SUPPLY CHAIN EXPLOITATION, EXPLORATION, AND FIRM PERFORMANCE: EFFECTS OF TOP MANAGEMENT AND INFORMATION TECHNOLOGY CAPABILITIES

Completed Research Paper

Shaobo Wei
USTC-CityU Joint Advanced Research Center, University of Science and Technology of China, City University of Hong Kong
83 Tat Chee Avenue, Hong Kong
shaobow@mail.ustc.edu.cn

Weiling Ke
School of Business
Clarkson University
Clarkson Ave, Potsdam, NY 13699, USA
wke@clarkson.edu

Hefu Liu
School of Management
University of Science and Technology of China
96 Jinzhai Road, Hefei, Anhui, China
liuhf@ustc.edu.cn

Kwok Kee Wei
College of Business
City University of Hong Kong
83 Tat Chee Avenue, Hong Kong
isweikk@city.edu.hk

Zhongsheng Hua
School of Management
University of Science and Technology of China
96 Jinzhai Road, Hefei, Anhui, China
zshua@ustc.edu.cn

Abstract

While supply chain (SC) exploitation and exploration have been playing an increasingly important role in supply chain management, there is a dearth of research examining their antecedents and outcomes. In this research, we examine how SC exploitation and exploration impact firm performance. Specifically, drawing upon the boundary spanning theory, we theorize how top management, as boundary spanners, and three types of information technology (IT) capabilities, as boundary objects, enable SC exploitation and exploration. Our research hypotheses are tested using data collected from 157 firms in China. We found that both SC exploitation and exploration have significantly positive effects on firm performance. Also, top management participation directly affects both SC exploitation and exploration. In addition, IT business partnerships and external IT linkages positively affect both SC exploitation and exploration, whereas IT infrastructure is not significantly related to either SC exploitation or exploration. Contributions and implications of this study are discussed.

Keywords: Supply chain exploitation and exploration, IT capabilities, top management, boundary spanning theory, firm performance

Introduction

The diffusion of Internet-based applications enables the firm to strategically collaborate with its supply chain (SC) partners in an efficient and effective manner (Liu et al. 2010; Rai et al. 2006). Consequently, the nature of competition in the business arena has been changed from company-to-company to SC-to-SC (Barua et al. 2004; Rai et al. 2006). To outperform others, SC partners need to work together to renew themselves by continuously exploiting existing SC competencies as well as exploring new ones for innovation (He and Wong 2004; Jansen et al. 2006; Kristal et al. 2010). Based on March (1991), Im and Rai (2008, p.1281) formally defined exploitation as "the use and refinement of existing knowledge" and exploration as "the pursuit of new knowledge and opportunities" in the long-term inter-organizational relationships. Accordingly, SC exploitation refers to the practices aimed at leveraging current SC competencies with SC partners. In contrast, SC exploration relates to the practices aimed at seeking new knowledge and ideas to develop new SC competencies with SC partners (Chandrasekaran et al. 2012; Kristal et al. 2010). These two types of practices have differential emphasis and require different routines, which compete for scarce resources (Gupta et al. 2006). As such, it is imperative to examine factors that would facilitate SC exploitation and exploration and explore how they would differentially affect firm performance (Kristal et al. 2010).

A careful review indicates that there are three limitations in the existing literature on SC learning. First, prior research has been primarily focused on investigating the exploitation and exploration at the intra-organizational level (e.g., Chandrasekaran et al. 2012; Voss and Voss 2012) or at the operational level (e.g., Patel et al. 2012), few comprehensive studies have touched upon the exploitation and exploration in the SC context, namely at the inter-organizational level (e.g., Im and Rai 2008; Kristal et al. 2010). As the hyper-competitive environment making firms shift toward "SC vs. SC" struggles (Hult et al. 2007), the exploitation and exploration transcends the interactions between exploitation and exploration at both intra-organizational and operational level. Research with a focus on exploitation and exploration at the inter-organizational level is significant but lacking. Second, while previous studies have been focused on identifying structural designs (e.g., Gibson and Birkinshaw 2004; Jansen et al. 2006) and/or behavioral contexts (e.g., Chandrasekaran et al. 2012; Lubatkin 2006) that would facilitate exploitation and exploration, they have neglected the critical role played by top management, especially in the supply chain management (SCM) context. Top management, as the firm's decision-makers, have the right and power to shape and manage organizational strategies and resources (Kor and Mesko 2013). In particular, top management's behavior and actions would influence the firm's strategic decisions, such as whether to pursue SC exploration or exploitation (Carmeli and Halevi 2009). Also, the top management has connections and personal ties with SC partners' top management teams. Thus, how top management's behaviors impact SC exploitation and exploration warrants scrutiny (Carmeli and Halevi 2009; Liang et al. 2007). Third, there is a lack of research on how information technology (IT) capabilities would promote SC exploitation and exploration practices. IT has become the enabler for SC relationships management (Barua et al. 2004; Rai et al. 2006), such as facilitating SC partners' mutual adaptation (e.g., Malhotra et al. 2007) and improving their ambidextrous knowledge sharing (e.g., Im and Rai 2008). To the best of our knowledge, however, most studies have focused on a specific aspect of IT capabilities or treated them as a unified concept, which limits our understanding on the IT capabilities-SC exploitation and exploration relationships. As such, unpacking the nature of IT capabilities and incorporating the different types of it in the research on SC exploitation and exploration would enrich the literature.

To address these three shortfalls in the literature, we conduct the current research. We intend to investigate the antecedents and outcomes of SC exploitation and exploration. Specifically, we assess the performance implications of SC exploitation and exploration in terms of financial and operational performance, which may provide a better understanding of the possible differential relationships between SC exploitation and exploration and firm performance. In addition, drawing upon boundary spanning theory, we simultaneously consider the roles of boundary spanners and boundary objects and propose that top management (boundary spanners) can leverage its power and connections to cultivate and configure the organizational abilities to manage business activities across boundaries; and IT capabilities (boundary objects) can support the development and renewal of boundary spanning competencies (Levina and Vaast 2005), thereby jointly affecting SC exploitation and exploration.

The rest of this paper is organized as follows. We first articulate the theoretical framework of our research

and associated hypotheses. Then we present our research methodology and data analysis, which is followed by the discussions of results, implications, and limitations of this study.

Theoretical Framework and Hypotheses

Boundary Spanning Theory

Boundary spanning theory highlights the communication, coordination, and collaboration across boundaries through the boundary spanners and boundary objects (Carlile 2002; Star and Griesemer 1989). In the context of SC, firms conduct practices and make decisions by drawing on diverse bases of expertise from SC partners (Levina and Vaast 2005). As such, firms need to overcome the barriers imposed by knowledge embeddedness and tacitness to span the boundaries across SC partners (Tortoriello et al. 2011). Specifically, three knowledge boundaries should be spanned to enable the sharing of knowledge and information: syntactic, semantic, and pragmatic (Carlile 2002). Syntactic refers to knowledge and information transferred should be based on a common and shared and stable syntax. Semantic refers to knowledge and information translated should be based on a common and shared meaning. Pragmatic refers to knowledge and information transformed should be based on the representation of different interests.

