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IT Ambidexterity Configurations for Competitive Performance: An Exploratory Study of the Digital Ecodynamics of Small and Medium-Sized Enterprises

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IT AMBIDEXTERITY CONFIGURATIONS FOR COMPETITIVE PERFORMANCE: AN EXPLORATORY STUDY OF THE DIGITAL ECODYNAMICS OF SMALL AND MEDIUM-SIZED ENTERPRISES

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Abstract

This paper examines the digital ecodynamics of small and medium-sized enterprises (SMEs) from a configurational approach to explain the competitive performance –innovation and internationalization performance – of these firms. Digital ecodynamics refer to the interplay between the triad of information technology (IT) ambidexterity, dynamic capabilities, and environmental uncertainty. A configurational approach involves a systems perspective of IT 'fit' in which variables are viewed in combination, forming configurations that generate the outcome of interest. The idea is to capture configurations of digital ecodynamics that account for the nonlinear complex interplay of its three constitutive elements as they jointly affect competitive performance. In doing so, we further distinguish between IT capabilities for exploitation that are oriented on the firm's productivity, and IT capabilities for exploration that are oriented on innovation. This paper theoretically combines configurational theory with the resource-based view, fit, and ambidexterity. A survey of 140 SMEs serves to test the proposed hypotheses. Three configurations characterize SMEs' digital ecodynamics and have consequences for performance. Configurations I and III positively influence innovation performance whereas Configuration I positively influences internationalization performance, demonstrating the equifinal properties of configurational theory. Furthermore, configurations that give priority to exploration goals through their IT capabilities show better competitive performance.

Keywords: IT capabilities, ambidexterity, dynamic capabilities, competitive performance, innovation, internationalization, SME, configuration, equifinality.

1 Introduction

Investments in information technology (IT) resources[1] have long been assumed to be essential to the survival and competitive performance of businesses (Ravinchandran & Lertwongsatein, 2005). In fact, more than 80% of business leaders believe IT resources to be fundamental to their business model (ComputerScienceSociety, 2012). For example, Canada's private sector invests an average of $40.6 billion per year in information and communications technology (ICT) (Dhubat, 2015), with the ICT sector accounting for 11.5% of all real Gross Domestic Product (GPD) growth since 2002 (StatisticsCanada). Those numbers make sense when a majority of CIOs (chief information officers) think that IT resources are likely to have a key role in enabling change and growth in their businesses (ComputerScienceSociety, 2014-2015).

Reflecting this, the business value of IT has been one of the defining cores of the information systems (IS) discipline for over 25 years. This research has provided an understanding of how IT investments affect firm performance (e.g., Dedrick, Gurbanaxi, & Kraemer, 2003; Kohli, Devaraj, & Ow, 2012). However, few studies have studied the relation between IT ambidexterity[2] (IT for exploitation and IT for exploration) and competitive performance (Mithas & Rust, 2016). The ambidexterity literature highlights that firms face conflicting demands (i.e., the need for exploitation for efficiency purposes, and the need for exploration for reasons of innovation) (Levinthal & March, 1993). However, two conflicting views exist: some argue that firms, if ambidextrous, are capable of pursuing both demands simultaneously (e.g., Gupta, Smith, & Shalley, 2006), others posit that organizations need to focus on one demand at a time (e.g., Winter & Szulanski, 2001). Thus, research calls exist highlighting the importance of studying the equilibrium between IT capabilities for exploitation and IT capabilities for exploration (i.e., IT ambidexterity) that enhance competitive performance (Pavlou & El Sawy, 2011) as well as the usefulness of doing so across varying contexts and with differing approaches (Mithas & Rust, 2016). Taking these calls at heart, our explorative research aims to study IT ambidexterity, along with dynamic capabilities[3] (DCs) and environmental uncertainty, as it affects competitive performance in industrial service SMEs (small and medium-sized enterprises), and from a configurational approach.

The context of industrial service SMEs is appropriate for several reasons. These firms are subjected to increased pressures and competing demands with respect to efficiency, innovation, quality, and information processing capability (Raymond, Bergeron, Croteau, & St-Pierre, 2016; Raymond & Croteau, 2009; Soto-Acosta, Placer-Maruri, & Perez-Gonzalez, 2016). Further, they are information intensive, and are likely to possess a wide variety of IT capabilities (i.e., different IT for exploitation and for exploration) (Raymond et al., 2016; Raymond & Croteau, 2009; Soto-Acosta, Popa, & Palacios-Marqués, 2015).

Our configurational approach answers calls for configurational research in both the IS strategy research and the literature on strategic management (El Sawy, Malhotra, Park, & Pavlou, 2010; Wilden, Devinney, & Dowling, 2016). The idea is to capture configurations that account for the nonlinear complex interplay of IT ambidexterity (along with other elements, i.e., DCs and environmental uncertainty) in developing business value and enhancing the firm's competitiveness. One way of capturing patterns of interconnected elements is through configurational theory (Meyer, Tsui, & Hinings, 1993),

[1] IT resources include tangible and intangible IT-related capabilities (e.g., IT capabilities, technical skills, IT managerial skills, etc.) (Melville, Kraemer, & Gurbaxani, 2004; Nevo & Wade, 2010; Piccoli & Ives, 2005).

