Improving SMEs' Service Innovation Performance in the Face of Uncertainty Through IT Ambidexterity: A Configurational Approach

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Abstract

Taking a configurational approach, this paper investigates the causal configurations of IT ambidexterity, dynamic capabilities, and environmental uncertainty that are associated to service innovation performance in SMEs. Results from a qualitative comparative analysis (QCA) of 63 industrial service SMEs show that these firms attain service innovation performance when they dispose of an IT capability for exploration, accompanied by an IT capability for exploitation in one configuration, whereas the IT capability for exploitation is absent in other configurations. These results also support the implications of the configurational approach: different configurations of the three elements equally lead to service innovation performance, the same element can both enable or inhibit service innovation performance, configurations leading to the outcome are different than those leading to its absence, and configurations might show different permutations of peripheral conditions. Such results are discussed in light of the current literature and implications for research and practice are explained.

1. Introduction

Small and medium-sized enterprises (SMEs) are paramount for the economy. In the European Union and the U.S., they represent around 99 percent of all firms accounting for more than 60% of all jobs [1]. Despite their importance, the strategic literature on these types of firms is scarce when compared to that of bigger firms [1]. Nowadays, in the case of SMEs, their competitiveness in a global economy that has become knowledge-based (instead of product-based) is mostly determined by their innovation performance [2], and by their service innovation performance in particular [3].

Further, SMEs face conflicting demands for exploitation and innovation, and thus, they have to be IT ambidextrous – capable of both exploit and explore with IT capabilities [4] – if they are to improve their performance [4]. IT ambidexterity has been considered either a dynamic capability (DC)[1] [6] or an antecedent to other DCs (e.g., organizational agility) [7], and recent calls for research exist into the specific form of IT ambidexterity needed and its effects on performance [8, 9] in different contexts (e.g., SMEs) [10].

At the same time, when studying strategic constructs (i.e., IT ambidexterity), the literature points to certain gaps that this study seeks to address. First, given the divide between the strategic literatures of IT and management [11, 12], IT-related constructs need to be studied in conjunction with other organizational ones (i.e., other DCs) so synergies can be captured [13]. Second, there is a need to include the firm's environment (i.e., environmental uncertainty) when studying the DCs-performance link since the majority of research fails to account for this construct [14]. Finally, because most research to date has taken a 'unifinal' approach leading scholars are calling for configurational approaches capable of accommodating for 'equifinality'.

Our paper, thus, focuses on the study of IT ambidexterity (i.e., IT for exploitation and IT for exploration) along with two other key strategic constructs – organizational-based DCs and environmental uncertainty – as they affect the service innovation performance of industrial service SMEs from a configurational approach. This phenomenon (i.e., the interplay between IT ambidexterity, DCs, and environmental uncertainty) has been termed as the *digital ecodynamics* of the firm [15]. The configurational approach is based on the premise that it is the holistic patterns and combinations of variables – called 'causal terms'[2] – that influence preferable

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[1] DCs refer to the ability to reconfigure resources and competencies in order to rapidly respond to changing environmental conditions [5].
[2] Our use of terms about causality (i.e., 'causal terms') is consistent with the accepted terminology employed in configuration theory [e.g.,

15]. In doing so, we do not claim the 'causality' or 'net effects' thinking that dominates variance-based quantitative social science. Instead, configuration theory allows for the study of 'INUS' conditions (please see Ortiz de Guinea & Webster [16] for a discussion on causality and an explanation of 'INUS' conditions).

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outcomes [15]. Such configurations allow for complex and nonlinear relations [17] as well as for "equifinality" [18]. Simply, equifinality is the possibility of reaching a particular outcome through different paths and from different starting conditions [18]. That is, there could be *different* constellations of DCs, IT ambidexterity and environmental uncertainty that, together, lead to the same level of service innovation performance. Therefore, our exploratory research question is as follows: *What are the different configurations of digital ecodynamics that lead to high service innovation performance in industrial service SMEs?*

2. Configuration view of IT ambidexterity

Integrating the insights from the dynamic capability-based view, from the configurational approach and from the IT capabilities literature stream, we posit that the firm's service innovation performance does not depend on direct relations with each element of its digital ecodynamics alone but on specific configurations of the three elements together. A configuration is a specific combination of causal elements or conditions (in our case, IT ambidexterity, DCs, and environmental uncertainty) that together generate the outcome of interest (in our case, service innovation performance) [19]. The basic idea is that there should be an appropriate 'fit' between the elements of digital ecodynamics that equally lead to service innovation performance. This reasoning leads to a conceptual framework based on fit logic and configuration theory (see Figure 1 below), further explained in the following sections.
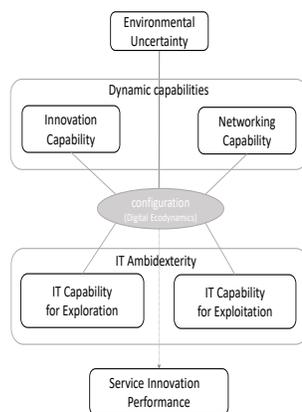
Figure 1: Configuration model of IT ambidexterity for service innovation