Boundary spanners represent the individuals that facilitate the sharing of knowledge and information by interacting with SC partners (Levina and Vaast 2005; Tortoriello et al. 2011). Boundary spanners such as top management can perform boundary spanning roles by facilitating the interaction and socialization with SC partners (Levina and Vaast 2005; Tortoriello et al. 2011). Following Liang et al. (2007) and Hu et al. (2012), we focus on top management participation (TMP) and regard it as the top management's involvement in and support for working with SC partners to manage the SC. TMP refers to the firm's top management's behavior and actions performed to facilitate the communication, coordination, and collaboration between SC partners in SCM.

Boundary objects refer to "artifacts or other forms of reification around which communities of practice can organize their interconnections" (Wenger 1998, p.107). Boundary objects such as IT capabilities can support the development of boundary competencies across SC partners (Levina and Vaast 2005; Star and Griesemer 1989). The digital boundary objects should be both of standardization and adaptability to facilitate interactions between SC partners. Standardization refers to the objects being "robust enough to maintain a common identity across sites" (Star and Griesemer 1989, p.393), while adaptability refers to its being "plastic enough to adapt to local needs and constraints of the several parties employing them" (Star and Griesemer 1989, p.393). In this view, we define IT capabilities as a firm's ability to deploy IT-enabled processes with its SC partners in adjusting and reconfiguring SC competencies (Malhotra et al. 2007; Zhu et al. 2006). According to Wade and Hulland (2004), capabilities can be classified into three types: inside-out capabilities, which are internally focused, deployed from inside the firm; outside-in capabilities, which are externally focused, emphasizing on creating continuous relationships with partners; and spanning capabilities, which are both internally and externally orientated, integrating the inside-out and outside-in processes. Following this classification, we identify three types of IT capabilities, namely, IT infrastructure capability (inside-out process), IT business partnerships (spanning process), and external IT linkages (outside-in process). Specifically, IT infrastructure capability refers to a set of technological resources providing the foundation for rapid development and implementation of present and future enterprise applications and services within and across the organizational boundary (Bharadwaj 2000; Ray et al. 2005). IT business partnerships refer to the firm's ability to create durable relationships between business and IS professionals in the SC (Bharadwaj et al. 1999; Zhang et al. 2008). External IT linkages refer to the IT-based connections between the firm and its SC partners (Bharadwaj et al. 1999; Zhang et al. 2008).

Building upon the boundary spanning theory, we propose that top management, as boundary spanners), and IT capabilities, as boundary objects, would enable SC exploitation and exploration by facilitating the cross-organizational sensing, seizing, and implementation of current and future business practices, and subsequently enhancing firm performance (Figure 1).

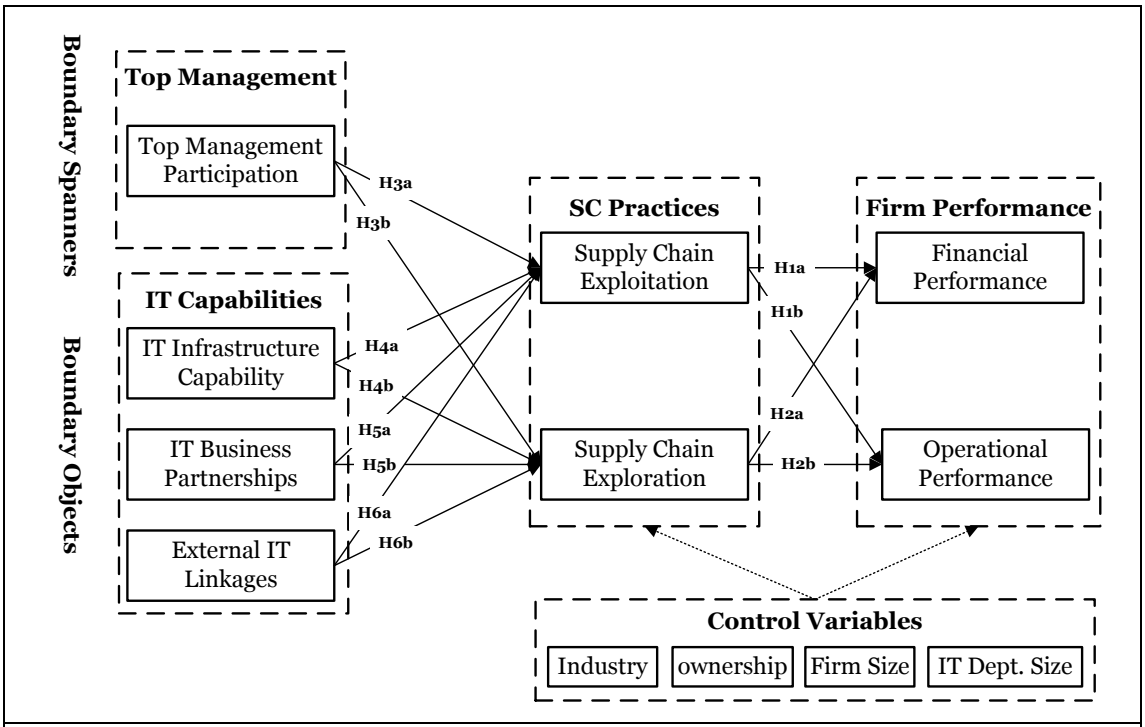

Figure 1. Research Model

Effects of SC Exploitation and Exploration

It is challenging to select the performance measures in the SC context. Previous studies focused largely on a specific aspect of performance (Flynn et al. 2010; Kristal et al. 2010) or mixed different aspects of performance at an aggregate level (e.g., Liu et al. 2013; Vaart and Donk 2008). To explore the potential relationships between SC exploitation and exploration and firm performance, we follow Flynn et al. (2010) and focus on two aspects of firm performance, i.e., financial performance and operational performance. Specifically, financial performance refers to the firm's performance in regard to investment return, profitability, and net income relative to its key competitors (Zahra and George 2002), while operational performance refers to the firm's ability to response to the market changes and its customer service relative to its key competitors (Fisher 1997; Flynn et al. 2010).

Drawing on the two pillars of learning (i.e., exploitation and exploration) (March 1991; Roberts et al. 2012), we classify SC practices along two types. SC exploitation stresses the firm's efforts to refine and extend current resources and skills in SCM (Kristal et al. 2010). Firms with SC exploitation jointly broaden their existing knowledge and skills, and thus leverage their current SC competencies to achieve efficiency and low costs (Jansen et al. 2006; Kristal et al. 2010). Conversely, SC exploration highlights the firm's efforts to develop new SC competencies through sensing and experimentation of new external knowledge (Carlo et al. 2012; Kristal et al. 2010). With exploration, firms continually seek new knowledge and resources by inter-organizational collaboration through digital enablement (Kristal et al. 2010; Sanders 2008).