[2] Following Levinthal and March's (1993) concepts of exploitation and exploration as well as the strategic management literature on ambidexterity (O'Reilly & Tushman, 2004), IT ambidexterity is defined as the firm's ability to both exploit and explore with IT capabilities (Chi, Zhao, George, Li, & Zhai, 2017).

[3] Dynamic capabilities refer to the ability to reconfigure resources and competencies in order to rapidly respond to changing environmental conditions (Pavlou & El Sawy, 2006; Pavlou & El Sawy, 2010; Teece, Pisano, & Shuen, 1997).

as this theory possesses equifinality properties (Meyer et al., 1993). In contrast to the traditional unifinal approach guiding most IS strategic literature – a 'best practices' approach that attempts to find a direct (or moderating or mediating) causal link between IT related constructs and performance – equifinality is a property of open systems by which is possible to reach a particular outcome through different means (Meyer et al., 1993). Thus, with a configurational approach one can identify different configurations of IT ambidexterity along with other relevant organizational (i.e., DCs) and external elements (i.e., environmental uncertainty) that might, together, equally lead to performance (Doty, Glick, & Huber, 1993; Meyer et al., 1993). We refer to the interplay of IT ambidexterity, DCs, and environmental uncertainty, as digital ecodynamics, which is consistent with past research (El Sawy et al., 2010). Our configurational approach thus allows us to study different digital ecodynamic profiles in a holistic way (Doty et al., 1993; Meyer et al., 1993). Thus, our three exploratory research questions are the following: *i)What are the different digital ecodynamic configurations (i.e., IT ambidexterity, DCs, and environmental uncertainty) that characterize industrial service SMEs with regards to their competitive performance? ii) Do different digital ecodynamic configurations lead to equally successful competitive performance outcomes for these firms? iii) In a conflicting demand environment (i.e., IT exploration vs. IT exploitation) which configurations – configurations that attend simultaneously to two conflicting environmental demands (i.e., pursuing both IT exploration and IT exploitation) vs. configurations that attend primarily to one environmental demand (i.e., pursuing either IT exploration or IT exploitation) – generate the better competitive performance for industrial service SMEs?*

2 A Configuration Model of Digital Ecodynamics

From a configurational approach, we posit that competitive performance does not depend on bivariate relationships between each element of the firm's digital ecodynamics but on specific configurations of the three elements together. A configuration is a specific combination of causal elements (named elements or conditions; in this case, IT ambidexterity, dynamic capabilities, and environmental uncertainty) that together generate the outcome of interest (in this case, competitive performance) (Rihoux & Ragin, 2009). The basic idea is that there should be an appropriate 'fit' between the elements of digital ecodynamics that equally lead to competitive performance. This reasoning leads to a conceptual framework based on fit logic and configuration theory (see Figure 1). The model presents environmental uncertainty, dynamic capabilities (absorptive capacity and networking capability) and IT ambidexterity (IT for exploration and IT for exploitation) as the three elements of digital ecodynamics that together affect competitive performance (innovation performance and internationalization performance).

We next provide a brief explanation of each of the elements found in the research model. After, we explain the configurational theory behind the model along with its general predictions in the form of hypotheses. In doing so we also integrate configurational theory with the notion of fit and the resource-based view (RBV). We then draw upon the ambidexterity literature to further explore the equilibrium between pursuing IT for exploitation or IT for exploration or both.

2.1 IT ambidexterity: IT for exploitation and IT for exploration

IT capabilities may be defined as the ability to "mobilize and deploy IT-based resources in combination or co-present with other resources and capabilities" (Bharadwaj, 2000, p. 171). More specifically, the firm's IT capabilities include tangible IT assets such as the software, technical platforms and data repositories that constitute its IT infrastructure capabilities (Piccoli & Ives, 2005; Wade & Hulland, 2004). 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 (Ross, Beath, & Goodhue, 1996; Zhu, Zhao, Tang, & Zhang, 2015). 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 (1993) conceptualization of how firms either exploit their existing resources or explore for new resources, or do both simultaneously. This categorization refers in particular to the concept of *IT ambidexterity* (O'Reilly & Tushman, 2008), that is, the firm's ability to both exploit and explore IT capabilities in the pursuit of performance (Chi, Zhao, George, Li, & Zhai, 2017; Mithas & Rust, 2016). In this last regard, IT capabilities for exploitation aim to enhance the firm's efficiency, productivity and profitability whereas IT capabilities for exploration aim to enhance its agility, innovativeness and growth (Lee, Sambamurthy, Lim, & Wei, 2015; Mithas & Rust, 2016), thus the deemed importance for SMEs to be IT ambidextrous if they are to improve their competitive performance.

2.2 Dynamic capabilities: absorptive capacity and networking capability

Dynamic capabilities are the ability to rearrange organizational resources and competencies in order to respond to changing environmental conditions (Teece, Peteraf, & Leih, 2016; D.J. Teece, 2007). Although the literature has identified a wide range of DCs (Wang & Ahmed, 2007; Wilden et al., 2016), in this study we focus on the following two: absorptive capacity and networking capability. These two DCs have been chosen for being especially relevant to the competitive performance of SMEs (Flatten, Greve, & Brettel, 2011; Huang & Rice, 2009; Mitrega, Forkmann, Ramos, & Henneberg, 2012; Street & Cameron, 2007; Zeng, Xie, & Tam, 2010).

