IT Capability Configurations for Innovation: An Empirical Study of Industrial SMEs

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Abstract

With the advent of globalization and the knowledge-based economy, industrial SMEs must constantly innovate to remain competitive. Now, an important research issue in this regard concerns the role played by IT capabilities in enabling innovation processes such as new product development, and in determining the product innovation performance of these organizations. Using a configurational approach grounded in the resource-based view, contingency theory, and the notions of "fit" and equifinality, we argue that IT capabilities can be leveraged for innovation purposes to the extent that they are coaligned and thus constitute IT capability configurations*. This paper presents the results of a survey of 588 Canadian industrial SMEs designed to further analyze this issue.*

1. Introduction

Innovation has long been considered to be one of the most if not the most important factor of strategic development for small and medium-sized enterprises (SMEs) [1, 2]. For these firms, greater innovativeness is deemed essential to counterbalance their greater vulnerability in a complex business environment characterized by a knowledge-based economy [3]. Referring to a new or modified version of a product, one type of innovation in particular, that is, product innovation is meant to enable industrial SMEs to increase their global competitiveness by maintaining their position in the market and their relation with important customers [4].

From both a descriptive and a prescriptive point of view, a most important issue for IS researchers and practitioners lies in identifying the role played by information technology (IT) in supporting innovation processes such as the new product development (NPD) process, in contributing to the innovation performance of organizations [5, 6, 7], and in identifying in particular the *IT capabilities* that must be acquired and developed by SMEs operating in the manufacturing sector in order to innovate and perform at the "world-class" level [8]. To further tackle this issue, we apply a configurational approach or more precisely a taxonomical approach [9] grounded in the resource-based view [10] and in contingency theory [11] by examining the IT capability configurations of SMEs to generate further insight and provide further explanation of the innovation performance of these organizations. Hence the first research question: *What are the different organizational configurations that characterize industrial SMEs with regard to their IT capabilities for product innovation?*

Originating in contingency theory and closely associated to the configurational approach is the notion of *equifinality*, generally defined as the state of achieving a specific outcome through different configuration types [12]. In applying this notion befittingly to the specific context of SMEs, we aim to further analyze the IT capability configuration-innovation performance relationship and thus pose a second research question: *Do the different IT capability configurations that characterize industrial SMEs lead to equally successful outcomes in terms of product innovation?* Aiming to answer these questions, this paper presents the results of a survey study of 588 Canadian manufacturers.

2. Theoretical Background

Within the strategic IT management literature, research has focused on IT capabilities as the source of performance differences between individual firms. Defined as the firm's "ability to mobilize and deploy IT-based resources in combination or co-present with other resources and capabilities" [10], IT capabilities are deemed to shape important organizational outcomes such as productivity, growth and innovation. With regard to the last outcome, and with the specific

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context of industrial SMEs in mind, we consider two types of IT capabilities to be most strategic and complementary, namely the firm's *e-business capabilities* and its *IT infrastructure* [13].

E-business capabilities are "outside-in" IT capabilities [14, p. 111] that are externally oriented and emphasize three basic activities: scanning the technological, commercial and competitive environment in search of ways and means to improve operations and decision-making, and seeking new product-market opportunities (e-business intelligence) [15]; transacting business over the Internet, and especially selling of goods and services (e-commerce) [13]; collaborative sharing and exchanging of information and knowledge on the extended value chain linking the firm with its business partners, and especially collaborating in the development of new products and services (e-collaboration) [16].

IT infrastructure capabilities are "inside-out" capabilities, essentially defined as the "information processing capacity" developed by the firm in response to threats and opportunities in the business environment [14, 17, 18]. In an industrial context, such capabilities are manifested by the advanced manufacturing technologies [19] or "plant information system" [20] adopted by the firm to enable its product development and manufacturing processes in terms of innovation, flexibility and integration [21, 22].

