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Yi Wang

Business School, Shantou University, Shantou, Guangdong Province, P.R. China, ywang63@stu.edu.cn

Yang Chen

School of Business Administration, Southwestern University of Finance and Economics, Chengdu, Sichuan Province, P.R. China

Saggi Nevo

Information Technology Management, School of Business, University at Albany, USA

Jiafei Jin

School of Business Administration, Southwestern University of Finance and Economics, Chengdu, Sichuan Province, P.R. China

Guiyao Tang

School of Business, Shandong University, Jinan, Shandong Province, P.R. China

See next page for additional authors

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Authors

Yi Wang, Yang Chen, Saggi Nevo, Jiafei Jin, Guiyao Tang, and Wing Chow

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Yi Wang

*Business School, Shantou University, Shantou, Guangdong Province, P.R. China
ywang63@stu.edu.cn*

Yang Chen

School of Business Administration, Southwestern University of Finance and Economics, Chengdu, Sichuan Province, P.R. China

Saggi Nevo

Information Technology Management, School of Business, University at Albany, USA

Jiafei Jin

School of Business Administration, Southwestern University of Finance and Economics, Chengdu, Sichuan Province, P.R. China

Guiyao Tang

School of Business, Shandong University, Jinan, Shandong Province, P.R. China

Wing S. Chow

Department of Finance and Decision Sciences, School of Business, Hong Kong Baptist University, Hong Kong

Abstract:

This article examines the process by which Information Technology (IT) capabilities affect innovation performance. The results of a survey of sixty-five matched business executives (chief information officers and chief financial officers) of firms in China show that market orientation fully mediates the effect of IT capabilities on innovation performance. The implications of this finding and limitations of this study are discussed.

Keywords: IT capabilities; innovation performance; market orientation; survey research

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I. INTRODUCTION

Information system (IS) scholars argue that IT capabilities are necessary components for firms aiming to achieve competitive advantage in terms of innovativeness [e.g., Bharadwaj, 2000; Ordanini and Rubera, 2010]. The value of IT in enabling business innovation has been supported by the 2012 Gartner Executive Programs' chief information officer (CIO) survey results which show a growing concentration on IT as a source of innovation among CIOs.¹ At their core, IT capabilities focus on mobilizing and deploying IT-related resources in combination with, and leveraging the value of, other resources and capabilities to improve firms' innovative ability [Bharadwaj, 2000; Pavlou and El Sawy, 2006]. For example, flexible IT infrastructure was found to strengthen cooperation among research and development (R&D) with other functional units and improve knowledge integration in the product innovation process [Luca and Atuahene-Gima, 2007]. Empirical evidence shows that IT capabilities could improve a firm's innovation performance [e.g., Davenport and Short, 2003; Ozer, 2000]. Despite the strong appeal of IT capabilities, how they contribute to superior innovation performance remains unclear and more research is needed [Ashurst, Freer, Ekdahl and Gibbons, 2012]. Relatedly, a lack of agreement about the value of IT in developing innovation exists among practitioners. While some firms use IT to facilitate customer-centered innovation, others fail to utilize IT to support innovativeness. Thus, both the "whether" and the "how" questions regarding the role of IT capabilities remain unanswered by academics and practitioners. Accordingly, this article seeks to find out if and in what way IT capabilities impact firms' innovation performance.

Recent studies investigated these questions from the perspectives of absorptive capacity theory [e.g., Joshi, Chi, Datta and Han, 2010] and organizational learning theory [e.g., Chi, Liao, Han and Joshi, 2010]. However, those studies tend to overlook the potentially significant impact of external market entities (such as customers and competitors) on a firm's ability to apply its IT capabilities to enhance innovation performance. The general management literature [e.g., Hurley and Hult, 1998; Lukas and Ferrell, 2000; Vázquez, Santos and Álvarez, 2001] informs us that firms tend to innovate successfully when they organize and manage innovation activities in a market-oriented and responsive manner in order to adapt to the dynamic business environment. Thus, we expect that a market-focused perspective would shed much needed light on the IT capabilities–innovation performance relationship, and this study fills the abovementioned gap by theorizing and then empirically examining the role of market orientation on this relationship. Market orientation is defined as a corporate culture that "places the highest priority on the profitable creation and maintenance of superior customer value" [Slater and Narver, 1995, p. 67]. It allows a firm to respond rapidly to external environmental change (e.g., shifts in customer preference and change in competitors' strategies), thereby enhancing performance [Hult, Ketchen Jr. and Slater, 2005]. A market-oriented firm usually has a strong set of core managerial values that describe how to treat customers, deal with competitors, and conduct various other business activities. It is these core values that foster responsiveness and innovativeness in firms. The introduction of market orientation informs an investigation of the process in which IT capabilities influence firms' innovation performance by focusing on the role of IT in enhancing market orientation.

Specifically, this study examines the mechanism through which IT capabilities contribute to a firm's innovation performance by enhancing its market orientation. This path, from IT capabilities to innovation performance, is partly motivated by recent IS research which notes that the former's impact on the latter is likely to be indirect, expressed via other organizational resources or capabilities [e.g., Dehning and Richardson, 2002; Kohli and Grover, 2008; Melville, Kraemer and Gurbaxani, 2004; Rai and Tang, 2010; Ravichandran and Lertwongsatien, 2005]. Market orientation is viewed as a fundamental corporate-wide resource capable of making a firm flexible and responsive in the face of ever-changing customer demands, and it has recently attracted much attention by strategic management researchers (see Zhou and Li [2007]). Positing that market orientation can be driven by technology, scholars observe that a firm may leverage its IT capabilities to strengthen market orientation [e.g., Bhatt, Emdad, Roberts and Grover, 2010; Borges, Hoppen and Luce, 2009]. In this sense, the impact of a firm's IT capabilities on innovation performance may depend first on its effect of market orientation. Next, to answer the question of how IT capabilities contribute to firm innovation, we adopt the perspective that innovation outcomes, in terms of new product development, are reflected in how well a firm links its competencies to technologies and customers [Eisenhardt and Martin, 2000]. Given this perspective, the present study contributes to extant knowledge by investigating the function of market orientation in the IT capabilities–innovation performance relationship.

¹ <http://www.gartner.com/it/page.jsp?id=1919115> (current August 28, 2012).

In the following sections, we first provide a theoretical background on IT capabilities and market orientation. Based on the resource-based view and related literature on IT capabilities and market orientation, we propose the mediating role of market orientation in the relationship between IT capabilities and innovation performance. Next we describe the research methodology and present our results, ending with discussion and limitations of our findings.

II. THEORETICAL BACKGROUND

Resource-based View and IT Capabilities

Organizational capabilities are defined as a firm's overall competencies to coordinate its complex human and other resources effectively to obtain competitive advantage [Grant, 1991]. Organizational capabilities are usually built in a history-dependent fashion with causal ambiguity and social complexity and also are valuable, rare, imperfectly imitable, and non-substitutable in unique combinations. Hence, capability-generated competitive advantages may be achieved and sustained over longer time periods [Amit and Schoemaker, 1993; Barney, 1991; Porter, 1985].