2.1. Digital ecodynamics of service innovation

Since DCs are multifaceted [20], two dimensions of DCs deemed most important for service innovation are

studied here: innovation capability and networking capability. These two DCs have been identified in the literature as being paramount for SMEs' performance [21]. In the services sector, innovation capability refers to the firm's ability to apply its knowledge, resources and competencies to innovation activities in order to develop new services or improve existing ones [22]. The firm's innovation capability is one DC that determines competitive performance [23]. Networking capability which is related to innovation capability [24], is another DC that is believed to impact performance [24], especially for small businesses [25]. It refers to the capability of managing business partnerships, the main idea being that such collaborations are established in order to improve performance [26].

To conceptualize the notion of IT ambidexterity, one must start by describing its components, that is, IT capabilities. These capabilities are the ability to "mobilize and deploy IT-based resources in combination or co-present with other resources and capabilities" [27:171]. More specifically, the firm's IT capabilities include tangible IT assets such as the technological platforms that constitute its IT infrastructure capabilities [28]. IT capabilities also include the IT competencies that allow a firm to enable its intra- and inter-organizational business processes as well as its knowledge management through its use of IT, namely e-business capabilities [29]. Now, in order to capture the firm's strategic IT priorities, certain IT infrastructure and e-business capabilities may be categorized as being IT capabilities 'for exploitation', whereas others may be categorized as IT capabilities 'for exploration', following Levinthal and March's [30] conceptualization of how firms pursue either exploitation for efficiency or exploration for innovation, or both simultaneously. This categorization refers in particular to the concept of IT ambidexterity: the firm's ability to use IT capabilities for both exploration and exploitation in the pursuit of performance [4].

The third component of the firm's digital ecodynamics, its environmental uncertainty, is defined as the extent to which the environment in which a firm operates is perceived to remain basically the same over time or is in a continued process of change [31]. Finally, the desired outcome of a tight fit between the three components of the firm's digital ecodynamics, its service innovation performance, is defined as the extent to which a company renews its service base for existing and potential customers [32, 33].

2.2. Configurational approach

The configurational approach proposed herein stems from 'open systems' theory, which puts the emphasis on the interactions of the elements of a system and its

environment, and in particular on the architecture of the firm's DCs [18]. The configurational approach to organizational analysis is thus better suited to capture holistic systemic effects than variance- and process-based approaches [34]. One paramount aspect of this approach is equifinality, or the property of open systems by which it is possible to reach a particular outcome through different paths [18]. Now, within the context of SMEs, 'suboptimal' equifinality is likely to apply, as these firms have only a limited set of alternative structural options to meet conflicting demands for exploitation and exploration [35]. Thus, engaging exclusively in one or another should have detrimental effects on their performance: exclusive exploration will prevent a firm from gaining returns on its knowledge while exclusive exploitation will eventually render the firm's services obsolete [22]. Yet some researchers emphasize that firms can attend both demands at the same time [36], while others affirm that companies can only attend competently to one functional demand at a time [37]. In any case, the pressure to pursue the two conflicting demands is exacerbated in industrial service SMEs that face demands for exploiting services with well-defined processes as well as for developing new services that will quickly respond to market changes.

The concept of equifinality is closely linked to the notion of 'fit' [38], which can be seen as the search for aligning the organization with its environment and as an arrangement of its resources and capabilities so as to support such alignment [17]. Configurational approaches that combine many elements, such as it is the case here (i.e., digital ecodynamics), are those that have been preferred in order to empirically asses fit [18]. Moreover, there exist different types of fit, depending on the functional form of the fit-based relationship (i.e., prevision) and the number of variables in the fit equation. In this study, a 'fit-as-gestalts' perspective is taken [38] because multiple variables are involved, thus, the degree of prevision must be relaxed and there is an absence of a priori evaluation criterion. Gestalts are defined "in terms of the degree of internal coherence among a set of theoretical attributes" [38:432]. According to Miller and Friesen [39], the pattern of elements forming the gestalts tap into the notion of equifinality. Such gestalts provide feasible sets of internally consistent and equally effective configurations [38].

Another characteristic of configurational approaches that differs greatly from the more traditional correlation type research is that of causal asymmetry [15, 40]. Causal asymmetry is the possibility that the causes leading to the existence of the outcome of interest will be different than those leading its absence [15, 40]. That is, elements might have different causal roles depending on the configuration. Thus, unlike the more common causal symmetry found in variance-based studies, configurational approaches accommodate nonlinearity in causation through causal asymmetry [13].

