Mediating Effects of Supply Chain Integration: From IT Capability to Firm Performance

Shao bo Wei  
U STC-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

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

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

Kwok Kee Wei  
College of Business  
City University of Hong Kong  
83 Tat Chee Avenue, Hong Kong  
isweikk@cityu.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 information technology (IT) has been increasingly embedded in firms’ supply chain processes, the underlying mechanisms of how IT capability improves firm performance remain unclear. Drawing upon resource-based view and theory of swift and even flow, this study examines how IT capability (i.e., internally-focused IT capability, externally-focused IT capability, and IT business spanning capability) influences firm performance through supply chain integration (SCI) (i.e., internal and external integration). Using data collected from 222 firms in China, we find performance impacts of different IT capability are mediated by different SCI. Specifically, internal integration mediates the impact of internally-focused IT capability and external integration mediates the impact of externally-focused IT capability, while both internal and external integration mediate the impact of IT business spanning capability. We also find IT business spanning capability positively moderates the impact of internally-focused IT capability on internal integration. Theoretical contributions and implications of this research are also discussed.

Keywords: IT capability, supply chain integration, resource-based view, theory of swift and even flow, firm performance
Introduction

Embedding information technology (IT) in firms’ intra- and inter-organizational processes to derive competitive advantage has generated much excitement among IS researchers and practitioners (Lu and Ramamurthy 2011; Otim et al. 2012; Roberts and Grover 2012). IT capability enables firms to establish a requisite set of technological resources, providing the foundation for diffusing and routinizing IT applications along the supply chain to better facilitate the implementation of innovation initiatives in response to the dynamics of business competition (Tu 2010). Despite the increasing research interests in IT capability, our understanding of the nature of IT capability and how it improves firm performance remains limited (e.g., Mithas et al. 2011). While some researchers provide empirical support for a positively significant IT capability-performance linkage (e.g., Bhatt and Grover 2005; Kim et al. 2013), others show an insignificant relationship (e.g., Carr 2003; Ho-Chang et al. 2014). Therefore, there is a need for fully exploring the relationship between IT capability and firm performance to improve our understanding of the mechanism of IT capability especially in the supply chain context (Liu et al. 2013).

Although it is well touted that IT capability can lead to superior firm performance, this research stream has been hampered by the lack of a unified conceptualization of IT capability (Kim et al. 2011; Tippins and Sohi 2003). Indeed, a review of the literature shows that some research focuses on individual-dimensions of IT capability (Kim et al. 2013; Liu et al. 2013), particularly IT infrastructure. For example, regarding IT assets as the replicable and standardized infrastructure, Carr (2003) raises the proposition that IT is ubiquitous and accessible to all firms, and thus cannot create competitive advantage. There are also studies employing various omnibus definitions and examine IT capability at an aggregate level (Lu and Ramamurthy 2011; Sambamurthy et al. 2003). As such, the construct of IT capability is characterized by its evolving dimensions in previous research (Bharadwaj 2000; Kim et al. 2011; Kim et al. 2013). It is argued that the mixed findings of previous studies on IT capability-performance relationships can be at least partly ascribed to the inconsistent conceptualization of IT capability and emphasize the importance of investigating the effects of IT capability separately (Kim et al. 2011; Santhanam and Hartono 2003; Wu et al. 2006). In order to study the nuances of IT capability, the first objective of our study is to conceptualize IT capability in terms of its three dimensions, i.e., internally-focused IT capability, externally-focused IT capability, and IT business spanning capability; and investigate how these three types of IT capability can provide differential benefits to the firm.

However, in addition to the inconsistent conceptualization of IT capability, the mixed findings on the IT capability-performance relationships can be also attributed to the missing of a comprehensive understanding of the underlying mechanism through which IT capability improves firm performance. For example, Mithas et al. (2011) indicate that “the role and articulation of the underlying mechanisms through which IT capabilities improve firm performance remain unclear” (p. 238). Kim et al. (2011) further propose “that research on IT business value should investigate the effects of IT on business processes” (p. 489). Researchers thus increasingly suggest that the value of IT capability can be realized when it is embedded in supply chain integration (SCI) processes through resource complementarities and co-specialization (Rai et al. 2006; Rai and Tang 2010). SCI consists of internal integration of different functions within a firm, as well as external integration with supply chain partners (Stank et al. 2001). Drawing upon the resource-based view (RBV) and theory of swift and even flow (TSEF), we argue that firms with appropriate organizational resources and capabilities can achieve better performance when they make their information and material flow move more swiftly and evenly (Barney 1991; Schmenner and Swink 1998). Therefore, the second objective of our study is to investigate the mediating effects of SCI on the relationship between three types of IT capability and firm performance.