In order to better conceptualize the relationship between IT capability configurations and the product innovation performance of SMEs, we view the potential effect of IT capabilities upon innovation through three distinct yet complementary theoretical lenses originating in strategic management research, namely the resource-based view, the configurational approach, and contingency theory with its central notions of "fit" and equifinality. The first lens focuses on the SMEs' IT capabilities as primary determinants of innovation outcomes, the second on how these capabilities interrelate and combine to achieve such outcomes, and the third on whether a "best" outcome may be obtained through one or more such combinations of IT capabilities.

2.1. IT capabilities from a resource-based view

In studying IT alignment from a strategic perspective, researchers have used the resource-based view (RBV) to focus on IT capabilities, including e-business capabilities, as critical factors of the firm's competitive advantage [14]. The RBV relies on two fundamental assertions, that of resource heterogeneity (resources and capabilities possessed by firms may differ) and of resource immobility (these differences may be long lasting). The firm's strategic success thus depends upon the combination of unique resources and competencies that it assembles internally. However, IT capabilities essentially differ from *IT resources*, the distinction being that "while resources can be easily duplicated, a unique set of capabilities mobilised by a firm cannot be easily duplicated and will result in sustained competitive advantages" [23, p. 128].

A number of studies have used the RBV to evaluate the impact of IT upon the firm's competitive advantage and business performance [10, 14, 22, 36]. Few of these however have looked at innovation performance specifically. One empirical study did find that developing a product development IT capability within the IT infrastructure constituted a process innovation for industrial SMEs, and that this innovation in the NPD process was positively associated with the product innovation performance of these firms [24]. Case studies have also generated models of the process by which e-business capabilities can enable both large and small firms to innovate in an era of "open innovation" [7, 25]. The initial implication for industrial SMEs is that a new competitive advantage (and the innovation performance that results from it) could be obtained by the leverage effect of "complementary" IT capabilities, most notably e-business capabilities and IT infrastructure capabilities [13].

2.2. IT capability configurations

As used in strategic management research, organizational configurations are meant to classify organizations by an orchestrating theme or profile [26, 27]. In relating these configurations to an organizational outcome, most often performance, the basic assumption has been that "competitive advantage may reside in the orchestrating theme and integrative mechanisms that ensure complementarity among a firm's various aspects: its market domain, its skills, resources and routines, its technologies" [28, p. 32]. Firms may thus achieve a sustainable competitive advantage by creating *capability configurations* as "a cohesive combination of resources and capabilities that is hard to imitate" [29, p. 43].

While a number of conceptualizations and categorizations of individual IT capabilities are found in the literature, including IT infrastructure, IT architecture, managerial IT, technical IT, e-business and ERP capabilities, most empirical studies have taken a "universalistic" or "best practices" approach, seeking to identify a direct causal link between individual IT capabilities and organizational performance or competitive advantage [30]. Now, the alternative "configurational" approach taken here implies is that innovation would not be enabled by individual IT capabilities, but rather by a coherent ensemble of such capabilities [29].

2.3. IT fit and equifinality

Originating in contingency theory, the concept of "fit" or alignment has shown its usefulness from both theoretical and managerial perspectives in strategic IS research [31]. Fit is viewed as a search for aligning the organization with its environment and as an arrangement of its resources and capabilities so as to support that alignment [32]. From this theoretical perspective, one could surmise that the IT capabilities of SMEs are leveraged to the extent that they are in a state of coalignment, i.e. to the extent that these firms can achieve coherence among their IT capabilities and thus enable their innovation strategy [9].

Configurational approaches that simultaneously consider many different elements are the ones that have been preferred by researchers in order to empirically assess fit [26]. Built upon equifinality, a property of open systems, these approaches assume that there exists a feasible set of equally effective, internally consistent organizational configuration types [33]. Moreover, in strategic alignment terms, such approaches correspond to the "fit as gestalts" perspective in Venkatraman's fit classification framework [34].

More precisely, the approach taken in this study is that of "configurational equifinality" [35], as befits the present situation of most industrial SMEs. In the global economy, these firms face multiple and conflicting competitive demands (say, product innovation vs. productivity, flexibility vs. integration) and operate in a wide set of industrial contexts and sectors [24], but now have a higher degree of latitude in configuring the IT capabilities needed to answer these demands [36]. The final implication here is that different combinations of IT capabilities could be equally successful in enabling the NPD process of industrial SMEs.