Absorptive capacity is defined as a "dynamic capability pertaining to knowledge creation and utilization that enhances a firm's ability to gain and sustain competitive advantage" (Zahra & George, 2002, p. 185). In other words, absorptive capacity is the capability to recognize the value of new knowledge, assimilate it, and apply it (Cohen & Levinthal, 1990; Malhotra, Gosain, & El Sawy, 2005), and has been found to positively influence competitive performance in SMEs (Francalanci & Morabito, 2008).

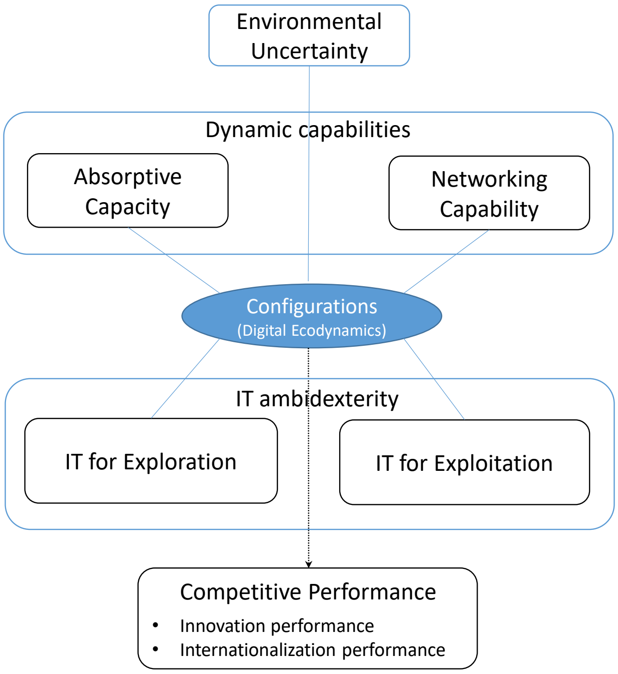

Figure 1. Configuration Model of the Digital Ecodynamics of SMEs

Closely related to the concept of absorptive capacity, is the notion of networking capability. Networking capability is related to absorptive capacity in that research has found that the effect of absorptive capacity on performance (at the interfirm level) is mediated by strategic alliances (Flatten et al., 2011). Networking capability is thus defined as the ability to establish and manage collaborations with other firms (Mitrega et al., 2012). Such collaborations are paramount for small business since they are established with the aim of reducing uncertainty, developing new knowledge (Johanson & Vahlne, 2009), and achieving greater efficiency, better response to market needs and greater competitiveness (Street & Cameron, 2007).

2.3 Environmental uncertainty

Environmental uncertainty refers to the extent to which the environment in which a firm operates remains basically the same over time or is in a continual process of change (Duncan, 1972). Environmental uncertainty has been largely ignored however in studyies of both IT-performance and DC-performance relationships (e.g., Ray, Muhanna, & Barney, 2005; Wang, Liang, Zhong, Xue, & Xiao, 2012). This error of exclusion has been characterized as "surprising" (Pezeshkan, Fainshmidt, Nair, Lance Frazier, & Markowski, 2016, p. 2953), given that environmental uncertainty, with regards to IT in particular, has long been identified as the fundamental problem with which managers need to deal with (Kearns, & Lederer, 2004). This uncertainty is thus at the heart of strategic IT management practice and must be taken into consideration along with the other two elements of the firm's digital ecodynamics (El Sawy et al., 2010; Wilden et al., 2016).

2.4 Competitive performance

Following Raymond et al.'s (2016) approach for manufacturing SMEs, the competitive performance of industrial service SMEs can be envisioned in two non-mutually exclusive ways. One way, referring herein to innovation performance, is through service innovation, which consists in creating new services for existing and potential customers (e.g., Roper & Love, 2002). Another way, internationalization performance, refers to the extent to which firms are involved abroad in selling their services (e.g., Acs & Terjesen, 2013; Vahlne & Johanson, 1977). The competitive performance of these firms can thus be conceptualized as their ability to a) to renew their competitive offer by developing and selling new services (i.e., innovation performance) and b) to expand their market by selling existing services abroad (i.e., internationalization performance) (Acs & Terjesen, 2013; Jin, Vonderembse, Ragu-Nathan, & Smith, 2014; Raymond et al., 2016).

2.5 Configurational theory and hypotheses

Originating in open systems, configurational theory offers a holistic approach for investigating digital ecodynamic configurations as they relate to a firm's competitive performance. This theory views phenomena as clusters of interconnected structures that need to be understood simultaneously and that seek to uncover 'causal configurations': it is not individual independent variables that are connected to dependent ones, but holistic patterns and combinations of causal elements that influence preferable outcomes (Fiss, 2007, 2011; Meyer et al., 1993). Configurational theory can thus accommodate high levels of causal complexity (Fiss, 2011) including the potential synergetic effects of the different elements of digital ecodynamics on organizational performance (El Sawy et al., 2010). As a result recent research has urged authors to take a configurational approach when investigating the performance effects of IT capabilities (i.e., IT ambidexterity) and DCs (El Sawy et al., 2010; Wilden et al., 2016).

Central to configurational theory is the notion of equifinality or the possibility of reaching the same outcome through different means and different initial positions (Gresov & Dazin, 1997). In other words, it is possible that different configurations lead to equal levels of competitive performance. That is, instead of looking at a few variables and at linear associations among them, the idea is to find clusters (or configurations) of attributes (or elements) leading to the same outcome (Miller, 1981). In fact, recent research argues that we should move from regression type analyses based on unifinality to configurational techniques based on equifinality in order to identify combinations of organizational attributes that explain a given outcome, in this case, competitive performance (Woodside, 2013).