We argue that SC exploitation and exploration are both critical for firms in the SCM context and improve both aspects of firm performance. High SC exploitation would enhance the firm's ability to perform the routine tasks by reducing operational redundancies in the SC relationships, such as cutting down the redundant staff and reducing coordination costs (Im and Rai 2008; Sanders 2008), which would improve the firm's financial performance. In addition, SC exploitation makes firms focus more on the existing skills and knowledge to refine the current SC processes and technologies (Huang et al. 2008), such as reconciling the inventory and payments by adopting the IT-enabled systems (i.e., electronic data integration systems) (Sanders 2008). Thus, SC exploitation can not only improve the firm's financial performance, but also contribute to operational performance improvement.

H1a. The extent to which a firm practices SC exploitation is positively related to its financial performance.

H1b. The extent to which a firm practices SC exploitation is positively related to its operational performance.

While high SC exploration focuses more on developing new SC competencies by sensing and experimentation of new processes and ideas, which can reduce uncertainties about external environment and technologies changes and avoid being locked-in with out-of-date technologies (Chandrasekaran et al. 2012). Therefore, on the one hand, high SC exploration continually seeks new SC solutions to SC problems to improve the firm's efficiencies (Kristal et al. 2010), such as collaborating with SC partners to better plan production cycles and reducing stock out occurrence through Internet-enabled SCM (Kulp et al. 2004; Sanders 2008). On the other hand, high SC exploration also proactively explores new opportunities by externalizing, combining, and socializing with external new knowledge and ideas in the SCM (Huang et al. 2008; Kristal et al. 2010), such as enabling the development of novel and close associations and linkages with partners, and thus can quickly respond to and capitalize on market, demand, or customer need changes (Lu and Ramamurthy 2011). Thus, we propose the following hypotheses.

H2a. The extent to which the firm practices SC exploration is positively related to its financial performance.

H2b. The extent to which the firm practices SC exploration is positively related to its operational performance.

Effects of Top Management on SC Exploitation and Exploration

According to boundary spanning theory, top management, as the boundary spanners, have the boundary-spanning ties and interpersonal connections with SC partners (Gao et al. 2008), which can facilitate the sharing of knowledge and information with SC partners (Hsiao et al. 2012; Tortoriello et al. 2011). In particular, these ties and connections would provide top management with the access to SC partners' knowledge and resources that complement what the focal firm has in-house, thereby enabling the focal firm to develop broader and more in-depth SC exploration and exploitation. In addition, Mitchell (2006) suggests that top management's boundary spanning roles can significantly influence IT-related projects such as SCM implementation through acquiring external knowledge, integrating external and internal knowledge, and then recombining internal knowledge components in new ways. Following this logic, we conjecture that SC exploitation and exploration would be affected by the TMP in important ways.

TMP focuses on the top management's behavior and actions to develop strategies and plans to enable the implementation of SCM. It is well established that TMP can facilitate the assimilation of innovative practices by creating appropriate organizational structures and roles (e.g., Liang et al. 2007). On the one hand, firms with high TMP would establish goals and standards to lend legitimacy to facilitating the implementation of SCM (Liang et al. 2007), which would make inter-organizational communication and collaboration more efficient and effective. For example, employees can use their own judgment to perform the routine business processes by following the formal rules and standards (Gibson and Birkinshaw 2004), which consequently would reduce the unnecessary operational redundancies. In this view, TMP enables firms to develop stronger competencies in their current SC processes. On the other hand, high TMP firms would proactively pursue more entrepreneurial opportunities by leveraging their personal contacts with SC partners, such as seeking quality materials, new technologies, and timely delivery (Peng and Luo 2000), which would promote responsiveness to opportunities and develop new SC competencies (Im and Rai 2008). Moreover, TMP can help resolve conflicts among the firms in the supply chain and allocate and commit resources to facilitate the development of SC exploitation and exploration practices (Hu et al. 2012; Liang et al. 2007). As such, TMP helps to build a large knowledge base and knowledge structures by combining external resources and ideas with the internal knowledge base, which generate more ways to try out new SC processes (Carlo et al. 2012). Hence, we hypothesize as follow.

H3a. The firm's top management participation in the SCM processes is positively related to its SC exploitation.

H3b. The firm's top management participation in the SCM processes is positively related to its SC exploration.

Effects of IT Capabilities on SC Exploitation and Exploration

In the context of Internet-enabled SCM, IT capabilities are considered digital boundary objects that enable the transferring, translating, and transforming of knowledge and information between SC partners (Carlile 2004; Im and Rai 2008; Malhotra et al. 2007). Levina and Vaast (2005, p.339) propose that boundary object "(This concept) is useful in understanding how IT-based artifacts can support the development of boundary spanning competence". In this view, IT capabilities as digital boundary objects would facilitate knowledge sharing across three knowledge boundaries (i.e., syntactic, semantic, and pragmatic) by communication, coordination, and cooperation between SC partners (Carlile 2002). We propose that the three types of IT capabilities, namely, IT infrastructure capability, IT business partnerships, and external IT linkages can address the three knowledge boundaries, namely, syntactic, semantic, and pragmatic respectively.

IT infrastructure capability reflects an integrated platform that enforces standardization and adaptability of data and processes for updating current infrastructure, resisting systems failure, and configuring new application (Kumar 2004; Lu and Ramamurthy 2011). In the SCM context, boundary objects would enable knowledge and information transfer across their syntactic boundaries based on shared and stable syntax and accurate communication (Carlile 2002; Im and Rai 2008). In particular, flexible IT infrastructure can enhance data compatibility between SC partners (Rai et al. 2006), which enables the firm to effectively and efficiently share information, coordinate activities, and align processes with its SC partners (Rai and Tang 2010). Moreover, the common standard interface and modular processes can accurately map local practices of different partners to a common referent (Malhotra et al. 2007). Lu and Ramamurthy (2011, p.936) argue that "boundary-spanning IT infrastructure services such as firm-wide applications, databases, and common systems are essential to quickly implement extensive, innovative, and radical process changes and best support demand-side initiatives". Integrated IT infrastructure enables knowledge transfer across syntactic boundary based on shared and stable syntax, which provides accurate knowledge needed for SC exploitation and exploration (Im and Rai 2008). As such, IT infrastructure capability increases the ability of SC partners to span the syntactic boundaries and thus improve the firm's ability to refine its existing SC competencies and develop new SC opportunities.

H4a. The firm's IT infrastructure capability is positively related to its SC exploitation.

H4b. The firm's IT infrastructure capability is positively related to its SC exploration.

IT business partnerships highlight the relationship building and synergy between IT function and other function areas, particularly with business department, which improves the technology users' understanding of IT's potential (Zhang et al. 2008). The rich and close interaction between IT and business facilitates the wider dialogue between them and foster the blending of them, and thus creating a mutual respect and trust over time (Bharadwaj et al. 1999; Lu and Ramamurthy 2011). In this view, the firm's IT business partnerships would enhance the common interpretations and meanings of communication and collaboration, which create a better understanding as to how its local actions impact the processes in the SC partners' organizations (Malhotra et al. 2007). IT business partnerships enable knowledge translation across semantic boundary based on common meaning, which provides effective knowledge needed for SC exploitation and exploration. In this view, IT business partnerships would facilitate the knowledge and information translation across their semantic boundary (Carlile 2002; Im and Rai 2008), thereby supporting sensing-making, perspective-sharing, and development of knowledge and information required by developing SC competencies (Sambamurthy et al. 2003). Therefore, we propose the following hypotheses.