3. Research Hypothesis

IT capabilities are among the organizational capabilities possessed by a firm that can be used to formulate and implement competitive strategies [14]. Now, in a global knowledge-based economy, a number of SMEs in the manufacturing sector are subjected to strong competitive pressures to attain "world-class" status by improving their productivity, their flexibility, the quality of their products and services, their information processing capability, and especially their capacity to innovate [37, 38]. As innovation is tied to the overall growth and development of the firm, the strategic intent of SMEs is deemed to manifest itself through the acquisition, preservation and development of its organizational capabilities, notably its IT capabilities [39].

The configurational approach to the firm's strategic IT development seeks to discover to what extent its IT capabilities constitute capability configurations or "gestalts" that form a coherent whole, and to associate these configurations to the firm's attainment of a competitive advantage and the realization of organizational outcomes [28]. Hence, product innovation performance should here be associated to IT capability configuration types rather than being linearly predicted by individual IT capabilities [40]. And from a contingency perspective, IT capabilities would determine the innovation performance of SMEs insofar as they are in a state of strategic coalignment [9]. Moreover, the configuration approach extends the contingency approach by positing that only a limited number of configuration types can be equally successful, that is, by positing equifinality [41]. Corresponding to the two research questions, the research hypotheses thus follow:

H1: Certain IT capability configurations will be associated to higher levels of product innovation performance than others.

H2: Different IT capability configurations will be associated to the same levels of product innovation performance.

4. Research Method

A questionnaire was developed as a survey research instrument. After pre-testing the instrument, the owner-managers or CEOs of 3000 manufacturing firms whose number of employees was less than 250, randomly chosen from a repertory of all manufacturers in the province of Quebec, Canada, were contacted by phone. Of these, 588 accepted the offer to answer the survey, thus giving a 19.6% response rate. The potential for non-response bias was ascertained through chi-square tests confirming that the sample was representative of the survey's target population of SMEs in terms of firm size and industry. It should also be noted that the potential for common method bias in this survey study is quite low [42], as all of the research variables are measured with index (rather than scale) and factual (rather perceptual) measures.[1]

[1] 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. Also, an index regroups elements not expected to be highly intercorrelated, hence the inappropriateness of Cronbach's alpha coefficient to test its reliability.

4.1. Sample

The mean number of employees for the sampled industrial organizations is 51, with a range of 4 to 230. More than twenty industrial sectors (NAICS code) are represented, including metal products (18.4 % of the sampled SMEs), textile products (12.6 %), non-metallic mineral products (10.0 %), printing (7.3 %), computer and electronic products (7.0 %), beverage and tobacco (4.3 %), and furniture (4.3 %). Approximately half of the sampled SMEs (49%) operate in low-tech sectors, 32 % in medium to low-tech sectors, 17% in medium to high-tech sectors, and twelve firms only (2%) in high-tech sectors.

4.2 Measurement

E-business capabilities of SMEs are assessed through three index measures by asking the SME owner-managers to indicate the number of business activities for which the Internet and the Web are used in their organization. The activities proposed are grouped under three categories, namely e-commerce (e.g. selling products), e-business intelligence (e.g. prospecting for new customers abroad), and e-collaboration (e.g. interacting with business partners in R&D to develop new products). This categorization corresponds to Wade and Hulland's [14] characterization of "outside-in" IT capabilities and to the various levels of e-business development observed in SMEs [44, 45].

Following prior studies [22, 45], IT infrastructure in an industrial context is measured by the number of advanced manufacturing technologies and systems adopted by the SME, using Kotha and Swamidass' [46] classification: product development technologies (industrial drafting and design applications) and manufacturing management technologies (production planning, control and logistics applications such as ERP, production scheduling, quality assurance and bar-coding). Following researchers such as Garcia and Calantone [47], product innovation performance is measured by the average percentage of sales attributed to new or modified products over the last two years. This definition is appropriate to the reality of SMEs, and is the one most accepted in innovation research [48].