According to Gresov and Dazin (1997), 'suboptimal' equifinality occurs when organizations face conflicting demands and dispose of only a restricted set of structural options to face these demands. This type of equifinality is always suboptimal in that if the firm decides to attend one of the conflicting demands the other would go unsatisfied (C. Gresov & Dazin, 1997). Such type of equifinality is likely to apply to industrial service SMEs because these organizations face conflicting demands for both productivity (exploitation) and innovation (exploration) while, due to their limited size and resources, they have a constrained set of structural options (March, 1991; Raymond & St-Pierre, 2010) in order to respond to these demands.

In summary, the configurational approach taken here contrasts to the 'best practice' approach that seeks to identify a direct causal link between each element of the firm's digital ecodynamics and its performance (e.g., Chae, Koh, & Prybutok, 2014; Chen, Wang, Nevo, Benitez-Amado, & Kou, 2015; Lin & Wu, 2014; Wang, Dou, Zhu, & Zhou, 2015; Wilhelm, Schlömer, & Maurer, 2015). That is, the configurational approach implies that competitive performance would not be enabled by individual IT capabilities (i.e., IT ambidexterity), DCs, or environmental uncertainty, but by coherent configurations of these elements (Miller, Eisenstat, & Foote, 2002). The implication then, based on the equifinality property of configurational theory, is that different combinations (i.e., configurations) of digital ecodynamics could be equally successful in enabling competitive performance. Thus the following hypothesis:

Hypothesis 1: Different digital ecodynamic configurations will be associated with competitive performance.

While different digital ecodynamic configurations might be associated to the same levels of competitive performance, from a RBV and fit perspectives, not all configurations will perform equally. The RBV explains that competitive performance is based on the characteristics or attributes of the resources a firm possesses (Barney, 1991; Penrose, 1959; Wernerfelt, 1984). More specifically, a firm can sustain a competitive advantage when its combination of resources and competencies shows signs of inimitability, non-substitutability, and immobility (Barney, 1991; Penrose, 1959; Wernerfelt, 1984). Relating this to configurational theory, one can deduce that those configurations of digital ecodynamics that are hard to imitate, non-substitutable, and immobile would show higher levels of competitive performance (Miller, 1999). This implies that not all configurations of digital ecodynamics would lead to the same level of competitive performance, but that there will be configurations that perform better than others.

The notion of fit would also predict some differences in performance between certain configurations and others. Originating in contingency theory, fit can be defined as the strategic alignment of the firm with its environment, in conjunction with the alignment of its its resources and its capabilities (Gresov, 1989). As in configurational theory, both contingency theory and the notion of fit allow for equifinality. However, fit would limit the power of equifinality to a handful of configurations. That is, there would be a limited set of internally consistent configurations that would be equally effective (Doty et al., 1993). Such definition corresponds to the 'fit as gestalts' perspective in Venkatraman's classification of fit types (Venkatraman, 1989). Accordingly, there is some order in the pattern of attributes forming the 'gestalts' or configurations (Miller, & Friesen, 1978) in that only coherent configurations would equally lead to the preferable outcome (Venkatraman, 1989). That is, when relating configurations with competitive performance, the expectation is that such performance stems from the mechanisms that ensure complementarity between a firm´s environment, its capabilities and its technology (Miller et al., 2002). That is, configurations that are capable of integrating the three complementary elements of digital ecodynamics (i.e., IT ambidexterity, DCs, and environmental uncertainty) would be those that show higher levels of competitive performance (El Sawy et al., 2010). Whereas configurations characterized by a misfit and a lack of integrative mechanisms among digital ecodynamic elements would show lower performance. In other words, industrial service SMEss should show better performance when there is a match (or fit) between their information requirements (in the face of environmental uncertainty), their information processing capacity (i.e., their IT capabilities for exploration or exploitation), and their dynamic capabilities (Raymond & St-Pierre, 2010). As a result:

> *Hypothesis 2*: Certain digital ecodynamic configurations will be associated to higher levels of competitive performance than others.

Note that although Hypotheses 1 (H1) and 2 (H2) might appear contradictory at first glance, they are not so; in fact, these two hypotheses are fundamentally different in that they correspond to our first two exploratory research questions, H1 corresponds to the second research question whereas H2 corresponds to the first research question.

2.6 IT ambidexterity and demands for exploitation versus exploration

Most SMEs operate in environments where they often face conflicting demands (Raymond & St-Pierre, 2010). According to Levinthal and March (1993) these conflicting demands can be summarized into two basic categories: the need for exploitation for reasons of productivity, and the need for exploration for reasons of innovation. Given these conflicting demands for exploration and exploitation, there are opposing views regarding which demands organizations need to focus on in order to increase their performance. Whereas one stream of the literature on organizational ambidexterity states that organizations, if ambidextrous, are capable of pursuing both demands simultaneously (e.g., Gupta et al., 2006), another posits that organizations need to focus primarily on one demand at a time (e.g., Winter & Szulanski, 2001). The focus on exploration and/or exploitation is paramount for IT capability investment since organizations will perform better when there is a match between the information requirements that organizations face and their information processing capacity (Dutot, Bergeron, & Raymond, 2014), again pointing to the necessity of studying the three elements of digital ecodynamics together. We may now explore these two competing perspectives.