An emerging body of IS literature suggests the need to characterize IT investments in terms of IT capabilities [Bharadwaj, Sambamurthy and Zmud, 1999; Fink, 2011; Saraf, Langdon and Gosain, 2007; Stoel and Muhanna, 2009; Tallon, 2008]. Viewed as one kind of organizational capability, IT capabilities can be defined as "abilities to mobilize and deploy IT-based resources in combination or co-presence with other resources and capabilities" [Bharadwaj, 2000, p. 171]. IT capabilities presenting the characteristics of rarity, appropriability, imperfect imitability, and non-substitutability could help a firm to achieve superior performance [Wade and Hulland, 2004]. Past research has posited that IT capabilities should be understood as a broad concept and be measured as a higher-level construct because it stems from a whole gamut of everyday IT applications across organizations [Bharadwaj, 2000; Bharadwaj et al., 1999]. Extant studies explore IT capabilities in terms of different dimensions. Primarily, those studies examine IT infrastructure, IT integration, IT management, and IT alignment as key IT capabilities (see Table 1). Building on past research, we conceptualize organizational IT capabilities as comprised of the following four dimensions, treating the latter as first-order measures of a higher-level IT capabilities construct.

IS researchers have extensively examined the impacts of IT capabilities on firm performance. For example, Bharadwaj [2000] finds that firms with high IT capabilities tend to outperform competitors on a variety of profit- and cost-based performance outcomes. Further, there is growing evidence showing that competitive advantage often depends on whether or not firms can take advantage of IT capabilities [Bhatt and Grover, 2005]. Studies have started to examine the value of IS applications in enhancing innovation, but there tends to be a selective focus on specific IT capabilities, such as IT infrastructure [Dong, 2010], IT-leveraging capabilities in new product development [Pavlou and El Sawy, 2006], or IT-enabled knowledge management [Joshi et al., 2010]. Business innovation is a firm-wide comprehensive process that involves various functional units and activities, rather than being limited to the R&D department. In addition, innovation is a long and cumulative process ranging from the phase of generation of a new idea to its implementation phase [Popadiuk and Choo, 2006]. Accordingly, an examination of IT-enabled innovation requires a systemic approach. Therefore, we examine the value of overall IT capabilities instead of specific components of IT capabilities.

IS scholars have examined the underlying mechanism of how IT capabilities contribute to firm performance. One important viewpoint on IT business value proposes that IT *per se* might not provide sustained competitive advantage of a firm, but may instead help other business resources to do so [Bhatt et al., 2010; Melville et al., 2004; Rai, Patnayakuni and Seth, 2006]. Such a perspective implies that IT capabilities contribute to firm performance through the mediating role of other resources or capabilities within the firm [Kohli and Grover, 2008]. By applying the mediating approach to IT-enabled performance, scholars use an integrative framework to understand IT capabilities and their impacts in a firm, in which IT and non-IT capabilities are interconnected and interdependent and must be jointly applied and managed in order to contribute to firm performance. For example, Ravichandran and Lertwongsatien [2005] conclude that variation in firm performance can be explained by the extent to which IT capabilities are used to support and enhance a firm's core competencies. Likewise, Radhakrishnan, Zu and Grover [2008] show that the business value of IT capabilities can be manifested by leveraging the value of managerial capabilities and operational capabilities in a firm. In sum, linking IT to business resources and capabilities is critical to develop a holistic understanding of the role of IT capabilities in a firm and provide practitioners with actionable guidelines for making decisions about IT applications development.

Market Orientation

Market orientation has been extensively studied in the marketing literature and is considered critical for a firm's superior performance [Jaworski and Kohli, 1993; Kirca, Jayachandran and Bearden, 2005; Narver and Slater, 1990; Zhou, Li, Zhou and Su, 2008]. There are two main perspectives on market orientation in the marketing literature: a behavioral and a cultural perspective. From the behavioral perspective, market orientation is seen as the priority placed on generating, disseminating, and interpreting information about customer needs [Kohli and Jaworski, 1990].

Table 1: Literature Involving Four Dimensions of IT Capabilities

Literature (In chronological order)	IT infrastructure	IT integration	IT management	IT alignment
Bharadwaj et al. [1999]	IT infrastructure	External IT linkages	IT management	Business IT strategic thinking, IT business process integration
Bharadwaj [2000]	Physical IT assets	Coordination of buyer and supplier	Managerial IT skills	IT-enabled synergy, IT-business process integration
Ravichandran and Lertwongsatien [2005]	IT infrastructure flexibility	IS partnership quality	IS human resource specificity	---
Byrd, Lewis and Bryan [2006]	IT investment	---	---	Alignment between IS strategy and business strategy
Wu, Yenyurt, Kim and Cavusgil [2006]	IT advancement	IT-partner alignment	---	---
Kohli and Grover [2008]	Infrastructural capability	---	IT management variables	Business-IT alignment
Tallon [2008]	Software modularity, network connectivity, hardware compatibility	---	Strategic plans for IT use, post-implementation review	IT-business partnership
Ordanini and Rubera [2010]	---	Partners readiness	Manager's skills	Relationship assets
Nevo and Wade [2010]	---	---	Integration efforts	Synergy, compatibility
Rai and Tang [2010]	---	IT integration, IT reconfiguration	---	---
Tallon and Pinsonneault [2011]	Hardware compatibility, software modularity, network connectivity	---	---	Strategic IT alignment

This perspective offers a practical viewpoint on which firms are market-oriented and how firms can become market-focused. For the cultural perspective, market orientation refers to the extent to which organizational culture is devoted to meeting customers' needs and outperforming competitors [Narver and Slater, 1990]. Accordingly, market orientation emphasizes the importance of creation and maintenance of superior customer value [Slater and Narver, 1994]. Narver and Slater [1990] conceptualized market orientation as composed of three components: customer orientation, competitor orientation, and inter-functional coordination. Customer orientation represents an emphasis on collecting and processing market intelligence about customer preferences. Competitor orientation indicates an emphasis on understanding competitors' strategies and capabilities. Inter-functional coordination reflects the concentration on the coordinated application of organizational resources to synthesize and disseminate market intelligence [Narver and Slater, 1990]. This three-dimensional framework adequately represents the structure and content of market orientation [Webb, Webster and Krepapa, 2000].

In this article, we adopt the cultural perspective of market orientation for two reasons. First, distinct from the behavioral perspective that highlights the relevant activities to become market-oriented, the cultural view emphasizes fundamental characteristics of a market-oriented firm [Homburg and Pflesser, 2000]. The cultural perspective scrutinizes organizational norms and values that motivate and encourage market-orientated behaviors. Second, the cultural view of market orientation aptly reflects its key characteristic of being a firm-wide resource. Hult and Ketchen [2001] argue that the distinguishing characteristic of market orientation is a system-wide attention to market entities (customers and competitors in markets) throughout the firm. With a firm-wide market-focused culture that shapes the way of conducting business, market-oriented firms seek an integrative way to understand customer needs and develop superior solutions to those needs.