Given the results of previous studies that have demonstrated the theoretical and empirical importance of organizational and environmental context variables such as the SME's environmental uncertainty, commercial dependency (power of customers) as potential determinants of its innovation performance, we included these factors as control variables or covariates in order to increase the validity of the capability configurations and the configuration-performance relationships uncovered. Thus, environmental uncertainty was measured by adapting an instrument initially validated by Miller and Dröge [49], in which the owner-manager is asked to evaluate on 5-point Likert scales the degree of change and unpredictability in the firm's markets (customers, competitors) and manufacturing technologies. Power of customers was measured by the percentage of total sales taken up by the three most important customers [39]. The size of the firm was measured by the number of employees while the industry control variable was measured as the technological intensity of the industrial sector in which the firm operates (1: low-tech, 2: medium to low-tech, 3: medium to high-tech, 4: high-tech), using the OECD's [50] classification.

5. Results

The correlation matrices of the research and control variables are presented in Tables 1 and 2, noting at the outset that no individual IT capability is highly correlated to product innovation performance, the highest of the five correlation values being 0.14 for the product development IT capability.

In order to test our research hypotheses, we had to derive a configurational classification (or taxonomy) of the sampled firms' IT capabilities. This was done through cluster analysis, using the five IT capability measures as clustering variables. This numerical taxonomic approach first aims to group organizations into clusters such that each cluster's membership is highly homogeneous with respect to certain attributes. A second aim is that each group differs from other groups with respect to these same characteristics.

The SPSS TwoStep clustering algorithm was chosen as it can handle a large number of cases and automatically determines the optimal number of clusters [51]. A three-cluster solution was found to be optimal in identifying groups of SMEs that could be clearly distinguished from one another. As shown in Table 3, the three IT capability configurations were labeled as Configuration I (with 234 firms), Configuration II (with 91 firms) and Configuration III (with 263 firms). Table 3 presents the means of the clustering variables for each of the three clusters. One-way analysis of variance (ANOVA) was used to evaluate the equality of variable means across the clusters and thus assess the distinctiveness of each. Added tests of significance of pairwise contrasts further specify differences between the clusters. The ANOVAs were repeated with firm size, environmental uncertainty and industry as covariates to control from the confounding effects of these variables, and no such effects were found.

The criterion-related validity of the clusters was assessed by ANOVA and analysis of covariance (ANCOVA) tests presented in Table 4, showing significant differences between the three clusters with regard to variables "theoretically related to the clusters, but not used in defining clusters" [52, p. 447], namely the product innovation performance variable.

Table 1. Correlation Matrix of the Research Variables (N = 588)

variable	1.	2.	3.	4.	5.
e-Business Capabilities					
1. e-business intelligence capability	-				
2. e-commerce capability	.19	-			
3. e-collaboration capability	.28	.25	-		
IT Infrastructure Capabilities					
4. product development IT	.16	.15	.14	-	
5. manufacturing management IT	.10	-.02	.03	.03	-
Product Innovation performance					
6. sales of new products / sales	.10	.06	.07	.14	.08

Table 2. Correlation of the Research Variables with the Control Variables (N = 588)

variable	Size of the firm	Environmental uncertainty	Power of Customers	Industry low-tech	Industry med. –high
e-Business Capabilities					
e-business intelligence	.04	.16	-.10	-.08	.09
capability	.01	.09	-.10	-.06	.06
e-commerce capability	.01	.13	-.01	-.06	.06
e-collaboration capability					
IT Infrastructure Capabilities					
product development IT	-.02	.16	-.04	-.32	.21
manufacturing management IT	.03	.05	.04	-.06	.06
Product Innovation performance					
sales of new products / sales	-.09	.10	-.01	.02	.15
Control variables					
Size of the firm	-	-.08	-.12	-.01	.01
Environmental uncertainty	-.08	-	.06	-.07	.17
Power of customers	-.12	.06	-	.02	-.04
Industry - low-tech	-.01	-.07	.02	-	-.45
- medium to high-tech	.01	.17	-.04	-.45	-