2.6.1 Perspective a: pursuing both exploitation and exploration

According to Levinthal and March (1993) pursuing exclusively one demand will have detrimental effects on performance: exclusive exploitation will make a firm become obsolete while exclusive exploration will prevent a firm from gaining returns on its new knowledge and know-how. There are a number of authors who agree and thus state that focusing on exploitation and exploitation concurrently enables firms to achieve greater performance and competitiveness (Gupta et al., 2006; Lubatkin, Simsek, Ling, & Veiga, 2006; Puranam, Singh, & Zollo, 2006).

More specifically, in order to achieve both functional demands (exploitation and exploration) simultaneously, organizations need to manage a mix of integration and differentiation practices (Andriopoulos & Lewis, 2009). Integration focuses on interdependence between both demands (exploration and exploitation) and in enabling coordination (Birkinshaw & Gibson, 2004; Gupta et al., 2006) in order to reach an appropriate balance to achieve well both goals (Atuahene-Gima, 2005). In contrast, differentiation focuses on putting efforts on exploitation and exploration separately, with for example, spatial separation (Puranam et al., 2006). The idea is to put in place parallel structures (McDonough & Leifer, 1983) as well as dual strategies in different units (Tushman & O'Reilly, 1996) for achieving exploration and exploitation goals. Both differentiation and integration are recognized approaches that enable organizations to achieve better performance (Raisch, Birkinshaw, Probst, & Tushman, 2009).

Empirical research has shown that while the imbalance between explorative and exploitive strategies negatively affects the firm's growth, the interaction between explorative and exploitive strategies has a positive effect on performance (He & Wong, 2004). As a result, pursuing both IT for exploration and IT for exploitation simultaneously would lead to better performance. Thus:

> *Hypothesis 3a*: In a suboptimal equifinality context, SMEs whose digital ecodynamic configurations align closely with both functional demands of IT for exploitation and IT for exploration will show higher levels of competitive performance.

2.6.2 Perspective b: pursuing either exploration or exploitation

Another stream of research on ambidexterity emphasizes that firms can only attend competently to one functional demand at a time; thus, exploration and exploitation are and should be pursued in sequence as opposed to in parallel (Winter & Szulanski, 2001). In fact, March (1991) acknowledged that organizations have a tendency to either attend to one demand or the other, that is, they have an inclination to focus on exploitation (Benner & Tushman, 2003; Rosenkopf & Almedia, 2003) or exploration (Miller & Friesen, 1980; Nohria & Gulati, 1996) at one point in time.

Sequential ambidexterity arises from temporally sequencing routines for exploitation and exploration (Puranam et al., 2006; Raisch et al., 2009). That is, organizations utilize temporal separation in order to achieve both exploitation and exploration sequentially (Brown & Eisenhardt, 1997). They achieve ambidexterity sequentially by shifting their structures over time and aligning them with the firm's new routines (Duncan, 1976), thus temporarily alternating between exploitive and exploratory activities and structures (Boumgarden, Nickerson, & Zenger, 2012; Siggelkow & Levinthal, 2003). In support of this view, numerous researchers note that pursuing both demands in parallel can be difficult because management efforts to attend one demand may contradict or cancel out the efforts to attend the other (Dougherty, 1996; March, 1991, 2006). These researchers argue that firms should pursue primarily one demand at a time in order to achieve higher performance. For instance, both positive and negative changes in R&D expenditures, indicative of transitions of between exploratory and exploitative pursuits, have been found to increase firm performance (Mudambi & Swift, 2014), and thus demonstrate the benefits of sequential ambidexterity. Hence our final hypothesis:

> *Hypothesis 3b*: In a suboptimal equifinality context, SMEs whose digital ecodynamic configurations align closely and primarily to one functional demand, either IT for exploitation or IT for exploration, will show higher levels of competitive performance.

3 Methodology

3.1 Sample

The data used in the study were obtained from a database created by a university research center for benchmarking purposes, containing information on 140 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. The number of employees of the sampled SMEs ranges from 2 to 185, with a median of 24, while their annual revenue ranges from 0.10 to 29.2 million Canadian dollars, with a median of 2.6 million.

3.2 Measures

Environmental uncertainty was measured by adapting an instrument initially validated by Miller and Dröge (1986), in which the owner-manager is asked to evaluate, on five 5-point Likert scales, the degree of change and unpredictability in the firm's markets (customers, competitors) and technologies. Absorptive capacity is estimated through a surrogate measure often-used, that is, the R&D budget per employee, which focuses on the 'learning' aspect of the construct (Leahy & Neary, 2007; Lucena & Roper, 2016). Networking capabilities were ascertained through the business collaborations established in matters of R&D and service development, operations, and marketing, following Raymond and St-Pierre's (2013). Managers are thus asked to indicate the number of formal partnerships established for these purposes with various partners such as customers, suppliers, competitors, and other third parties such as research centers and universities. IT ambidexterity was measured through the capture of IT infrastructure and e-business capabilities. The SME's IT infrastructure capabilities were assessed through two summative index variables obtained from the identification of the various IT-based systemss and applications implemented by the firm, each system or application being assigned as being either mainly for exploitation (e.g. ERP) or for exploration (e.g. computer-aided design), following Brandyberry, Rai and White (1999) and Rai, Tang, Brown and Keil (2006). E-business capabilities for exploitation and for exploration were also assessed through two summative index variables obtained from the respondent's identification, from a checklist, of the number of business activities that were carried out through e-business applications, the Internet and the Web. The activities are grouped under two categories for exploitation, namely e-commerce and e-HRM, and two categories for exploration, namely e-business intelligence and e-collaboration, following Raymond and Bergeron's (2008) and Zhu (2004). Innovation performance was measured through the sales of new or modified services divided by the total sales, whereas internationalization was measured by the percentage of total sales made abroad (e.g., McCormick & Fernhaber, 2018). Finally, three control variables were also captured: size of the firm (i.e., number of employees), age of the firm (i.e., number of years), and power of customers (i.e., percentage of total sales to the three main customers).[4]

