Determinants and Outcomes of IT Governance in Manufacturing SMEs: A Strategic IT Management Perspective

Abstract

The need to strategically manage IT resources such that they enhance the business value of firms makes IT governance (ITG), in conjunction with IT alignment, an ongoing issue for IS researchers and practitioners. In addressing this issue, the present study aims to validate a research model that relates, within a strategic IT management framework, the firm's ITG and IT alignment capabilities to its IT performance. To do so, a survey of 223 manufacturing SMEs (small and medium-sized enterprises) was realized. Results confirm the hypothesized relationships between the firm's environmental uncertainty, strategic IT orientation, IT governance and IT alignment capabilities. They constitute a solid validation of the impact of the strategic management of IT resources and governance of IT on IT performance in the specific context of SMEs.

Keywords: IT governance; SME; strategic IT orientation; IT alignment; IT performance.

1. Introduction

The focus of the firm's management of IT has evolved from supplying systems that support internal processes to the more strategic role played by IT in business transformation, innovation and derivation of IT-based business opportunities (Tanriverdi, Rai and Venkatraman, 2010). From a resource-based view and, more specifically, a capability-based view, the firm must thus develop its strategic IT capabilities, more specifically IT governance (Wilkin and Chenhall, 2010) and IT alignment capabilities (Jewer and McKay, 2012), Furthermore, this must be done in accordance with the firm's strategic IT orientation, that is, in accordance with the shared view of the role of IT in the organization (Chen, Mocker, Preston and Teubner, 2010; Joshi, Bollen, Hassink, De Haes and Van Grembergen, 2018).

In the manufacturing sector, the need to develop strategic IT capabilities is especially critical for small and medium-sized enterprises (SMEs), as these firms face greater environmental

uncertainty than large enterprises (LEs) but have more to gain, in terms of agility and competitiveness, from the strategic use and management of IT (Blili and Raymond, 1993; Levy and Powell, 1998). Manufacturing SMEs have long been considered to be overly dependent upon a few major customers, to have little influence over market prices and to suffer from "resource-poverty" when compared to LEs (Welsh and White, 1981). In particular, these firms show a greater dependency with regards to their IT resources and competencies when, in facing the challenges of strategic positioning and global competition, they seek to incorporate IT into their governance structures and business processes (Bergeron, Croteau, Uwizeyemungu and Raymond, 2016; Limaj, Bernroider and Choudrie, 2016). Yet manufacturing SMEs constitute a most dynamic part of the industrial economy in North America and Europe, due to a greater capacity for product and process innovation, a quicker response to the changing customer needs and an increasing assimilation of advanced manufacturing technology (OECD, 2010; Raymond and St-Pierre, 2010).

Given that the firm's strategic management of IT is increasingly based on its governance of IT (Kude, Lazic, Heinzl and Neff, 2018; Lee and Lee, 2009), there is a need for a more holistic description and explanation of the nature and extent of the relationships between IT strategy, IT governance and strategic IT alignment. Moreover, the performance outcomes of IT governance have been studied mostly in terms of the various dimensions of organizational performance (Turel and Bart, 2014; Zhang, Zhao and Kumar, 2016), that is, a rather distal outcome. There is thus a need to study IT governance in terms of its effect on IT performance, a proximal outcome related to the firm's attainment of business value from its investment in IT resources (Mitra, Sambamurthy and Westerman, 2011; Tiwana, Konsynski and Venkatraman, 2013). More specifically, we need to identify the relative importance of ITG on the IT alignment capabilities of SMEs and ultimately on the IT performance of these firms.

Despite a solid body of work on different aspects of the relationship between IT strategy, IT governance (ITG), IT alignment and IT performance, added empirical evidence is needed to provide further, more integrated knowledge of the ITG phenomenon, its strategic determinants and performance outcomes in the specific context of SMEs. Following Tallon, Ramirez and Short's (2013) theoretical framework for ITG and drawing upon previous studies that have explored the antecedents of ITG (Bradley, Byrd, Pridmore, Thrasher, Pratt and Mbarika, 2012) and its consequences for IT alignment (De Haes and Van Grembergen, 2009; Wu, Straub and Liang, 2015) and IT performance (Benaroch and Chernobai, 2017; Lunardi, Macada, Becker and Van Grembergen, 2017), we formulate and empirically validate a nomological network in attempting to answer the following research questions: *What is the impact of the manufacturing SME's environmental uncertainty and strategic IT orientation upon its ITG capabilities and IT alignment capabilities? What is the impact of the manufacturing SME's ITG capabilities upon its IT alignment capabilities and IT performance?*

Answering the questions above provides our first research objective, which is to study the following concurrent relationships: a) the direct and indirect effects of the firm's environmental uncertainty on its ITG and IT alignment capabilities, b) the direct and indirect effects of the firm's strategic IT orientation on its ITG and IT alignment capabilities, c) the direct and indirect effect of the firm's ITG capabilities on its IT alignment capabilities and IT performance, and d) the direct effects of the firm's IT alignment capabilities on its IT performance. By including ITG and IT alignment capabilities as mediating elements, the second objective is to examine these IT capabilities as mediating components within a nomological network of strategic IT management in manufacturing SMEs to 'illuminate how IT can be mobilized' for strategic purposes (Maiga, Nilsson and Jacobs, 2013, p. 298). We also hope to gain added insight on the IT capabilities

developed by these firms to deploy and manage their IT resources effectively. To achieve these two objectives, we develop and test a research model using structural equation modeling (SEM), using survey data obtained from 223 manufacturing SMEs. Moreover, our use of 'component-based' SEM (Lee, Petter, Fayard and Robinson, 2011) allows us to fully assess the mediating effects hypothesized for the IT governance and alignment capabilities within the nomological network and provide a further theoretical contribution in this regard. Our findings from this study demonstrate the fruitfulness of using a capability-based strategic IT alignment perspective to study IT governance. More precisely, we find that IT governance capabilities of the sampled SMEs positively influence their IT performance through their IT alignment capabilities. We also find that IT governance capabilities are positively influenced by the SMEs' environmental uncertainty and IT strategy.

The rest of the paper is divided into six sections. Section 2 presents the study's theoretical background, including the research model and hypotheses. The survey research method is presented in section 3, followed in the next section by the empirical results obtained from the SEM analysis. The discussion and implications of these results are found in section 5. The last section describes the limitations of the study and presents its final conclusions.

2. Theoretical and Empirical Background

A question that has been left unanswered until now is whether ITG relates directly to the IT performance of manufacturing SMEs. Now this may be due to the 'halo effect' of the firm's corporate governance that includes IT governance and thus may also be enabled by IT (Rezaee, 2009). Or ITG may influence IT performance solely through the mediating effect of the SME's IT alignment capabilities (Luftman, Ben-Zvi, Dwivedi and Rigoni, 2010). Authors such as Bartens, Chunpir, Schulte and Voss (2017) and Gomes and Romão (2017) thus ask that further research be

specifically conducted with an ITG perspective on the various business contexts, models and facets of business-IT alignment. Moreover, there remains a number of 'theory-practice gaps' with regards to ITG (Ko and Fink, 2010), and in particular with regards to the different ITG models and mechanisms to be prescribed for different contexts (Wilkin, Couchman, Sohal and Zutshi, 2016).

Another aspect of the IT governance paradigm lies in the antecedent factors that could directly or indirectly influence the firm's ITG and IT capabilities. In this regard, environmental uncertainty is seen to be a primary driver of the strategic choices made by SMEs (Parnell, Lester, Long, and Köseoglu, 2012). The strategic IT orientation of these firms also supports their strategic choices (Huang, Zmud and Price, 2009), and is expected to be a driver of their ITG capabilities and ultimately of their IT performance. Empirically testing this critical set of four predictors of IT performance would then allow researchers to build a nomological understanding of the contribution of ITG to IT performance as well as to provide recommendations or guidelines as to the appropriate governance of IT in the specific context of SMEs. As previously noted, the particularities of SMEs such as limited resources and competencies, a flatter structure and greater proximity to their markets, relative to LEs, justify this investigation in the specific context of SMEs (Raymond and Croteau, 2009; Wilkin et al., 2016).

