Revisiting Dynamic Capability for Organizations' Innovation Types: Does it Matter for Organizational Performance in China?

Abstract

Purpose: Despite the existing literature on the impact of IT capability and innovation capabilities, this study examines how IT-enabled dynamic capabilities impact on firm innovative capability to achieve organizational performance.

Design/methodology/approach: Drawing on the dynamic capability theory, this study empirically investigates the entire chain of relationships among dynamic capability, innovative capability, organizational performance and turbulent environment.

Findings: Using the data from 254 Chinese firms, this study reveals IT-enabled dynamic capability dimensions have a positive and significant relationship with firm innovative capability types which in turn have a significant relationship with organizational performance except the process innovation.

Research limitations/implications: This study contributes to the growing information systems literature and also suggests theoretical and practical implications.

Originality/value: This study examines IT-enabled dynamic capability with firm innovative capability types which has received limited attention in the past.

Keywords: IT-enabled dynamic capability, dimensions, firm innovative capability, firm performance.

Paper type: Research paper

1. Introduction

Modern business environments are characterized as being highly unpredictable and hyper-competitive that require firms to detect and exploit on market opportunities with speed and surprise to survive (Ravichandran 2018; Sambamurthy et al. 2003). In this hypercompetitive business environment, the firm's IT-enabled dynamic capability [1] (ITDC) and innovative capability have become a significant firm competence that can have insightful impacts on firm performance. IT as a digital options generator (Sambamurthy et al. 2003), and "the engineered artifact" has been penetrated by every facet of the firm and it does matter a lot (Roberts and Grover 2012). With the emergence of new digital era, IT is ever more seen as an enabler of innovation through various applications of mobile technologies, cloud computing, big data, and data analytics (Ashurst et al. 2012; Chen et al. 2015).

Among recent industry cases, for instance, Dell developed a custom graphical user interface (GUI) for Ubuntu on Dell netbooks to sense (via "IdeaStorm" Website) and respond customer-based opportunity through IT-enabled external partnerships for innovation (Roberts and Grover 2012). Amazon offers radical service innovation, as it uses Internet technologies to renovate its service purchasing and delivery processes with great success (Cheng et al. 2016). Cisco's IT infrastructure through its ERP implementation offered web-based digitization platform which enabled Cisco to be agile with its suppliers and integrate with firms for its strategic acquisitions (Ravichandran 2018). All these industry cases evidence that IT-enabled capabilities [2] shape innovation to achieve organizational performance. However, the below gaps inspired this study.

First, IT is often expected to generate value through enabling and reconfiguring of core competencies, thereby nurturing through innovation. Though ample of academic research has focused on the relationship between IT and innovation (e.g.,Pavlou and El Sawy 2006;

[1] For ease of expression, we refer to Information Technology – IT, IT- enabled dynamic capabilities as ITDC, firm innovative capability as FIC, and firm performance as FP, Enterprise Resource Planning – ERP.

[2] Several IT-enabled capabilities have been studied by IS scholars, such as IT-based synergies (Kude et al. 2018), IT-leveraging competence (Pavlou and El Sawy 2006), IT-enabled business capabilities (El Sawy and Pavlou 2008) , IT-enabled inter-firm collaboration (Wang et al. 2017), IT-related capabilities (Prasad et al. 2012), IT application orchestration capability (Queiroz et al. 2018), IT-enabled knowledge management capability (Mao et al. 2016), IT-enabled capabilities (Tan et al. 2019) , IT-enabled combinative capabilities (Hwang et al. 2015).

Raymond et al. 2018; Wang et al. 2017; Yang 2012), there remains inadequate empirical findings for IT-enabled innovation and its subsequent impact on organizational performance. A few studies address the effect of ITDC and its significances on innovation (e.g., Mikalef and Pateli 2017), but they are limited in scope (Camisón and Villar-López 2014). Moreover, past studies have relied on cumulative overall measures of the firm's dynamic capability (e.g., Eisenhardt and Martin 2000; Li and Liu 2014; Mu 2017), ignoring the specific type and nature of IT-enabled dynamic capability. Instead of tracing a direct connection between ITDC and organizational performance, scholars try to identify the enabling processes by which a firm tends to execute its IT capability to achieve better performance (e.g., Pavlou and El Sawy 2006). Hence, this study seeks to varnish the gap in the literature by examining how innovative capabilities can intermediate the impact of ITDC dimension on organizational performance.

Second, extant research often examines a variety of IT-related capabilities such as, IT application orchestration capability (Queiroz et al. 2018), IS ambidexterity (Tai et al. 2019), IT competence (Ravichandran 2018; Sambamurthy et al. 2003), IT-enabled information management capability (Mithas et al. 2011), that enable performance benefits to firms. Similarly, prior studies focused on the impact of IT on innovation from a technical viewpoint, such as the impacts of IT integration and flexibility (Rai and Tang 2010), IT-embedded product innovation (Tarafdar and Tanriverdi 2018) and conceptual discussions (e.g., Ashurst et al. 2012; Damanpour and Aravind 2012; Rampersad et al. 2012). Comparatively, less attention has been paid to IT capability that are more likely to enable firm ability for innovation (Queiroz et al. 2018; Roberts and Grover 2012). Though studies show that IT can enable innovation (Roberts and Grover 2012; Zhang and Hartley 2018), the IS literature is fairly silent on how firms should configure their IT capabilities to provide superior innovation towards organizational performance. Thereby a systemic approach is required to examine IT-enabled innovation towards organizational performance.

Third, many studies have claimed that the primary effects of IT occur in the process-level and it is essential to understand how IT capabilities transmit to firm-level performance (Mithas et al. 2011; Queiroz et al. 2018). Constant with IT's process-level effects, studies

examined the impact of IT capabilities on new product development (NPD) that revealed the competitive advantage in NPD depends on ITDC and functional competencies (Pavlou and El Sawy 2006; Pavlou and El Sawy 2011). Regardless of its significance, a few studies in innovation capability tend to be rather general (e.g., Wu and Chiu 2015; Yang 2012), management innovation oriented (Lin et al. 2016; Rampersad et al. 2012), and discussing absorptive capacity (Ali et al. 2016; Najafi-Tavani et al. 2018). In addition, there is a lack of agreement in literature that how IT-enabled dynamic capability drives to greater firm performance. As a result, the recent studies in IT and innovation not only warrant additional examination to flesh out more details on firm innovative capabilities (Wu and Chiu 2015), but also in practice and academia (Wang et al. 2017). In this regard, this study investigates the following research questions.

1. How do firm's IT-enabled dynamic capabilities dimensions enable to firm innovative capabilities?
2. How do firm innovative capabilities types impact on organizational performance?

This study aims to contribute in the following ways. First, it synthesizes and conjectures the widely perceived, but the unexplored IT capability-innovative capability relationship ambiguity that IT capability may empower firm's innovative capability. Thus, it adds to the growing IS literature by theoretically synthesizing and empirically validating a model that directs the path from ITDC dimensions to firm's innovative capability to achieve firm performance. Second, we develop the ground that IT capability is critical and the antecedent for innovative capability. Hence, this study extends IT capabilities and integrates with dynamic capability theory to demonstrate how ITDC can enable innovation capability. Third, this study contributes to managerial practice by supporting business executives to better exploit business environments where the inevitable roles of ITDC dimensions appear. Thereby, guide for managers for their managerial decisions about IT strategic implementation in the turbulent business conditions is proposed.

The remainder of the paper proceeds as follows. Next section discusses the theoretical background with literature review, followed by research model with hypothesis

development (§3), the analysis, (§4), discussion of the results (§5), and implications and conclusion (§6).