To meet these two objectives, we first conceptualize IT capability in terms of internally-focused IT capability (inside-out capability), externally-focused IT capability (outside-in capability), and IT business spanning capability (spanning capability) (Day 1994; Wade and Hulland 2004). Drawing upon the RBV and TSEF, we then explore how the relationships between three types of IT capability and firm performance are mediated by SCI. In particular, we propose that different types of IT capability would differentially affect the internal and external SCI, which in turn would affect firm performance. In addition, building on the RBV, we also suggest that IT business spanning would positively moderate the effects of internally-focused IT capability and externally-focused IT capability.
Theoretical Background and Hypotheses

RBV indicates that a firm’s performance can be explained by the heterogeneity in their possession of value, rare, inimitable, and non-substitutable resources and capabilities (Barney 1991). This theory highlights the ability of a firm to integrate, build, and reconfigure internal and external competencies, such as IT capability, would lead to sustained competitive advantage (Sambamurthy et al. 2003). In this view, combining and configuring proper IT capability can help the firm attain and sustain a competitive advantage (Bharadwaj 2000). However, organizational capabilities are always embedded with other resources or capabilities which process is path-dependent and complex, preventing imitation by competitors. In particular, IT capability is becoming increasingly embedded in both intra- and inter-organizational processes (Kim et al. 2011; Rai et al. 2006).

Meanwhile, TSEF assumes that “the more swift and even the flow of materials through a process, the more productive that process is” (Schmenner and Swink 1998, p. 102). That is, effectiveness and efficiency for a process would increase with the speed and smoothness by which the information and material flow through the process, and fall with increases in the variability associated with the flow. The TSEF is generally governed by five basic laws (Schmenner and Swink 1998): i) The law of variability proposes that the greater the variability of the process, the less productivity the process is; ii) the law of bottlenecks suggests that the operation’s productivity will be improved by managing its bottlenecks; iii) the law of scientific methods relates the productivity of labor to the using of scientific methods; iv) the law of quality points that productivity improved by improvements of quality and reduction of waste; and v) the law of factory focus states that firms will be more productive if they focus on a limited set of tasks.

By adopting the perspective of TSEF, the swifter and more even the flow of information and materials through a process, the more productive that process is (Schmenner and Swink 1998). In order to facilitate the information and material flow more swiftly, firms can eliminate or reduce the non-value-added work and focus more on value-added work and ensure there are no bottlenecks or other impediments to flow in the way (Schmenner and Swink 1998). While for information and material to flow more evenly, firms should narrow the variability associated with either the demand on the process or with the process’s operations steps. We suggest that internal and external integration can speed up the flow of information and material as well as reduce the variability of the process both within and across organizational boundaries (Zhao et al. 2011). Under this condition, how well IT capability improves firm performance is dependent on how IT capability enables information and materials flow swiftly and evenly in both intra- and inter-organizational processes (Rai et al. 2006).

After conducting a careful review, we find that most existing studies examining how IT capability influences firm performance focus on either only internal process or on external process, or regard IT capability at an aggregate level, but less is known on the nuanced and in-depth nature of how different types of IT capability influence firm performance through both the internal and external process simultaneously (Kleis et al. 2012). Drawing upon the RBV and TSEF, IT capability should enable not only internal process but also external process integration to generate swift and even information and material flow. Thus, investigating how different IT capability supports internal and external integration to achieve superior firm performance would shed new light on the understanding of performance impacts of IT capability. Accordingly, we develop a research model as depicted in Figure 1.

![Figure 1. Research Model](image_url)
Supply Chain Integration

SCI refers to the degree to which a firm manages intra- and inter-organizational processes collaboratively with its supply chain partners to achieve collective goals (Zhao et al. 2011). Generally, there are two types of SCI: internal integration and external integration (Saeed et al. 2005; Stank et al. 2001). Internal integration refers to “the strategic system of cross-functioning and collective responsibility across functions” (Wong et al. 2011, p.605), whereas external integration refers to the degree to which a firm structures its inter-organizational operations, such as information sharing and collaborative planning with its supply chain partners to realize mutual goals (Saeed et al. 2005; Stank et al. 2001).

