capability[a]	3,000	500	0	4,525	12,352	0	69,747
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

Notes: [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. 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.

4.1 Configurations for high innovation performance and high productivity

While we have first described fsQCA 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. combinations of causal conditions) and the outcome (Ragin, 2008). As the configurations (or solution sets) 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

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

Note: 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* *Consistency*	*Coverage*	*High productivity* *Consistency*	*Coverage*
Strategic capabilities 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

conditions (Pappas, Giannakos and Sampson, 2019). This table is sorted on the basis of the frequency and consistency, where frequency represents the number of observations for each possible configuration and consistency estimates “the degree to which cases correspond to the set-theoretic relationships expressed in a solution” (Fiss, 2011, p. 402). Given our intermediate-sized sample, we set the frequency threshold at 2; hence, all configurations with a frequency of 1 or 0 were deleted from further analysis. Furthermore, we applied the recommended threshold of 0.75 for consistency (Ragin, 2006); hence, for configurations below the consistency threshold, the outcome variable was set at 0 and for the rest at 1, given that these configurations are the ones that fully explain the outcome (Pappas *et al.*, 2019).

Then, the fsQCA method allows one to analyze the configurational elements that, together, are “sufficient” to produce the chosen outcomes (Ragin, 2008). That is, using Boolean algebra and counterfactual analysis, fsQCA effectuates a logical reduction of the truth table into three types of solutions that combine the causal conditions that are deemed “sufficient” to achieve the desired outcome, that is, parsimonious solutions, intermediate solutions and complex solutions [2]. Because of its difficult interpretation and poor applicability, the complex solution – which produces all possible configurations of conditions – is simplified into the parsimonious and intermediate solutions. The intermediate solution is obtained through counterfactual analysis on the complex and parsimonious solutions (Ragin, 2008). The parsimonious solution yields the “core” conditions while the “peripheral” conditions are those that are included in the intermediate solution but not in the parsimonious solution (Ragin, 2008). Therefore, “core” conditions are those found to strongly influence the outcome and cannot be left out from any configuration, while “peripheral” conditions have a lesser influence on the outcome, and thus, may be exchangeable (with other peripheral conditions) or even expendable (Fiss, 2011). For interpreting results, it is recommended to combine the parsimonious and intermediate solutions to identify core and peripheral conditions in the resulting configurations (Fiss, 2011).

In our case, this method was, thus, used twice, one for each outcome: first for finding the explorative learning capability configurations for high innovation performance and second, for identifying explorative learning capability configurations for high productivity. As presented in Table 4, the initial results of the fsQCA analysis present 10 parsimonious solutions overall (for the two outcomes), each in the form of a Boolean expression (where the * symbol signifies the logical AND operation and ~ signifies NOT). In terms of the

Table 4 Configurations of core conditions sufficient for competitive performance

Parsimonious solutions (configurations)	*Raw coverage*	*Unique coverage*	*Consistency*
High innovation performance solutions			
1. R&D * eBUS	0.435	0.076	0.774
2. R&D * ~NETW	0.343	0.033	0.713
3. ~ORGSIZE * R&D	0.323	0.005	0.655
4. ~ORGSIZE * SHRM* ~eBUS	0.171	0.007	0.647
5. ~ORGSIZE * SHRM * ~NETW	0.244	0.021	0.645
Solution coverage = 0577		Solution consistency = 0.632	
High productivity solutions			
1. SHRM * ~NETW * ~eBUS	0.246	0.127	0,762
2. ORGSIZE * NETW * eBUS	0.262	0,083	0.746
3. ~ORGSIZE * ~ITinf	0.246	0.020	0.663
4. SHRM * ~ITinf	0.287	0.005	0.763
5. NETW * ~ITinf	0.243	0.000	0.797
Solution coverage = 0.550		Solution consistency = 0.676	

Note: Legend: ORGSIZE = firm fize; SHRM = SHRM capability; R&D = R&D capability; NETW = networking capability; ITinf = IT infrastructure capability for exploration; eBUS = e-Business. Capability for exploration innovation performance outcome, the analysis first produced five parsimonious solutions or in other words, five causal combinations of core conditions associated to a high level of innovation performance. With respect to the productivity outcome, the analysis also yielded five parsimonious solutions of core conditions. For clarification purposes, one may interpret the first parsimonious solution as follows: SMEs that have developed a strong R&D capability and a strong e-business capability for exploration are likely to achieve a high level of innovation performance. In addition, one may interpret the last solution as follows: firms that have developed a strong networking capability and have not developed a strong IT infrastructure capability for exploration are likely to achieve a high level of productivity.