Following Jewer and McKay (2011) and De Haes, Van Grembergen and Debreceny (2013), the governance of enterprise IT is herein defined as: 'ITG, a responsibility of top-management and an integral part of corporate governance, encompasses the decision rights and the accountability framework for encouraging desirable behavior in the use of IT, and ensuring that IT goals and objectives are realized in an efficient and effective manner' (Bergeron et al., 2016, p. 55). Now, manufacturing SMEs increasingly depend on IT-enabled business processes and IT-induced competitive advantages to increase their organizational agility and competitiveness in the digital

economy (Dutot, Bergeron and Raymond, 2014; Limaj et al., 2016). This greater dependence upon organizational IT assets induces a concomitant need for these firms to develop an ITG capability, i.e. appropriate ITG mechanisms in order to achieve the most business value from these assets (Devos, Van Landeghem and Deschoolmeester, 2012; Wilkin, 2012).

The firm's IT governance capability 'is a means to govern organizational IT assets in order to deliver organizational value' (Wilkin et al., 2016, p. 7). Previous studies have largely demonstrated that SMEs, as economic, organizational, and cultural entities whose realities and needs are in many ways different from those of LEs, should apply IT governance mechanisms tailored for them instead of copying ITG mechanisms developed with LEs in mind (Devos et al., 2012; Vogt, Küller, Hertweck and Hales, 2011; Wilkin, 2012).

The research model and hypotheses, in the form of a nomological network, are outlined in Figure 1. We present in the following subsections prior theoretical and empirical developments that underlie our research model and our formulation of the research hypotheses. It is important to note at the outset that this model reflects the strategy-structure-performance paradigm still dominant in the strategic management literature (Amitabh and Gupta, 2010; Wasserman; 2008).

2.1 ITG capability: strategic determinants

Although ITG best practices have been proposed (Batyashe and Iyamu, 2016), a consensus that a universal best ITG framework does not exist has emerged from the literature (Brown and Grant, 2005; Pereira and Mira da Silva, 2012; Sambamurthy and Zmud, 1999): contingency factors must be factored in for an effective ITG framework. Thus, any firm needs to develop its ITG capabilities in accordance with its organizational and contextual specificities. And given that, as compared to LEs, SMEs have less control over their business environment (Parnell, Lester, Long and Köseoglu

(2012), a more uncertain environment will generate greater information requirements and require stronger IT capabilities on their part (Dutot et al., 2014).

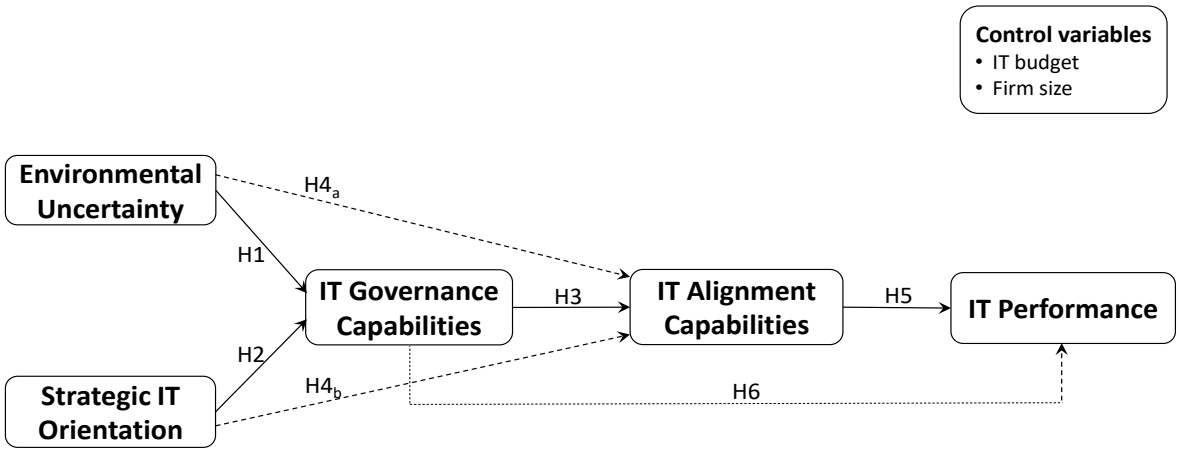


Figure 1. Research Model

According to Parnell et al. (2012, p. 559), 'uncertainty in market, technological, and competitive realms is high for all SMEs by definition'. This shows to what extent the environmental uncertainty is relevant in studies on SMEs in general, and more so on SMEs in highly dynamic environment. SMEs evolving in a dynamic environment characterized by unpredictable market and technological changes face more pressures than LEs in the same environment. Unlike LEs, SMEs do not have extra resources to withstand the pressure for change or to use as buffer while adapting to change, and they have to commit whatever resources they can muster to immediately implement the required changes (Lonbani, Sofian and Baroto, 2016).

From information processing theory (Tushman and Nadler, 1978), we know that one way that organizations try to cope with uncertainty is by developing buffers to reduce its effect, while another is by implementing 'structural mechanisms and information processing capability to

enhance the information flow and thereby reduce uncertainty' (Premkumar, Ramamurthy and Saunders, 2005, p. 260). Similarly, we surmise that SMEs, confronted with an environmental uncertainty that makes it difficult to garner and correctly interpret IT-related information, will need to develop stronger ITG capabilities than other SMEs that evolve in more predictable environments. Hence our first research hypothesis:

> Hypothesis 1: SMEs with greater environmental uncertainty are more likely to develop stronger IT governance capabilities.

Based on the strategy-structure paradigm, Banker, Hu, Pavlou, and Luftman (2011) have demonstrated that the chief information officer (CIO) reporting structure, which is an important component of an ITG framework (Bradley et al., 2012a), depends on IT initiatives designed to facilitate a firm's strategic positioning. These IT initiatives reflecting the strategic intentions of the firm are elsewhere referred to as strategic IT orientations (Gupta, Karimi and Somers, 1997; Sobol and Klein, 2009).

Previous studies have shown that IT investments fulfil different roles for different business firms (Venkatraman, 1994), as each firm has specific expectations with regards to IT that depend upon its ability to 'align' these technologies with its strategic aims (Philip and Booth, 2001). Thus, a SME may assign a more operational role to IT such as monitoring production operations to reduce manufacturing costs (Lefebvre, Langley, Harvey and Lefebvre, 1992), or a more strategic role such as providing the firm with a sustained competitive advantage (Bergeron and Raymond, 1992).

Nolan and McFarlan (2005) proposed an IT strategic impact grid that classifies firms according to two dimensions, the need for reliable IT, and the need for new IT. These dimensions define the levels of a firm's IT dependency (Héroux and Fortin, 2014). According to Nolan and

McFarlan's (2005) grid, the strategic approaches to IT can be declined into four modes, two defensive modes (factory and support), and two offensive modes (strategic and turnaround). Based on this classification, Nolan and McFarlan (2005) as well as Héroux and Fortin (2014) have shown that ITG mechanisms vary from one firm to another according to each firm's situation, thus taking into account its operational and strategic needs. Bart and Turel (2010, p. 150) used Nolan and McFarlan's (2005) IT modes grid to demonstrate that when 'the ideas related to IT governance frameworks and IT modes are combined,' members of the board of directors iteratively improve their ITG knowledge and experience through more selective and relevant IT governance questions.