The configurational approach can also distinguish between the elements of a configuration that are critical and those that are less important [15]. The criticality of each element is ascertained in terms of its 'coreness' [41:536]. More specifically, Fiss [15] defines core elements as those for which the evidence for a causal relationship with the outcome of interest is strong while peripheral elements are those for which the evidence indicates a weak cau,sal relationship to the outcome. Therefore, configurations are formed by causal elements that are more or less critical for the outcome. Core and periphery elements are also related to the notion of neutral permutations of a given configuration [15]. Neutral permutations mean that "within any given configuration, more than one constellation of different peripheral causes may surround the core causal condition, and the permutations do not affect the overall performance of the configuration" [15:398]. That is, there exists the possibility that a configuration might show different permutations of peripheral conditions or elements that do not alter the connection between all the configuration's elements and the outcome of interest.

Although departing from the resource-based view (RBV) and the dynamic capability-based view (DCV), the configurational approach complements – and gains insights from – these two views. From a configurational viewpoint, when relating configurations to organizational performance, the basic assumption is that performance may reside in the integrative mechanisms that ensure complementarity among the three elements of the firm's digital ecodynamics: its environmental uncertainty, IT ambidexterity, and dynamic capabilities [42]. In fact, it is believed that the firm's integration competencies increase the development and use of its DCs, which in turn enhance performance [43]. Relating this to the RBV and DCV, one can think of digital ecodynamic configurations as nonlinear combinations (of the three elements) that are hard to imitate [44]. Here the concept of fit is crucial as one assumes that digital ecodynamic configurations are leveraged to the extent that their components are in a state of coalignment [45]. It would thus be these 'coaligned' configurations that equally lead to innovation performance.

In summary, our propositions are that, in a suboptimal equifinality context, P1) disparate digital ecodynamic configurations are equifinal in leading to high service innovation performance, P2) the same element can either enable or inhibit service innovation performance depending on how it is configured with other elements, P3) the configurations leading to high service innovation performance differ from those leading to the absence of this performance, and P4) the

configurations may show different permutations of peripheral elements.

3. Methodology

The data used in the study were obtained from a database created by a university research center for benchmarking purposes, containing information on 63 SMEs located in the province of Quebec, Canada, and operating in the industrial services sector. These firms offer to the manufacturing industry high-knowledge value-added services, high-knowledge support services and technical/functional services that are equipment-based and rely on less highly educated personnel, and in areas such as marketing, production, logistics, human resources, information systems and technologies, finance and accounting. The database was created by having the SMEs' CEO and functional executives such as the marketing managers, accounting/finance manager and IT manager fill out a 20-page questionnaire to provide wide-ranging information on the competitive performance and business practices of their firm. In exchange for this information, the SMEs were provided with a full comparative diagnostic of their strategic positioning and competitive vulnerability.

Environmental uncertainty was measured by a 5-point Likert scale initially validated by Miller and Dröge [46]. Innovation capability was estimated from the frequency with which activities such as idea generation, prefeasibility, and analysis of ideas, customer information (suggestions, complaints), competitors' offerings and economic trends are undertaken [47, 48]. Networking capability was measured by the number of business collaborations established by the firm in matters of R&D and service development, operations, and marketing [49]. IT ambidexterity was measured through the capture of IT infrastructure and e-business capabilities. The SME's IT infrastructure and e-business capabilities were assessed through two summative index variables obtained from the identification of the various IT-based systems implemented by the firm, each system being assigned as being either mainly for exploitation (e.g., ERP) or for exploration (e.g., computer-aided design) [29, 31, 50, 51]. Finally, service innovation performance was measured by the average percentage of sales attributed to new or modified services, this measure being appropriate to the reality of SMEs [52] and thus, commonly used [53].

4. Results

The research variables' reliability, descriptive statistics and intercorrelations are presented in Table 1. Note that IT for exploration and IT for exploitation, are intercorrelated. Note also that these and networking capability are operationalized through 'index' rather than 'scale' measures [54]. An index variable tends to follow a Poisson-type rather than a normal distribution, that is, to be right-skewed if the mean is small. Moreover, an index regroups elements not expected to be highly intercorrelated, hence the inappropriateness of Cronbach's α coefficient to test its reliability [55].

We investigated our configuration framework using fuzzy set qualitative comparative analysis (fsQCA), a second-generation configurational analysis technique [56] developed to deal with small sample sizes [57, 40]. In a nutshell, fsQCA is an analytical technique that uses Boolean algebra for determining the different configurations of elements that generate the same outcome [40, 56]. In this technique each element is considered a fuzzy set. Fuzzy sets have different degrees of membership into the set [40]. We used direct calibration of the raw data for identifying the three points of membership based on the scales' (or indexes') values because it is the recommended method when Likert scales and indexes have been used for data gathering [58].