Market orientation is considered an important way through which firms interact with their market environment and can explain inter-firm performance variance over time [Zhou, David and Li, 2006]. By prioritizing customers' expressed wants and latent needs, a market-oriented firm seeks and investigates market information to deliver better customer value and superior performance [Morgan, Vorhies and Mason, 2009]. Market orientation also promotes cooperation among business units to achieve the same goals. It brings a sense of belonging to employees, thereby enhancing their satisfaction and improving product quality [Zhou et al., 2008]. Therefore, market orientation is a valuable resource. However, even though firms pay more attention to the significant role of market orientation, few know how to develop this resource and become more market-oriented [Gebhardt, Carpenter and Sherry Jr., 2006], suggesting that market orientation is a rare resource. As an organizational culture, market orientation allows managers to efficiently select the most productive resource combinations to match market conditions. This procedure stems from organizational routines, thus making it harder for the competitors to discern which parts or processes are important [Morgan et al., 2009]. This lack of transparency for outsiders suggests that market orientation is difficult to imitate and non-substitutable. In sum, market orientation has the characteristics of a strategic organizational resource [Barney, 1991] that can contribute to superior performance by helping the firm to better match the demands of its market environment.

The relationship between market orientation and firm performance has been theoretically and empirically examined in the marketing literature [Jaworski and Kohli, 1993; Narver and Slater, 1990]. Various impacts of market orientation within a firm have been proposed and tested and can be grouped into four categories: organizational performance, customer consequences, innovation consequences, and employee consequences [Jaworski and Kohli, 1996]. Matear, Osborne, Garrett and Gray [2002] find that market orientation contributes to the financial and market performance of service firms both directly and through the mediation of innovation. Im and Workman Jr. [2004] argue that market orientation enhances creativity of product development teams. Hult and Ketchen [2001] propose that market orientation combined with other organizational capabilities constitutes a firm's positional advantage which has a positive effect on firm performance. Slater and Narver [1994] propose that market orientation enhances customer satisfaction and loyalty by allowing firms to anticipate customer needs and to offer relevant products. The impact of market orientation on enhancing employee commitment, team spirit, and job satisfaction also has been emphasized by Kohli and Jaworski [1990]. This study focuses on the less known impacts of market orientation on innovation performance in terms of new product development success. The following section examines these effects.

III. RESEARCH MODEL

Drawing upon the literature on IT capabilities and market orientation literature, we develop a framework that depicts the relationships between IT capabilities, market orientation, and innovation performance (see Figure 1). Viewing market orientation as an organizational resource, we propose that market orientation acts as a mediator to the relationship between IT capabilities and innovation performance.

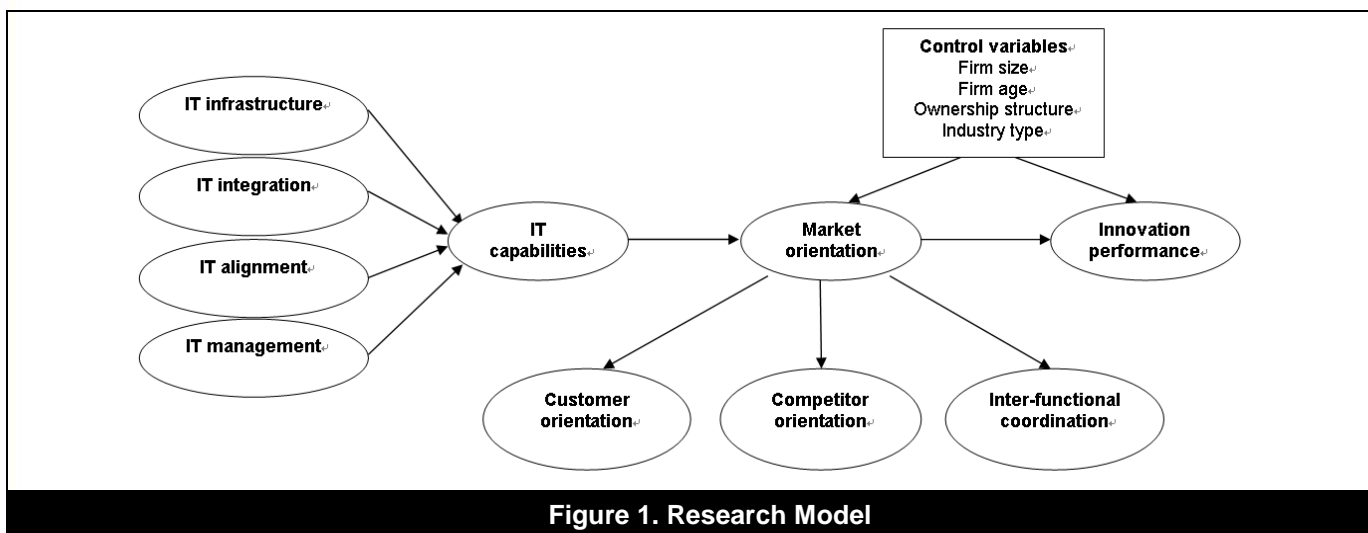


Figure 1. Research Model

IT Capabilities and Market Orientation

According to marketing literature, market orientation consists of customer orientation, competitor orientation, and inter-functional coordination. A firm's market orientation capability and market-oriented behaviors rely on various aspects within a firm, including values, norms, and artifacts [Kohli and Jaworski, 1990; Slater and Narver, 1994]. IT

capabilities, which are deeply and comprehensively embedded in everyday business activities and processes, are believed to have a fundamental role in developing organizational capabilities and skills [Day, 1994]. The concept of IT capabilities in this study is conceptualized as an integration of four dimensions: IT infrastructure, IT integration, IT alignment, and IT management. The following sections discuss the role of IT capabilities in enabling market orientation by elaborating how various dimensions of IT capabilities contribute to market orientation.

IT Infrastructure and Market Orientation

IT infrastructure refers to a set of shared, tangible IT resources that provide a platform or foundation for enabling present and future business applications [Duncan, 1995]. It comprises hardware and operating systems, network and telecommunication technologies, and data and core information-processing applications [Byrd and Turner, 2001]. The basic business function of IT infrastructure is to enable information to be seamlessly and automatically shared across systems and services [Bharadwaj, 2000].

IT infrastructure has been found to improve market orientation and responsiveness [Shang and Seddon, 2002]. Fichman [2004] and Weill, Subramani, and Broadbent [2002] indicate that hardware compatibility, software modularity, and unit scalability are critical for various aspects of market orientation (i.e., customer orientation, competitor orientation, and inter-functional coordination). Specifically, firms could rely on their flexible IT infrastructures to provide seamless and consistent access to their customer, production, order, and market data [Bhatt et al., 2010]. Database-oriented applications in routine operations increase the speed for adjusting production plans or product delivery based on changing customer demands. For competitor orientation, IT infrastructure enables a firm to obtain low cost, up-to-date competitor information from external sources and disseminate the information across units [Duncan, 1995]. The analytical capacity of the IT infrastructure is required to better understand and interpret competitors' strategies and support decision making. For example, a real-time data warehouse may be used to facilitate the modeling of sales patterns of the firm compared to its competitors in order to adjust pricing in real time [Joshi et al., 2010]. These applications are enabled by scalable IT infrastructure. Finally, a robust IT infrastructure enables easy communication and collaboration across various business units. Thus, inter-functional coordination could be strengthened by IT infrastructure. Based on this information, we propose that IT infrastructure can positively impact a firm's market orientation.