As the firm's strategic IT orientation is deemed to significantly influence its governance of IT (Peterson, O'Callaghan, and Ribbers, 2000), the specific role assigned to IT by the organization reflects a particular form of IT orientation and a specific level of IT dependency (Héroux and Fortin, 2015; Nolan and McFarlan, 2005). We thus surmise that a firm will develop its ITG capabilities to reflect the role it is expecting from its IT assets, or otherwise stated, to reflect its level of dependency on IT. Furthermore, given the role they now play in the firm's digital business strategy (Chen et al., 2010; Joshi et al., 2018), ITG capabilities may be defined as being truly 'strategic', i.e., as 'bundles of skills and accumulated knowledge' that allow organizations to deploy their IT assets and coordinate their IT activities (Desarbo, Di Benedetto, Song and Sinha, 2005, p. 49). We thus further surmise that SMEs expecting their IT assets to play a more 'transformational' role will need a greater ITG capability to effectively deal with the IT-enabled changes brought about by this strategic choice. Hence the following hypothesis:

> Hypothesis 2: SMEs with a more strategic IT orientation are more likely to develop stronger IT governance capabilities.

2.2 ITG capability: strategic IT outcomes

The main goal of ITG implementation is to 'enable that IT sustains and extends the business goals, or in other words, enable that IT is aligned to the business needs (business/IT alignment)' (De Haes and Van Grembergen, 2009, p. 123). Business-IT alignment has thus become an aspect of ITG performance that has been widely discussed in the literature (e.g. Croteau and Raymond, 2004; Gomes and Romão, 2017; Gupta, Karimi and Somers, 1997; Huang, 2012; Hussin, King and Cragg, 2002). In particular, the ITG structures, ITG processes and relational mechanisms that constitute the firm's ITG capabilities are designed to enable firms to achieve a higher state of business-IT alignment and an improved alignment process (Alreemy, Chang, Walters and Wills, 2016; Bartens et al., 2017).

The IT alignment capability concept is defined herein as a component of a SME's IT capability that allows it to achieve a 'realized' – as opposed to a 'planned' – IT strategy (Croteau and Bergeron, 2001; Wu et al., 2015) that is in coherence with the firm's overall business needs and strategic goals. Thus defined, our concept of IT alignment capability is operationalized in terms of the firm's capacity to effectuate IT-business process integration, external IT linkages and business-IT strategic thinking, i.e. as the strategic component of the SME's overall IT capability (Dutot et al., 2014).

Referring to the firm's IT organization, Buchwald, Urbach and Ahlemann (2014) have demonstrated that one of the main goals of a successful ITG implementation was to increase business-IT alignment. For their part, Reynolds and Yetton (2015) have shown that the firm's ITG competencies are strategic drivers of the alignment between its business strategy and IT strategy. Drawing on the resource-based view (RBV), Zhang et al. (2016) found the firm's ability to govern its IT resources to be an important determinant of its IT capability, and of its IT-business alignment capability in particular. We can thus surmise that a successful ITG implementation will translate

into a firm's capability to attain a higher level of alignment between its business strategy and IT strategy. In line with the preceding findings and argument, we formulate our third hypothesis as follows:

> Hypothesis 3: SMEs with stronger IT governance capabilities are more likely to develop stronger IT alignment capabilities.

Prior empirical studies found the firm's governance of IT to be impacted by its environmental context and its strategic context (Xue, Liang and Boulton, 2008; Xue, Ray and Gu, 2011). Likewise, the firm's quest for business-IT alignment was found to be influenced by environmental and strategic contingencies (Chang, Wang and Chiu, 2008; Rivard, Raymond and Verreault, 2006). Furthermore, we argue that the impact of ITG capabilities on IT alignment capabilities could outweigh the impact of environmental uncertainty and strategic IT orientation on these same capabilities. As the firm's environment becomes more uncertain and its IT strategy changes accordingly, one of the outcomes of such change is better IT alignment (Gerow, Grover, Thatcher and Roth, 2014), suggesting an indirect impact of environmental uncertainty and strategic IT orientation on IT alignment. Hence the effect of IT governance on IT alignment may mediate the effects of environmental uncertainty and strategic IT orientation on IT alignment. On the basis of the preceding findings and argument, we therefore hypothesize the following:

> Hypothesis 4_a: A SME's IT governance capabilities positively mediate the effect of its environmental uncertainty on its IT alignment capabilities.

> Hypothesis 4_b: A SME's IT governance capabilities positively mediate the effect of its strategic IT orientation on its IT alignment capabilities.

A substantial body of work in the information systems (IS) literature is evaluative in nature, as researchers wish to understand the process by which the firm's IT investments are converted into IT assets, how these assets are used to generate the IT impacts expected, and how these

impacts translate into improved (or worsened) organizational outcomes (Gable, Sedera and Chan, 2008; Petter, DeLone and McLean, 2012; Soh and Markus, 1995; Tallon, 2008). Now, an important part of this work focuses on managers' perceptions of their firm's IT performance, that is, of the extent to which the use of IT by their firm contributes to – or otherwise impacts – organizational performance (Gable, Sedera and Chan, 2008; Karake, 1995; Petter, DeLone and McLean, 2008; Tallon, Kraemer and Gurbaxani, 2000; Uwizeyemungu and Raymond, 2009). Consequently, one research stream within the IS evaluation literature has sought to identify the organizational determinants of IT performance (Petter, DeLone and McLean, 2013), mostly drawing upon the RBV which assumes that differences between firms with regard to the achievement of IT-business value stem from their respective capacity to develop, deploy and strategically align their IT resources (Soto-Acosta and Meroño-Cerdan , 2008; Uwizeyemungu and Raymond, 2012; Wade and Hulland, 2004).

The business-IT alignment process is essentially meant to enable firms to gain superior business value from their IT investments, in other words to achieve IT performance by adopting and using technologies in a manner that is coherent with their strategic goals (Leonard and Seddon, 2011). In empirical studies, strategic IT alignment has been found to have a positive impact on IT performance as a result of better IT choices, i.e. choices that yield greater organizational benefits because they are made by the firm in full view of its corporate and IT strategies (Coltman, Tallon, Sharma and Queiroz, 2015; Gerow et al., 2014; Zhang et al., 2016). These considerations lead us to the following hypothesis:

> Hypothesis 5: SMEs with stronger IT alignment capabilities are more likely to achieve greater IT performance.

IT governance and strategic IT alignment are two concepts that have been understood by researchers to be complementary and strongly related (Tiwana and Konsynski, 2010; Weill and Ross, 2004). Furthermore, IT alignment capabilities have been observed to play a complementary role with regard to the firm's strategic capabilities (Johnson and Lederer, 2010; Tallon, Queiroz, Coltman and Sharma, 2016). In particular, the strategic alignment of IT may constitute an enabling mechanism for the firm's strategic capabilities, that is, a mechanism that enhances the impact of these capabilities upon proximal and distal organizational outcomes such as IT performance and financial performance (Bradley, Pratt, Byrd, Outlay and Wynn, 2012; Coltman et al., 2015; Gerow et al., 2014). Furthermore, we argue that the impact of IT alignment capabilities on IT performance could outweigh the impact of ITG capabilities on this same outcome. As the firm's achieves a greater state of business-IT alignment, one of the outcomes of such change is better IT performance (Chan and Reich, 2007), suggesting an indirect impact of IT governance on IT performance. Hence the effect of IT alignment on IT performance may mediate the effect of IT governance on IT performance. On the basis of the preceding findings and argument, we therefore posit the following:

> Hypothesis 6: A SME's IT alignment capabilities positively mediate the effect of its IT governance capabilities on its IT performance.