2. Theoretical Background

2.1 Resource-based view (RBV) and dynamic capability view (DCV)

The RBV gives a set of essential conditions to accomplish competitive advantage, however, it does not visibly mention how the competitive advantage is realized. Similarly, it does not amply detail how firms achieve competitive advantage during dynamic environmental conditions (Zhou and Li 2010). As the resources are circumstance based, their values depend on the characteristics of the specific environment; resources are fairly stickier than their environment, its variations and adaptations often lag behind environmental changes (Teece et al. 1997). The RBV covers the notion of dynamic capabilities as a means to elucidate how firms respond to the rapid changes in customer needs and business environments (Turel et al. 2017). Researchers stated that dynamic capabilities view appeared from the RBV of the firm (Yeow et al. 2017); where RBV highlights resource selection (choosing resource combinations) whereas dynamic capabilities emphasizes resource renewal (reconfiguring resources into new mixtures of operational capabilities (Pavlou and El Sawy 2011). Dynamic capabilities enable firms to sense, seize opportunities, integrate, build, and reconfigure resources and increase their competencies to cope with threats in the face of changing conditions to cope with threats and increase its competitiveness (Mikalef and Pateli 2016; Zhang et al. 2016). In closing, the traditional RBV under-emphasizes the role of turbulent environment, hence, dynamic capabilities fill this limitation as more viable to respond to environmental turbulence (Nevo and Wade 2011; Pavlou and El Sawy 2011). The dynamic capabilities view of the firm is a suitable theoretical background to elucidate how firms differentiate and compete, wherein firms advance and reconfigure their operations to stay competitive (Mikalef and Pateli 2016).

2.2 Dynamic capability view and firm innovative capability

The sustainable competitive advantage depends on a firm's dynamic capabilities to innovate with the ability to adapt and reconfigure resources and capabilities (Eisenhardt and Martin

2000). The dynamic capabilities comprise of specific activities, for example, alliances, new product development, joint ventures, cross line of business innovation, and other general actions that foster coordination and organizational learning (O'Reilly III and Tushman 2008). Dynamic capabilities are strengthened by organizational routines and managerial skills, thus the firm's ability to integrate, build, and reconfigure internal competencies to address, and compete changes in the business environment (Teece 2018). Firm's viable competitive advantage decides the capacity to reconfigure and to frequently renovate its idiosyncratic resources and competencies to nurture innovation (Camisón and Villar-López 2014).

A firm having strong dynamic capabilities will be able to effectively renew resources, and reconfigure them to innovate and respond to the market changes. Firms are keen on innovative strategies to invest more in IT systems that helps product and process innovation (Aral and Weill 2007). The firm's sustainable competitive advantage rests on its dynamic capabilities to innovate, and the capacity to adapt and reconfigure resources and capabilities. The dynamic capabilities such as sensing, learning, coordinating, and integrating were identified to support reconfiguration of the firm's existing operational capabilities. Scholars have argued that the firm's sustainable competitive advantage depends on its dynamic capabilities to innovate, and the ability to adapt and reconfigure resources and capabilities (e.g., Camisón and Villar-López 2014). Firms with strong dynamic capabilities are powerful in entrepreneur by shaping through innovation and collaborating with other firms and business entities.

In IS literature, the dynamic capabilities have been conceptualized in related view regarding innovation. For instance, *absorptive capacities* - to acquire, assimilate, transform, and exploit new and external knowledge, that enables to realize high performance in product, process, and management innovation (Ali et al. 2016). *The knowledge-based dynamic capabilities* - the ability to acquire, generate and combine internal and external knowledge resources to sense, explore and address environment dynamics (Cheng et al. 2016). Likewise, Mikalef and Pateli (2016) defined IT-enabled dynamic capabilities as the "firm's abilities to leverage its IT resources and IT competencies, in combination with other organizational resources and capabilities, in order to address rapidly changing business environments". The IS literature

suggests that firms have dissimilar dynamic capabilities that serve different purposes and functions in a typical firm. Accordingly, prior studies considered dynamic capabilities as a multi-dimensional construct (Ali et al. 2016; Mikalef and Pateli 2017). Hence, this study advocates the multi-dimensional view for the IT-enabled dynamic capability construct.

2.3 IT-enabled dynamic capabilities (ITDC) and firm innovative capabilities

Over the past decade, IS researchers considered IT capability as three types of resources, namely firm's IT infrastructure, human knowledge and skills, and relational resources (Bharadwaj 2000; Bhatt and Grover 2005; Sambamurthy et al. 2003). But, in the past, there have been significant arguments on what is considered in IT capability and through what causal mechanism it carries performance outcomes. Firm's IT resources and capabilities create IT competence that describes the capacity for IT-based innovation and the ability to transform IT assets and services into strategic applications (Sambamurthy et al. 2003). The flexible IT infrastructure and the digitization of business processes of the firm allows to form IT-enabled business innovations more cost-effectively than their competitors. Accordingly, Raymond et al. (2018) argued that IT capabilities can be leveraged for innovation purposes to the extent that they are aligned, thus, create IT capability configurations. Ravichandran (2018) argued that unlike radical product innovations, IT-enabled innovations often stem from business units and necessitate the use of emerging and new technologies to rethink the activity systems of the firm.

In literature, dynamic capabilities have been characterized into different types. In this study, the ITDC dimensions are consistent with the prior study of Mikalef and Pateli (2017) such as sensing, coordinating, learning, integrating, and reconfiguring. The *sensing* denotes the ability to identify, interpret, and pursue opportunities in the environment (Pavlou and El Sawy 2011). Once the opportunity for innovation is sensed, firm coordinates and integrates operational processes both internal and external. Hence, the *coordinating* refers the ability to orchestrate and deploy tasks, resources, and activities in the new operational capabilities"(Pavlou and El Sawy 2011). The *learning* is the ability to revamp existing operational capabilities with new knowledge"(Pavlou and El Sawy 2011). The *integrating* is the ability to combine individual knowledge into the unit's new operational capabilities

(Pavlou and El Sawy 2011). The *reconfiguration* includes transformation or renewal of resource bases that better fit the environment (Pavlou and El Sawy 2010).

Study focuses on three types of firm innovative capabilities such as product innovation, process innovation and management innovation. First the *product innovation* denotes the introduction of a good or service that is new or significantly improved with respect to its features or intended uses (DATA 2005). Second, *process innovation* refers the execution of a new or significantly improved production or delivery method such as techniques, equipment and/or software (DATA 2005). Process innovation has internal focus on efficiency to cut the delivery lead-time or reduce operational cost (Camisón and Villar-López 2014). Third, management innovation is the implementation of a new organizational method into the business practices, workplace organization, or external relations (Ali et al. 2016; Damanpour and Aravind 2012). It has been referred to as organizational, managerial, and administrative innovations which are significantly overlapped (Damanpour and Aravind 2012).

Figure 1 is the research model of this study. The rationale in this study is that the ITDC has five dynamic capabilities, namely sensing, coordinating, learning, integrating and reconfiguring. Similarly, there are three organization's innovation types such as product, process and management innovation that in turn impact on organizational performance. Each of ITDC impacts on organization's innovation types. This study has drawn on the resource-based view (RBV), dynamic capability view (DCV) and systematically reviewed in the topic of dynamic capability, firm innovative capability and IT-enabled dynamic capabilities. Hence, the research model not only resembles theoretical aspects, but also is embedded naturally in practice for examination.