IT Integration and Market Orientation

IT integration, defined as interorganizational system integration [Grover and Saeed, 2007], refers to the extent to which a firm's systems and applications are linked to business partners, helping them to exchange information, communicate, and establish collaborative relationships [Rai et al., 2006]. For example, customer information is collected through various channels and then combined to provide firms with important and holistic input regarding changing customer demands and to enable quick response [Barua, Konana, Whinston and Yin, 2004; Grover and Saeed, 2007]. IT integration helps firms to build efficient communication and information exchange environments within and across firm boundaries, thereby improving firms' market orientation [Shang and Seddon, 2002]. For example, a firm can apply computer-aided design linked to its business partners' IT to deliver fast and relevant designs [Bhatt et al., 2010].

On the other hand, in a competitive environment, integrated systems and applications enable a firm to share competitor information across various channels, to coordinate activities and align processes with its partners in order to effectively respond to competitors' moves [Grover and Saeed, 2007]. For instance, to match Sony's aggressive discounts on the PlayStation 2 by 2003 [Lee, 2004], Microsoft streamlined its supply chain processes to achieve cost reduction, and its business partner, Flextronics, shifted the Xbox's supply chain from Mexico and Hungary to China to cut manufacturing costs [Rai and Tang, 2010].

For inter-functional coordination, an IT-integrated firm could disseminate operational information from its suppliers (such as inventory level and transport capability) to the firm's various business units, which could effectively work together in offering value to the customers. In sum, IT integration contributes to firm market orientation capability by transforming firms to real-time enterprises [Gold-Bernstein and Ruh, 2004]. Automating information flow and communication across functional systems accelerates business processes and reduces business cycle times.

IT Alignment and Market Orientation

IT alignment refers to the extent to which technology and business operations share coherent and congruent goals with each other [Luftman and Brier, 1999]. It reflects an organization's ability to synthesize competencies or resources from both business and technology domains. With the increasing availability of sophisticated IT, firms explore the potential of various technologies to provide platforms for enabling market segmentation and customer communication [Kearns and Lederer, 2003]. This alignment, between technology and business operations, substantively determines a firm's responsiveness in dealing with environmental challenges.

Understanding business needs and business processes may enable the IT staff to better anticipate specific implementation needs of their business unit colleagues and support business operations [Duncan, 1995], which help increase internal responsiveness to changes [Ballantine and Stray, 1999; Broadbent, Weill and St. Clair, 1999]. IT units with improved understanding of business operations can rapidly and efficiently gather and distribute meaningful market information to business units. For example, facing changing environments, firms need to be more flexible and agile to provide key products or services to their customers and respond to their competitors. Thus, the IT department should be able to gather information from customers and competitors and to reduce the lead time of information flows [Buonanno et al., 2005; Goodhue, Wybo and Kirsch, 1992]. Furthermore, alignment and close communication between IT and business units are essential in interpreting information about customers and competitors and transforming this information to insights about customer preferences and competitor strategies [Tallon, Kraemer and Gurbaxani, 2000]. Additionally, business–IT alignment is useful for enabling knowledge sharing and coordination between IT and business staff [Qu, Oh and Pinsonneault, 2010]. These IT-enabled advantages are fundamental for a firm to better leverage IT to achieve collaboration and agreement among employees from various business units in order to serve customers well [Prasad, Ramamurthy and Naidu, 2001]. Furthermore, tight IT alignment is conducive for fostering trust among disparate groups and allowing different business units to communicate and collaborate with each other to meet customer needs. In sum, we conclude that IT alignment could impact on a firm's market orientation.

IT Management and Market Orientation

IT management refers to the firm's ability to effectively implement IT project management practices, systems development practices, and IT evaluation and control systems, among others [Zhang and Sarker, 2008]. The IT management capability reflects a firm's capacity for system planning and design, applications delivery, project management, and planning for standards and controls [DeLone, 1988]. IT management represents a firm's ability to acquire, deploy, and leverage technology resources in combination with other resources. It also represents an ability to achieve business objectives and respond to environmental changes. For example, a firm requires effective IT planning and project management skills to facilitate a shift from a traditional offline channel to an online channel to match customers' changing shopping preferences [Nolan and McFarlan, 2005].

With increasing incorporation of IT among business operations and activities, IT management becomes a critical capability for a firm to adapt to changing market conditions. One of the main competitive advantages of a firm involves the extent to which it can rapidly transform its business processes to fulfill business imperatives, which often involve modifying or redesigning enterprise systems. Effective and relevant system design and development is dependent on whether the IT organization can understand and respond flexibly to business needs. Firms with a high level of IT planning and project management skills can rapidly and efficiently implement new systems, deploy new applications, and solve maintenance hurdles associated with old systems [Van Oosterhout, Waarts and Van Hilleberg, 2006]. This implies that a firm with a low level of IT management capabilities, potentially due to the disadvantages associated with difficult-to-replace legacy systems, would fail to respond to the changes of customer needs and competitors' actions effectively and quickly. As IT management includes "abilities such as the effective management of IT functions, coordination and interaction with user community, and project management and leadership skills" [Bharadwaj, 2000, p. 173], associated with the successful implementation of IT systems, firms could efficiently coordinate the disparate activities across different business units to achieve common goals, such as meeting customer needs [Zhang and Sarker, 2008]. In sum, IT management contributes to market orientation by enabling and supporting coordination between IT and the business units, frequent recalibration of IT priorities, and timely reallocation of IT resources. Thus:

Hypothesis 1: IT capabilities can positively influence market orientation.

Market Orientation and Innovation Performance

A market-oriented firm centers on the profitable creation and maintenance of superior customer value. With the value of facilitating innovation and responsiveness, market orientation is viewed as a source of competitive advantage [Day, 1994; Grant, 1991]. By developing a market-oriented value and culture, as well as engaging in market-oriented activities, a firm is better at gathering information on environmental changes, sharing information and knowledge, and developing market-focused responses compared to its competitors. The generated market intelligence can help the firm to more accurately understand the frequently changing customer demands, and use this knowledge to improve the effectiveness of new product development and introduction [Deshpandé, Farley and Webster Jr, 1993; Lukas and Ferrell, 2000; Slater and Narver, 1994]. Market orientation is conceptualized as an integration of three dimensions—customer orientation, competitor orientation, and inter-functional coordination—and we elaborate how the three dimensions of market orientation impact innovation performance.

Customer orientation focuses on the collection and dissemination of market intelligence about customers [Narver and Slater, 1990]. A customer-oriented firm that closely monitors and deeply understands customers' needs tends to develop and introduce novel products [Lukas and Ferrell, 2000]. The comprehensive understanding of customers' preferences also helps a firm develop meaningful products that better satisfy customers' existing needs. Furthermore, customer-oriented firms tend to outperform their competitors in developing brand new products to address customers' potential needs.

Competitor orientation indicates a firm's propensity to identify, analyze, and respond to competitors' capabilities and strategies. Firms with strong competitor orientation tend to continuously monitor competitors and rapidly respond to changes in competitors' strategies [Im and Workman Jr., 2004]. A corporate-wide competitor-oriented culture that permeates R&D, marketing, manufacturing, and customer services allows firms to stay ahead of competitors' innovation efforts [Han, Kim and Srivastava, 1998]. An understanding of industry trends also results in development of new products in response to competitors' actions [Im and Workman Jr., 2004].