Given the need for added validity yet clarity and parsimony in testing the research model (Bacharach, 1989), this model includes the two potentially most relevant control variables as determined from the IT management literature (e.g. Raymond, Paré and Bergeron, 1995; Wang, Wan, Burke, Bazzoli and Lin, 2005). First, firm size is a widely studied antecedent of strategic IT management (Pflughoest, Ramamurthy, Soofi, Yasai-Ardekani and Zahedi, 2003) and IT governance (Wilkin et al., 2016). Second, the firm's IT budget has been significantly and

positively related to its development of IT capabilities (Lee and Larsen, 2009) and its IT performance (Khallaf and Majdalawieh, 2012).

3. Research Method

3.1 Research design and sampling

Empirical data were obtained from a questionnaire-based survey. The survey population consisted of 1825 manufacturing SMEs, selected from a repertory of all manufacturing firms in the province of Quebec, Canada. We adopted the European Union's definition of a SME for the manufacturing sector, i.e. firms whose number of employees range from 20 to 249. The choice of this sampling population in terms of firm size, industry and location was made because these firms have previously been shown to vary greatly in their use IT for strategic purposes (Raymond and St-Pierre, 2010), and thus the potential to acquire further knowledge with regard to the question under study was high. As a pre-test, two managers responsible for IT in their respective firms were interviewed as to the questionnaire's format and instructions, and as to the wording of questions and possible answers to ensure that these were interpreted as intended by the researchers. Following a few minor adjustments to the survey instrument, the study received final approval from the ethics committee of the researchers' institution.

Being addressed to the person in charge of IT in the firm, the questionnaire was mailed to all SMEs in the survey population. The first responses were received on June 19, 2017, and the last one was received seven weeks later, on August 6 (responses received after July 9 were deemed to be 'late'). A total of 223 questionnaires were completed and usable for the analysis (12% response rate). The characteristics of the survey's respondents are presented in Table 1. The greater part of these respondents held the title of financial manager (29%), IT manager (26%), chief-executive (16%) and IT technician (8%) while others held titles such as administrative or executive

assistant, operations manager and HR manager, reflecting the varied leadership and formalization of the IT function in the SME context. The mean size of the sampled firms is 88 employees, with a median of 65. A majority of these firms operate in low-tech (42%) or low- to medium-tech (41%) industrial sectors, the others operating in medium- to high-tech (10%) or high-tech (7%) sectors. The descriptive statistics and intercorrelations of the research variables are presented in Table 2.

Table 1. Characteristics of the Respondents

Characteristics of the respondents (n = 223)	frequency
Gender	
Male	168
Female	55
Education	
High-school	17
College	59
University (bachelors)	104
University (masters or doctorate)	43
Age	
20 - 29 years old	17
30 - 39	47
40 - 49	77
50 - 59	64
60 - 69	18
Position	
V.-P. finance/Financial manager	64
IT manager	57
Chief-executive	36
IT technician	17
Operations/Production manager	10
Executive V.-P.	8
Administrative assistant	7
HR manager	5
Other	19
Experience in present position	
1 - 4 years	73
5 - 9	45
10 - 19	67
20 - 29	27
30 - 45	11

Table 2. Descriptive Statistics and Intercorrelations of the Research Variables

variable (n = 223)	mean	stdev	α[a]	VIF[b]	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Environmental Uncertainty															
1. competitive uncertainty	3.7	0.7	.70	1.3	-										
2. commercial uncertainty[c]	3.1	0.8	.67	1.3	.43	-									
3. technological uncertainty	2.6	0.9	.76	1.2	.38	.33	-								
Strategic IT Orientation															
4. strategic IT orientation	2.2	1.3	-	-	.15	.01	-.08	-							
IT Governance Capabilities															
5. IT governance structures	3.7	0.7	.77	1.7	.08	.10	.07	.19	-						
6. IT governance processes	3.3	0.8	.85	1.7	.19	.04	.22	.20	.54	-					
7. relational mechanisms	3.7	0.7	.76	1.9	.15	.12	.24	.20	.60	.60	-				
IT Alignment Capabilities															
8. IT-business process integration	3.4	0.9	.87	1.7	.14	.03	.26	.14	.45	.57	.59	-			
9. external IT linkages	3.5	0.9	.75	1.6	.11	.07	.13	.11	.40	.50	.60	.62	-		
10. business IT strategic thinking	2.9	0.9	.74	1.1	.25	.10	.29	.16	.36	.38	.42	.33	.31	-	
IT Performance															
11. contribution of IT use	3.8	0.6	.92	1.9	.19	.20	.16	.23	.52	.51	.61	.55	.54	.43	-
12. contribution of e-business use	3.5	0.7	.86	1.4	.24	.20	.27	.12	.30	.27	.32	.29	.34	.41	.52

[a]Cronbach's alpha coefficient of reliability

[b]variance inflation factor = $1/(1-R_i^2)$ [where R_i^2 is the unadjusted R^2 obtained when variable$_i$ is regressed against all other variables forming a construct]

[c]removed from the measurement model

As generally recommended in survey research (Hikmet and Chen, 2003), the possibility of non-response bias was evaluated by comparing the responses associated with the 48 'late' respondents, those who responded over a month after reception of the questionnaire, with the responses provided by the 175 other ('early') respondents. After statistical comparison through t-tests, no significant differences were found between the two groups, thus indicating the absence of non-response bias. Moreover, given that the questionnaire is answered by a single respondent at one point in time, there is also a possibility of common method bias (Podsakoff, MacKenzie, Lee and Podsakoff, 2003). One way to evaluate the presence of such a bias is to use a 'marker' variable that should not be highly correlated to any of the research variables (Lindell and Whitney, 2001). We thus used the 'commercial uncertainty' variable associated to the Environmental Uncertainty construct as the marker variable in relation with the four other research constructs. High correlation

between commercial uncertainty and the nine indicators of the other research constructs would be indicative of a common method bias. As the average correlation between commercial uncertainty and each of the other constructs' indicators was equal to 0.167 (with a maximum of 0.24), this last result indicates the absence of common method bias in the data.

3.2 Measurement

Strategic IT Orientation. Conceptualized as the role of IT in the firm's achievement of its business strategies and goals (Teo and Too, 2000), the strategic IT orientation of manufacturing SMEs was assessed through a self-typing ordinal measure whose development is based on Venkatraman's (1994) and Philip and Booth's (2001) IT-stage models. The respondents were asked to choose one among the following four statements that best describes their understanding of the role that is assigned to IT-based applications in their firm: IT applications are used to improve managerial control and monitoring of the firm's manufacturing operations (IT strategy 1), increase the flexibility of the firm's manufacturing operations and better respond to its customers' needs (IT strategy 2), accelerate and facilitate the firm's development of new products and increase its market share (IT strategy 3), or increase the integration of the firm's manufacturing and business processes and improve relations with its business partners (IT strategy 4).

IT Governance Capabilities. The strength of the firm's ITG capabilities was measured by the extent to which it has put in place three types of governance mechanisms, namely ITG structures, processes and relational mechanisms, following De Haes and Van Grembergen (2008). The fifteen mechanism items that compose these three variables were culled from the extant literature and adapted to the SME context (Wilkin et al., 2016; Willson and Pollard, 2009; Simonsson, Johnson and Ekstedt, 2010). The respondent thus indicates on a 5-point Likert scale

the extent to which a particular ITG mechanism is applied (e.g. 'The firm's organizational climate encourages risk taking and experimentation with regards to IT').