Figure 1: Research model

3. Hypothesis Development

3.1. Sensing enables firm innovative capabilities

Sensing capability is defined as "the ability to spot, interpret, and pursue opportunities in the environment"(Pavlou and El Sawy 2011). It denotes the identification of market and technological opportunities or threats (Tai et al. 2019). Sensing allows to collect market intelligence on market needs, competitor moves, and latest technologies in order to managers recognize new product opportunities, and involve in new product prototypes. The market intelligence stimulates product innovation to explore emergent opportunities for new products that better meet customer needs (Pavlou and El Sawy 2011). The mechanisms by which a firm creates, transfers, and applies knowledge should influence the firm's customer-sensing capability (Roberts and Grover 2012). As a result, the firm should always sense and seize the chances that involves scanning, searching, and exploring, and proactively reposition and transform itself to overcome new threats and opportunities in rapidly unstable markets (O'Reilly III and Tushman 2008; Teece 2018). Firms retaining the superior innovation capacity tend to be more open to new ideas. These firms are smarter to identify market opportunities and ready to make new products to the market faster than their competitors. For instance, BMW senses emerging customer needs by concerning key customers via idea generation of its product innovation activities, and they also respond swiftly by executing novel ideas in future products (Roberts and Grover 2012). The Sensing capability of a firm helps evaluation of management practices such as performing an outside search, sensing potential risks and rewards of innovations in motivation system, perceiving employees' attitudes toward adopting management practices, and forecasting progress and effectiveness of the innovation implementation (Lin et al. 2016). Hence, the hypothesis is stated as follows:

H1a, 1b, 1c: The sensing capability positively impacts on firm's product, process, and management innovation capabilities.

3.2. Coordinating enables firm innovative capabilities

The coordinating capability is defined as "the ability to orchestrate and deploy tasks, resources, and activities in the new operational capabilities"(Pavlou and El Sawy 2011).

Once an opportunity for innovation is sensed, a firm coordinates and integrates operational processes, both internal and external to the firm, impacting its customer-responding capability (Roberts and Grover 2012). The coordinating capability consists of resource allocation to tasks, appointing the right person for the task, coordinating tasks and activities, and arranging the activities. Responding to market demand involves connecting and coordinating resources within and across the firms, it suits easier when firms are joined through digital platforms (Ravichandran 2018). IT systems offer a formal structure for gathering, analyzing, storing, sharing and effectively using market information to design new products during the innovation process (Zhang and Hartley 2018). Hence, the flexible IT infrastructure allows strategic innovations in business processes by permitting development of required applications, enabling information-sharing across business units, and integrating various organizational functions (Kim et al. 2011). Thus, the hypothesis is stated as follows:

H2a, 2b, 2c: The coordinating capability positively impacts on firm's product, process, and management innovation capabilities.

3.3. Learning enables firm innovative capabilities

Learning capability is defined as " the ability to revamp existing operational capabilities with new knowledge"(Pavlou and El Sawy 2011). Once a market opportunity is identified from sensing and new product introduced, it necessitates a decision to restore the existing operational capabilities with learning, and new knowledge and skills (Teece 2007). Learning is essential to the advancement of innovation capabilities that involves effective internal knowledge sharing and knowledge transfer (Börjesson et al. 2014). Further, gaining innovation capability is a process of learning to advance present knowledge based on prior analysis (Yang 2012). The learning helps to reconfigure and innovate; thus, learning is an enabler to reconfigure by restoring the exiting operational capabilities. Innovative firms are more likely to involve in learning, investigating, and able to cope with high uncertainty while these firms leverage digital platforms respond to opportunities and threats (Ravichandran 2018). IT systems are positively associated to knowledge generation which is crucial for innovation capability (Zhang and Hartley 2018). Thus, investments in strategic IT applications are linked to product innovation (Aral and Weill 2007). The continuous studies

focus on innovation and learning as they are vital to competitiveness that enables how to best place the innovation capabilities in height (Yang 2012). Top managers as enablers of innovation encourage entrepreneurial thinking, support to the exploration of new business and potential innovation opportunities, and advocate an innovative corporate culture for learning opportunities, and risk-taking (Börjesson et al. 2014). Hence, the hypothesis is stated as follows:

H3a, 3b, 3c: The learning capability positively impacts on firm's product, process, and management innovation capabilities.

3.4. Integrating enables firm innovative capabilities

Integrating capability is defined "as the ability to combine individual knowledge into the unit's new operational capabilities"(Pavlou and El Sawy 2011). The new knowledge generated by learning generally resides in individuals. Thus, the individual's knowledge and their interaction should be combined into a sharable system to use the new arrangements of operational capabilities. The ability of a firm to identify the value of new external information, integrate, and apply new external knowledge to commercial ventures is a vital factor to firms' innovative capabilities (Ali et al. 2016). The dynamic approaches enable firms to how they can recombine and integrate their resources to adapt to market and technological changes (O'Reilly III and Tushman 2008). Hence, firms may succeed at greater innovation rates and gain better new product success through organizational integration (Kude et al. 2018). IT systems help knowledge gathering, storage, retrieval, integration, transformation, and exploitation; thus they should improve a firm's capabilities for enlightening its products and processes (Zhang and Hartley 2018). Highly innovative firms are more likely to gather and integrate knowledge as to cope with high uncertainty and have the potential to achieve high levels of firm innovative capability (Lin 2007). The execution of management innovation rests on the capabilities of a firm to acquire, absorb, and assimilate internal and external sources of knowledge to integrate information sources from outside searches with those internally generated to identify novel problems while concurrently integrating the interests of various stakeholders (Lin et al. 2016). So, the hypothesis is stated as follows:

H4a, 4b, 4c: The integrating capability positively impacts on firm's product, process, and management innovation capabilities.

3.5. Reconfiguration enables firm innovative capability

The firm's innovative capacity is dependent on both its innovativeness and the preparation it creates when introducing new initiatives that allow to successfully optimize existing resources (Ravichandran 2018). Reconfiguration includes transformation or renewal of resource bases (i.e., assets and associated skills, processes, or routines) (Tai et al. 2019). The reconfiguration capability allows for the new product development by reconfiguring the outdated operational capabilities into modern one matching the environment. From a strategic standpoint, realizing lasting success means the ability to recombine and reconfigure assets and firm structures to adapt to emerging markets and technologies (O'Reilly III and Tushman 2008). Teece (2007, p. 1338) claimed: "both innovation and reconfiguration may necessitate cospecialized assets being combined with management in order for (systemic) innovation to proceed." And if the assets cannot be assimilated from external opportunities, the firm needs to be built inside. According to Ravichandran (2018) firm's innovation capacity offers the flexibility to configure resources and these innovative firms are more likely to be agile when they have higher IT competence. Thus, the hypothesis is stated as follows:

H5a, 5b, 5c: The reconfiguring capability positively impacts on firm's product, process, and management innovation capabilities.

3.6. Firm innovative capability and firm performance

A firm's innovative capability is the sole most significant characteristic a firm needs, to ensure growth and preserve competitive advantage (Yang 2012). The firm's innovative capability is an important strategic asset for the creation of sustainable competitive advantage that is likely to generate greater performance. In literature, there is a wealth of evidence demonstrating a positive relationship between innovation capability and firm performance (e.g., Ali et al. 2016; Camisón and Villar-López 2014; Wang et al. 2017; Yang 2012; Zhang and Hartley 2018). Similarly, the firm's innovative capability allows a firm to

grow and enhance its corporate growth performance (Yang 2012). But, the types of innovation that drive organizational performance have received a limited attention.

Firms with superior effective dynamic capabilities such as greater product innovation and alliances are likely to have a competitive advantage over firms with less effective capabilities (Eisenhardt and Martin 2000). Product innovation could increase sales as they have a better performance, better features compared to the existing products offered by competitors in the market (Prajogo 2016). The product and process innovation capability is recognized as one of the most significant internal resources that can result in superior firm performance (Najafi-Tavani et al. 2018).