H5a. The firm's IT business partnerships are positively related to its SC exploitation.

H5b. The firm's IT business partnerships are positively related to its SC exploration.

External IT linkages stress the IT-based connections between SC partners (Zhang et al. 2008). It supports the firm's business strategies and creates business opportunities by helping firms acquire and assimilate external knowledge and resources (Han et al. 2012; Rai and Tang 2010). Strong external IT linkages can facilitate the timely, consistent, and comprehensive interactions between SC partners, which provide an adequate means for assessing value and sharing of knowledge and resources across the organizations (Bharadwaj et al. 1999; Joshi et al. 2010; Malhotra et al. 2007). Following this logic, firms with high external IT linkages can resolve the different interests among SC partners by establishing proactive,

cooperative, win-win, and long-term inter-organizational relationships, through which firms can engage in joint efforts to extend and develop the SC competencies and commit further to ensuring improved partnerships (Carlile 2002). As such, external IT linkages enable knowledge transformation across pragmatic boundary based on the representation of different interests, which provides comprehensive knowledge needed for SC exploitation and exploration. In other words, IT linkages would enable the transformation of knowledge and information across the pragmatic boundaries (Carlile 2002; Carlile 2004; Im and Rai 2008), thereby facilitating mutual discovery, adaptive leaning, and collaboration required by SC exploitation and exploration (Hsiao et al. 2012).

H6a. The firm's external IT linkages are positively related to its SC exploitation.

H6b. The firm's external IT linkages are positively related to its SC exploration.

Research Method

Sample and Data Collection

We conducted a survey to collect data to test our hypotheses. As Chinese companies have become critical players of global supply chains, we chose China as the site to examine the development of SC practices. As our study requires that respondents have related knowledge of IS and SCM, we collaborated with a Chinese institute that is famous for its senior executive training programs in order to make the context more related to our topic. From the institute, we obtained a sampling pool that included 258 firms to which both SC exploitation and exploration were relevant. Following the standard practice of using senior executives as data sources (Flynn et al. 2010; Liu et al. 2010), we chose a senior executive from each targeted firm. These senior executives were appropriate respondents due to three reasons. First, after participating in the information systems and SCM training, they had a better understanding of their firms' SC practices and IT deployment. Second, as active executives, they had significant responsibility in overseeing their firms' SC and information systems. Third, with their posts at the top of the organizational structure, they had the power and opportunities to make or affect their firms' strategic decisions regarding IT configuration and SC practices.

Before starting the data collection, we held a meeting with most of the target firms' representatives to explain the research design, research method, and the time needed to fill the questionnaire and most firms were interested in our research, and thus participating in the study more actively. Moreover, we conducted follow-up phone calls after the questionnaires were sent out. We received 170 returned questionnaires, among which 13 incomplete questionnaires were discarded. Thus, we ended up with 157 useful questionnaires and achieved a response rate of approximately 61%. To test the possible non-response bias, we compared the Chi-squares from the first 25% of the respondents to that of the final 25%, and found no significant difference between these two groups on demographic information (Armstrong and Overton 1977). The results suggest that non-response bias was not an issue in this study. Table 1 shows the demographic information of the sample.

Table 1. Sample Demographic (N=157)

	N	Percentage
Respondent titles		
President, Managing Director, CEO	33	21.02%
Senior VP of Operations , COO	55	35.03%
CIO/CTO	69	43.95%
Industry		
Manufacturing	83	52.87%
Service	74	47.13%

Ownership		
State owned	77	49.04%
Privately owned	46	29.30%
Foreign controlled	14	8.92%
Joint venture	20	12.74%
Number of employees		
≤ 100	33	21.02%
100–500	56	35.67%
500–1000	9	5.73%
1000–2000	15	9.55%
More than 2000	44	28.03%
Number of IT employees		
≤ 5	81	51.59%
6–10	20	12.74%
11–15	10	6.37%
More than 15	46	29.30%

Measures

We conducted a literature review to identify the previously validated measures that could be adopted or adapted. Given this research was conducted in China, an English questionnaire was first developed, which was then translated into Chinese. Three native Chinese speakers who were fluent in English were invited to form a translation committee of bilinguals to translate the English questionnaire into Chinese first (Van de Vijver and Leung 1997). To ensure the Chinese questionnaire was equivalent to its English version, a professional translator who was unfamiliar with the study was employed to back-translate the Chinese questionnaire into English. No semantic discrepancies were found between the translated questionnaire and the original English version. We used 5-point Likert scales, with options ranging from 1 ("strongly disagree") to 5 ("strongly agree") to measure the items in the questionnaire.

The measures for SC exploitation and exploration practices, top management, and IT capabilities were collected from Information Systems (IS) and Operations Management (OM) literature. Specifically, the items used to measure SC exploitation and exploration were adopted from Kristal et al. (2010). For example, when measuring SC exploration, we asked the respondents to indicate his/her level of agreement with the statements, such as "we proactively pursue new supply chain solutions.", "we continually experiment to find new solutions that will improve our supply chain", and so on. TMP items were adapted based on the work of Liang et al. (2007). IT infrastructure capability items were developed from Rai et al. (2006), Bharadwaj et al. (1999), and Lu and Ramamurthy (2011), whereas items used to measure the IT business partnerships were adapted from Lu and Ramamurthy (2011) and Zhang et al. (2008). External IT linkages items are adapted from Bharadwaj et al. (1999) and Zhang et al. (2008). In particular, we used the items such as "we have technology based links with customers.", "we have technology based links with suppliers", and so on to measure the external IT linkages of the firm.

According to Chen et al. (2004), we measured the two aspects of firm performance by testing the senior executives' perceptions of their firm's performance relative to their key competitors. The items used to measure financial performance were adapted from Carr and Pearson (1999), while operational performance items were adapted from Rai et al. (2006) and Chen et al. (2004).

Drawing on IS and OM literature (Ke et al. 2009; Liu et al. 2010), this study also includes several control variables that might affect SC exploitation and exploration and firm performance, namely, the industry,

ownership, firm size, IT department size. Specifically, we used a dummy variable for the industry, with values of 1 and 0 for the manufacturing and service industries, respectively. Dummy variables were also used for firm ownership types, namely, state-owned, private-owned, foreign-controlled, and joint venture. The size of the firm was measured by the number of full-time employees, while the size of the focal firm's IT department was measured by the number of employees in the department.

Analysis and Results

Common Method Bias Test

Common method bias is a possible threat to the validity of the study, because all the data were perceptual and collected from a single source at the same time. Thus, we first used Harmon's single-factor test to analyze common method bias. The results showed that the test could categorize the items into six constructs with eigenvalues greater than 1.0, accounting for 74.44% of the variance. Meanwhile, the first construct did not account for the majority of the variance (16.35%), indicating that common method bias was not a serious concern in this study. Furthermore, following Liang et al. (2007), a method factor associated all the principal constructs' indicators was included in the Partial least squares (PLS) model. We then compared the indicator variances explained by the method factor and the substantive constructs. The results showed that the substantively constructs explained, on average, 0.776 of the variance, whereas the average method-based variance of the indicators is 0.004 (Table 2). All the method factor loadings were insignificant, indicating the method is unlikely to be a serious problem.