IT Alignment Capabilities. The strength of firm's IT alignment capabilities was measured by the extent to which it has developed three types of alignment mechanisms, namely IT-business process integration, external IT linkages and business IT strategic thinking, in line with prior conceptualization and operationalization of these capabilities in a SME context (Dutot et al., 2014; Zhang, Sarker and Sarker, 2013). The nine capability items that compose these three variables were culled from prior empirical studies (Fink and Neumann, 2007; Kim, Shin, Kim and Lee, 2011; Pavlou and El Sawy, 2006). The respondent thus indicates on a 5-point Likert scale the extent to which a particular IT alignment capability has been developed (e.g. 'The firm restructures its business processes through IT in order to create opportunities for improvement.').

IT Performance. Conceptualized as the managers' perceptions of the business value of IT (Tallon et al., 2000), the IT performance of manufacturing SMEs was measured by the level of attainment of the organizational benefits associated with the firm's use of IT and e-business, based on the various criteria proposed in the literature for evaluating the contribution of IT use to organizational performance (Chang and King, 2005; Gable et al., 2008; Ranganathan and Kannabiran, 2004; Saunders and Jones, 1992; Seddon, Graeser and Willcocks, 2002), following a process-based approach wherein the respondents evaluate this contribution (Tallon, 2008). A list of nineteen benefits expected from the firm's use of IT (e.g. 'reduce the firm's manufacturing costs') and e-business applications (e.g. 'facilitate the recruitment of personnel') is thus presented to the respondent who estimates on a 5-point Likert scale the extent to which each of these benefits is attained.

Environmental Uncertainty. Following Duncan's (1972) conceptualization of environmental uncertainty, this construct was measured by adapting an instrument initially validated by Miller and Dröge (1986), in which the respondent is asked to evaluate, on 5-point Likert scales, the degree of change and unpredictability in the firm's competitive, commercial and technological environments (competitors, customers, manufacturing technologies).

Control variables. Firm size was measured by the number of employees while IT budget was measured by the percentage of the firm's turnover that is attributed annually to IT.

A summary of the conceptualization and operationalization of the five research constructs is presented in Table 3.

Table 3: Conceptualization and Operationalization of the Research Construct

Construct	Conceptualization	Operationalization	Source
Strategic IT Orientation	Role of IT in the achievement of the firm's strategies (Teo and Too, 2000) 1. Operational orientation 2. Operational/Tactical orientation 3. Tactical/Strategic orientation 4. Strategic orientation	4 statements, each describing the firm's orientation with regard to the adoption and use of IT	– Philip and Booth (2001) – Venkatraman (1994)
ITG Capabilities	IT governance mechanisms (De Haes and Van Grembergen, 2008) • ITG structures • ITG processes • Relational mechanisms	19 five-point Likert scales culled from the extant IT governance literature (adapted to the SME context)	– Simonsson et al. (2010) – Wilkin et al. (2016) – Willson and Pollard (2009)
IT Alignment Capabilities	IT alignment mechanisms (Dutot et al., 2014; Zhang et al., 2013) • IT-business process integration • External IT linkages • Business IT strategic thinking	9 five-point Likert scales culled from the extant IT alignment literature (adapted to the SME context)	– Fink and Neumann (2007) – Kim et al. (2011) – Pavlou and El Sawy (2006)
IT Performance	Perceived business value of IT (Tallon, 2008; Tallon et al., 2000) • Contribution of IT use to organizational performance • Contribution of e-business use to organizational performance	19 five-point Likert scales culled from the extant IT evaluation literature (adapted to the SME context)	– Chang and King (2005) – Gable et al. (2008) – Ranganathan and Kannabiran (2004) – Saunders and Jones (1992) – Seddon et al. (2002)
Environmental Uncertainty	Characteristics of the organizational environment as perceived by decision makers (Duncan, 1972) • Competitive environment • Commercial environment • Technological environment	9 five-point Likert scales (adapted to the SME context)	– Miller and Dröge (1986)

The elements of the questionnaire designed to measure the twelve research variables are presented in Appendix A.

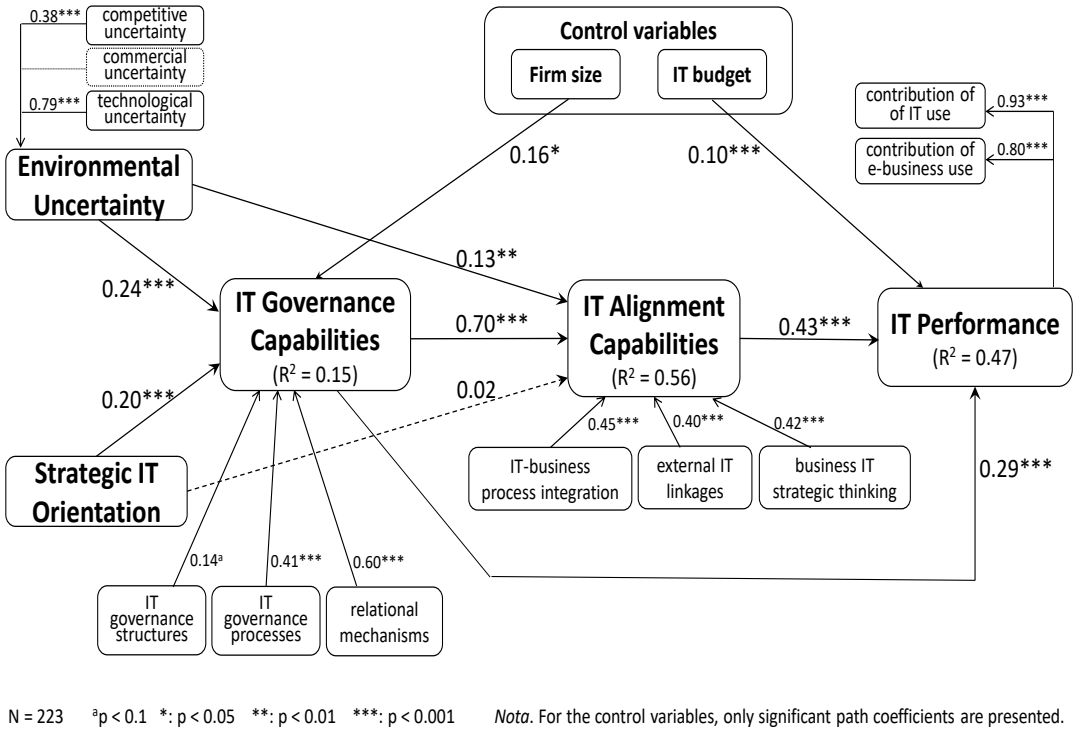
4. Results

Structural equation modeling (SEM) was used to validate the research model, employing the PLS component-based technique for this purpose. PLS was chosen because of its robustness and lower requirements with regard to the distribution of residues when compared to covariance-based techniques such as LISREL and EQS, in addition to being more appropriate when the goal is to explain variance (Gefen, Rigdon and Straub, 2011). PLS is also more apt to handle measurement models that include endogenous formative constructs (Henseler, Hubona and Ash Ray, 2016).

4.1 Assessment of the measurement model

The first step in the SEM analysis is to simultaneously evaluate the measurement model and the structural model with PLS. In this regard, one must first note that three of the research constructs, namely environmental uncertainty, ITG capabilities and IT alignment capabilities, are modelled as being formative due to their composite and multidimensional nature (Roberts and Thatcher, 2009). Psychometric properties of the measurements are evaluated in the context of the structural model by assessing the unidimensionality and reliability of the research constructs. As the standard reliability and validity criteria applicable to reflective constructs do not apply to formative constructs, one must first verify that there is no multicollinearity among a formative construct's indicators. In order to do so, one uses the variance inflation factor (VIF) statistic, the rule being that the VIF must not be greater than 10 (Gujarati, 2003). The VIF values for the nine formative indicators in the measurement model varied from 1.1 to 1.9 and thus indicate the absence of multicollinearity.