The process innovation aims to reduce delivery lead-time or reduce operational cost, hence it has focused on efficiency, enabling firms to follow cost leadership strategies (Camisón and Villar-López 2014; Damanpour and Aravind 2012). Firms with more IT resources, leverage through customer information inquiry and consultation, improving multi-channel purchasing features, and increasing after-sale services, thus achieve a high degree of process innovation (Chen and Tsou 2012). The product and process innovation can be used as competitive strategies to deliver customers with greater values, therefore, enlightening firm performance (Prajogo 2016). Process innovation will enable a firm to improve its product quality or produce completely new products (Camisón and Villar-López 2014).

Management innovation is defined as to formulate strategy and structure of the organization, modify the organization's management processes, and motivate and reward its employees (Damanpour and Aravind 2012). In prior studies, product, process, and management innovation have shown a positive relationship with organizational performance (e.g., Anning-Dorson 2018; Camisón and Villar-López 2014; Jiménez-Jiménez and Sanz-Valle 2011). Hence, the hypotheses are summarized as follows.

H6a: The firm's product innovation positively impacts on organizational performance.

H6b: The firm's process innovation positively impacts on organizational performance.

H6c: The firm's management innovation positively impacts on organizational performance.

4. Research methodology and data analysis

4.1. Measurement development

All constructs for this study are extracted from the prior studies. The five first-order reflective constructs (sensing, coordinating, organizing, integrating and reconfiguring) of ITDC second-order formative construct extracted from (Mikalef and Pateli 2016; Protogerou et al. 2012). The reflective items of firm innovative capabilities such as product innovation (Ali et al. 2016; Liao et al. 2007; Paladino 2008), process innovation (Ali et al. 2016; Liao et al. 2007), and management innovation (Ali et al. 2016; Liao et al. 2007) extracted from the past studies. Firm performance consists of three first-order formative constructs namely financial return (Prasad et al. 2010; Wu et al. 2006; Wu et al. 2015), operational excellence, (Ravichandran et al. 2005; Wu et al. 2015), and marketing performance (Wu et al. 2006) to best measure the firm's total performance relative to its competition (Wu et al. 2015). The firm performance is multidimensional in nature and accounting measures may be misleading because of ''their (1) inadequate handling of intangibles and (2) improper valuation of sources of competitive advantage'' (Bharadwaj et al. 1993; Morgan and Strong 2003). This study used objective measures for firm performance (Ilmudeen et al. 2019). In this study the first-order reflective and formative constructs are based on the criteria suggested by Diamantopoulos (2011). For all items, a five-point Likert- scale used, ranging from 1 = "strongly disagree" to 5 = "strongly agree." This study includes firm size, firm age, and IT budget as control variables in the model. The reason for including control variables is the potential effects it offers. For example, firms large in size with plentiful IT resources and capabilities can have the competencies to bring significant impact on their current performance (Wang et al. 2012). Firm age as it assumed that older firms might enjoy an experience-based progress that empowers them to tolerate growth better than younger firms (Chen et al. 2014).

4.2. Sample and data collection procedure

For the data collection, the key informant method was used which is a common approach in IS research (Ilmudeen and Yukun 2018; Nevo and Wade 2011; Wu et al. 2015). The data collection started from mid of July to last week of October 2017. This study's sampling frame was senior level IT and business managers from Chinese firms. These working professionals graduated from the School of Management, Huazhong University of Science and Technology which conducts postgraduate programs in the major metropolitan cities of China (Wuhan, Shenzhen, Suzhou, Guangzhou, Jinan, and Nanjing). The Center for Modern Information Management attached to this School maintains a database for all the alumni working professionals. The researcher collected the target respondent's e-mail addresses from this accreditation Center. The electronic version of the questionnaire in Chinese language was developed in a paid Chinese electronic platform (www.sojump.com). Respondents were only allowed to answer one questionnaire, to avoid the multiple responses from a single respondent. Collecting data from a single respondent may not be ideal for firm-level studies yet, this method was used in recent studies (e.g., Ilmudeen and Yukun 2018; Mao et al. 2016). The opening paragraph of the electronic questionnaire highlighted the survey objectives, target respondents, and the roles of respondents. These respondents are likely to be involved in IT governance activities, IT and business operations in their firms. The questionnaire link sent to 100 selected working professionals for each city, both 2015 and 2016 batch alumni IT and business professionals targeting 600 respondents. After three weeks of follow-up, in the 1st wave 112 and in the 2nd wave 167, for a total of 279 initial responses that yielded an overall response rate of 23.25%. Among these 25 records were excluded as they had the same answer for all questions, incomplete, and missing responses. Finally, a usable sample of 254 valid records were obtained and accounted for a 91.04% valid response rate for this study. This study sample is an exact representation of the population of interest, thus 43.3% of respondents are IT professionals (IT Controller and Head of IT / MIS), and 44.1% of respondents are business professionals (department manager and marketing manager). Other respondents belonged to senior executives such as CEO, CIO, and MD. In terms of experience, 63.1% of the respondents have above six years of working experience. 23.3% of respondents have above 12 years of experience. The sample includes a wide range of industry sectors such as manufacturing 37.8 %, IT and technology 28.3 %, construction 8.7 %,

transport/logistics 8.3 %, banking/finance/insurance 6.3%, trade and business 5.5 %, and others 5.1 %. Table 2 shows the demographic profile of the sample.

Table 1: Demographic profile of the sample

4.3. Data validation

1. Non-response bias

The external validity was tested through *t*-tests to check the existence of non-response bias. Based on the assumption that the last group of respondents are most similar to non-respondents, a comparison of the first and last timed quartile of respondents show a test of non-response bias in this study sample (Armstrong and Overton 1977). Hence, the first and last quartiles were compared, and it revealed there was no significant difference between the early and late respondents. T-tests on the means of independent variables such as SN ($P = 0.349$), CRD ($P = 0.137$), LRN ($P = 0.464$), INT ($P = 0.031$), RCF ($P = 0.400$), PROD ($P = 0.261$), PROC ($P = 0.405$), and MGTP ($P = 0.845$). It reveals the evidence that there is no significant threat of non-response bias in this study sample.

2. Common Method Bias (CMB)

To address the CMB, different methods were used. First, following the suggestion recommended by Podsakoff et al. (2003) the Harman's single-factor test was conducted by including all the independent and dependent variables in an exploratory factor analysis. The first factor explained 44.77 % out of 71.4% of the total variance that is below than the cutoff value of 50% of Harman's single factor test (Podsakoff et al. 2003). Owing to the increasing drawbacks on the Harman's single-factor test, we re-confirmed CMB by using the other two methods (Ilmudeen et al. 2019). First, any high correlation ($r > .90$) is also the indication for the CMB (Gaskin 2011; Lowry and Gaskin 2014). This study confirms the Pearson's correlation r value is less than this threshold value (Table 3: $r < 0.9$). Second, according to Kock (2015) if all VIFs generated from a full collinearity test has equal or less than 3.3, the model is free from common method bias. In this study, the VIF values are less than 3.3 and demonstrates the evidence that this study is free from CMB.

Table 2: Descriptive statistics, correlations, and reliability

5 Results

5.1 Measurement Model

For the data analysis, the partial least squares (PLS) (smart PLS 3.0) was used as it efficiently deal with small dataset and has greater statistical power (Hair Jr et al. 2016). The reason for selecting PLS is the data does not require to be normally distributed, the measurement scales may be ordinal, and the sample can be smaller as long as ten times larger than the number of formative indicators or ten times the largest number of structural paths directed at a particular construct in the structural model (Chen 2012; Croteau and Bergeron 2001; Rivard et al. 2006). This study's dataset satisfies the above criteria. The analysis comprises of two steps; first, the measurement model is measured for the proper psychometric properties and the second measures the structural model (Aboobucker and Bao 2018). The reliability, convergent validity, and discriminant validity were assessed to check for the quality of measurement item (Hair Jr et al. 2016), and then the hypotheses were tested using path analysis. The item to cross loadings were above 0.808 and exceed the loadings between other constructs and the items. The loadings of the item with its primary construct should be higher than 0.7 and those of the item to the other constructs should be lower than 0.6 (Gefen and Straub 2005). Thereby signifying that the variance shared between the primary construct and each item exceeded the error variance (Chin et al. 2003). Appendix A presents the loading between the item to construct. The values for composite reliability the Cronbach's Alpha is above 0.7, and AVE also higher than 0.5 (Fornell and Larcker 1981). The value of square roots of AVE greater than all other cross-correlations, confirm the sufficient discriminant validity (see Table 2). To sum, these measures confirm sufficient discriminant validity and convergent validity of this study.