4 Analyses and Results

The research variables' reliability, descriptive statistics and intercorrelations are presented in Table 1. Note here that the two IT ambidexterity variables, IT for exploration and IT for exploitation, are intercorrelated ($r = 0.37$, $p < 0.001$). Note also that the networking capability and IT capability variables are operationalized through 'index' rather than 'scale' measures (Babbie, 2009). 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 (Bollen & Lennox, 1991).

The analysis of the data consisted in a cluster analysis, which is consistent with configurational theory since it allows for equifinality and for the identification of different configurations (Raymond, & St-Pierre, 2013). In a nutshell, cluster analysis identifies homogenous groups called clusters: cases belonging to a cluster share many characteristics but are dissimilar to cases not belonging to the cluster (Ketchen & Shook, 1996; Mooi & Sarstedt, 2011). Thus, cluster analysis allows us to derive a configurational classification of the sampled firms' digital ecodynamics. The idea is to group firms into clusters (or configurations) such that each cluster's membership is highly homogeneous with respect to the elements of digital ecodynamics, and each cluster differs from other clusters with respect to these same elements.

The SPSS TwoStep clustering algorithm was chosen because it can handle large samples, determines the optimal number of clusters and was found to be best performing (Gelbard, Goldman, & Spiegler, 2007). A three-cluster solution was found to be optimal in identifying groups of SMEs that could be clearly distinguished from one another in terms of their digital ecodynamic elements. As shown in Table 2, the three digital ecodynamic configurations were labeled as Configuration I with 44 firms, Configuration II with 46 firms, and Configuration III with 50 firms. Table 2 presents the means of the clustering variables (i.e., the digital ecodynamic elements) along with a set of one-way analysis of variance (ANOVA) tests. ANOVA was used to evaluate the differences of variable means across the clus-

[4] All measures used in this study are available from the authors upon request.

ters in order to assess the distinctiveness of each cluster. Size of the firm, age of the firm, and power of customers were added as covariates to control for the potential confounding effects of these variables.

Variable	α[a]	mean	stdev	min	max	intercorrelations 1.	2.	3.	4.	5.	6.
1. Environmental Uncertainty	.72	2.7	0.6	1.0	4.2	-					
2. Absorptive Capacity[b]	-	2.9	4.0	11.2	4.0	.10	-				
3. Networking Capability	-	2.5	3.0	0	14	-.03	.01	-			
4. IT Capabilities for Exploration	-	4.2	1.7	0	9	.28	.21	.16	-		
5. IT Capabilities for Exploitation	-	3.6	1.5	0	7	.20	.01	.08	.37	-	
Competitive Performance											
6. Innovation Performance[c]	1.0	0.19	0.31	0.00	1.00	.10	.38	.04	.28	-.03	
7. Internationalization Performance[d]	1.0	0.06	0.18	0.00	1.00	.17	.26	-.08	.24	.10	.39

[a] Cronbach's alpha coefficient of reliability [inappropriate for index variables]
[b] ln (R&D budget / no. of employee)
[c] sales of new or modified services / sales
[d] exported sales / sales

Table 1. Reliability, descriptive statistics and intercorrelations of the research variables (N=140)

Configuration / Variable	*I* (n = 44) mean	*II* (n = 46) mean	*III* (n = 50) mean	ANOVA F	ANCOVA F[¶]
Environmental uncertainty	2.8_2	2.1_3	3.0_1	49.4***	38.7***
IT Capabilities for Exploration	4.7_1	3.5_2	4.4_1	7.8***	3.5*
IT infrastructure for exploration	3.0_1	1.3_2	3.5_1	43.1***	23.4***
e-Business capabilities for explor.	1.7_1	2.2_1	0.9_2	7.5***	4.4*
IT Capabilities for Exploitation	3.5	3.0	3.6	1.7	0.6
IT infrastructure for exploitation	2.5_1	1.4_2	3.1_1	13.2***	5.8**
e-Business capabilities for exploit.	0.9_2	1.6_1	0.5_3	19.4***	9.9***
Networking Capability	2.2_2	4.3_1	1.3_2	14.8***	12.7***
Absorptive Capacity	8.4_1	0.7_2	0.0_3	439.1***	290.1***

with covariates: Size of the firm, Age of the firm, Power of customers
*: $p < 0.05$ ***: $p < 0.001$
$_{1,2,3}$*Nota*. Within rows, different subscripts indicate significant ($p < 0.05$) pair-wise differences between means on Fisher's LSD (*post hoc*) test.