In demonstrating equifinality and as presented in Table 5, further results of the fsQCA analysis identify identify several intermediate solutions. Note that Table 5 uses the notation introduced by Ragin (2008): black circles represent the presence of a condition, circles with a cross-out indicate the absence of the condition, large circles represent core conditions, small circles represent peripheral ones and blank spaces represent an immaterial condition (or a situation characterized by a "do not care" in which one condition may be either present or absent without altering the outcome. More specifically, there are two intermediate solutions or causal configurations equally associated to high levels of innovation performance (HI1 and HI2) and four sets equally associated to high levels of productivity (HP1, HP2, HP3a and HP3b). 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).

One should note that, as previously explained, all parsimonious solutions (cf. Table 4) are embedded in the intermediate solutions and that all elements of the parsimonious solutions are core conditions that have a strong causal relationship with innovation performance or productivity (Fiss, 2011). In contrast, causal elements that appear only in the intermediate solutions are deemed to be peripheral conditions that, given their weaker relationship with the two outcomes of interest, nonetheless contribute to the realization of these outcomes by complementing the core conditions[3].

Table 5 Configurations for high innovation performance and productivity

Configuration (intermediate solution) configurational element	*High innovation performance HI1*	*HI2*	*HP1*	*High productivity HP2*	*HP3a*	*HP3b*
Strategic capabilities 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	0.834	0.780	0.835	0.822	0.779	0.736
Raw coverage	0.314	0.255	0.152	0.215	0.179	0.120
Unique coverage	0.093	0.034	0.050	0.102	0.084	0.025
Overall solution consistency	0.779			0.800		
Overall solution coverage	0.348			0.402		

Note: Legend. ●: presence of a core condition; •: presence of a peripheral condition; ⊗: absence of a core condition; ⊗: absence of a peripheral condition; blank: immaterial condition ("do not care")

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

By looking at the commonalities and differences shown between the HI1 and HI2 configurations, we can provide added insight on the components of explorative learning and the determinants of innovation performance in SMEs. First, the strong complementarity of R&D, SHRM and IT capabilities for exploration is shown to constitute the bedrock upon which SMEs may develop their explorative learning capability to become highly innovative. Second, small-sized – in contrast to medium-sized – firms may develop their explorative learning capability and become highly innovative by allocating initially more resources to their IT infrastructure than to their e-business capabilities for exploration.

The first two high-productivity configurations, HP1 and HP2, highlight the primary importance of having a strong networking capability. Furthermore, HP1 is under the condition that the firm has a strong SHRM capability, does not have a strong IT infrastructure capability for exploration and applies to small-sized enterprises, whereas HP2 includes a strong e-business capability for exploration as an additional core condition. The last two high productivity configurations, HP3a and HP3b, are characterized by the presence of the same three core conditions, that is, a strong SHRM capability and the absence of strong networking and e-business capabilities for exploration and by the presence of a strong IT infrastructure capability for exploration as a peripheral condition. Also, whereas HP3a applies to medium-sized enterprises, HP3b requires a strong R&D capability as a peripheral condition and is irrespective of firm size.

Here again, the commonalities and differences between HP1, HP2, HP3a and HP3b may be observed to provide further insight on the components of explorative learning and the determinants of productivity in SMEs. First, having a strong SHRM capability is a condition that is shared by all four configurations. In addition, to complement this capability, these firms may develop either their networking or e-business capabilities for exploration (HP1 and HP2), be they small or medium-sized or their IT infrastructure capability for exploration (HP3a and HP3b). There, thus, appears to be two different "ways" for SMEs to develop their explorative learning capability and, in turn, become highly productive, one resting upon the complementarity between their SHRM, networking and e-business capabilities for exploration, the other resting on their SHRM and IT infrastructure capabilities for exploration.