4.1. Necessity analysis

The study of necessary conditions (or elements/variables) is usually the first step in fsQCA analysis. A condition is necessary when its consistency score is above 0.9 [53]. Consistency measures the extent to which members in a condition also show membership in the outcome [59]. That is, they represent the proportion of fuzzy set scores in a condition (across all cases) that are less than equal to the corresponding scores in the outcome [59]. As it is shown in Table 2, consistency scores indicate that none of the conditions alone is necessary for the outcome.

4.2. Configurations for high service innovation performance

Up until now, we have described fsQCA in terms of relationships between the case sets constructed for individual elements (or conditions) and for the outcomes. However, the major analytical contribution of fsQCA resides in its ability for evaluating relations between configurations (that is, combinations of condi-

Variable	α^a	mean	stdev	min	max	intercorrelations					
						1.	2.	3.	4.	5.	6.
1. Environmental Uncertainty	.60	2.4	0.7	1.0	4.2	-					
2. Innovation Capability	.74	2.8	0.5	1.4	4.0	.04	-				
3. Networking Capability	-	3.4	3.4	0	14	.16	.22	-			
4. IT Capability for Exploration	-	4.1	2.0	0	9	.27	.36	.34	-		
5. IT Capability for Exploitation	-	3.1	1.5	0	7	.14	.27	.01	.49	-	
6. Service Innovation Performance[b]	1.0	0.234	0.300	0.00	1.00	-.04	.21	.12	.36	.14	-

[a] Cronbach's alpha coefficient of reliability [inappropriate for index variables]
[b] Sales of new or modified services / total sales

Table 1. Reliability, descriptive statistics and intercorrelations of the research variables

Configurational elements:	High Service Innovation Performance	
	Consistency	Coverage
Environmental Uncertainty	.457	.653
Innovation Capability	.576	.642
Networking Capability	.618	.573
IT Capability for Exploration	.734	.621
IT Capability for Exploitation	.644	.597

Table 2. Analysis of necessary elements

tions) and the outcome(s) [40, 56]. Table 3 shows the results of the fsQCA analysis with the causal configurations for the presence and absence (indicated by '~') of high service innovation performance[3].

With respect to the presence of the outcome, the analysis yields two different configurations leading to high service innovation performance. The raw coverage[4] is between .262 and .316, the unique coverage[5] is between .124 and .177, and the consistency[6] values for all the configurations are above .770. According to Ragin [56] a consistency score below .75 indicates substantial inconsistency, which is not the case care. Finally, the overall solution consistency is .750 and the overall solution coverage[7] is .440. The first configuration is characterized by the presence of IT for exploration (core condition), along with the absence of innovation and networking capabilities (core conditions), and IT for exploitation (peripheral condition) in both uncertain and stable environments. The second configuration is characterized by firms facing uncertain environments with IT for exploitation

(core conditions), along with innovation and networking capabilities as well as IT for exploration (peripheral conditions). These results first show that disparate digital ecodynamic configurations are equifinal in leading to high service innovation performance (*confirmation of P1*). The results also show that the same configurational element can either enable or inhibit innovation performance, that is, IT for exploitation inhibits high service innovation performance in the first configuration while it enables it in the second one (*confirmation of P2*).

With respect to the absence of the outcome, the analysis yields two different configurations. The first is characterized by the absence of networking capability and IT for exploration (core conditions), along with the absence of innovation capability (peripheral condition), regardless of IT for exploitation and environmental uncertainty. The second configuration involves firms lacking environmental uncertainty and IT for exploration (core conditions), as well as lacking innovation capability and IT for exploitation (peripheral conditions), regardless of networking capability. Thus, configurations leading to the presence of service innovation performance are different than those leading to its absence (*confirmation of P3*).

4.3. Configurations for very high service innovation performance

Table 4 shows the results for the presence and absence ('~') of a different outcome, that is, 'very high' (instead of "high") service innovation performance[8], obtained by recalibrating the performance data. The resulting configurations can be classified into first and

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[3] The calibration for high service innovation performance is as follows: .30 for full membership, .15 as the cross-over point, and 0 as the threshold for nonmembership.

[4] The proportion of cases (in terms of fuzzy membership value) that can be described by the configuration [40].

[5] The proportion of cases (in terms of fuzzy membership value) that can be described by a configuration appearing in a solution set but cannot be described by any other configuration from the set [40].

[6] The extent to which a given combination is a sufficient condition for the outcome [59].

[7] The proportion of cases (in terms of fuzzy membership value) that can be described by at least one configuration in a solution set [40].

[8] The calibration for very high service innovation performance is as follows: .40 for full membership, .15 as the cross-over point, and 0 as the threshold for nonmembership.