Table 2. Configurations resulting from cluster analysis

Looking at Table 2 we can start characterizing the different resulting configurations of the digital eco-dynamics of the sampled SMEs. It is important to note at this juncture that, interestingly, all configurations are comparable in terms of IT capabilities for exploitation. That is, there are no significant differences among the IT capabilities for exploitation across the three configurations, pointing to similar efforts in pursuing competitive performance through exploitive IT among the sampled firms. One might say in this regard that these exploitive capabilities are considered here as a strategic necessity rather than a competitive weapon, or even that IT for exploitation "doesn't matter" (Carr, 2003, p.5) if it weren't for the fact that Configuration II firms rely less on IT infrastructure for exploitation and more on e-business capabilities for exploitation than the other two configurations.

Configuration I encompasses firms that are characterized by the highest absorptive capacity of all configurations and the strongest IT capabilities for exploration along with Configuration II. Furthermore, Configuration I is composed of firms showing the second level of environmental uncertainty out of the three configurations and the second weakest networking capability along with Configuration III. For their part, the SMEs in *Configuration II* face the lowest environmental uncertainty and have the weakest IT capabilities for exploration while they enjoy the strongest networking capability. Moreover, they are located in the middle, i.e. between the other two configurations, in terms of absorptive capacity although their absorptive capacity is still quite low. Finally, *Configuration III* is composed of firms facing the highest environmental uncertainty while having the lowest absorptive capacity. Additionally, they are comparable to Configuration I in terms of both having the strongest IT capabilities for exploration and the weakest networking capability.

Table 3 shows the ANOVA and ANCOVA analyses used to assess the criterion-related validity of the clusters. Such analyses show significant differences between the three clusters with regards to variables that are theoretically related to the clusters or configurations but are not used in defining them. Looking at Table 3, one can also characterize the three digital ecodynamic configurations in terms of the outcome (i.e., innovation and internationalization performance) and control variables. Firms in Configuration I distinguish themselves by having the customers with the most power over them as well as being the best performers in terms of innovation and internationalization (although not statistically different than Configuration III in terms of internationalization performance). Configuration III, in contrast, is characterized by having the oldest SMEs on average. Firms composing Configurations II and III are similar in terms of innovation performance and power of customers, and the three configurations are similar in terms of average firm size.

Configuration variable	*I* (n = 44) mean	*II* (n = 46) mean	*III* (n = 50) mean	ANOVA F	ANCOVA F¶
Size of the firm (no. of employees)	26	43	39	1.7	-
Age of the firm (no. of years)	26_2	32	38_1	4.6*	-
Power of customers[a]	0.45_1	0.33_2	0.35	2.8	-
Innovation performance sales of new services / total sales	0.359_1	0.125_2	0.099_2	10.8***	3.8*
Internationalization performance sales exported / total sales	0.118_1	0.014_2	0.061	3.9*	2.0

with covariates: Size of the firm, Age of the firm, Power of customers

*: $p < 0.05$ **: $p < 0.01$ ***: $p < 0.001$

[a] percentage of total sales to the 3 main customers

$_{1,2,3}$*Nota*. Within rows, different subscripts indicate significant ($p < 0.05$) pair-wise differences between means on Fisher's LSD (*post hoc*) test.

Table 3. Breakdown of control and competitive performance variables by configuration

To further test the derived digital ecodynamic configurations as predictors of innovation and internationalization performance, multivariate regression analyses were performed with the configuration group memberships as independent variables through two dummy variables indicating whether a firm is a member of Configuration I or II, and with Configuration III memberships as the constant term (or base against which the other two are assessed) in the regression. Different multivariate regression analyses were performed on the two dependent variables, innovation performance and internationalization performance. Given the intercorrelation of the two dependent variables, a multivariate regression approach allowed us to simultaneously assess each independent variable across the regression equations, as these two equations are interdependent. More specifically, two regression models were tested for each dependent variable: model 1 only includes the configuration membership (dummy) variables whereas model 2 also includes the control variables as well (see Table 4). Moreover, multivariate F tests assess the total effect of each independent variable on the dependent variables when both are considered in concomitant fashion as representing competitive performance.

The regression results indicate that digital ecodynamic Configurations I and III are positively associated to innovation performance even when the control variables are included in the analyses. Moreover, the analyses also suggest that the younger the firms the better their performance with respect to innovation. This might be because younger firms might not yet be established so that they are still growing in terms of their new sales to total sales ratio. Remembering that SMEs in Configuration I have the highest absorptive capacity and those in Configuration III show the lowest absorptive capacity while they face the highest environmental uncertainty, the previous results support Hypothesis 2, in that these two configurations show better competitive performance than firms in Configuration II, thus, certain digital ecodynamic configurations are associated to higher levels of performance than others.

As indicated by the multivariate F test presented in Table 4, Configurations I and III are associated with significantly higher competitive performance than Configuration II. The fact that Configuration III is the top-performing in terms of internationalization performance also supports Hypothesis 2, in that certain ecodynamic configurations perform better than others.