Table 2. Common Method Bias Analysis

Construct	Indicator	Substantive Factor Loading(R1)	$R1^2$	Method Factor Loading(R2)	$R2^2$
Top Management Participation (TMP)	TMP1	0.914	0.835	-0.032	0.001
	TMP2	0.901	0.812	0.043	0.002
	TMP3	0.923	0.852	-0.012	0.000
IT Infrastructure Capability (ITI)	ITI1	0.856	0.733	0.036	0.001
	ITI2	0.934	0.872	-0.007	0.000
	ITI3	0.850	0.723	-0.030	0.001
IT Business Partnerships (ITBP)	ITBP1	0.743	0.552	-0.049	0.002
	ITBP2	0.870	0.757	-0.022	0.000
	ITBP3	0.889	0.790	-0.011	0.000
	ITBP4	0.726	0.527	0.075	0.006
	ITBP5	0.817	0.667	0.005	0.000
External IT Linkages (EITL)	EITL1	0.927	0.859	-0.007	0.000
	EITL2	0.926	0.857	-0.009	0.000
	EITL3	0.870	0.757	0.017	0.000
SC Exploitation (SCEI)	SCEI1	0.853	0.728	0.004	0.000
	SCEI2	0.928	0.861	-0.025	0.001
	SCEI3	0.916	0.839	0.020	0.000
SC	SCER1	0.907	0.823	-0.033	0.001

Exploration (SCER)	SCER2	0.865	0.748	0.069	0.005
	SCER3	0.955	0.912	-0.039	0.002
	SCER4	0.930	0.865	-0.002	0.000
Financial Performance (FIN)	FIN1	0.832	0.692	0.082	0.007
	FIN2	0.909	0.826	0.024	0.001
	FIN3	0.890	0.792	0.010	0.000
	FIN4	0.909	0.826	-0.115	0.013
Operational Performance (OPE)	OPE1	0.712	0.507	0.165	0.027
	OPE2	0.788	0.621	0.031	0.001
	OPE3	0.948	0.899	-0.085	0.007
	OPE4	0.797	0.635	0.061	0.004
	OPE5	0.995	0.990	-0.176	0.031
Average		**0.876**	**0.772**	**-0.0004**	**0.004**

Reliability and Validity

Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) were used to assess the construct reliability and validity. Due to the relative small number of observations in our dataset, we followed the approach used in Paiva et al. (2008) and conducted the analysis via three separate CFA models. The three measurement models fit well as indicated by the CFA results for the three IT capabilities constructs ($\chi2$=82.20 on 41 d.f., RMSEA=0.080, CFI=0.98, IFI=0.98, NFI=0.96, NNFI=0.98), the two SC practices constructs ($\chi2$=20.91 on 13 d.f., RMSEA=0.063, CFI=0.99, IFI=0.99, NFI=0.99, NNFI=0.99), and the two firm performance constructs ($\chi2$=52.32 on 26 d.f., RMSEA=0.080, CFI=0.98, IFI=0.98, NFI=0.97, NNFI=0.98). We also ran a full CFA model which included all constructs. The results demonstrated a good model fit ($\chi2$=576.74 on 377 d.f., RMSEA=0.058, CFI=0.98, IFI=0.98, NFI=0.96, NNFI=0.98).

As shown in Table 3, Cronbach's alpha ranged from 0.855 to 0.935 and composite reliability ranged from 0.905 to 0.953, which were both higher than 0.70, indicating the good reliability. We further tested construct validity by convergent and discriminant validity. The convergent validity was tested based on the value of loadings and average variance extracted (AVE). As Table 3 reported, the loading of each item was higher than 0.70 and significant at $p<0.001$ level. Further, the AVEs ranged from 0.657 to 0.836, which were above the recommended level of 0.50. These results confirmed the convergent validity of the measures.

Table 3. Results of Confirmatory Factor Analysis (CFA)

Items	Loading Range	Composite Reliability	Cronbach's Alpha	AVE
TMP	0.894-0.933	0.937	0.899	0.832
ITI	0.826-0.928	0.912	0.855	0.775
ITBP	0.703-0.879	0.905	0.863	0.657
EITL	0.799-0.838	0. 934	0.894	0.825
SCEI	0.857-0.933	0.927	0.882	0.810
SCER	0.879-0.933	0.953	0.935	0.836
FIN	0.898-0.927	0.951	0.931	0.829

OPE	0.813-0.875	0.927	0.901	0.718
Ownership (OWS)	Single item			
Industry (IND)	Single item			
Firm Size (SIZE)	Single item			
IT Dept. Size (ITS)	Single item			
Note: AVE=Average Variance Extracted.				

To assess the discriminant validity, we first calculated the square roots of the AVE of each construct and then compared them with the correlations among constructs. As shown in Table 4, the square roots of AVEs for all constructs were greater than the correlations between constructs, thus confirming the discriminant validity. In addition, we followed Kristal et al. (2010) and performed two separate CFA models (i.e., unconstrained and constrained) for all possible pairs of constructs. The unconstrained CFA model allows the paired constructs to freely correlate, while he constrained CFA model sets the paired constructs correlations to one. A significant Chi-square difference between the two models indicates that the two constructs are distinct. Table 5 listed the Chi-square difference values calculated for all possible constructs pairs. All of the Chi-square differences are statistically different at $p<0.001$ level, which indicated good discriminant validity among the constructs. As some inter-correlations values were relatively high, we conducted an alternative analysis to test the discriminant validity. Specifically, we followed Fink and Neumann (2009) and compared the $\chi 2$ of measurement model with its eight constructs against a series of alternative measurement models with seven constructs, where every possible pair of constructs was combined into a single construct. The results indicated that the $\chi 2$ of the measurement model was significantly lower ($p<0.001$) than any alternative measurement model with combined constructs, which provided an additional support for the discriminant validity.

Table 4. Means, Standard Deviations, Correlations, and Average Variance Extracted (N=157)

	Mean(SD)	TMP	ITI	ITBP	EITL	SCEI	SCER	FIN	OPE	IND	OWS	SIZE	ITS
TMP	3.85(0.70)	**0.91**											
ITI	3.80(0.71)	0.57	**0.88**										
ITBP	3.72(0.72)	0.54	0.62	**0.81**									
EITL	3.78(0.81)	0.47	0.54	0.60	**0.91**								
SCEI	3.85(0.69)	0.59	0.55	0.58	0.55	**0.90**							
SCER	3.83(0.72)	0.66	0.54	0.60	0.53	0.71	**0.91**						
FIN	3.61(0.74)	0.53	0.54	0.57	0.52	0.66	0.61	**0.91**					
OPE	3.80(0.67)	0.65	0.63	0.55	0.44	0.67	0.62	0.71	**0.85**				
IND	NA	0.26	0.21	0.12	0.01	0.151	0.26	0.14	0.27	**NA**			
OWS	NA	-0.03	-0.04	-0.04	-0.05	-0.03	-0.04	-0.06	-0.02	-0.14	**NA**		
SIZE	NA	0.13	0.22	0.13	0.08	0.20	0.18	0.15	0.10	0.09	-0.10	**NA**	
ITS	NA	0.09	0.12	0.10	0.12	0.12	0.09	0.05	0.01	-0.18	0.01	0.67	**NA**

Note: The diagonal elements are the square root of the AVE.