Inter-functional coordination reflects firms' concentration on communication among different units; it promotes cooperation and collaboration among various business units by unifying goals and building the same values [Narver and Slater, 1990]. Congruent values and norms toward customer value within a firm help to resolve conflicts and misunderstandings among employees from different business functions [Han et al., 1998]. Further, shared market information about customers and competitors among units enhances the efficiency and effectiveness of new product development. For example, inter-functional coordination and collaboration between R&D and marketing departments is crucial to the success of new product development [Song, Neeley and Zhao, 1996]. Thus:

Hypothesis 2: Market orientation can positively improve innovation performance.

The Mediating Effect of Market Orientation

According to the RBV and the IT business value literature, IT capabilities may not directly impact firm performance. Instead, IT capabilities are valuable in shaping technology-related abilities that provide a technology-enabled basis for firms' operational and strategic activities and behaviors. Noting that innovation is a complex process consisting of a wide range of interdependent activities [Boer and During, 2001], we argue that IT capabilities do not directly contribute to innovation performance. Rather, they are expected to contribute to firm performance through the mediating role of other resources or capabilities within the firm [Kohli and Grover, 2008]. Market orientation is a key organizational resource that is enabled by IT and then leveraged by a firm to adapt to the changing business environment. Therefore:

Hypothesis 3: Market orientation mediates the effect of IT capabilities on innovation performance.

IV. RESEARCH METHODOLOGY AND ANALYSIS

Data Collection

To test our hypotheses, we collected cross-sectional data from firms in China in 2011. We approached eighty-two senior executives attending executive training courses at the university who agreed to participate in this study. We then visited the participating firms in person and asked the senior executives to nominate their top management team members (i.e., the CIOs and chief financial officers [CFOs]) to complete the questionnaire. These respondents were appropriate informants given their level of knowledge about the variables of interest, that is, IT capabilities, market orientation, and innovation performance [Armstrong and Sambamurthy, 1999]. Different questionnaires were designed for CIOs and CFOs, in order to obtain distinct perspectives of the firm's operational information. Specifically, CIOs answered questions related to IT capabilities and market orientation, and CFOs answered questions related to innovation performance. The questionnaires were delivered and collected in person by three trained research assistants.

We received completed responses from eighty-two CIOs and seventy-one CFOs. After deleting unmatched and/or missing cases, the final sample in this study consisted of sixty-five matched questionnaires. The response rates were separately 79.3 percent for CIOs and 91.5 percent for CFOs. Of the sixty-five sets of questionnaires from CIOs, the average organizational tenure of respondents was eleven years (SD = 7). For CFOs, the average organizational tenure was seven years (SD = 5). Of the firms in our sample, 54.5 percent identified themselves as manufacturing firms and the remainder (45.5 percent) classified themselves as service firms. Ownership types included state-owned (16.1 percent) and non-state-owned (83.9 percent). A total of 53.7 percent of the firms had operated for ten years or less, and 46.3 percent operated for 11 years or more. Firms ranged in size as follows: less than 100 employees (50.0 percent), more than 100 but less than 1,000 employees (36.5 percent), and more than 1,000 employees (13.5 percent).

Measurement Items

We developed measurement items by adopting measures from prior studies and modifying them to fit the context of our study. Appendix A lists the measurement items.

Since the questionnaire was originally developed in English, we translated it into Chinese to facilitate respondents' understanding. We followed the approach of Bhalla and Lin [1987] by adopting the linguistic equivalence of the two versions and employing the back-translation technique. Several faculty members and doctoral students reviewed the initial version of the questionnaire and provided their feedback on the content validity and the clarity of instructions. Their feedback led to several minor changes in item wording in the final version of the questionnaire.

IT capabilities. Consistent with our conceptualization, we measured IT capabilities as a formative second-order construct, composed of IT infrastructure, IT alignment, IT integration, and IT management. Measurements of IT infrastructure are from Premkumar and Ramamurthy [1995], Bhatt and Grover [2005], and Bhatt et al. [2010]; measurements of IT integration are from Rai and Tang [2010]; measurements of IT alignment are from Kearns and Lederer [2003]; and measurements of IT management are from Zhang and Sarker [2008]. Five-point Likert-type scales were used, ranging from one (strongly disagree) to five (strongly agree).

Market orientation. Following Kumar, Subramanian, and Yauger [1998], we treated market orientation as a reflective second-order construct, composed of customer orientation, competitor orientation, and inter-functional coordination. Five-point Likert-type scales were used, ranging from one (strongly disagree) to five (strongly agree).

Innovation performance. Past research showed that subjective measures of performance are highly correlated with objective measures or information released by firms or governments [Dess and Robinson, 1984; Venkatraman and Ramanujam, 1986]. Therefore, measurements from Luca and Atuahene-Gima [2007] were adopted to evaluate performance on new product development of respondents' firms. A multi-item, five-point Likert-type scale was used, with values ranging from one (strongly disagree) to five (strongly agree).

Control variables. The following were identified as relevant control variables for the model developed in this study. (1) Firm size was included on the grounds that larger firms may have more resources than smaller firms, which may affect the relationship between firm strategy and the dependent variables [Rueda-Manzanares, Aragon Correa and Sharma, 2008]. We controlled for firm size by taking the natural logarithm of the number of employees of a firm. (2) Firm age was included since it could affect sales growth [Autio, Sapienza and Almeida, 2000]. We controlled for firm age by taking the natural logarithm of the number of years the firm operates. (3) Ownership structure was included because firms with different ownership structures may systematically be linked to different performance levels [Darnall and Edwards, 2006]. We coded ownership structure as zero for non-state owned, one for state owned. (4) Industry type was controlled for since the performance of IT applications might be dependent upon the type of industry [Banerjee, Iyer and Kashyap, 2003]. We coded industry type as zero for service and one for manufacturing.

Data Analysis and Results

We used the partial least square (PLS) method to test our research model because it permits modelling of latent variables under conditions of non-normality with small to medium sample sizes [Chin, 1998]. In PLS, latent variables could be modelled as formative and reflective constructs. In this study, the construct of IT capabilities is a formative second-order construct, market orientation is a reflective second-order construct, and innovation performance is a reflective first-order construct, suggesting that the PLS approach is appropriate for this study; SmartPLS 2.0 was used to analyze the research model.

Testing the Measurement Model

We assessed construct reliability with the PLS internal consistency measure. Table 2 describes the results. All values were above 0.70, indicating adequate reliability. We tested convergent validity by examining average variance extracted (AVE) from the measures [Hair, Black, Babin, Anderson and Tatham, 2010]. Table 2 shows that the AVE values range from 0.67 to 0.80, indicating that they are above the acceptability value 0.50 [Fornell and Larcker, 1981]. In addition, we examined the results of a confirmatory factor analysis, using the measures of our research model. Table 3 shows the weights and loadings. All the measures are significant on their path loadings, indicating acceptable convergent validity. Finally, we assessed the discriminant validity of the measures. We followed the guidelines suggested by Gefen, Straub, and Boudreau [2000], examining whether the square root of the AVE for each construct was larger than its correlation with other factors. The test did not detect any anomalies. Table 4 summarizes the major descriptive statistics and the correlations derived from the sample. Table 4 also shows that all constructs met the previous requirements. Thus, all constructs displayed adequate discriminant validity.