Table 3. IT Capability Configurations Resulting From the Cluster Analysis

IT Capability configuration variable	**I** (n = 234) mean	**II** (n = 91) mean	**III** (n = 263) mean	ANOVA F	ANCOVA F¶
e-Business Capabilities	low	medium	high		
e-business intelligence capability	0.5_c	1.4_b	1.7_a	310.7***	288.5***
e-commerce capability	0.6_c	0.9_b	1.3_a	62.5***	57.3***
e-collaboration capability	0.9_c	1.4_b	1.7_a	99.0***	91.4***
IT Infrastructure Capabilities	low	high	medium		
product development IT	0.8_b	1.2_a	1.3_a	14.4***	9.0***
manufacturing management IT	0.1_b	1.7_a	0.1_b	605.7***	598.4***

¶ with covariates: Size of the firm, Environmental uncertainty, Power of customers, and Industry
***: $p < 0.001$
a,b,c *Nota*. Within rows, different subscripts indicate significant ($p < 0.05$) pair-wise differences between means on Tamhane's T2 (*post hoc*) test.

Table 4. Breakdown of Control Variables and Product Innovation Performance by IT Capability Configuration

IT Capability configuration	I (n = 234)	II (n = 91)	III (n = 263)	ANOVA	ANCOVA
variable	mean	Mean	Mean	F	F¶
Size of the firm	49	50	52	0.4	-
Environmental uncertainty	3.0_b	3.3_a	3.3_a	9.1***	-
Power of customers	0.44	0.47	0.41	2.0	-
Industry					
low-tech	0.55_a	0.38_b	$0.47_{a,b}$	4.1*	-
medium to high-tech	0.12_b	0.23_a	$0.20_{a,b}$	4.0*	-
Product Innovation performance					
sales of new products / total sales	0.156_b	0.225_a	0.228_a	7.6***	6.3**

¶ with covariates: Size of the firm, Environmental uncertainty, Power of customers, and Industry
*: $p < 0.05$ **: $p < 0.01$ ***: $p < 0.001$
$_{a,b,c}$*Nota*. Within rows, different subscripts indicate significant ($p < 0.05$) pair-wise differences between means on Tamhane's T2 (*post hoc*) test.

Returning to Table 3, Configuration I SMEs are characterized by the weakest IT capability configuration in terms of the three e-business capabilities (e-business intelligence, e-commerce and e-collaboration) and the two IT infrastructure capabilities (product development IT and manufacturing management IT). The SMEs in Configuration II are strongest in terms of IT infrastructure and "in-between" in terms of e-business capabilities (significantly stronger than I but weaker than III). The SMEs in Configuration III clearly lead on average the two other groups on every e-business capability, that is, on the e-business intelligence, e-commerce and e-collaboration capabilities. They are comparable however to Configuration I firms on one aspect of their IT infrastructure, i.e. a weaker manufacturing management IT capability, and to Configuration II firms on another aspect, i.e. a stronger product development IT capability.

Returning to Table 4, one can also characterize the three IT capability configurations in terms of the control variables and product innovation performance. Configuration I firms distinguish themselves by perceiving less uncertainty in their environment on average, and by being more present in low-tech industrial sectors than those in Configurations II and III. Moreover, Configuration I underperforms the other two with regard to product innovation. Conversely, firms in Configuration II and III are similar on average with regard to environmental uncertainty and industry. And more importantly, these last two IT capability configurations are also similar in terms of innovation performance, this similarity remaining true even when the effects of the control variables are accounted for.

To further test the derived IT capability configurations as predictors of innovation performance, multivariate regression analyses were performed for the individual SMEs in the sample, as presented in Table 5. The independent variables are the configuration group memberships, i.e., two dichotomous or "dummy" variables (1: yes, 0: no) indicating whether the firm is a member of Configuration II or Configuration III, with Configuration I membership as the constant term (i.e., the base category against which the other two categories are assessed) in the regression equation. The dependent variable is the indicator of product innovation performance, namely the ratio of new product sales to total sales. Two regression models are tested, the first (model 1) only includes the configuration group membership variables, while the second (model 2) also includes the control variables.