Figure 2: Path analysis results

5.2 Structural Model

The path analysis shows satisfactory path coefficients except for process innovation that are significant at 0.05. The structural model has explained variance (R^2) on PRO_INO = 21%, PROC_INO = 27%, MGT_INO = 25%, and FRM_PFM = 59%. Besides the R^2, we measured the predictive relevance Q^2 of the constructs to confirm whether the structural model has satisfactory predictive relevance. Q^2 values > 0 confirm predictive relevance in contrast, Q^2 values of 0 and below indicates a lack of predictive relevance (Hair Jr et al. 2016). The results of the blindfolding procedure show that PRO_INO ($Q^2 = 0.15$), PROC_INO ($Q^2 = 0.19$), MGT_INO ($Q^2 = 0.17$), and FRM_PFM ($Q^2 = 0.34$) respectively exhibit acceptable predictive relevance.

5.3 Hypothesis Testing

We assessed the significance of direct paths for all constructs in which subsamples of 5000 were used for bootstrapping to analyze the statistical significance of the path coefficients in PLS (Hair et al. 2011). For hypothesis testing, the strength and direction of the relationships assessed. First, the sensing has a significant relationship with innovation types such as PRO_INO ($\beta = 0.379, p < 0.001$), PROC_INO ($\beta = 0.387, p < 0.001$), and MGT_INO ($\beta = 0.334, p < 0.001$). Hence, H1a, 1b, and 1c supports that the firm's sensing capability relates positively to product innovation, process innovation, and management innovation. Second, coordinating PRO_INO ($\beta = 0.411, p < 0.001$), PROC_INO ($\beta = 0.481, p < 0.001$), and MGT_INO ($\beta = 0.429, p < 0.001$). Hence, H2a, 2b, and 2c supports that the firm's coordinating capability relates positively to product innovation, process innovation, and management innovation. Third, learning PRO_INO ($\beta = 0.425, p < 0.001$), PROC_INO ($\beta = 0.500, p < 0.001$), and MGT_INO ($\beta = 0.456, p < 0.001$). Thus, H3a, 3b, and 3c supports that the firm's learning capability relates positively to product innovation, process innovation, and management innovation. Fourth, integrating PRO_INO ($\beta = 0.468, p < 0.001$), PROC_INO ($\beta = 0.513, p < 0.001$), and MGT_INO ($\beta = 0.471, p < 0.001$). Thus, H4a, 4b, and 4c supports that the firm's integrating capability relates positively to product innovation, process innovation, and management innovation. The reconfiguring PRO_INO ($\beta = 0.462, p < 0.001$), PROC_INO ($\beta = 0.531, p < 0.001$), and MGT_INO ($\beta = 0.510, p < 0.001$). Hence, H5a, 5b, and

5c supports that the firm's reconfiguring capability relates positively to product innovation, process innovation, and management innovation.

We tested the relationship between innovative capability types and organizational performance. Accordingly, the product innovation has a positive and significant relationship ($\beta = 0.483$, $p < 0.001$). Thus, H6a is supported that the firm's product innovation positively impacts on its performance. Similarly, management innovation has a positive and significant relationship ($\beta = 0.270$, $p < 0.05$). Thus, H6c is supported that the firm's management innovation positively impacts on its performance. In contrary to the expectation, the process innovation has an insignificant relationship ($\beta = 0.053$, $p > 0.05$). Thus, H6b not supported that the firm's management innovation not impacts on its performance. This insignificant finding is consistent with the prior study that the process innovation capability does not have a significant direct effect on firm performance (Camisón and Villar-López 2014).

Table 3: Reflective Constructs and Measurement Item

Table 4: 1st order formative constructs measurement item

6 Discussion and implications

6.1 Discussion

Though plenty of studies have been conducted on the impact of dynamic capability – innovation relationship, the intended results have not been addressed neither empirically nor methodologically. The dynamic capabilities by virtue of a firm's people or material resources (Eisenhardt and Martin 2000) are crucial in executing innovations in an effective and efficient manner. Innovation is becoming ever more prominent in nurturing competitiveness and assist firms' survival with sustainable competitiveness (Rampersad et al. 2012). The constant innovation, and competitive action have become essential aspects of strategic move in most modern corporations (Sambamurthy et al. 2003). In contrast, innovation merely is inadequate for generating outcomes without the dynamic capabilities of a firm to decisively create, extend or modify its resource base (Lin et al. 2016). Despite the literature proposing a relationship between dynamic capability, firm innovation, and performance, to date very limited research empirically examines these relationships in a holistic model. In response to this call, this study investigates how IT may be exploited to facilitate dynamic capabilities to enable firm innovative capabilities that in turn direct to firm performance. This has been the great interest in IS research, such as product innovation (e.g., Anning-Dorson 2018), process innovation (e.g., Anning-Dorson 2018; Chen and Tsou 2012), and management innovation (Lin et al. 2016).

Past studies have widely been focused on IT capabilities (Chen et al. 2014; Kim et al. 2011; Lu and Ramamurthy 2011) and IT-related resources (Nevo and Wade 2011). Similarly, the recent studies on IT capabilities have highlighted that IS research wants to test IT-enabled artifact, e.g. innovation, and IT resources (Nevo and Wade 2011; Tan et al. 2017; Wang et al. 2017). The impact of IT on firm performance is best measured through intermediate-level contributions of innovation capabilities. Though, IT is assumed as an important enabler of innovation the mechanisms required to innovate and how IT and complementary firm elements enable firms' innovative capability ruins vague (Van de Wetering et al. 2017). As a result, the recent studies on dynamic capabilities have called for research to elaborate more details about IT's enabling impact on innovation (Battistella et al. 2017; Teece 2018), and

firm innovation capability (Wang et al. 2017). This study is in part consistent with the research of Ali et al. (2016) focused how absorptive capacity impact on organizational performance via organizational innovation. They examined the absorptive capacity's role for organizational innovation and organizational performance, whereas we incorporated five IT-enabled dynamic capabilities that enables firm innovative capabilities.

Studies claimed that the dynamic capability addressing the effect of turbulent environment. For example, Teece et al. (1997) proposed dynamic capability to explain why some firms are more successful than others in establishing competitive advantages in dynamic markets. In this study, we expect the synergies arising from ITDC in turbulent environment that produce the firm's ability to innovate in order impact on firm performance. Coping with turbulent environment, constant innovations in products, services, or channels and alertness to emerging opportunities or countermeasures for threats are vital for superior performance (Sambamurthy et al. 2003). With dynamic capabilities, firms can recurrently achieve technical fitness by modifying their capacities of executing regular activities in turbulent environments through reconfigured resource bases (Tai et al. 2019). A firm with superior dynamic capabilities is capable of rapidly responding to changes and succeed in turbulent environments, whereas firms with less dynamic capabilities are less able to rapidly respond (Leidner et al. 2011). In the turbulent environment, technology updates are fast, product/service obsolescence, competitors' moves, and customer demand change frequently (Chen et al. 2014; Wang et al. 2012). Thus, application such as market intelligence systems, expert systems, enterprise resource planning, and customer relationship management system better support to translate customer requirement to be fulfilled.