Table 2: Results of Confirmatory Factor Analysis

Measures	Items	Composite reliability	Average variance extracted
IT infrastructure	7	0.94	0.67
IT integration	3	0.92	0.80
IT alignment	6	0.95	0.77
IT management	6	0.95	0.74
Customer orientation	5	0.90	0.72
Competitor orientation	3	0.82	0.80
Inter-functional coordination	5	0.91	0.72
Innovation performance	5	0.92	0.71

Table 3: Factor Loadings, Weights, and T-values

Model construct	Measures	Factor loading	Weights of the measures	t-value
IT infrastructure	ITF 1	0.70	0.15	8.99
	ITF 2	0.78	0.17	15.38
	ITF 3	0.85	0.18	26.85
	ITF 4	0.86	0.18	27.32
	ITF 5	0.82	0.18	18.59
	ITF 6	0.89	0.19	31.91
	ITF 7	0.84	0.17	28.46
IT integration	ITI 1	0.89	0.37	34.71
	ITI 2	0.90	0.35	35.40
	ITI 3	0.88	0.41	38.22
IT alignment	ITA 1	0.85	0.20	22.67
	ITA 2	0.87	0.19	24.11
	ITA 3	0.88	0.19	35.06
	ITA 4	0.90	0.20	34.37
	ITA 5	0.86	0.18	27.95
	ITA 6	0.90	0.19	38.35
IT management	ITM 1	0.89	0.21	29.80
	ITM 2	0.79	0.18	13.15
	ITM 3	0.85	0.20	26.60
	ITM 4	0.89	0.19	35.29
	ITM 5	0.85	0.19	17.16
	ITM 6	0.91	0.19	34.81
Customer orientation	CUO 1	0.83	0.23	23.68
	CUO 2	0.84	0.23	26.46
	CUO 3	0.89	0.24	48.04
	CUO 4	0.85	0.24	22.60
	CUO 5	0.82	0.24	16.63
Competitor orientation	COO 1	0.89	0.38	27.50
	COO 2	0.91	0.39	26.50
	COO 3	0.88	0.35	27.99
Inter-functional coordination	INO 1	0.84	0.25	33.32
	INO 2	0.84	0.22	23.39
	INO 3	0.86	0.24	38.57
	INO 4	0.86	0.23	32.06
	INO 5	0.85	0.24	28.89
Innovation performance	INP 1	0.84	0.26	25.92
	INP 2	0.91	0.25	50.58
	INP 3	0.79	0.26	14.48
	INP 4	0.82	0.22	18.84
	INP 5	0.84	0.20	17.71



Table 4: Correlation between Constructs

	Mean	St.d ev	Square root of AVE	ITF	ITI	ITA	ITM	MO	INP	FS	FA	OS	IT
ITF	3.66	.81	.81	1.0									
ITI	3.57	.90	.89	.75	1.0								
ITA	3.76	.83	.88	.78	.78	1.0							
ITM	3.50	.91	.86	.73	.65	.77	1.0						
MO	3.82	.76	.75	.65	.60	.67	.62	1.0					
INP	3.55	.67	.84	.38	.36	.46	.42	-.01	1.0				
FS	2.14	.85	--	.26	.16	.23	.24	.29	.08	1.0			
FA	1.07	.31	--	.11	.04	.06	-.04	.07	.14	.51	1.0		
OS	.16	.34	--	.00	-.13	.06	.07	-.04	.06	.29	.38	1.0	
IT	.55	.46	--	-.04	-.09	-.06	-.05	-.15	.08	-.27	-.09	-.01	1.0

ITF = IT infrastructure
 ITI = IT integration
 ITA = IT alignment
 ITM = IT management
 MO = Market orientation
 INP = Innovation performance
 FS = Firm size
 FA = Firm age
 OS = Ownership structure
 IT = Industry type

The values above .24 are significant at $p \leq .05$.

Because IT capabilities and market orientation are from the same source, common method variance (CMV) was a concern. We adopted several procedural and statistical remedies suggested by Podsakoff et al. [2003] to minimize potential CMV. First, during the data collection process, we guaranteed anonymity and confidentiality of the respondents to limit concerns such as evaluation apprehension and social desirability. Second, we applied different sets of instructions and put a number of filler items in between constructs to reduce the participants' perception of any direct connection between these constructs. Finally, we tested the potential influence of CMV statistically using Harman's one-factor test. Principal factor analysis with Varimax rotation was performed to determine whether a single method factor explained a majority of variance. More than one factor with Eigen values greater than 1 was reported, with the first factor accounting for 21.52 percent of the total variance explained (75.41 percent). Thus, CMV did not appear to be a pervasive problem in this study.

Structural Model

With an adequate measurement model, the proposed hypotheses were tested with SmartPLS 2.0. The results of the analysis are depicted in Figure 2.

Hypothesis 1 was supported (path coefficient is 0.75 at $p \leq 0.01$). This result is consistent with Bhatt et al. [2010], demonstrating that IT capabilities improve a firm's market orientation on aspects such as information building, information leveraging, and organizational responsiveness. Hypothesis 2 was also supported (path coefficient is 0.49 at $p \leq 0.01$). This result reveals that market orientation enables firms to be both more effective and efficient by allowing managers to invest in research and development based on customer needs to match market conditions and improve innovation performance.

Using procedures recommended by Baron and Kenny [1986], we tested Hypothesis 3—that is, whether market orientation mediates the effect of IT capabilities on innovation performance. The path from the independent variable (i.e., IT capabilities) to the dependent variable (i.e., innovation performance) is significant (path coefficient is 0.47 at $p \leq 0.01$). Full mediation is present when the following conditions are met: A path from the independent variable (i.e., IT capabilities in our study) to the dependent variable (i.e., innovation performance) becomes not significant, while paths from the independent variable to the mediator (i.e., market orientation) and from the mediator to the dependent variable are both significant [Wold, 1985]. Partial mediation is presented when all three of these paths are significant [Wold, 1985]. After linking IT capabilities with innovation performance based on Figure 2, the path from IT capabilities to innovation performance becomes not significant (path coefficient is 0.23 at $p > 0.05$), and the other two paths are significant (path coefficients are, respectively, 0.65 at $p \leq 0.01$ and 0.28 at $p \leq 0.05$). We conclude that Hypothesis 3 is supported and market orientation fully mediates the effect of IT capabilities on innovation performance.