The Cronbach's α values of the reflective and formative indicators varied from 0.70 to 0.92, confirming their internal consistency. As seen in Figure 2, the reflective indicators' loadings (λ) are above the 0.70 threshold, thus indicating the unidimensionality of the IT Performance construct. Moreover, the weights (γ) of the formative indicators are all positive and strong enough to be retained in the measurement model, save for the "commercial uncertainty" indicator of the environmental uncertainty construct which had a negative and nonsignificant weight and thus was excluded (Bollen, 2011). One can also see in Table 4 that the composite reliability coefficient of the reflective construct is equal to 0.86, above the 0.70 threshold and thus confirming this construct's reliability. Also confirmed is its convergent validity as the average variance extracted (AVE) is equal to 0.57, above the 0.50 threshold.



N = 223 $^{a}p < 0.1$ *: p < 0.05 **: p < 0.01 ***: p < 0.001 *Nota*. For the control variables, only significant path coefficients are presented.

Figure 2. Test of the Research Model

The last property to be analyzed in the measurement model is discriminant validity. This property indicates the extent to which a construct differs from other constructs in the research model. In the case of reflective constructs, the shared variance between such a construct and other constructs must be less than the AVE from its indicators, as confirmed in Table 4. In the case of formative constructs, the fact that such a construct shares less than 50% variance with any other construct is an indication of such validity (MacKenzie, Podsakoff and Jarvis, 2005). Here, a correlation of 0.73 between IT Governance and IT Alignment Capabilities, slightly above the 0.71 threshold, may indicate a slight problem in this regard; this is counter-balanced however by the absence of collinearity between these two constructs (VIF = 1.2).

Table 4. Reliability, Intercorrelations and Discriminant Validity of the Research Constructs

Construct	c.r.[a]	AVE[b]	1.	2.	3.	4.	5.	6.	7.
1. Environmental Uncertainty	-	-	-						
2. Strategic IT Orientation	-	-	.00	-					
3. IT Governance Capabilities	-	-	.27	.23	-				
4. IT Alignment Capabilities	-	-	.31	.18	.73	-			
5. IT Performance	.86	.75	.27	.22	.60	.65	.87[c]		
6. IT budget	-	-	.10	.12	.14	.13	.20	-	
7. Firm size	-	-	.09	.12	.20	.10	.04	-.02	-

[a]composite reliability= $(\Sigma\lambda_i)^2/((\Sigma\lambda_i)^2+\Sigma(1-\lambda_i^2))$ [inappropriate for formative constructs]
[b]average variance extracted = $\Sigma\lambda_i^2/n$ [" " " "]
[c]diagonal: $(AVE)^{1/2} = (\Sigma\lambda_i^2/n)^{1/2}$
sub-diagonals: correlation = $(\text{shared variance})^{1/2}$

4.2 Assessment of the research model

The research model was tested by evaluating the path coefficients (β) that links the constructs in the research model (using the SmartPLS 3.2.7 software), as shown in Figure 2. The essential quality of model fit is assessed here by the strength and significance of the path coefficients and the proportion of explained variance, as befits PLS's focus on prediction and concern with generalization (Ringle, Sarstedt and Straub, 2012). Model fit may be assessed as well by the

standardized root mean squared residual (SRMR) goodness-of-fit index whose value here is 0.060, well below the 0.08 threshold (Henseler et al., 2016).

Hypothesis 1 (confirmed). As shown in Figure 2, a positive and significant path coefficient (ß = 0.24, $p < 0.001$) confirms the hypothesis that SMEs who perceive greater uncertainty in their business environment will develop stronger ITG capabilities. This initial finding is an indication that manufacturing SMEs first respond to increased levels of uncertainty in their business environment by strengthening their ITG capabilities rather than their IT alignment capabilities or more generally their 'information processing capacity' (Tushman and Nadler, 1978).

Hypothesis 2 (confirmed). A positive and significant path coefficient (ß = 0.20, $p < 0.001$) also confirms the hypothesized relationship between the firm's strategic IT orientation and its ITG capabilities. Manufacturing SMEs thus require a stronger governance of their IT resources when these resources are meant to play a more strategic role, that is, are meant by these firms to sustain or improve their competitive position.

Hypothesis 3 (confirmed). The hypothesis that developing stronger ITG capabilities leads the firm to develop stronger IT alignment capabilities is confirmed, as the corresponding path coefficient is shown to be positive and significant (ß = 0.70, $p < 0.001$). This result highlights the strategic importance of IT governance in enabling the IT alignment process of manufacturing SMEs.

Hypotheses 4_a (partially confirmed) and 4_b (confirmed). Obtained from a bias-corrected bootstrapping procedure (Nitzl, Roldan and Cepeda, 2016), the evidence presented in Table 5 confirms the hypothesis that the influence of the firm's environmental uncertainty and strategic IT orientation upon its development of IT alignment capabilities is positively mediated by its ITG capabilities. Given a positive and significant indirect effect equal to 0.17 ($p < 0.001$), one may

speak here of 'partial' – rather than 'full' – mediation (Nitzl et al., 2016) as the direct effect of environmental uncertainty on IT alignment capabilities ($\beta = 0.13$, $p < 0.01$) remains significant. On the other hand, the strategic IT orientation of the firm has no direct effect whatsoever on its IT alignment capabilities ($\beta = 0.02$) but is found to have a significant indirect effect (*via* the firm's ITG capabilities) that is equal to 0.14 ($p < 0.001$). This finding highlights IT governance's pivotal role in relating the competitive environment, technological environment and strategic IT intent of manufacturing SMEs to their alignment of IT resources, and eventually to the attainment of business value from these resources.

Hypothesis 5 (confirmed). A positive and significant path coefficient ($ß = 0.43$, $p < 0.001$) confirms the hypothesis that firm's development of stronger IT alignment capabilities will improve its IT performance. This finding demonstrates that in the context of manufacturing SMEs, IT performance is directly impacted by strategic IT alignment. Hence these firms must develop stronger IT alignment capabilities, that is, greater IT-business process integration, external IT linkages and business IT strategic thinking if they are to achieve greater IT-business value.

Table 5. Analysis of Direct and Indirect Effects

Path	Direct effect	*t*	p	Indirect effect	95% confidence interval[a]	*t*	p
Env. Uncertainty → IT Alignment Capabilities (*via* IT Governance Capabilities)	0.128	2.6	0.010	0.170	[0.074, 0.248]	3.9	0.000
Strateg. IT Orientation → IT Align. Capabilities (*via* IT Governance Capabilities)	0.018	0.2	0.715	0.140	[0.052, 0.221]	3.3	0.001
IT Governance Capabilities → IT Performance (*via* IT Alignment Capabilities)	0.286	3.8	0.000	0.304	[0.196, 0.419]	5.3	0.000

[a]bias-corrected

Hypothesis 6 (partially confirmed). Looking anew at Table 5, the evidence provided by the bootstrapping procedure confirms the presence of a positive and significant indirect effect of the sampled firms' ITG capabilities upon their IT performance. Again, we may speak only of partial

moderation as the direct effect of the ITG capabilities on IT performance (ß = 0.29, $p < 0.001$) is as strong and significant as its indirect effect which is equal to 0.30 ($p < 0.001$). This finding first demonstrates that in the context of manufacturing SMEs, IT performance is indeed directly influenced by IT governance. It thus follows that these firms must develop stronger ITG capabilities, that is, better ITG structures, processes and relational mechanisms in order to achieve greater business value from their IT assets. This also highlights the fact that the IT alignment capabilities of manufacturing SMEs complement their ITG capabilities in the achievement of IT performance. These firms should thus develop both types of capabilities concomitantly, and in coherence with their strategic IT intent.