Configuration element	High Service Innovation Performance		~High Service Innovation Performance	
	1	**2**	**1**	**2**
Environmental Uncertainty		●		⊗
Innovation Capability	⊗	•	⊗	⊗
Networking Capability	⊗	•	⊗	
IT Capability for Exploration	●	•	⊗	⊗
IT Capability for Exploitation	⊗	●		⊗
Conditions tested				
Consistency	.770	.780	.782	.782
Raw coverage	.316	.262	.360	.381
Unique coverage	.177	.124	.100	.121
Overall solution consistency	.750		.800	
Overall solution coverage	.440		.481	

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

Table 3. Causal configurations for the presence and absence (~) of high service innovation performance

Configuration element	Very High Service Innovation Performance	~ Very High Service Innovation Performance		
	1	**1a**	**1b**	**1c**
Environmental Uncertainty	⊗		⊗	●
Innovation Capability		⊗	⊗	⊗
Networking Capability	⊗	⊗		
IT Capability for Exploration	●	⊗	⊗	⊗
IT Capability for Exploitation	⊗		⊗	●
Conditions tested				
Consistency	.792	.914	.916	.896
Raw coverage	.302	.068	.380	.255
Unique coverage	.302	.186	.051	.030
Overall solution consistency	.792	.889		
Overall solution coverage	.302	.523		

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

Table 4. Causal configurations for the presence and absence (~) of very high service innovation performance

second-order solutions based on their neutral permutations and equifinality of the different core conditions exhibited [15]. With respect to the presence of very high innovation performance, there is a high-order configuration characterized by the presence of IT for exploration (core condition), the absence of

networking capability and IT for exploitation (core conditions), in environments without uncertainty (peripheral condition), regardless of innovation capability ('don't care' condition). With respect to the absence of very high innovation performance, there is a second-order configuration characterized by firms lacking IT for exploration (core condition). Such firms can be further characterized by either a) their lack of innovation capability and networking capability (peripheral conditions), b) their lack of environmental uncertainty, innovation capability and IT for exploitation (peripheral conditions), or c) their operating in uncertain environments with IT for exploitation but without innovation capability (peripheral conditions). These results show that digital ecodynamic configurations can show different permutations of peripheral conditions (*confirmation of P4*).

5. Discussion

The purpose of this exploratory research was to determine the causal conditions associated with the digital ecodynamic configurations that enable (and do not enable) SMEs to attain high (and very high) service innovation performance from a configurational approach and with special attention to IT ambidexterity. In doing so, this study's findings contribute to the literature in several ways. First, research on ambidexterity holds two opposing views: some posit that firms should be ambidextrous, i.e. should focus on both exploration and exploitation simultaneously [36], while others argue that organizations need to focus on either exploration or exploitation, achieving ambidexterity by sequentially alternating between the two [37]. Our configurational approach suggests that these two conflicting views might each hold some truth. According to our results, firms that pursue solely IT for exploration can attain a high level of service innovation performance (in the absence of a networking capability, of an innovation capability and of IT for exploitation); as well, these firms can attain a very high level of service innovation performance (in the absence of environmental uncertainty, networking capability, and IT capability for exploitation). Firms that possess both IT capabilities for exploration and exploitation can also attain high service innovation performance in uncertain environments (when accompanied by an innovation capability and a networking capability). Furthermore, the absence of an IT capability for exploration is a core condition preventing SMEs to attain high and very high levels of service innovation performance. By allowing for equifinality and causal asymmetry, our configurational approach thus,

provides a starting point from which to start reconciling opposing views about IT ambidexterity: IT for exploration is key in leading to (very) high service innovation performance in SMEs, and can be combined with IT for exploitation in uncertain environments when innovation and networking capabilities are in place. As a result, this explorative study answers calls for research on IT ambidexterity with more systemic, holistic and non-linear approaches that allow for a deeper understanding of the firm's digital ecodynamics [10], that is, of the interplay between the firm's IT capabilities for exploration and for exploitation, its dynamic capabilities and environmental demands for service innovation performance [9].

Second, within the strategic management and IS research domains, efforts have been made to explain how IT-related capabilities and DCs lead to high organizational performance [27, 35, 60]. Most of this literature has taken a 'unifinal' approach based on the 'best practices' assumption that there is one best way in which these elements may be combined to achieve performance. Our results, in contrast, suggest that DCs (i.e., innovation and networking capabilities) and IT capabilities for exploration and exploitation can affect innovation performance in different ways, depending on how these elements are configured in relation to the environment in which the firm operates.

Third, most strategic management studies have explored the dynamic capabilities-performance link without including IT-related constructs, while the reverse is true for most IS studies with regards to the IT capabilities-performance link [11, 12]. Thus, our results contribute to the literature by showing the synergetic effects of the elements comprising digital ecodynamic configurations that lead to high or very high service innovation performance.

Fourth, empirical research on the relation between IT capabilities and performance and between DCs and performance has yielded contradictory results [e.g., 14, 27, 35, 60]. Our results resolve these contradictions by showing that the contribution of DCs and IT capabilities to service innovation performance depends on how these elements of the firm are configured with each other and the environment.