	Innovation Performance		**Internationalization performance**		multivariate F test	
	model 1	model 2	model 1	model 2	model 1	model 2
Configuration III [constant]	2.3*	2.5*	2.4*	1.6	5.7*	4.1*
Configuration II	0.6	0.5	-1.3	-1.5	0.2	0.1
Configuration I	3.1**	2.6**	1.6	1.2	18.3**	12.2***
Size of the firm		0.6		1.4		0.0
Age of the firm		-2.2*		-1.4		3.1
Power of customers		0.2		0.5		1.3
F	5.4**	3.2*	3.9*	2.3*		
R^2	0.093	0.135	0.040	0.078		

[a] t coefficient (N = 140) *: $p < 0.05$ **: $p < 0.01$ ***: $p < 0.001$

Table 4. Regression analyses

The previous results also support Hypothesis 1. Configurations I and III are associated with the same outcome, i.e., innovation performance, thus demonstrating that different configurations can attain performance. The same occurs with Configurations II and I that show no statistically significant relationship with internationalization performance, thus supporting Hypothesis 1.

With respect to competing Hypotheses 3a and 3b, we can see that, as stated before, the two configurations that best perform in terms of innovation performance are Configurations I and III. Also, Configuration III is the one best performing with respect to international performance. Firms in both configurations show that although they have IT capabilities for exploitation similar to the ones in Configuration II, they possess more IT capabilities for exploration thus, giving priority to innovation goals and thus, pursuing primarily exploration rather than exploitation. It is not surprising then that those two configurations show better innovation performance. This evidence supports Hypothesis 3b to the detriment of Hypothesis 3a. Further support for Hypothesis 3b is given by the fact that Configuration II is the one whose IT capabilities for exploitation and exploration are more similar (as confirmed by paired t-tests) whereas it is the worst performing configuration with respect to both outcomes.

5 Discussion

The aim of this exploratory study was twofold. First, this research sought to evaluate the effect of IT ambidexterity (IT for exploitation and IT for exploration) along with DCs, and environmental uncertainty on the competitive performance of industrial service SMEs. Second, this study also investigated, from a configurational approach, the causal conditions associated with the digital ecodynamics (IT ambidexterity, DCs, and environmental uncertainty) that enable industrial service SMEs to achieve a high level of competitive performance. In so doing, this research makes several contributions.

First, our study provides a contribution to theory by testing competing hypotheses regarding IT and ambidexterity. Note that such assessment of competing perspectives constitutes a significant theoretical contribution because it improves the coherence of a given theoretical domain (Gray & Cooper, 2010). We also provide an initial answer to calls for research on what should be the appropriate equilibrium between IT capabilities for exploitation and exploration (Pavlou & El Sawy, 2011). In this regard, our results show that SMEs are better off focusing primarily on their IT capabilities for exploration while still developing sufficient IT capabilities for exploitation, and favors the perspective that IT ambidexterity should be achieved sequentially rather than in parallel (Winter & Szulanski, 2001).

This research also contributes to the IS and strategic management literatures by studying IT capabilities and DCs in joint fashion. In fact, the majority of research in leading management journals has ignored the IT-performance link while the majority of research in leading IS journals has overlooked the DC-performance link (Orlikowski, 2010; Zammuto, Griffith, Majchrzak, Dougherty, & Faraj, 2007). This has created the need to study DC and IT capabilities together from a configurational or gestalts approach in which synergies between the two elements can be captured (El Sawy et al., 2010; Wilden et al., 2016). This need is even more crucial when the relation between capabilities and performance is viewed as being ‘complex’ and thus unexplainable by simple direct effects (Wang & Ahmed, 2007).

This study also contributes by answering calls for research to take an equifinal approach, that is, an alternative to the ‘best practice’ approach in exploring the relationship between IT capabilities and performance (El Sawy et al., 2010; Wilden et al., 2016). Research to date has, for the most part, investigated the IT-performance (e.g., Chae et al., 2014; Chen et al., 2015; Liu, Ke, Wei, & Hua, 2013) and the DC-performance relationships (e.g., Lin & Wu, 2014; Wang et al., 2015; Wilhelm et al., 2015) as being unifinal, using variance theories. In contrast, this research takes an equifinal approach in which disparate digital ecodynamic configurations can successfully lead to competitive performance. That is, the elements composing the configurations might take different values in different configurations, yet these different configurations can equally lead to competitive performance. For example, the elements composing digital ecodynamic Configurations I and III greatly differ (i.e., one has the highest absorptive capacity while for the other, absorptive capacity is non-existent), yet the two configurations lead to innovation performance. Thus, this equifinal approach provides a taxonomy (Bailey, 1994) of digital ecodynamic configurations and of their relation to SMEs’ competitive performance that differs greatly from the traditional approach. In doing so, our study also contributes to practice by providing managers with different successful digital ecodynamic profiles that they can emulate, depending upon their particular strategic goals, to achieve better competitive performance.

Finally, this research also contributes to the literature by empirically including environmental uncertainty as a core element of digital ecodynamics, given the central role theoretically attributed to the environment in the dynamic capability-based view (Teece, Pisano, & Shuen, 1997). This is important to the extent that much of the literature studying the IT-performance and DC-performance relationships has done so without taking this element into account (e.g., Ray et al., 2005; Wang et al., 2012).

This study has some limitations that must be mentioned. There might exist a sample bias as these firms have chosen to undertake a benchmarking exercise and could thus differ from the general population in terms of their capabilities and performance (Cassell, Nadin, & Grey, 2001). Also, adding other dynamic capabilities such as integrating and coordinating capabilities (Pavlou & El Sawy, 2011) would provide deeper knowledge of the different paths to competitive performance that may be taken by these organizations. Finally, given the cross-sectional (as opposed to longitudinal) nature of the study, causality between the digital ecodynamic configurations and performance cannot be inferred.

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