With regards to the control variables, IT budget and firm size, both are shown to have little influence, save for the unsurprising positive associations between firm size and ITG capabilities and between IT budget and IT performance. Overall, the independent constructs in the research model explain 47% of the variance in the dependent construct, IT Performance, indicating that the hypothesized relationships between IT strategy, IT governance and IT alignment constitute a sound basis for prediction and prescription with regards to the strategic management of IT in manufacturing SMEs.

5. Discussion and Implications

The results of this study indicate that the environmental uncertainty and strategic IT orientation of manufacturing SMEs are major influencing factors of their ITG capabilities. These capabilities in turn directly and indirectly, through the firms' IT alignment capabilities, influence their IT performance. The findings that emanate from these results are thus aligned with the theoretical assumptions upon which our research model was built.

First, our results confirm that manufacturing SMEs' develop their ITG capabilities in reaction to the uncertainty of their business environment. This finding is in line with a basic tenet of information processing theory (Tushman and Nadler, 1978) which states that an increase in environmental uncertainty consequently increases the firm's need for information and requires it to concomitantly strengthen its IT capabilities (Dutot et al., 2014).

Second, this study's results confirm the proposition that links a firm's strategic IT orientation to its IT governance capabilities (Héroux and Fortin, 2014) in the specific context of manufacturing SMEs. More precisely, SMEs with an 'offensive' IT orientation, in the sense of Nolan and McFarlan's (2005) IT strategic impact grid, will be more prone to develop stronger ITG capabilities than SMEs with a 'defensive' IT orientation.

Third, in line with the two aforementioned findings, these results allow us to confirm Sambamurthy and Zmud's (1999, p. 278) proposition that the development of ITG capabilities by manufacturing SMEs depends upon multiple contingency factors that 'operate together in shaping firms' IT governance arrangements'. In this study, both environmental and strategic contingency forces were identified and empirically confirmed to influence the ITG mechanisms put in place by the firms, namely their environmental uncertainty and strategic IT orientation.

Fourth, we have empirically established a positive relationship between the manufacturing SMEs' ITG capabilities and IT alignment capabilities, which in turn are linked to these firms' IT performance. In so doing, our study extends and reinforces the results of previous studies that have highlighted the mediating effect of business-IT alignment (Bradley et al., 2012b; Gerow et al., 2014). These results also reinforce the resource-based and capability-based views of IT governance and IT alignment as being closely-related and complementary strategic capabilities whose unique combination may provide firms with a competitive advantage.

In this study, IT performance was observable in terms of the contribution of IT use and e-business applications to the organizational performance. As IT alignment capabilities were strongly related to IT performance, this means that for manufacturing SMEs, their level of IT-business process integration, IT external linkages and business IT strategic thinking should be improved in order to increase these firms' IT performance. Moreover, given the strong links previously established between IT performance and organizational performance (Melville, Kraemer and Gurbaxani, 2004; Tallon et al., 2000), one would also expect that such improvements would eventually lead to greater organizational agility, productivity or customer benefit (Bradley et al., 2012; Dong, Xu and Zhu, 2009; Tallon and Pinsonneault, 2011; Tallon et al., 2016).

The ITG capabilities of manufacturing SMEs constitute an important determinant of their IT alignment capabilities. These firms may thus be reminded that their ITG structure, processes and relational mechanisms must be developed in coherence with their specific business environment and strategic context, if they are to achieve IT-business value through strategic IT alignment. Moreover, the firm's situation with respect to ITG is determined by three factors: environmental uncertainty, strategic IT orientation and firm size. Environmental uncertainty is a determinant of ITG capabilities. This means that SMEs must adapt their ITG capabilities to the competitive and technological uncertainty of the environment in which they evolve in order to achieve IT-business value. Strategic IT orientation refers to the SME's evolution stage with regards to its own use of IT. While an initial strategic stage with a focus on controlling internal operations is associated with a low level of ITG capabilities, a more sophisticated strategic IT orientation involving an extended value chain with multiple links with suppliers and customers, asks for enhanced ITG capabilities. To a lesser extent, firm size is also related to ITG capabilities,

possibly meaning that medium-sized manufacturing enterprises have a greater need for enhanced IT governance than small enterprises.

The contributions of this research relate first to the importance of ITG capabilities as a determinant of the manufacturing SME's IT alignment capabilities and IT performance in two ways. First, ITG is seen to acts directly on IT performance of these firms, and indirectly through the mediating effect of their IT alignment capabilities. Second, the strategic IT orientation of these firms is a determinant of their ITG capabilities but not their IT alignment capabilities. Thus, it is only through their ITG capabilities that the IT strategy of manufacturing SMEs is linked to their IT alignment capabilities.

The implications of this research for the strategic management of IT is that ITG capabilities is confirmed as an important predictor of IT alignment capabilities. Moreover, the proposed nomological network represents a significant contribution to the explanation of IT performance. In terms of implications for practitioners, our findings suggest that manufacturing SMEs develop IT governance capabilities that correspond to their environmental uncertainty. Another suggestion would be more these firms discuss their strategic IT orientation at the board-level (or at the executive committee-level if there is no board of directors). This could provide guidance and a clear mandate to ITG committee members (or to the IT manager if there is no ITG committee) as to the ITG and IT alignment capabilities that must be developed (Turel, Liu and Bart, 2017). This study also raises awareness among managers and others working in and for SMEs to the effect that ITG has become a necessary component of IT performance, that is, insofar as ITG capabilities are developed concurrently and coherently with other components of the firm's IT strategy and IT function.

In reinforcing the critical importance of ITG capabilities for the strategic management of IT and the attainment of IT-business value, the results may provide SME managers, consultants and IT practitioners with insights on the development and deployment of the firm's IT resources and competencies. Indeed, when they are developed to leverage the firm's IT alignment capabilities, ITG capabilities are found have both a direct and an indirect effect upon IT performance, and thus may contribute to the formulation and implementation of the firm's IT strategy. Furthermore, the nomological network validated in this study could provide the conceptual base and methodological kernel for a capabilities-based diagnostic approach to the strategic management of IT in manufacturing SMEs. As used by managers or outside consultants, such an approach may allow these firms to 'focus on and delve more deeply into strategic IT causal issues' and provide them with practical insights on translating their IT resources and IT competencies into increased IT performance (Rivard et al., 2006, p. 46). Furthermore, this approach could assist manufacturing SMEs in formulating an IT strategy that is in coherence with their business strategy and environment, and in implementing the appropriate IT governance and alignment practices.

6. Limitations and Conclusion

The results of this study must be interpreted with some caution due to its inherent limitations. Given the small nature of the sample, its representativeness in relation to all SMEs limits the scope of these results. While comparing the strategic management of IT resources of firms in the same industry (manufacturing in our case) should be viewed as a legitimate approach, we acknowledge that the sample's homogeneity also limits the generalizability of our findings to organizations in other sectors and industries, and especially in the services sector. The nomological network could

also have been extended downstream to include organizational performance variables in addition to IT performance.

In answering its research questions, this empirical investigation was able to provide further knowledge of the antecedents and outcomes of IT governance in the context of manufacturing SMEs, and to do so in holistic fashion by adopting a capability-based strategic IT alignment perspective. Taking the capability-based view of the relationship between IT strategy, IT governance, IT alignment and IT performance, the results of this study have revealed the specific ITG capabilities that are associated to higher levels of IT alignment and IT performance in this context. These results also support the proposition that ITG is basically driven by the SMEs' strategic IT orientation and environmental uncertainty.