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 6, 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 a strong R&D capability and a strong e-business capability for exploration. Also, NHI1 is

Table 6 Configurations for non-high innovation performance and productivity

Configuration (intermediate solution) configurational element	*Non-high innovation performance NHI1*	*Non-high innovation performance NHI2*	*Non-high productivity NHP1*
Strategic capabilities 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

Notes: Legend. ●: presence of a core condition; •: presence of a peripheral condition; ⊗: absence of a core condition; ⊗: absence of a peripheral condition; blank: immaterial condition ("do not care")

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 and the presence of strong R&D, networking and explorative e-business capabilities, with the added peripheral condition that the firm be small-sized.

4.3 Predictive validity of the configurations

As recommended by Woodside (2013), the predictive validity of the configurations obtained from the fsQCA analysis was tested by dividing the sample randomly into two subsamples of equal size (Subsample A: $n = 46$, Subsample B: $n = 46$). The configuration analysis was then carried out again, based only on the data from the companies belonging to Subsample A. The seven configurations, thus, obtained were used subsequently to predict the level of competitive performance of the firms in Subsample B. As presented in Table 7, the levels of consistency and coverage of the configurations applied to the second subsample are comparable for the most part to those from the first, which indicates an adequate level of predictive validity (Pappas *et al.*, 2019). By way of example and as presented in Figure 3, Configurations 1 and 4 from Subsample A are plotted against the respective result variable (innovation performance and productivity) for the firms in Subsample B.

5. Discussion

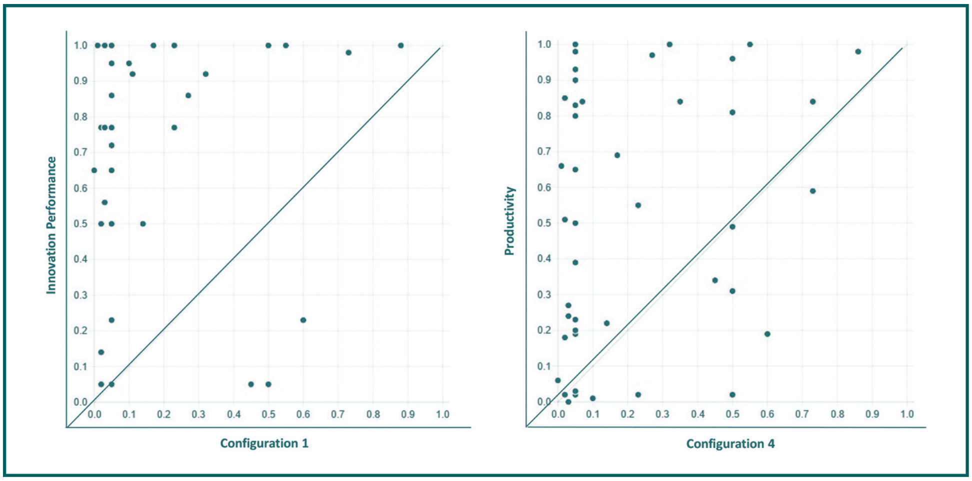
In answering the research question, a fsQCA analysis allowed us to unveil different capability configurations, that is, six causal "recipes" of explorative learning capabilities of industrial service SMEs to attain high levels of innovation performance and productivity. In line with configurational theory 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

Table 7 Test of the predictive validity of the configurations

Complex solutions (configurations)	*Solutions obtained from Subsample A* *Raw coverage*	*Consistency*	*Solutions applied to Subsample B* *Raw coverage*	*Consistency*
High innovation performance solutions				
1. ORGSIZE * R&D * SHRM * ITinf * eBUS	0.217	0.837	0.240	0.827
2. R&D * SHRM * NETW * ITinf * eBUS	0.229	0.876	0.284	0.844
3. ~ORGSIZE * R&D * SHRM * ~NETW * ITinf * ~eBUS	0.113	0.847	0.065	1.000
Solution coverage = 0.313		Solution consistency = 0.810		
High productivity solutions				
4. ORGSIZE * SHRM * NETW * ITinf * eBUS	0.215	0,822	0.323	0.814
5. ~ORGSIZE * ~R&D * SHRM * NETW * ~ITinf * eBUS	0.129	0.878	0.209	0.872
6. ORGSIZE * ~R&D * SHRM * ~NETW * ITinf * ~eBUS	0.155	0.885	0.099	0.967
7. ~ORGSIZE * R&D * SHRM * ~NETW * ITinf * ~eBUS	0.097	0.855	0.063	0.937
Solution coverage = 0.393		Solution consistency = 0.843		