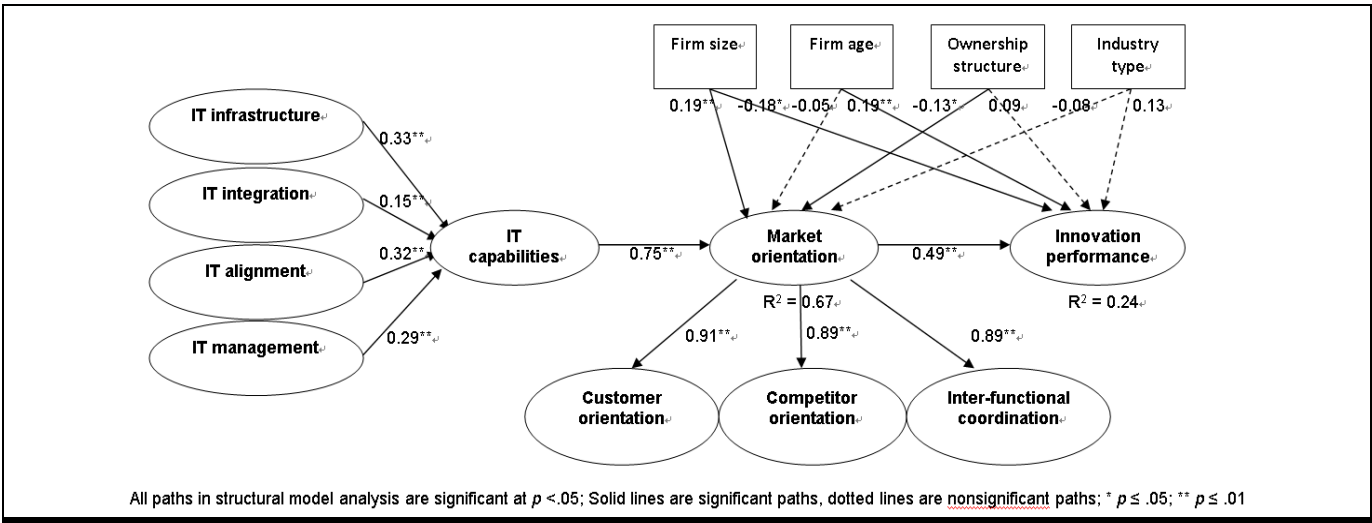


Figure 2. Full Mediation Results of PLS Analysis

V. DISCUSSION

The role of IT capabilities in building competitive advantages and enhancing firm performance has been extensively examined by previous research. Although innovation is one of the critical performance indicators for firms, insufficient knowledge had been accumulated regarding how IT contributes to a firm’s innovation performance. Partly motivated by this gap, we propose that a market-focused perspective is likely to be conducive to examine a company’s IT capabilities–innovation performance relationship. Specifically, this article puts forward a theoretically driven model that explicates the role of market orientation.

The significant and positive impact of market orientation on innovation performance is consistent with the notion that the former is an important factor of a firm’s superior performance in changing business environments. The relationship is built on the premise that because market orientation is widely embedded into firm norms, values, and culture, it reflects a firm’s ability to flexibly leverage resources to enable market-oriented activities and strategic movements based on market requirements. The nature of market orientation as a form of organizational resource determines its critical value in enhancing innovation.

Regarding the role of IT capabilities, the results in our study imply that IT capabilities positively contribute to market orientation, and indirectly influence firm innovation performance in terms of new product development. The empirically supported full mediation of market orientation on IT capabilities–innovation performance suggests that despite being valuable and rare, IT capabilities do not directly contribute to innovation performance. Rather, certain resources or capabilities (market orientation in our study) are needed for realizing the strategic potential of IT capabilities, translating value and rarity into business innovation activities and outcomes. A firm with enhanced IT capabilities needs to consider aligning and combining IT with marketing orientation capabilities to better develop new products. Market orientation, which helps firms to focus on the efficiency of providing products and services to satisfy customer needs, links IT capabilities with the outcomes of new product development.

Our study contributed to the IT capabilities literature by investigating the process through which IT capabilities influence firms’ innovation performance. Distinct from prior work, we explicitly focus on the mediating role of market orientation in this IT–performance relationship. To this end, we examined the relationship between IT capabilities and non-IT capabilities in enabling innovation. The empirically supported role of market orientation indicates that IT capabilities play an important role in enhancing firm flexibility and responsiveness in changing environments.

These findings have implications for practitioners by suggesting a new perspective on IT business value. First, our study addresses the “whether” concern among managers and executives by confirming the value of IT in enabling a firm’s innovation performance. The value of IT largely resides in a firm’s ability to innovate and quickly respond to the changing environment. Our study informs those executives who perceive the return on IT to be vague and inconsistent, proposing a useful approach for understanding and evaluating the value of IT by focusing on its role in supporting innovation. Second, the “how” question is answered by showing that the value of IT in developing business innovation largely depends on the extent to which a firm is able to hone and sharpen its focus on external stakeholders (such as customers and competitors) by way of superior market orientation. Our study indicates a promising approach to achieve benefits from IT by leveraging IT for the development of market orientation. Executives should be cognizant of the fact that market-oriented behaviors conducted by firms are significantly

influenced by IT capabilities, suggesting they should leverage IT to enhance marketing and product development performance. Further, managers should explore opportunities to leverage IT to better understand and respond to the market and prioritize IT investments to develop marketing-related activities and build a market-oriented culture in the firm. On the other hand, IT managers ought to continuously assess the value of IT investments and how new technologies can be integrated into the existing organizational marketing architecture and innovation architecture. Extending their horizon to other business activities, such as marketing and R&D, would enable managers to better leverage and align IT resources and capabilities with business demands. For managers involved in innovation strategy development, it is important to note that effective innovation might not result from simply implementing more technologies and applications. Instead, it will require a holistic strategy that takes into account technologies' potential, business goals, and environmental conditions.

VI. LIMITATIONS AND FUTURE RESEARCH

There are several limitations in our study. First, even though our use of the term "effects" implies causal relationships among IT capabilities, market orientation, and innovation performance, we acknowledge the need for more evidence based on longitudinal or experimental research before the suggested pattern of causation is defensible [Mustonen-Ollila and Lyytinen, 2004; Preston and Karahanna, 2009]. Second, although we used a matched sample approach, a single key informant provided data for each of the main constructs studied in our study. Based on established guidelines, we considered our informants to be appropriate and capable of providing valid and reliable data since they were the most knowledgeable informants working in corresponding positions [Armstrong and Sambamurthy, 1999; Slater and Olson, 2001]. Nonetheless, additional studies using multi-informant designs should be conducted to confirm our findings [Saraf et al., 2007]. Third, the control variable industry type is somewhat crude as it mainly distinguishes between manufacturing and service firms. Within these sectors the innovation behavior of firms from different sub-industries might differ in important ways [Pennings and Harianto, 2006]. Therefore, future research should consider using a finer measure of industry and sub-industry affiliation in order to scrutinize its impact on innovation performance. Fourth, this study focuses on the mediating role of market orientation. We recognize that market orientation is unlikely to be the sole explanation for the many positive effects of IT capabilities on innovation performance. Moreover, many successful firms may have adopted other strategic orientations such as service [Homburg, Hoyer and Fassnacht, 2002] and selling orientation [Noble, Sinha and Kumar, 2002]. Therefore, it would be worthwhile to theorize and test the possible effects of other organizational capabilities, such as entrepreneurial orientation and knowledge management, on the IT capabilities–innovation performance linkage. Finally, since some of our respondents are from small-to-medium firms, objective data (e.g., financial reports) were not available. Consequently, we relied upon subjective measures for the study's main constructs. Although perceptual measures are often used in the IS and management literatures [Ketokivi and Schroeder, 2004; Rai et al., 2006; Tallon et al., 2000] and were found to be highly correlated with objective information released by firms or governments [Venkatraman and Ramanujam, 1986], possible gaps between subjective measures and objective information may still exist [Straub and Burton-Jones, 2007]. Furthermore, the respondents in this study were CIOs and CFOs which could have led them to overestimate the various IT capabilities, market orientation, and innovation performance. However, we believe that such overestimation is not a major concern in our study since only aggregate measures were reported and because the identity of the respondents and the firms was not revealed, suggesting a lack of incentives to inflate the measures. Nevertheless, the potential for the inflation of the path coefficients still exists and should be acknowledged [Barone, Shimp and Sprott, 1997; Tallon and Kraemer, 2007]. It should be noted that recent meta-analytic research indicates that although this problem continues to be commonly cited, the magnitude of such inflation may be overestimated [Crampton and Wagner, 1994]. In spite of this, future research should augment our study by employing additional objective measures, although it should be noted that such measures might not exist for market orientation. To address the lack of objective measures, market orientation may be assessed by collecting data from multiple informants.