Further, several inter-construct correlations were higher than the benchmark value of 0.60, which indicated that multicollinearity may be a potential problem. Generally, multicollinearity is indicated by a variance inflation factor (VIF) value that is higher than 10 or a tolerance value that is less than 0.1 (Mason and Perreault 1991). We tested these values, and found that the highest VIF and the lowest tolerance values were 3.16 and 0.32, indicating that multicollinearity was not a significant issue in this study.

Table 5. CFA Tests of Measurement Scale Discriminant Validity						
	Constructs Scale Pairs	Unconstrained		Constrained		
		χ^2	DF	χ^2	DF	χ^2 Difference*
TMP	ITI	11.6	8	151.56	9	139.96
	ITBP	45.1	19	282.79	20	237.69
	EITL	9.28	8	228.67	9	219.39
	SCEI	7.1	8	184.57	9	177.47
	SCER	37.76	13	194.26	14	156.5
	FIN	28.78	13	248.54	14	219.76
	OPE	26.91	19	198.41	20	171.5
ITI	ITBP	43.8	19	166.84	20	123.04
	EITL	23.28	8	178.55	9	155.27
	SCEI	10.08	8	151.98	9	141.9
	SCER	26.26	13	164.03	14	137.77
	FIN	39.43	13	190.4	14	150.97
	OPE	25.15	19	143.38	20	118.23
ITBP	EITL	51.17	19	240.83	20	189.66
	SCEI	54.75	19	226.28	20	171.53
	SCER	44.09	26	315.92	27	271.83
	FIN	68.97	26	346.53	27	277.56
	OPE	54.94	34	354.41	35	299.47
EITL	SCEI	6.5	8	199.5	9	193
	SCER	16.2	13	218.72	14	202.52
	FIN	25.58	13	236.05	14	210.47
	OPE	27.49	19	252.06	20	224.57
SCEI	SCER	20.91	13	135.87	14	114.96
	FIN	27.05	13	168.25	14	141.2
	OPE	43.05	19	168.44	20	125.39
SCER	FIN	31.6	19	475.32	20	443.72
	OPE	43.81	26	408.62	27	364.81
FIN	OPE	52.32	26	266.04	27	213.72
*All χ^2 Difference tests are significant at $p<0.001$ (Critical χ^2 for 1 degree freedom at $p=0.001$ is 10.827)						

Structural Model

We used PLS Graph Version 3.0 to test our research model due to our relatively small sample size (e.g., Liang et al. 2007; Sun et al. 2012). In addition, PLS can estimate the loadings/weights of indictors on constructs and explain the complex relationships among constructs (Fornell and Bookstein 1982).

The results of PLS analysis were shown in Figure 2, indicating that SC exploitation had a significant effect on both financial ($\beta=0.447$, $p<0.001$) and operational performance ($\beta=0.486$, $p<0.001$), which supported H1a and H1b. It had also been shown that SC exploration had a positive effect on both financial ($\beta=0.304$, $p<0.001$) and operational performance ($\beta=0.262$, $p<0.01$), thereby H2a and H2b were supported. According to Pavlou and Dimoka (2006), we compared the PLS path coefficients and found SC

exploitation had a stronger impact on both financial (t=15.449, p<0.001) and operational performance (t=23.851, p<0.001) compared to SC exploration. In addition, top management participation had a positive effect on both SC exploitation (β=0.285, p<0.01) and exploration (β=0.397, p<0.001), thus supported H3a and H3b. Furthermore, neither the relationship between IT infrastructure capability and SC exploitation (β=0.125, p>0.05) nor the relationship between IT infrastructure and SC exploration (β=0.036, p>0.05) was significant. Hence, H4a and H4b were not supported. While the relationships between IT business partnerships and SC exploitation (β=0.201, p<0.05) and SC exploration (β=0.235, p<0.01), between external IT linkages and SC exploitation (β=0.233, p<0.01) and SC exploration (β=0.181, p<0.05) were all positively significant. Therefore, H5a, H5b, H6a, and H6b were all supported.

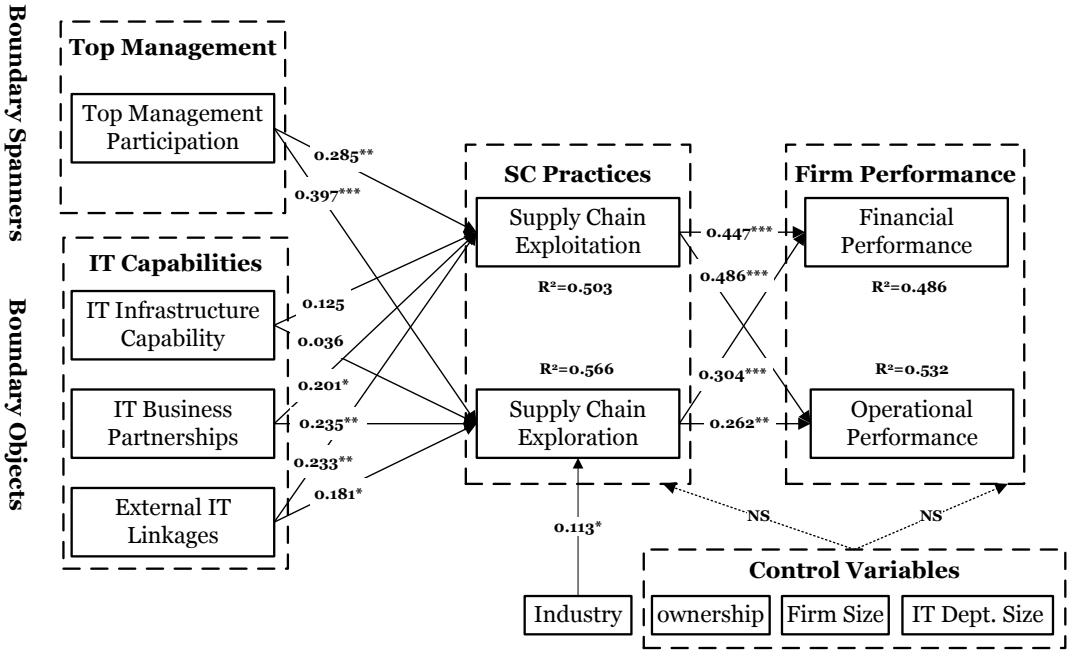

Figure 2. Results of PLS Analysis

More interestingly, we found that IT business partnerships had a weaker impact on SC exploitation (t=-3.678, p<0.001) but a stronger impact on SC exploration (t=5.489, p<0.001) compared with external IT linkages. However, except for the relationship between industry and SC exploration (β=0.113, p<0.05) was significant, all other control variables were found to be insignificant. In addition, it is necessary to highlight the high levels of explained variance in SC exploitation (R^2=0.503), SC exploration (R^2=0.566), financial performance (R^2=0.486), and operational performance (R^2=0.532).