This increased emphasis on IT dynamic capabilities may allow firms to change the way they interact and coordinate activities in the market and inside firm during the turbulent environment. According to Leidner et al. (2011), a constant pursuit of an innovative IS strategy facilitate firm to cultivate dynamic capabilities, which is then used to grasp the changes, turn them into opportunities. In recent times, scholars have called for research across IT capability profiles with varying levels of uncertainty, and research is looking beyond technology to structures and processes that IT in enabling innovation (Tan et al. 2017). Therefore, this research provides a distinctive context that fits the research on firm's

innovation, which in turn, will suggest valuable elucidations to firms struggling to survive and thrive in the turbulent business environments.

6.2 Implication for theory and IS research

This study provides notable theoretical implications for IS research. First, the dynamic capability view (DCV) has been confirmed that it has better explanatory power than the RBV (Wu 2010). Similarly, the RBV of IT resources are inadequate to produce superior firm performance due to many theoretical limitations[3] (Nevo and Wade 2011; Tallon 2008). Further, this study is one of the first to test the dimensions of ITDC - innovation capability relationship that helps to shed light on their theorization by identifying the principal components of each capability to measure, conceptualize, benchmark, and operationalize IT dynamic capability. As a result, this study lengthens to address the limitations in RBV and suggests the ITDC dimension as the theoretical base for the future studies.

Second, unlike the past IT capability studies (e.g., Chen and Tsou 2012; Chen et al. 2014; Rai and Tang 2010; Raymond et al. 2018) this study elucidates the role of ITDC dimensions as the key driver for firm innovation types as the essential internal capabilities that enable firms to achieve performance. Furthermore, this study includes a comprehensive dynamic capability dimension that encouraged in prior studies to extend the alternative sets of dynamic capabilities (e.g., learning, integration, and coordination) (Tai et al. 2019). Similarly, studies necessitate further study to examine the complementary of dynamic capability by combing with innovative capabilities to explore whether they can have varying relationship (Najafi-Tavani et al. 2018). Accordingly, this study contributes to the literature by being the first to examine ITDC dimension's impact on innovation capability types i.e., product, process, and management.

[3] RBV limitations are described in Nevo and Wade (2011) as
1. It overlooks resources that are not strategic in and of themselves, like IT assets.
2. The theory is silent on the mechanisms through which organizational resources become strategic.
3. As IT assets often combined with firm resources, extant RBV logic cannot be used to theorize about the outcomes, thereby hiding their inner workings from view.

Third, despite plenty of scholarly works in dynamic capability and innovation capability, considerable concerns fail to focus on the performance consequences between these constructs. In literature, the salient features of ITDC and innovation capability relationship is slightly abstracted and that received limited attention. More specific to this research context, it seems that the majority of studies in IT-enabled capabilities have been grounded on surveys of firms in Western economies (i.e., North America, Europe, and Australia). There may be differences exist in different country context owing to cultural and regional variations that can bring remarkable insights (Wang et al. 2015). Hence, this study is conducted in China as the testing ground, and the empirical findings from China has the greater anticipation for scholars and practioners, and it offers valuable suggestions for firms operating in other emerging economies (Su et al. 2013; Su and Yang 2018).

6.3 Implications for management and practice

This study offers noteworthy implications for management and practice. First, for practitioners and managers, a business firm is made up of several processes, routine and firm wide capabilities which are expected to work together to achieve firm goals. Managers, need to constantly cultivate and develop superior firm-wide IT capability to effectively manage and leverage their IT resources to build dynamic organization. Hence, focusing on ITDC would be a vital strategic decision that firms can use to position and maintain their competitive advantage in the turbulent environment. Equally, for firms pursuing differentiation, ITDC permits them to focus on the creation of idiosyncratic IT applications to support innovation and time-to-market.

Second, strategy scholars have long been examining whether firms pursuing mixed-focus strategies outperform those with a singular focus (Thornhill and White 2007).) Queiroz et al. (2018) suggested for firms pursuing differentiation can focus on the singular IT application strategy to support innovation and time-to-market. Further,) found that firms with a singular focus on either operational excellence or product leadership perform superior than those with mixed-focus strategies. Managers should not see the sensing,

coordinating, learning, integrating and reconfiguring that makes up this ITDC as cumulative. Instead, managers must design these dimensions in a sequence or matching manner.

Third, managers who oversee and diagnose the strategic value of ITDC must sharply build and configure sophisticated ITDC to exploit on new market opportunities. For that, they can cultivate and explore state-of-the-art IT capabilities that can facilitate innovative capabilities in the face of turbulent environment. For this purpose, managers can involve activities to (1) gather data on the market trend and customers' behavior, (2) use analytics or business intelligence technologies (3) share synchronized information with business partners, (4) exploit the information to enable firm innovative capability. Further, managers need to manage streamlining processes for swiftly detecting and separating IT applications that are no longer valuable as they once were. This creates a valuable portfolio of IT infrastructure and IT capability that could be better positioned to develop strategic IT capability for future turbulent business conditions.

Fourth, managers should produce knowledge assets combining IT-enabled dynamic capabilities and firm innovative capability, that in turn establish a strategic weapon for complex and turbulent environment. Industry leaders need to consider the external environments where the firm operates and evaluate those environment's impact on their IT capabilities and strategies. In doing so, the leaders can improve their innovative capability depending on the source of turbulence, harnessing these capabilities will achieve firm performance. Furthermore, managers should not merely look at IT capabilities, and use diagnostic tools to identify the strategic potential of a firm's IT capability and innovative capability to address in the turbulent environment. Similarly, managers should simultaneously develop collaboration with external actors to increase their absorptive capacity that enable to identify new opportunities and develop new products and processes through innovation in turbulent environment.

7. Limitations, directions for future research and conclusion

This study has the following limitations. First, this study is conducted collecting data from a single country as China. It is notable that this study could be extended to other countries / emerging economies beyond its geographical boundary. Second, our conceptualization and measurement of ITDC as a higher-order construct including five dimensions are derived from theoretical suggestions. Therefore, the underlying IT-based activities cannot be considered comprehensive but merely representative of core areas of focus. Future context-specific studies can be directed towards areas of IT-based interest that are embedded in dynamic capabilities. Third, the literature vaguely suggests that dynamic capabilities can potentially promote the tendency of firms in the development of innovative products/services; however, there is limited empirical evidence to support this claim. Examining the impact of dynamic capabilities in such settings would bring better insights for innovation and its subsequent impact on firm performance. Fourth, many scholars agree that turbulent environment plays significant moderating effect between dynamic capabilities and firm performance (Cheng and Yang 2017; Prajogo 2016; Wilden and Gudergan 2015; Xue et al. 2012). Similarly, recent studies suggest that the impact of IT capabilities on firm performance should be examined by considering other firm resources as intermediaries and the business environments as moderators (Chen et al. 2015; Nevo and Wade 2010; Stoel and Muhanna 2009). Hence, it is noteworthy to consider the turbulent environment as the moderator in future studies. Finally, this study centers on innovation capabilities types (e.g. product, process and management). Future studies would examine the relationships between ITDC and other type of innovations such as exploitative innovation, incremental innovation, and breakthrough innovation (Su and Yang 2018).

Conclusion

As firms are increasingly shifting towards ITDC due to turbulent environment, the need to understand the subsequent impact of ITDC has become more important. Though dynamic capability and innovation has been widely researched, the understanding on how ITDC enables firm innovative capability types received a limited focus. This study examines how the firm innovative capabilities types (e.g., product, process and management) are shaped

by ITDC for achieving firm performance considering the turbulent market condition. Drawing on IT capability, dynamic capability, and innovation literature, this study empirically investigates the entire chain of relationships between IT dynamic capability, innovative capability, and firm performance in a turbulent environment. Using the data from 254 Chinese firm's reveals ITDC has a significant relationship with firm innovative capability types which in turn have a significant relationship with firm performance except the process innovation. This study contributes to the growing IS research and accumulate to the IT dynamic capability and innovation literature and proposing insightful implications.