Table 5. Regression Analysis of the IT Capability Configurations[a]

dependent variable	Product Innovation performance	
independent variable	model 1	model 2
IT Capability config. I (constant)	11.0***	3.1**
IT Capability configuration II	2.6**	2.2**
IT Capability configuration III	3.7***	3.3***
Size of the firm		-2.2*
Environmental uncertainty		1.1
Power of customers		-0.2
Industry (medium to high-tech)		3.0**
F	7.6***	5.3***
R^2	0.025	0.052

[a]t coefficient (N = 588) *: $p < .05$ **: $p < .01$ ***: $p < .001$

The regression results indicate that IT capability configurations II and III are associated to a significantly higher level of product innovation performance, even when the control variables are factored. In this last regard, one sees that being of smaller size and operating in a sector of medium to high technological intensity also contributes to a better performance. Remembering that the SMEs in Configuration II show the strongest IT infrastructure capabilities and those in Configuration III show the strongest e-business capabilities, the previous results support Hypothesis 1 in that these two capability configurations are clearly higher-performing in terms of product innovation. Furthermore, within the taxonomy derived from our study, there is not "one best" but there are rather "two best" IT capability configurations for innovation, confirming Hypothesis 2. We found these two configurations to show the "best" product innovation performance by concentrating on different IT capabilities however.

Configuration II firms rely more on their IT infrastructure, and in particular on their manufacturing management IT capability, with the production process integration and monitoring provided by applications such as ERP, production scheduling and quality control. As such, their IT capability configuration would allow Configuration II firms to meet a demand for innovation but also competing demands for productivity.

For their part, Configuration III firms are the ones that rely on their e-business capabilities to develop their absorptive capacity, and thus their ability to bring new products to the market. Moreover, these SMEs have selectively developed their IT infrastructure by concentrating on their product development IT capability. To parallel Miles and Snow's [27] strategic typology, Configuration III firms could be viewed as *IT Prospectors*, as opposed to *IT Analyzers* for the Configuration II firms.

While the worst-performing SMEs with regard to product innovation are those in Configuration I, one may note that their performance in absolute terms is still quite acceptable, with an average innovation intensity of 16%. These firms are the least developed in terms of e-business capabilities and IT infrastructure. While their typical IT capability configuration is internally consistent, it may satisfy no dominant functional demand, be it innovation or another strategic function. They could be viewed here as *IT Defenders*; as such, they should be more oriented toward process innovation than product innovation [24]. Given that these SMEs are of the same size but operate more in low-tech industries and perceive less uncertainty in their business environment than the two other groups, their continued existence and performance may also be better explained by their "value appropriation" capabilities, configured to extract profits in the marketplace [53], than by the "value creation" IT capabilities examined in this study.

6. Implications

First and foremost, this study answers the call for research on the new product architectures that are enabled by information technology and in particular on the development of the IT capabilities such as the e-business and IT infrastructure capabilities that underlie the "organizing logic" of innovation [54]. There are a number of research implications that emanate from this study, given the present level of knowledge on the IT capabilities of industrial SMEs in the global economy and on the role of IT capabilities with regard to innovation.

6.1 Contributions to knowledge

First, we have identified different IT capability configurations that characterize industrial SMEs with regard to innovation. In so doing, we have contributed to the IT capabilities literature by using a configurational approach based on a systemic and holistic capabilities-based view to gain further insight into the strategic IT co-requisites of innovation. We have also contributed to research on equifinality by applying this notion to further understand the IT capability configuration-innovation performance relationship. As the proposed multidimensional contingency fit model was empirically validated in its ability to predict product innovation performance, the IT capability configurations found have theoretical and practical significance.

In order to test the universalistic or "best practice" argument as an alternative to the configurational argument taken in this study, two other multivariate regressions were made, this time using the five individual IT capabilities as predictors instead of the three IT capability configurations. Results presented in Table 6 indicate that none of these capabilities, save for the product development IT capability, significantly predict the product innovation performance of industrial SMEs.