Notes: Legend: ORGSIZE = firm size; SHRM = SHRM capability; R&D = R&D capability; NETW = networking capability; ITinf = IT infrastructure capability for exploration; eBUS = e-Business. Capability for exploration

Figure 3 Example of testing the predictive validity of the configurations



than being linearly predicted by each of its individual components, as it would be in the variance-based approach (i.e. the more traditional causal or "path" analyzes based on SEM) (Ortiz de Guinea and Webster, 2017).

With regard to the capability configurations unveiled, one first notes that the SHRM capability is present as a core or peripheral condition in all configurations of both high innovation performance and high productivity and could, 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 dissimilar capability configurations. One might also surmise that productivity, as opposed to innovation, would benefit more from exploitative rather than explorative learning and particularly from IT capabilities for exploitation such as ERP systems and e-commerce applications.

In regard 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 productivity, that is, it may 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. 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 (HP3a and HP3b). 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 *et al.*, 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 behaviors (such as their strategic orientation and environmental uncertainty). This lens is also likely to provide a better understanding of the specific IT and OL capabilities to be embedded into the digital transformation strategy of industrial service enterprises in facing new competitive challenges.

Though the fsQCA-based configurational approach may be viewed as being complementary to the SEM-based universalistic approach for OL research purposes

(Cabrilo and Dahms, 2018; Nguyen *et al.*, 2019), our study found that there is “no best way” for industrial service SMEs to achieve high levels of competitive performance by enabling their explorative learning capability with IT. This constitutes a further methodological contribution, in line with prior empirical studies on the strategic alignment of the firm’s organizational capabilities and managerial practices (Dean and Snell, 1996; Ketokivi and Schroeder, 2004; Ordanini *et al.*, 2014). As our study confirmed a new, “best practices” are rarely found to exist in the small business field and the configurational approach, thus, provides a fuller explanation of the competitive performance of SMEs than the universalistic approach.

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 operationalizations of IT capabilities that have generally used 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 both the IT and general management literatures, as most management studies have explored the strategic capability-performance link without including the IT capability dimension, while IT research often ignores strategic capabilities when investigating the IT-capability-performance link link (Orlikowski, 2010; Zammuto *et al.*, 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 *et al.*, 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 innovation performance and productivity. 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. In addition, 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 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 analyzes because the former analytical approach provides managers with equally-effective strategic options for the digital transformation of their firm whereas the latter approach only yields one best way.

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).

6. Conclusion

A configurational approach allowed us to identify the explorative learning capability configurations that enable industrial service firms to achieve high levels of innovation performance and productivity. These configurations were characterized in terms of the firms' IT capabilities for exploration (including e-business and infrastructure capabilities), strategic capabilities for explorative learning and firm size. In further empirical investigations of the OL capability, future research could rather focus on exploitative learning to better help industrial service firms in dealing with the increasing complexity of their business environment. In addition, 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. Finally, given the present situation of SMEs with regard to the emergence of Industry 4.0 (Castelo-Branco *et al.*, 2019; Moeuf *et al.*, 2018) and the ensuing managerial challenges faced by these firms (Fakhar-Manesh *et al.*, 2020), future studies should investigate how the components of Industry 4.0 such as cloud computing, big data and the internet of things may be harnessed to further enable OL processes in these organizations.

Notes

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).

2 Counterfactual analysis distinguishes "difficult" counterfactual cases from "easy" ones, the former being empirically unobserved causal combinations that omit a condition and the latter being combinations that add a condition (Ragin, 2000).

3 Ragin (2008, p. 204) indicates that peripheral conditions "are "complementary" or "contributing" conditions in the sense that they make sense as important contributing factors and can be removed from the solution only if the researcher is willing to make assumptions that are at odds with existing substantive and theoretical knowledge."

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).

5 The necessity analyzes 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).

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Appendix: 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	☐