Acknowledgement

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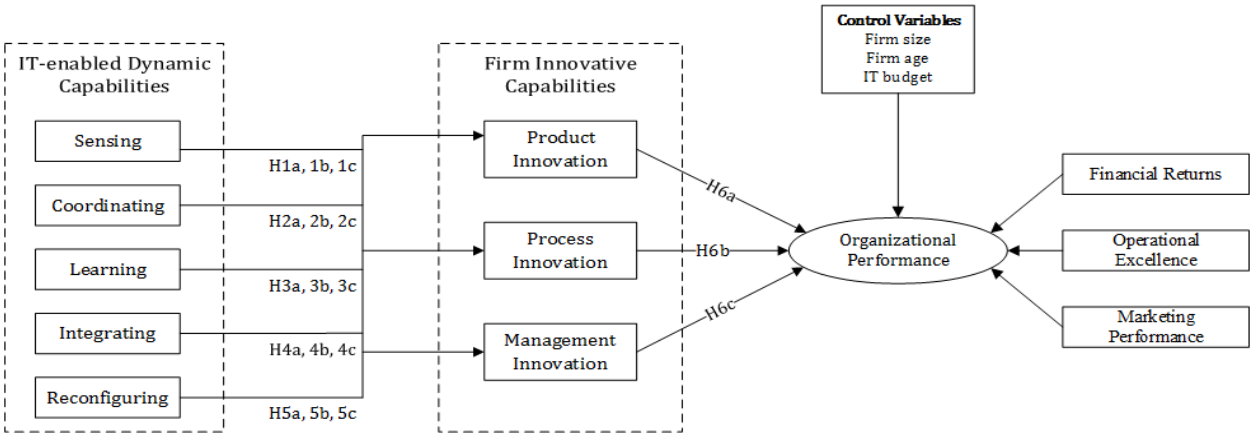

Figure 1: Research model

Table 1: Demographic profile of the sample

Position	N	%	Total sales in Last year	N	%
CEO and CIO	14	5.5	< 100 million $	96	37.8
Managing Director	18	7.1	100 - 499 million $	40	15.7
IT Controller	46	18.1	500 - 999 million $	35	13.8
Head of IT / MIS	64	25.2	1000 -1499 million $	15	5.9
Depart. Manager	57	22.4	1500 - 1999 million $	17	6.7
Market. manager	55	21.7	> 2,000 million $	51	20.1
Experience	**N**	**%**			
< 3 years	27	10.6	**Employees**	**N**	**%**

3.1– 6 years	66	25.9	Less than 100	21	8.2
6.1–9 years	87	34.3	100 – 500	61	24
9.1 - 12 years	15	5.9	500 - 1000	54	21.3
12.1 - 15 years	34	13.4	1000–1500	15	5.9
15.1 - 18 years	4	1.6	1500 - 2000	20	7.9
18.1 – 20 years	20	7.9	More than 2000	83	32.7
> 20 years	1	0.4			
IT budget in annual sales	**N**	**%**	**Org_Age**	**N**	**%**
< 1 %	81	31.9	< 4.9 Years	21	8.3
1.1%–2%	45	17.7	5 - 9.9 Years	26	10.2
2.1%–3%	33	13	10 - 14.9 Years	51	20.1
3.1%–4%	28	11	15 - 19.9 Years	80	31.5
4.1%–5%	32	12.6	> 20 years	76	29.9
>5%	35	13.8			

Table 2: Descriptive statistics, correlations, and reliability

	SNS	CRD	LRN	INT	RECON	PRO_INO	PROC_INO	MGT_INO	FRM_PFM	Frm_age	Frm_size	IT_budget
SNS	**0.883**											
CRD	0.737	**0.867**										
LRN	0.727	0.82	**0.891**									
INT	0.683	0.806	0.769	**0.832**								
RECON	0.706	0.793	0.77	0.813	**0.837**							
PRO_INO	0.408	0.41	0.424	0.468	0.462	**0.86**						
PROC_INO	0.42	0.48	0.499	0.513	0.53	0.791	**0.841**					
MGT_INO	0.383	0.45	0.479	0.494	0.524	0.761	0.815	**0.831**				
FRM_PFM	0.269	0.333	0.34	0.335	0.344	0.736	0.67	0.689				
Frm_age	0.144	0.071	0.082	0.049	0.031	0.041	0.045	0.043	0.068	1		
Frm_size	0.128	0.056	0.032	0.036	0.035	0.016	0.104	0.074	0.079	0.257	1	
IT_budget	0.196	0.132	0.118	0.017	0.069	0.183	0.207	0.214	0.185	0.071	0.118	1
Mean	3.906	3.938	3.982	3.901	3.844	3.610	3.610	3.629	3.567			
SD	0.874	0.787	0.797	0.803	0.829	0.922	0.884	0.942	0.892			
CR	0.934	0.923	0.939	0.9	0.903	0.919	0.906	0.899				
CA	0.935	0.923	0.939	0.9	0.903	0.919	0.906	0.897				
AVE	0.779	0.751	0.794	0.692	0.701	0.739	0.707	0.691				

Note: Diagonal bolded elements are the square root of AVE; off diagonal elements are correlation values. For discriminant validity, diagonal elements should be higher than off-diagonal elements; all of the correlations are significant at the $p < 0.01$ level, CA: Cronbach's Alpha, CR: Composite Reliability, AVE: Average Variance Extracted