Fifth, most research on the IT capabilities-performance and the DCs-performance links does not account for the environment, something "surprising" [14:2953]. Thus, our study contributes to the literature by demonstrating environmental uncertainty to be a core element of digital ecodynamics.

Finally, the relation between DCs and performance has been characterized as being "complex" and unexplainable by simple direct effects [61:42]. Thus, some researchers argue that an organizational outcome

of interest rarely results from single causal factors [62] and thus call for organizational research to take a configurational approach [13, 34]. Our exploratory study contributes to this research stream by taking such an approach that provides a starting answer as to what configurations of DCs, IT capabilities, and the environment do and do not attain performance. Furthermore, our findings corroborate the proposed implications of using a configurational approach to study the digital ecodynamics of SMEs: a) equifinality, b) the same element can either enable or inhibit high service innovation performance, c) causal asymmetry, d) configurations can show permutations of peripheral conditions.

Our exploratory study also has implications for practice. It provides managers of industrial service SMEs and those who assist them with different digital ecodynamic configurations that may be emulated with the purpose of improving the firm's innovation performance. That is, given the resources at the disposal of these SMEs, they can envisage the successful configuration that best fits their specific environmental conditions. And given causal asymmetry, they can avoid configurations that lead to the absence of service innovation performance.

6. Conclusion

In summary, a QCA-based approach allowed us to identify causal configurations that associate the digital ecodynamics of industrial service SMEs to high and very high levels of service innovation performance. These configurations were characterized in terms of the firms' environmental uncertainty, dynamic capabilities and IT ambidexterity. Our study is not free of limitations however. Although our sample size is enough for performing fsQCA, its representativeness might be limited as these are firms that have chosen to undertake a benchmarking exercise [63]. Also, ours is a cross-sectional study and as such, delayed effects on performance of the configurations cannot be ascertained.

In further exploring the digital ecodynamics of SMEs, future research could include other salient dynamic capabilities, such as the absorptive capacity developed by these firms to deal with the increasing complexity of their business environment [32]. All in all, by using a configurational approach, future studies may add to our comprehension of how a firm attains IT-business value by further untangling the ways in which the various elements of the firm's digital ecodynamics interact in the pursuit of performance.

7. References

[1] Street, C., B. Gallupe, and J. Baker, "Strategic alignment in SMEs: Strengthening theoretical foundations", *Communications of the Association for Information Systems 40*, 2017, pp. Article 20.

[2] Aragón-Sánchez, A., and G. Sánchez-Marín, "Strategic orientation, management characteristics, and performance: A study of Spanish SMEs", *Journal of Small Business Management 43*(3), 2005, pp. 287–308.

[3] Barrett, M., E. Davidson, J. Prabhu, and S.L. Vargo, "Service innovation in the digital age: key contributions and future directions", *MIS Quarterly 39*(1), 2015, pp. 135–154.

[4] Chi, M., J. Zhao, J.F. George, Y. Li, and S. Zhai, "The influence of inter-firm IT governance strategies on relational performance: The moderation effect of information technology ambidexterity", *International Journal of Information Management 37*(2), 2017, pp. 43–53.

[5] Teece, D.J., G. Pisano, and A. Shuen, "Dynamic capabilities and strategic management", *Strategic Management Journal 18*(7), 1997, pp. 509–533.

[6] Li, Y.-H., and J.-W. Huang, "Exploitative and Exploratory Learning in Transactive Memory Systems and Project Performance", *Information & Management 50*(6), 2013, pp. 304–313.

[7] Lee, O.-K. (Daniel), V. Sambamurthy, K.H. Lim, and K.K. Wei, "How Does IT Ambidexterity Impact Organizational Agility?", *Information Systems Research 26*(2), 2015, pp. 398–417.

[8] Luca, D., A. Ferraris, A. Papa, and D. Vrontis, "The role of external embeddedness and knowledge management as antecedents of ambidexterity and performances in Italian SMEs", *Small Business Economics*, 2018, pp. 1–27.

[9] Pavlou, P.A., and O.A. El Sawy, "Understanding the elusive black box of dynamic capabilities", *Decision Sciences 42*(1), 2011, pp. 239–273.

[10] Mithas, S., and R.T. Rust, "How Information Technology strategy and investments influence firm performance: Conjecture and empirical evidence", *MIS Quarterly 40*(1), 2016, pp. 223–245.

[11] Orlikowski, W.J., "The sociomateriality of organizational life: Considering technology in management research", *Cambridge Journal of Economics 34*(1), 2010, pp. 125–141.

[12] Zammuto, R., T.L. Griffith, A. Majchrzak, D. Dougherty, and S. Faraj, "Information Technology and the changing fabric of organization", *Organization Science 18*(5), 2007, pp. 749–762.

[13] El Sawy, O.A., A. Malhotra, Y.K. Park, and P.A. Pavlou, "Seeking the configutrations of digital ecodynamics: It takes three to tango", *Information Systems Research 21*, 2010, pp. 835–848.