Given that top management have the power to allocate the resources and their cognitive capacities may influence the firm's capabilities configuration (Lavie 2006), we further constructed an alternative model by adding the casual direction from TMP to three types of IT capabilities. The results of this alternative model showed that TMP could significantly influence IT infrastructure capability (β=0.568, p<0.001), IT business partnerships (β=0.544, p<0.001), and external IT linkages (β=0.474, p<0.001). However, the significance of other path coefficients remained the same.

Mediating Effect Test

To test the mediating effects of SC exploitation and exploration, we followed the three-step method suggested by Baron and Kenny (1986). As shown in Table 6, the direct links between top management

participation and firm performance (both financial and operational performance), between IT infrastructure capability and operational performance, and between both IT business partnerships and external IT linkages and financial performance were significant and thus satisfied the first condition for mediating effects. Further, the links between top management participation and SC exploitation and exploration, between IT business partnerships and SC exploitation and exploration, and between external IT linkages and SC exploitation and exploration were significant, and therefore they satisfied the second condition for the existence of mediating effects. In addition, the direct relationships between top management participation and financial performance, between IT business partnerships and financial performance, and between external IT linkages and financial performance became insignificant when we added the link between SC exploitation and financial performance, while the latter links are significant. Therefore, the results showed that SC exploitation fully mediated the relationship between top management participation, IT business partnerships, and external IT linkages and financial performance. Meanwhile, the direct link between top management participation and operational performance still remain significant when we added the link between SC exploitation and operational performance while the latter was significant, suggesting that the relationship between top management participation and operational performance was partially mediated by SC exploitation.

Table 6. Results of Mediating Effects Tests

IV	**M**	**DV**	**IV→DV**	**IV→M**	**IV+M→DV**		
					IV→DV	**M→DV**	**Mediating**
TMP	SCEI	FIN	0.213*	0.269**	0.059	0.320***	Full
TMP	SCEI	OPE	0.376***	0.269**	0.250*	0.343***	Partial
TMP	SCER	FIN	0.213*	0.366***	0.059	0.166	Not
TMP	SCER	OPE	0.376***	0.366***	0.250*	0.032	Not
ITI	SCEI	FIN	0.155	0.157	0.105	0.320***	Not
ITI	SCEI	OPE	0.323***	0.157	0.277***	0.343***	Not
ITI	SCER	FIN	0.155	0.046	0.105	0.166	Not
ITI	SCER	OPE	0.323***	0.046	0.277***	0.032	Not
ITBP	SCEI	FIN	0.249*	0.202*	0.147	0.320***	Full
ITBP	SCEI	OPE	0.152	0.202*	0.067	0.343***	Not
ITBP	SCER	FIN	0.249*	0.249**	0.147	0.166	Not
ITBP	SCER	OPE	0.152	0.249**	0.067	0.032	Not
EITL	SCEI	FIN	0.192*	0.217**	0.086	0.320***	Full
EITL	SCEI	OPE	0.006	0.217**	-0.086	0.343***	Not
EITL	SCER	FIN	0.192*	0.178*	0.086	0.166	Not
EITL	SCER	OPE	0.006	0.178*	-0.086	0.032	Not

Note 1: *p<0.05, **p<0.01, ***p<0.001.

Note 2: IV: independent variable; M: mediator; DV: dependent variable; TMP: top management participation; ITI: IT infrastructure capability; ITBP: IT business partnerships; EITL: external IT linkages; SCEI: supply chain exploitation; SCER: supply chain exploration; FIN: financial performance; OPP: operational performance.

Note 3: Three-step method was used to test the mediating effects suggested by Baron and Kenny (1986):

Step 1: IV→DV is significant.

Step 2: IV→M is significant.

Step 3: IV+M→DV.

a) If M is significant and IV is not, then M has full mediating effect.

b) If both M and IV are significant, then M has partial mediating effect.

Discussion

Our findings provide broad support for our theoretical arguments on how SC exploitation and exploration practices affect firm performance and how top management participation and IT capabilities enable both SC exploitation and exploration.

Our research findings reveal that exploitation and exploration at inter-organizational level would positively affect firm performance. This implies that SC exploitation and exploration can be regarded as firms' higher-order competencies directly influencing both firm's financial and operational performance, which is consistent with Kristal et al.'s (2010) proposition of strategic role of ambidextrous SC strategies. Also, our results show that SC exploitation contributes more to both financial and operational performance than SC exploration, which is contrary to the findings of research on exploitation and exploration at organizational level (Li et al. 2012). A possible explanation is that the firm in the SC relationships has the access to the needed resources that have already been possessed by its SC partners (Billington and Davidson 2012), which allows the focal firm to apply the shared knowledge and resources to re-evaluate the value of what exists in house and realize its potential. Also, jointly conducting exploration with SC partners may not be as efficient and effective as exploitation in the short run since identifying new opportunities and developing new SC competencies are time-consuming processes.

Our findings suggest that top management help the development of SC exploitation and exploration. Specifically, top management participation directly improves firms' SC exploitation and exploration. This implies that top management, as boundary spanners, plays an active role to cultivate the organizational abilities to manage SC exploitation and exploration. On one hand, top management participation allows the focal firm to create a supportive environment that encourages employees to engage in leveraging knowledge. On the other hand, top management participation enables the top management to proactively anticipate and recognize the relevant valuable knowledge and resources for the current SC competencies as well as pursue new SC opportunities (Lu and Ramamurthy 2011). Our findings on direct effects of TMP are consistent with what is found by Liang et al. (2007), thereby confirming the critical role of top management as boundary spanners in the SCM context. In addition, our study finds that TMP can also indirectly enhance SC exploitation and exploration by improving the three types of IT capabilities. To fully understand this relationship, future research may examine how this relationship varies under different boundary conditions.

Overall, our results support that IT capabilities positively enhance SC exploitation and exploration. This implies that IT capabilities can facilitate the knowledge and information sharing across knowledge boundaries in the course of SC exploitation and exploration. Specifically, IT business partnerships help the focal firm better understand how knowledge and information shared by SC partners are related to its internal knowledge base, which facilitate the common and shared meaning and interpretation of the knowledge across the semantic boundary (Roberts et al. 2012), thereby improving SC exploitation and exploration. External IT linkages help SC partners better present the differences and dependencies between shared knowledge and information through dynamical and comprehensive IT-based connections, which facilitate the sharing of knowledge and information across pragmatic boundary (Malhotra et al. 2007), and consequently enhancing SC exploitation and exploration. Interestingly, although IT business partnerships and external IT linkages both significantly improve SC exploitation and exploration, they have differential emphasis. Specifically, for SC exploitation, external IT linkages show a stronger impact, while for SC exploration, IT business partnerships express a stronger effect. This can be partly explained by the different requirements of exploitation and exploration. That is, in the SCM context, IT connections allow firms to build a large and diverse knowledge repository by externalizing and socializing with partners, which can support SC exploitation's need for information and expertise. In contrast, IT business partnerships enable SC partners' joint sensing-making and perspective-sharing as they integrate IT and business processes across organizational boundaries, which would provide more new ideas and opportunities required for SC exploration.