The results presented here provide added theoretical validity to the configurational (as opposed to the universalistic or "best practices") approach to determine the link between the IT capabilities and product innovation performance of industrial SMEs. The coalignment of IT capabilities thus constitutes a fruitful theoretical basis to investigate the determinants of strategic behaviour and innovation of these firms. A methodological contribution also resides in the effectiveness with which the cluster analysis-based configurational perspective allowed us to describe and predict the level of innovation achieved through the development of IT capabilities. The taxonomical approach employed in this study may allow for a better understanding of the strategic IT management realities of industrial SMEs in a business context that is now globalized and knowledge-based.

Table 6. Regression Analysis of the IT Capabilities[a]

dependent variable	Product Innov. performance	
Independent Variable	model 1	model 2
(constant)	5.3***	2.5*
e-Business Capabilities		
e-business intelligence	1.5	1.4
e-commerce	0.6	0.5
e-collaboration	0.6	0.4
IT infrastructure Capabilities		
product development IT	3.0***	2.3*
manufacturing management IT	1.6	1.5
Size of the firm		-2.1
Environmental uncertainty		0.9
Power of customers		-0.1
Industry (medium to high-tech)		2.6**
F	3.9**	3.6***
R^2	0.033	0.054

[a]t coefficient (N = 588) *: p < .05 **: p < .01 ***: p < .001

6.2 Managerial contributions

This study also has some prescriptive implications for owner-managers of industrial SMEs and for those whose mission is to provide assistance to these firms. Given the increasing complexity of the business environment, it has become essential, even urgent to better understand the strategic orientation of SMEs and the IT capabilities needed by these firms in order to provide them with the appropriate support. When changes in the organizational or environmental context require strategic decisions that affect the firm's development, innovation and performance, these decisions and their consequences must be related to the SME's existing IT capabilities in order to prevent eventual dysfunctions between its "outside-in" and "inside-out" capabilities.

Notwithstanding the configurational argument taken in this study, if there is one "best" IT practice that can be recommended to SME managers in matters of product innovation, it is the adoption of product development technologies (e.g. CAD). Indeed, these technologies have been found in this study as well as in previous studies to influence product innovation performance in a direct and positive manner, irrespective of other IT capabilities.

Future research should allow for a better understanding of the multiple adjustments to their IT capabilities that industrial SMEs will have to make in order to increase their innovation performance in the face of the new competitive challenges brought about by globalization and the knowledge-based economy. Furthermore, these firms operate in situations of uncertainty that require frequent adjustments to their business processes, thus the need for flexibility in order to respond to changes in their business environment. Given that knowledge management is an "IT-driven capability" [55, p. 149], SME owner-managers should thus consider their firm not only as a producer of goods and services but also as a producer of knowledge, where the capacity to learn from multiple sources through their e-business capabilities, in complementarity with their IT infrastructure, becomes a determining factor in their innovation performance.

7. Limitations and Conclusion

This study has certain limitations that must be mentioned. While the studied sample of firms is relatively representative of industrial SMEs in terms of size and industry, it may have certain particularities that limit the generalization of the results. The index measures employed may not adequately reflect the breadth and depth of the SMEs' IT capabilities in matters of e-business and IT infrastructure. Product innovation performance could have been further conceptualized as NPD performance [56], with perceptual measures of process efficiency, product effectiveness and competitive advantage [57]. Finally, a further study could focus on a particular industry sector to account for differences in business models and core technologies between sectors, and thus provide a more contextualized IS theoretical and managerial contribution [58].

Emanating from a strategic alignment perspective founded on the RBV and IT capabilities, the results of this study reveal that two different IT capability profiles with regard to e-business and IT infrastructure are associated to a higher level of product innovation for industrial SMEs. This supports the basic contingency argument that IT capabilities can be leveraged for purposes of innovation to the extent that these capabilities are strategically coaligned, that is, constitute coherent IT capability configurations.

Facing competition that is more and more global and under pressure from their main business partners, many industrial SMEs are called upon to grow and innovate. In light of their strategic objectives, developing their IT capabilities with regard to e-business and IT infrastructure in a coherent manner thus constitutes a key success factor for these firms. This should lead researchers to identify the interactions among the strategic IT attributes of industrial SMEs that determine the performance of these organizations, notably in terms of innovation, rather than identifying individual determinants of performance.

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