[14] Pezeshkan, A., S. Fainshmidt, A. Nair, M.L. Frazier, and E. Markowski, "An empirical assessment of the dynamic capabilities–performance relationship", *Journal of Business Research 69*(8), 2016, pp. 2950–2956.

[15] Fiss, P., "Building better causal theories: A fuzzy set approach to typologies in organization research.", *Academy of Management Journal 54*(2), 2011, pp. 393–420.

[16] Ortiz de Guinea, A., and J. Webster, "Combining variance and process in information systems research: Hybrid approaches", *Information and Organization 27*(3), 2017, pp. 144–162.

[17] Gresov, C., and R. Dazin, "Equifinality: functional equivalence in organizational design", *Academy of Management Journal 22*(2), 1997, pp. 431–452.

[18] Meyer, A.D., A.S. Tsui, and C.R. Hinings, "Configurational approaches to organizational analysis", *Academy of Management Journal 36*(6), 1993, pp. 1175–1195.

[19] Rihoux, B., and C. Ragin, *Configurational Comparative Methods: Qualitative Comparative Analysis (QCA) and Related Techniques*, SAGE Publications, Inc., 2455 Teller Road, Thousand Oaks California 91320 United States, 2009.

[20] Winter, S.G., "Understanding Dynamic Capabilities", *Strategic Management Journal 24*(10), 2003, pp. 991–995.

[21] Saunila, M., "Innovation capability for SME success: perspectives of financial and operational performance", *Journal of Advances in Management Research 11*(2), 2014, pp. 163–175.

[22] Liao, S.-H., W.-C. Fei, and C.-C. Chen, "Knowledge sharing, absorptive capacity, and innovation capability: an empirical study of Taiwan's knowledge-intensive industries", *Journal of Information Science 33*(3), 2007, pp. 340–359.

[23] Calik, E., F. Calisir, and B. Cetinguc, "A Scale Development for Innovation Capability Measurement", *Journal of Advanced Management Science Vol 5*(2), 2017.

[24] Romijn, H., and M. Albaladejo, "Determinants of innovation capability in small electronics and software firms in southeast England", *Research Policy 31*(7), 2002, pp. 1053–1067.

[25] Mitrega, M., S. Forkmann, C. Ramos, and S.C. Henneberg, "Networking capability in business

relationships - Concept and scale development", *Industrial Marketing Management 41*(5), 2012, pp. 739–751.

[26] Street, C.T., and Cameron, A.F., "External Relationships and the Small Business: A Review of Small Business Alliance and Network Research", *Journal of Small Business Management 45*(2), 2007, pp. 239.

[27] Bharadwaj, A.S.A., "A resource-based perspective on information technology capability and firm performance: An empirical investigation", *MIS Quarterly 24*(1), 2000, pp. 169–196.

[28] Ajamieh, A., J. Benitez, J. Braojos, and C. Gelhard, "IT infrastructure and competitive aggressiveness in explaining and predicting performance", *Journal of Business Research 69*(10), 2016, pp. 4667–4674.

[29] Zhu, K., "The complementarity of information technology infrastructure and e-commerce capability: A resource-based assessment of their business value", *Journal of Management Information Systems 21*(1), 2004, pp. 167–202.

[30] Levinthal, D.A., and J.G. March, "The Myopia of learning", *Strategic Management Journal 14*, 1993, pp. 95–112.

[31] Brandyberry, A., A. Rai, and G.P. White, "Intermediate performance impacts of advanced manufacturing technology systems: An empirical investigation", *Decision Sciences 30*(4), 1999, pp. 993–1020.

[32] Raymond, L., F. Bergeron, A.M. Croteau, and J. St-Pierre, "IT-enabled knowledge management for the competitive performance of manufacturing SMEs: An absorptive capacity-based view", *Knowledge and Process Management 23*(2), 2016, pp. 110–123.

[33] Roper, S., and J.H. Love, "Innovation and export performance: evidence from the UK and German manufacturing plants", *Research Policy 31*(7), 2002, pp. 1087–1102.

[34] Wilden, R., T.M. Devinney, and G.R. Dowling, "The architecture of dynamic capability research: Identifying the building blocks of a configurational approach", *The Academy of Management Annals 10*(1), 2016, pp. 997–1076.

[35] Chae, H.C., C.E. Koh, and V.R. Prybutok, "Information technology capability and firm performance: Contradictory findings and their possible causes", *MIS Quarterly 38*(1), 2014, pp. 305–326.

[36] Gupta, A.K., K.G. Smith, and C.E. Shalley, "The interplay between exploration and exploitation", *Academy of Management Journal 29*(4), 2006, pp. 693–706.

[37] Winter, S., and G. Szulanski, "Replication as strategy", *Organization Science 12*(6), 2001, pp. 730–743.