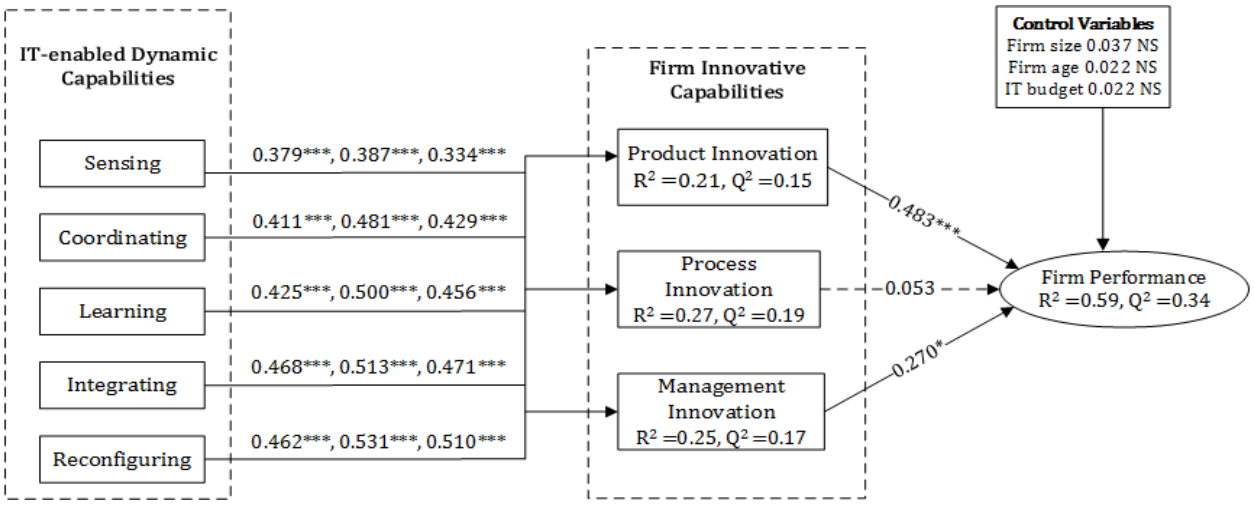

Figure 2: Path analysis results

Note: *p <0.05; **p <0.01; ***p<0.001

Table 3: Reflective Constructs and Measurement Item

Constructs and measurement items	Loading	STDEV	T Statistics
Sensing (SNS) SNS1 Scanning the environment and identifying new business opportunities	0.889	0.064	13.849
SNS2 Reviewing our product development efforts to ensure they are in line with what the customers want	0.866	0.061	14.31
SNS3 Implementing ideas for new products and improving existing products or services	0.802	0.062	12.862
SNS4 Anticipating discontinuities arising in our business domain by developing greater reactive and proactive strength	0.966	0.072	13.331
Coordinating (CRD) CRD1 Providing more effective coordination among different functional activities	0.872	0.059	14.782
CRD2 Providing more effective coordination with customers, business partners and distributors	0.886	0.053	16.587
CRD3 Ensuring that the output of work is synchronized with the work of other functional units or business partners	0.874	0.058	15.142
CRD4 Reducing redundant tasks, or overlapping activities performed by different operational units	0.834	0.066	12.687
Learning LRN1 Identify, evaluate, and import new information and knowledge	0.904	0.046	19.694
LRN2 Transform existing information into new knowledge	0.907	0.048	18.928
LRN3 Assimilate new information and knowledge	0.902	0.039	22.927
LRN4 Use accumulated information and knowledge to assist decision making	0.849	0.044	19.181
Integrating (INT) INT1 Easily accessing data and other valuable resources in real time from business partners	0.784	0.056	13.984
INT2 Aggregating relevant information from business partners, suppliers and customers. (e.g. operating information, business customer performance)	0.829	0.056	14.774
INT3 Collaborating in demand forecasting and planning between our firm and our business partners	0.845	0.045	18.623
INT4 Streamlining business processes with suppliers, distributors, and customers	0.866	0.054	16.076
Reconfiguring (RCF) RCF1 Adjusting for and responding to unexpected changes easily	0.87	0.04	21.599
RCF2 Easily adding an eligible new partner that you want to do business with or removing ones that you have terminated your partnership	0.768	0.06	12.795
RCF3 Adjusting our business processes in response to shifts in our business priorities	0.877	0.044	19.871
RCF4 Reconfiguring our business processes in order to come up with new productive assets	0.83	0.052	16.021
Product innovation PI1 Our company often develops new products and services well accepted by the market.	0.845	0.034	24.762
PI2 Our company can often launch new products or services faster than our competitors.	0.886	0.031	28.907
PI3 Our company has better capability in R&D of new products or services than our competitors.	0.872	0.033	26.688
PI4 Our product design is superior than of our competitors (in terms of functionality and features).	0.835	0.04	21.014
Process innovation PRI1 Our company often tries different operation procedures to accelerate the realization of the company's goals.	0.804	0.044	18.292

PRI2 Our company always acquires new skills or equipment to improve the manufacturing operation or service process.	0.844	0.035	24.014
PRI3 Our company can develop more efficient manufacturing process or operation procedure.	0.843	0.036	23.105
PRI4 Our company changes production methods at a great speed in comparison with our competitors	0.871	0.041	21.309
Management innovation			
MI2 Our company's department heads will adopt new leadership approaches to lead all staff towards task completion.	0.719	0.068	10.635
MI3 Our company emphasizes innovative and creative capability when recruiting staff.	0.833	0.046	18.042
MI4 The new staff recruitment system adopted by our company is efficient and effective.	0.897	0.032	28.041
MI5 The new performance assessment method adopted by our company can enable department heads to gain a better picture of how far the staff has achieved the company goal.	0.865	0.035	24.823

Table 4: 1st order formative construct measurement item

Constructs and measurement items	Weight	STDEV	T Statistics
Financial Returns (FR) FR1 Our company's return on investment (ROI) is better compared to other companies in the same industry.	0.285	0.135	2.111
FR2 Our company's return on equity (ROE) is better compared to other companies in the same industry.	0.235	0.126	2.634
FR3 Our company's return on asset (ROA) is better compared to other companies in the same industry	0.212	0.151	3.022
Operational Excellence (OE) OE1 Our company has better productivity improvements compared to other companies in the same industry	0.245	0.118	3.382
OE2 Our company has better timeline of customer service compared to other companies in the same industry.	0.203	0.105	3.286
OE3 Our company has better production cycle time compared to other companies in the same industry	0.428	0.119	3.595
Marketing Performance (MP) MP1 Our company performs much better than competitors in sales growth.	0.385	0.142	2.705
MP2 Our company performs much better than competitors in market share.	0.216	0.134	2.123
MP3 Our company performs much better than competitors in product development and market development.	0.312	0.116	2.017

Appendix A

Appendix B: Item to construct cross loadings.

	SNS	CRD	LRN	INT	RECON	PRO_INO	PROC_INO	MGT_INO
SNS1	0.897	0.569	0.588	0.512	0.537	0.353	0.342	0.333
SNS2	0.934	0.591	0.591	0.54	0.575	0.351	0.339	0.31
SNS3	0.923	0.649	0.654	0.616	0.632	0.302	0.341	0.282
SNS4	0.902	0.694	0.659	0.624	0.635	0.372	0.387	0.357
CRD1	0.634	0.901	0.74	0.671	0.665	0.345	0.398	0.372
CRD2	0.597	0.905	0.654	0.63	0.61	0.342	0.406	0.385
CRD3	0.641	0.913	0.68	0.679	0.697	0.374	0.391	0.354
CRD4	0.603	0.887	0.684	0.675	0.647	0.301	0.391	0.371
LRN1	0.632	0.7	0.929	0.652	0.654	0.372	0.441	0.396
LRN2	0.586	0.69	0.914	0.639	0.606	0.376	0.431	0.408
LRN3	0.654	0.736	0.93	0.668	0.69	0.358	0.422	0.427
LRN4	0.638	0.684	0.904	0.645	0.663	0.343	0.4	0.394
INT1	0.531	0.649	0.642	0.861	0.665	0.359	0.366	0.378
INT2	0.582	0.639	0.642	0.889	0.69	0.375	0.409	0.382
INT3	0.559	0.659	0.613	0.908	0.752	0.421	0.388	0.382
INT4	0.529	0.634	0.589	0.849	0.718	0.337	0.458	0.419
RCF1	0.607	0.617	0.652	0.721	0.895	0.372	0.447	0.436
RCF2	0.495	0.577	0.554	0.651	0.848	0.337	0.403	0.37
RCF3	0.573	0.709	0.641	0.759	0.893	0.401	0.419	0.45
RCF4	0.612	0.646	0.648	0.703	0.883	0.37	0.422	0.408
PRDI1	0.353	0.36	0.386	0.417	0.39	0.885	0.661	0.662
PRDI2	0.353	0.398	0.413	0.42	0.388	0.906	0.677	0.625
PRDI3	0.339	0.316	0.337	0.374	0.385	0.917	0.644	0.617
PRDI4	0.313	0.28	0.275	0.313	0.347	0.878	0.608	0.584
PROI1	0.328	0.345	0.387	0.38	0.381	0.629	0.879	0.643
PROI2	0.366	0.404	0.457	0.428	0.423	0.635	0.9	0.679
PROI3	0.347	0.417	0.404	0.415	0.423	0.617	0.88	0.654
PROI4	0.326	0.385	0.381	0.413	0.467	0.669	0.873	0.694
MGTI2	0.279	0.325	0.277	0.311	0.343	0.534	0.629	0.808
MGTI3	0.308	0.337	0.387	0.393	0.407	0.632	0.682	0.884
MGTI4	0.326	0.389	0.435	0.429	0.472	0.631	0.651	0.913
MGTI5	0.319	0.384	0.431	0.416	0.426	0.624	0.686	0.891

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