However, IT infrastructure capability is not found to have an effect on neither SC exploitation nor exploration. It may be because a shared and stable syntax is not enough for understanding and assessing the knowledge needed for SC exploitation and exploration (Carlile 2002; Malhotra et al. 2007). Rather, the focal firm should actively build IT-based connections with other functional areas and SC partners to improve mutual understanding and opportunity discovering for SC exploitation and exploration. Indeed,

Joshi et al. (2010) indicate that only by direct human interactions and discourse, can IT capability be leveraged to build shared frame of references and pursue new knowledge and ideas tailored for SC exploitation and exploration. In addition, Bhatt and Grover (2005, p. 260) further argue that "the existence of open architectures and standardized enterprise packages suggest that this capability (IT infrastructure capability) might not be heterogeneously distributed across firms-or, even if it is, that access to infrastructure is not restrictive", and therefore IT infrastructure can be purchased or duplicated fairly easily by rivals that becomes a competitive necessity for firms (Bharadwaj 2000). In this view, IT infrastructure may not directly contribute to SC exploitation or exploration practices. However, we recognize that IT infrastructure has reshaped the business outlook for IT, without which could be a serious disadvantage. We appeal further research to more examine the indirectly effect of the IT infrastructure capability on the firm's SC strategies such as SC exploitation and exploration.

Our current study further finds that SC exploitation can fully mediate the impact of top management participation, IT business partnerships, and external IT linkages on financial performance. Moreover, SC exploration can also partially mediate the relationship between top management participation and operational performance. This finding indicates that the firm's top management participation, IT business partnerships, and external IT linkages influence firm's performance especially financial performance through their positive impacts on SC exploitation practices by refining and extending its SC competencies.

Implications and Limitations

The current research enriches exploitation and exploration research in the SCM context. Given that there is a dearth of research on exploitation and exploration at the inter-organizational level in the SC context (e.g., Kristal et al. 2010), this study extends our understanding of the underlying causal mechanisms between SC exploitation and exploration and firm performance. Our findings show that refining and extending the existing SC competencies is much more important for the focal firm to improve financial and operational performance. In the view of this finding is different from the findings on the differential effects of exploitation and exploration at organizational level, we would like to urge future research to empirically investigate the possible contingencies upon which SC exploitation and exploration exert effects on firm performance.

In addition, our study contributes to boundary spanning theory by extending its applicability to the domain of exploitation and exploration in SCM. Specifically, our findings lend support to the roles of top management and IT capabilities in enhancing SC exploitation and exploration. Although boundary spanning theory has been used to explain a variety of inter-organizational behaviors such as knowledge sharing, adaptive leaning, marketing activities, and SC partnerships (Hsiao et al. 2012; Im and Rai 2008; Malhotra et al. 2007), few studies examine how the boundary spanners and boundary objects may affect SC exploitation and exploration. Also, we identify top management participation and three types of IT capabilities (i.e., IT infrastructure capability, IT business partnerships, and external IT linages) to provide a more fine-grained insight into the effects of boundary spanners and boundary objects on SC exploitation and exploration. Future research can explore how the effects of top management and IT capabilities may differ in different cultural contexts and how they may interact with each other.

Furthermore, our research offers guidelines for managers who strive to pursue exploitation and exploration to sustain value creation in SCM context. First, managers may want to change their traditional either-or logic and recognize the potential benefits of both SC exploitation and exploration. In case that the firm does not have enough resources to pursue both hand in hand, it may want to put more emphasis on SC exploitation by refining and extending its current skills and resources. Second, firms developing SC exploitation and exploration can enhance their chance of success by ensuring favorable TMP as top management behavior has a significant effect on these SC practices. Third, managers would actively develop IT-based connections with business functions and SC partners, rather than just focusing on developing IT infrastructure capability. Also, managers can place different emphases on IT business partnerships and external IT linkages, depending on the priorities of SC exploitation and exploration. That is, firms having SC exploitation as top priority would invest more on external IT linkages building. Otherwise, firm would focus more on IT business partnerships building.

Evaluating the contributions along with its limitation is of primary importance, which can be addressed in future research. First, the current research tests the hypotheses with cross-sectional data. Given that IT

capabilities reconfiguration, top management involvement, and SC practices are complex activities and our results also show that top management participation can influence the IT capabilities, a longitudinal study may help better understand the mechanisms of how top management affect IT capabilities configuration and how the three types of IT capabilities may influence each other over time (Lavie 2006), and thus enriching our understanding of SC exploitation and exploration. Meanwhile, a longitudinal design can also reduce common method bias (Podsakoff and Organ 1986).

Second, although all the square roots of AVEs are greater than the inter-correlations between the constructs and the CFA model for assessing Chi-square differences for all possible paired constructs confirm the discriminant validity, several inter-correlations values are still relatively high, which indicate that measurement of the constructs can be improved. Thus, more work should be done on the measurement improvement in future research.

Third, we draw on boundary spanning theory to investigate how top management and IT capabilities facilitate the SC exploitation and exploration. Although our findings show top management and different types of IT capabilities have differential impacts, the boundary spanning theory itself does not touch upon the ambidextrous capability needed for SC exploitation and exploration. Therefore, future research should advance theory to generate a more holistic and comprehensive understanding of the nature of exploitation and exploration in the SC context.

Finally, the demography of the respondents in this study may limit the generalizability of our findings. Although an additional analysis had been conducted to confirm that no significant differences on supply chain exploitation and exploration had been found among CEO, COO, and CIO/CTO data sets, different position may differentially emphasize on supply chain exploitation or exploration. Furthermore, we focus our study in the context of emerging economy of China. We chose respondents who obtained training form the same institution and thus may lead to systematic biases. We note that researchers and practitioners should be cautious when generalizing the findings of the current study to other contexts. Hence, future studies should include different setting comparisons to extend our findings.

Conclusion

In this study, we extend the literature on exploitation and exploration to the context of supply chain management. Specifically, our arguments related to the performance influence of supply chain exploitation and exploration practices are confirmed. This result suggests that both supply chain exploitation and exploration significantly contribute to firm performance in terms of financial and operational performance. Further, we also find that supply chain exploitation has a stronger impact on firm performance (both financial and operational performance) than supply chain exploration. In addition, by drawing upon the boundary spanning theory, we examine how top management participation (as boundary spanners) and three types of IT capabilities (as boundary objects) enable the development of supply chain exploitation and exploration. The results support our key assertions, except for those involving IT infrastructure capability. The findings imply that IT infrastructure may not directly contribute to the development of supply chain exploitation and exploration. Thus, our empirical evidence provides guidance for firms on where to direct their resources. This study provides a new venue for future research to further explore the nomological network of exploitation and exploration in general and the supply chain management context in particular.

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