[38] Venkatraman, N., "The concept of fit in strategy research: Toward verbal and statistical correspondence", *Academy of Management Review 14*(3), 1989, pp. 423–444.

[39] Miller, D., and Friesen, P.H., "Archetypes of strategy formulation", *Management Science 24*(9), 1978, pp. 921–933.

[40] Ragin, C.C., *Fuzzy-set social science*, University of Chicago Press, 2000.

[41] Hannan, M.T., M.D. Burton, and J.N. Baron, "Inertia and change in the early years: Employment relations in young, high technology firms", *Industrial and Corporate Change 5*(2), 1996, pp. 503–536.

[42] Miller, D., R. Eisenstat, and N. Foote, "Strategy from the inside out: Building capability-creating organizations", *California Management Review 44*(3), 2002, pp. 37–54.

[43] Zahra, S.A., H.J. Sapienza, and P. Davidsson, "Entrepreneurship and Dynamic Capabilities: A Review, Model and Research Agenda*", *Journal of Management Studies 43*(4), 2006, pp. 917–955.

[44] Miller, D., "Notes on the study of configurations", *MIR: Management International Review*, 1999, pp. 27–39.

[45] Miller, D., "Configurations revisited", *Strategic Management Journal*, 1996, pp. 505–512.

[46] Miller, D., and C. Dröge, "Psychological and traditional determinants of structure", *Administrative Science Quarterly*, 1986, pp. 539–560.

[47] Akman, G., and C. Yilmaz, "Innovative capability, innovation strategy and market orientation: an empirical analysis in Turkish software industry", *International Journal of Innovation Management 12*(01), 2008, pp. 69–111.

[48] Hogan, S.J., G.N. Soutar, J.R. McColl-Kennedy, and J.C. Sweeney, "Reconceptualizing professional service firm innovation capability: Scale development", *Industrial Marketing Management 40*(8), 2011, pp. 1264–1273.

[49] Raymond, L., and St-Pierre, J., "Strategic capability configurations for the internationalization of SMEs: A study in equifinality", *International Small Business Journal 31*(1), 2013, pp. 82–102.

[50] Rai, A., R. Patnayakuni, and N. Seth, "Firm Performance Impacts of Digitally Enabled Supply Chain Integration Capabilities", *MIS Quarterly 30*(2), 2006, pp. 225–246.

[51] Raymond, L., and Bergeron, F:, "Enabling the business strategy of SMEs through e-business capabilities: A strategic alignment perspective", *Industrial Management & Data Systems 108*(5), 2008, pp. 577–595.

[52] Mennens, K., A. Van Gils, G. Odekerken-Schröder, and W. Letterie, "Exploring antecedents of service innovation performance in manufacturing SMEs", *International Small Business Journal*, 2018, https://doi.org/10.1177/0266242617749687.

[53] Sachdeva, M., and R. Agarwal, "Innovation in services and its measurement at firm level: A literature review", *ANZAM Operations, Supply Chain and Services Symposium*, 2011 ANZAM Operation, Supply Chain and Services Symposium, 2011.

[54] Babbie, E.R., *The Basics of Social Research*, Wadsworth Pub Co, Belmont, CA, USA, 2009.

[55] Bollen, K., and Lennox, R., "Conventional wisdom on measurement: a structural equation perspective", *Psychological Bulletin 110*, 1991, pp. 305–314.

[56] Ragin, C.C., *Redesigning social inquiry: Fuzzy sets and beyond*, University of Chicago Press, Chicago, IL, 2008.

[57] Cooper, B., and J. Glaesser, "Exploring the robustness of set theoretic findings from a large n fsQCA: an illustration from the sociology of education", *International Journal of Social Research Methodology 19*(4), 2016, pp. 445–459.

[58] Liu, Y., J. Mezei, V. Kostakos, and H. Li, "Applying configurational analysis to IS behavioural research: a methodological alternative for modelling combinatorial complexities", *Information Systems Journal 27*(1), 2017, pp. 59–89.

[59] Ragin, C.C., "Set relations in social research: Evaluating their consistency and coverage", *Political Analysis 14*(3), 2006, pp. 291–310.

[60] Santhanam, R., and E. Hartono, "Issues in linking information technolgoy capability to firm performance", *MIS Quarterly 27*(1), 2003, pp. 125–153.

[61] Wang, C.L., and P.K. Ahmed, "Dynamic Capabilities: A Review and Research Agenda", *International Journal of Management Reviews 9*(1), 2007, pp. 31–51.

[62] Woodside, A.G., "Moving beyond multiple regression analysis to algorithms: Calling for adoption of a paradigm shift from symmetric to asymmetric thinking in data analysis and crafting theory", *Journal of Business Research 66*(4), 2013, pp. 463–472.

[63] Cassell, C., Nadin, S., and Grey, M. O., "The use and effectiveness of benchmarking in SMEs", *Benchmarking: An International Journal 8*(3), 2001, pp. 212–222.