Future research is needed to further support the present study's findings and conclusions, and especially to provide added robustness to the nomological network. Hence, case studies of the strategic IT management "process" effectively realized in manufacturing SMEs would provide answers to the "how" question as it concerns IT governance and IT alignment principles, policies and practices. Moreover, survey studies of SMEs operating in sectors other than manufacturing yet similarly challenged with regards to their IT capabilities, such as in the industrial services sector (Uwizeyemungu, Raymond, Poba-Nzaou and St-Pierre, 2018), would provide comparative evidence and thus further knowledge on strategic IT management in SMEs.

Now faced with the challenge of competing globally and operating in a knowledge-based economy, many SMEs will be asked to do more and better with regards to the strategic management of their IT resources. It thus behoves them to develop their IT governance and IT alignment capabilities coherently, that is, in view of their strategic IT goals, if they are to improve

their IT performance and eventually their competitive performance in the face of such contemporary management challenges.

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

A1. Environmental Uncertainty

Indicate the extent to which you agree with the following statements on the uncertainty of your firm's business environment, on the following scale:

strongly disagree 1	rather disagree 2	neither disagree nor agree 3	rather agree 4	strongly agree 5

Competitive environment					
Competition on the basis of product and service quality is fierce in our sector of activity.	①	②	③	④	⑤
Competition on the basis of product and service innovation is fierce in our sector of activity.	①	②	③	④	⑤
Competition on the basis of product and service prices is fierce in our sector of activity.	①	②	③	④	⑤
Our firm must frequently change its business strategy in order to face its competitors or to adjust to its customers.	①	②	③	④	⑤
Commercial environment					
Customers in our sector of activity have a wide range of needs for products and services.	①	②	③	④	⑤
Product lines are very broad in our sector of activity.	①	②	③	④	⑤
Products and services become obsolete very rapidly in our sector of activity.	①	②	③	④	⑤
Technological environment					
Manufacturing and service processes and technologies change rapidly in our sector of activity.	①	②	③	④	⑤
In our industry, it is difficult to predict the technologies that will prevail in more than two years.	①	②	③	④	⑤

A2. Strategic IT Orientation

Among the following statements, which one best describes your firm's strategy with regard to the adoption and use of IT (check only one):

The adoption and use of IT should allow us to improve our managerial control and our production monitoring.	○
The adoption and use of TI should insure greater operational flexibility and better response to our customers' needs.	○
The adoption and use of TI should facilitate and accelerate the development of new products, and allow us to increase our market share.	○
The adoption and use of IT should allow us to integrate our business and production processes, and to improve exchanges with our business partners.	○

A3. IT Governance Capabilities

A3.1 IT governance structures

Indicate the extent to which you agree with the following statements on the IT governance capabilities of your firm, on the following scale:

strongly disagree 1	rather disagree 2	neither disagree nor agree 3	rather agree 4	strongly agree 5

The persons responsible for the management of IT have the capacity to support the firm's business strategy through human resource management (HRM) practices.	①	②	③	④	⑤
The decisions taken by the persons responsible for the management of IT respond well to the firm's needs.	①	②	③	④	⑤
The decisions taken by the persons responsible for the management of IT are effectively propagated within the firm.	①	②	③	④	⑤

A3.2 IT governance processes

Indicate the extent to which you agree with the following statements on the IT governance processes in your firm, on the following scale:

The firm's IT planning is effective.	①	②	③	④	⑤
The firm manages its IT projects in a formal fashion.	①	②	③	④	⑤
The firm has developed a plan relative to computer security, IT standards and disaster recovery.	①	②	③	④	⑤
The firm has implemented IT-based systems development practices (development methodologies, schedules, follow-up and control tools).	①	②	③	④	⑤
The firm's policies in IT matters are coherent.	①	②	③	④	⑤
The firm has implemented systems to evaluate and control its IT-based systems.	①	②	③	④	⑤
The firm invests sufficiently in IT compared to its competitors.	①	②	③	④	⑤

A3.3 Relational mechanisms

Indicate the extent to which you agree with the following statements on the integration of IT governance in your firm, on the following scale:

The firm has employees that are capable of combining a business expertise with an IT expertise.	①	②	③	④	⑤
The firm's management maintains good relations with its IT solution and service providers.	①	②	③	④	⑤
The firm's owner-managers provide strong support for IT initiatives.	①	②	③	④	⑤
The firm's organizational climate encourages risk taking and experimentation in matters of IT.	①	②	③	④	⑤
The firm's organizational climate is favourable to the success of IT initiatives.	①	②	③	④	⑤

A4. IT Alignment Capabilities

A4.1 IT-business process integration

Indicate the extent to which you agree with the following statements on the integration of IT with your firm's business processes, on the following scale:

strongly disagree 1	rather disagree 2	neither disagree nor agree 3	rather agree 4	strongly agree 5

There is a strong coherence between the firm's IT portfolio (the set of IT projects) and its business processes.	①	②	③	④	⑤
The firm restructures its business processes through IT in order to create opportunities for improvement.	①	②	③	④	⑤
The firm restructures its IT use and IT management processes in order to create opportunities for improvement.	①	②	③	④	⑤

A4.2 External IT linkages

Indicate the extent to which you agree with the following statements on the integration of IT with your firm's business partners, on the following scale:

The firm uses IT that allow it to establish strong relationships with its customers (CRM, Web 2.0, etc.).	①	②	③	④	⑤
The firm uses IT that allow it to establish strong relationships with its suppliers (SCM, EDI, etc.).	①	②	③	④	⑤
The firm has established IT-based collaboration programs with its external partners (sharing of documents, etc.).	①	②	③	④	⑤

A4.3 Business IT strategic thinking

Indicate the extent to which you agree with the following statements on the integration of IT with your firm's business strategy, on the following scale:

Within the firm, there is a shared vision of the role of IT in creating business value.	①	②	③	④	⑤
The firm integrates its IT planning to its business objectives (information technology is a component of the firm's strategy).	①	②	③	④	⑤
Management well understands the value of IT investments for the firm.	①	②	③	④	⑤

A5. IT Performance

A5.1 Contribution of IT use

Indicate the extent to which you agree with the following statements on the contribution of the governance and use of IT in your firm, on the following scale:

strongly disagree 1	rather disagree 2	neither disagree nor agree 3	rather agree 4	strongly agree 5

Assure the quality of operation, maintenance and availability of IT-based systems in the firm	①	②	③	④	⑤
Improve coordination within and between the firm's departments	①	②	③	④	⑤
Support the realization of innovative and mobilizing projects in the firm	①	②	③	④	⑤
Allow for a more proactive management of the firm	①	②	③	④	⑤
Improve the productivity of the firm's personnel	①	②	③	④	⑤
Provide greater agility to the firm's processes	①	②	③	④	⑤
Improve the circulation of information within the firm	①	②	③	④	⑤
Reduce the firm's manufacturing costs	①	②	③	④	⑤
Allow for a better transfer of knowledge within the firm	①	②	③	④	⑤
Improve the firm's capacity to respond to the demands or exigencies of customers or other external partners	①	②	③	④	⑤
Allow the firm to achieve its strategic objectives	①	②	③	④	⑤

A5.2 Contribution of e-business use

Indicate the extent to which you agree with the following statements on the contribution of the use of e-business, the Internet and the Web in your firm, on the following scale:

strongly disagree 1	rather disagree 2	neither disagree nor agree 3	rather agree 4	strongly agree 5

Allow for customization of customer relations	①	②	③	④	⑤
Increase customer loyalty	①	②	③	④	⑤
Improve the firm's visibility	①	②	③	④	⑤
Allow proposals for new products and services	①	②	③	④	⑤
Facilitate the penetration of new markets	①	②	③	④	⑤
Allow collaboration with other organizations	①	②	③	④	⑤
Help to diversify the number of suppliers	①	②	③	④	⑤
Facilitate the recruitment of personnel	①	②	③	④	⑤