VII. CONCLUSION

The evidence accumulated thus far indicates that IT capabilities are likely to be accompanied by improved organizational performance [Stoel and Muhanna, 2009]. However, IT-enabled business value may be vulnerable given the increasing competition, fast-changing technology, and business conditions, where firms find it difficult to maintain their competitiveness in the changing environment. The present study contributes to better understanding of how IT capabilities can lead to superior innovation performance. Specifically, the study finds that the influence of IT capabilities on innovation performance is significant, positive, and fully mediated by market orientation. The study's findings should help to inform the debate on the relationship between IT capabilities and innovation and, thus, contribute to the IT business value literature.

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APPENDIX A: CIO AND CFO QUESTIONNAIRES

Table A-1: CIO and CFO Questionnaires

CIO questionnaire	
IT capabilities	To what extent do you agree with the following statements (1 = "Strongly disagree" to 5 = "Strongly agree")
IT infrastructure	ITF 1: A good telecommunication infrastructure is available in our firm.
	ITF 2: There are integrated IS applications encompassing different functional areas.
	ITF 3: We use database-oriented applications regularly in daily operations.
	ITF 4: Our information systems are scalable.
	ITF 5: Our information systems are compatible.
	ITF 6: Our information systems are adopted to share information.
	ITF 7: Our information systems are modular.
IT integration	ITI 1: Our firm transfers data with our suppliers.
	ITI 2: Our firm connects our systems with our suppliers' systems, which allows for the sharing of real-time information with our suppliers.
	ITI 3: Our firm combines information across different suppliers to support decision-making.
IT alignment	ITA 1: IS plans reflect the business plan goals.
	ITA 2: IS plans support the business strategies.
	ITA 3: IS plans recognize external business environment forces.
	ITA 4: Business plans refer to IS plans.
	ITA 5: Business plans refer to specific information technologies.
	ITA 6: Business plans have reasonable expectations of IS.
IT management	ITM 1: Effectiveness of IT planning in our firm is better than other firms in our industry.
	ITM 2: IT project management practices in our firm are better than other firms in our industry.
	ITM 3: Planning for security control, standard compliance, and disaster recovery in our firm is better than other firms in our industry.
	ITM 4: System development practices in our firm are better than other firms in our industry.
	ITM 5: Consistency of IT policies throughout the enterprise in our firm is better than other firms in our industry.
	ITM 6: IT evaluation and control systems in our firm are better than other firms in our industry.
Market orientation	To what extent do you agree with the following statements (1 = "Strongly disagree" to 5 = "Strongly agree")
Customer orientation	CUO 1: Our firm shows commitment to customers.
	CUO 2: Our firm creates services that offer value for customers.
	CUO 3: Our firm makes customer satisfaction a major objective.
	CUO 4: Our firm measures customer satisfaction.
	CUO 5: Our firm provides follow-up service.
Competitor orientation	COO 1: Employees in our firm discuss competitor information.
	COO 2: Employees in our firm respond rapidly to competitors' actions.
	COO 3: Top managers discuss competitors' strategies.
Inter-functional coordination	INO 1: Various units work close together to meet customer demands.
	INO 2: Various units share business information with each other.
	INO 3: All units work together in offering value to customers.
	INO 4: Business strategies are integrated between different units.
	INO 5: Different units share resources with each other.
CFO questionnaire	
Innovation performance	To what extent do you agree with the following statements (1 = "Strongly disagree" to 5 = "Strongly agree")
	INP1: Product and service development in our firm have achieved market share relative to the firm's stated objectives.
	INP2: Product and service development in our firm have achieved sales relative to stated objectives.
	INP3: Product and service development in our firm have achieved return on assets relative to stated objectives.
	INP4: Product and service development in our firm have achieved return on investment related to stated objectives.
	INP5: Product and service development in our firm have achieved profitability relative to stated objectives.



ABOUT THE AUTHORS

Yi Wang is an Associate Professor in Business School, Shantou University in China. She has published research papers in the *European Journal of Information Systems*, *International Journal of Electronic Business*, *Journal of Shantou University (Humanities Edition)*, and *Journal of Systems and Information Technology*. Her current research interests include IT diffusion and adoption and IT business value.

Yang Chen is an Associate Professor in the School of Business Administration, Southwestern University of Finance and Economics in China. He has published research papers in the *Journal of Business Ethics*, *Human Resource Management*, *International Journal of Human Resource Management*, *European Journal of Information Systems*, and *Journal of Computer Information Systems*. His current research interests include corporate sustainable development, IT business values, and human resource management.

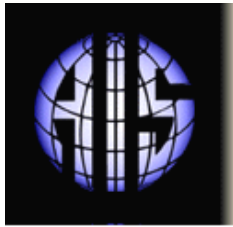
Saggi Nevo is an Assistant Professor in the Information Technology Management Department at the University at Albany. His work has been accepted or published in journals such as the *MIS Quarterly*, *The DATA BASE for Advances in IS*, *Communications of the Association for Information Systems*, *International Journal of Electronic Commerce*, *European Journal of Information Systems*, and *Journal of Strategic Information Systems*. His current research interests include open source software, social computing, and virtual worlds.

Jiafei Jin is an Associate Professor in the School of Business Administration, Southwestern University of Finance and Economics in China. He has published research papers in the *Journal of Business Ethics*, *Human Resource Management*, *European Journal of Information Systems*, and *International Journal of Human Resource Management*. His current research interests include work-family conflict and human resource management.

Guiyao Tang is an Assistant Professor in the School of Business, Shandong University in China. She has published research papers in the *Asian Pacific Management of China*, *International Journal of Human Resource Management*, and *Journal of General Management*. Her current research interests include strategic human resource management and leadership management.

Wing S. Chow is an Associate Professor of MIS in the School of Business, Hong Kong Baptist University. He has published more than seventy papers in journals and conference proceedings. He has published research papers in journals such as the *Journal of Business Ethics*, *OMEGA*, *European Journal of Operational Research*, *European Journal of Information Systems*, and *Journal of Computer Information Systems*. His current research interests include corporate information systems and e-commerce.

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