Internal integration involves cross-functional collaboration and cooperation, which integrates product design, procurement, production, sales, and distribution functions within the firm (Wong et al. 2011; Zhao et al. 2011). As such, internal integration enables the information and material flow to move across internal functions by breaking down the functional barriers (Wong et al. 2011; Zhao et al. 2011). Based on the TSEF’s law of variability, internal integration facilitates cross functional teams to simultaneously engage in product and process designs, and thus making the information and material flow move more swiftly and evenly within the firm (Schmenner and Swink 1998; Wong et al. 2011). Furthermore, highly integrated internal function may work together more closely and reduce the operational redundancies, which is also consistent with the law of quality (Flynn et al. 2010; Wong et al. 2011). Thus, we propose:

**H1.** The firm’s internal integration is positively related to firm performance.

External integration enables firms to build strategic partnerships with supply chain partners and to collaboratively develop strategies to capitalize on the market opportunities (Zhao et al. 2011). The collaborative partnerships between supply chain partners create mutual understanding to jointly resolve problems, which helps leverage each other’s core competencies while reducing transaction costs. Thus, based on the TSEF’s laws of variability and quality, external integration enables information and material flow to move more accurately and speedily across organizational boundaries, as well as to decrease unnecessary resources deployment, which would result in a better firm performance (Flynn et al. 2010; Kulp et al. 2004). In addition, by developing external integration with supply chain partners, firms not only can make the information and material housed within its limits move swiftly and evenly but also can make the information and materials beyond its firm boundary move swiftly and evenly and thus is consistent with the law of bottlenecks (Rai and Tang 2010; Schmenner 2001). Accordingly, we propose:

**H2.** The firm’s external integration is positively related to firm performance.

IT Capability

Extending prior research, we define IT capability as a firm’s ability to assemble, integrate, and deploy IT resources to meet business needs and capitalize on business opportunities (Bharadwaj 2000; Sambamurthy et al. 2003). IT capability has been treated as an important catalyst to realize business value and sustain competitive advantage by embedding IT-enabled resources in support and enhancement of the firm’s strategies and processes (Wu et al. 2006). According to Day (1994) and Wade and Hulland (2004), capabilities can be classified into three types based on the orientation and focus of the process: i) inside-out capabilities, which are internally focused, deployed from inside the firm in response to market requirements; ii) outside-in capabilities, which are externally focused, emphasizing on creating continuous relationships with external partners; and iii) spanning capabilities, which are both internally and externally orientated, integrating the inside-out and outside-in processes. Accordingly, we conceptualize IT capability in terms of three dimensions, namely, internally-focused IT capability (inside-out capability), externally-focused IT capability (outside-in capability), and IT business spanning capability (spanning capability). Internally-focused IT capability refers to a set of internal and firm-specific technological resources providing the foundation for the development of enterprise applications within the organizational boundary (Bharadwaj 2000; Dale Stoel and Muhanna 2009). Externally-focused IT capability refers to a firm’s ability to develop the durable IT-based connections with supply chain partners to sense and respond to market opportunities (Bharadwaj et al. 1999; Zhang et al. 2008). IT business spanning capability refers to a firm’s ability to manage and exploit IT-related resources in supporting business processes by integrating business and IS professionals (Lu and Ramamurthy 2011; Wade and Hulland 2004; Zhang et al. 2008).
Internally-focused IT capability reflects a firm’s strategically integrated internal systems, which reduces the technological constraints of IT innovations implementation and makes information and knowledge more easily accessible and shared between internal functions (Bharadwaj 2000; Zhao et al. 2011). The strategically integrated infrastructure helps firms optimize operation decisions and reduce controls requiring human intervention (Liu et al. 2013). Based on the perspective of RBV, internally-focused IT capability can help break down functional barriers and engender cooperation in response to market requirements by facilitating the movement of information and material across different functions (Devaraj et al. 2013; Flynn et al. 2010). As a result, internally-focused IT capability can enable the firm to effectively and efficiently share information, coordinate activities, and align processes within organizational boundaries to facilitate internal integration (Flynn et al. 2010). Hence, we propose:

**H3.** The firm’s internally-focused IT capability is positively related to internal integration.

Externally-focused IT capability stresses the durable IT-based connections between supply chain partners (Zhang et al. 2008). By developing the IT-based linkages with external partners, externally-focused IT capability can support connectedness, interaction, coordination, and communication between supply chain partners through creating an electronic network (Joshi et al. 2010). Drawing upon the RBV, externally-focused IT capability can help firms acquire the external resources and more proactively detect market information and changes to avoid bottlenecks in the internal process and resolve the conflicting objectives among supply chain partners by establishing cooperative partnerships, and thus improving external integration (Rai et al. 2006). Moreover, externally-focused IT capability can help firms identify and seize more opportunities to collaborate with external partners (Lu and Ramamurthy 2011). As such, externally-focused IT capability can create more chance for firms to couple inter-organizational operations with external partners (Rai and Tang 2010). Therefore, we propose:

**H4.** The firm’s externally-focused IT capability is positively related to external integration.

IT business spanning capability highlights the IT-business partnership and synergy (Lu and Ramamurthy 2011; Zhang et al. 2008). The rich and close interaction between IT and business facilitates the wider dialogue and thus create a mutual respect and trust between IT and business professionals (Bharadwaj et al. 1999; Lu and Ramamurthy 2011). As such, IT business spanning capability can facilitate the information and knowledge sharing between IT and other business functions and help integrate the different function’s resources and capabilities to make effective joint decision (Lu and Ramamurthy 2011; Sambamurthy et al. 2003). This ongoing relationship between IT and business functions can promote mutual understanding of each other’s work, expertise, and responsibilities through bilateral interactions, which consequently lead to effective collaboration among these internal functions (Zhang et al. 2008).

On the other hand, the firm’s IT business spanning capability would also enhance the common interpretations of the local meanings and practices of knowledge and process, which create a better understanding of how its local actions impact the processes in the supply chain partners’ firms (Malhotra et al. 2007). This, in turn, helps resolve the differences between supply chain partners and would result in high external integration (Liu et al. 2013; Zhao et al. 2011). According to RBV, IT business spanning capability not only helps bridge the traditional gaps between internal functions but also create a common referent between supply chain partners to integrate organizational internal processes and external processes to enable both internal and external integration (Liu et al. 2013; Malhotra et al. 2007). Thus, we propose:

**H5a.** The firm’s IT business spanning capability is positively related to internal integration.

**H5b.** The firm’s IT business spanning capability is positively related to external integration.

In addition to the direct effects of IT business spanning capability, we also draw on the RBV and suggest that IT business spanning capability would positively moderate the impacts of internally-focused and externally-focused IT capability. The RBV also indicates the importance of the interaction between

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1 In this study, we do not hypothesize a direct effect of internally-focused IT capability on external integration. This is because internally-focused IT capability mainly aims to streamline the internal processes, rather than to couple with external partners. Likewise, we also do not hypothesize a direct effect of externally-focused IT capability on internal integration. This is because externally-focused IT capability focuses on developing the linkages with external partners while internal integration involves integration between different functions within the firm.
different organizational capabilities for a firm’s performance (Saeed et al. 2011). Specifically, this theory suggests that firms’ capabilities can interact with each other (Narasimhan et al. 2010). That means, capabilities that complement with each other can jointly enhance firm performance more than the sum of contributions made by each capability individually because it would develop a complex and imperfectly imitable process that may lead to sustained competitive advantage (Moorman and Slotegraaf 1999). In this view, IT business spanning capability that integrates inside-out process and outside-in process should strengthen both the effect of internally-focused IT capability on internal integration and the effect of externally-focused IT capability on external integration. Internally-focused IT capability facilitates the internal integration between functions by providing an integrated system to link each other, which also requires mutual understanding, respect, and trust between different functions (Roberts and Grover 2012). High IT business spanning capability creates a harmonious relationship between IT and other business functions, which further promote joint understanding and mutual trust (Roberts and Grover 2012; Zhang et al. 2008). Such IT business partnerships can help firms deploy strategic systems to link different functions more easily (Roberts and Grover 2012). Therefore, internally-focused IT capability and IT business spanning capability should operate as complements and generate synergies for internal integration.

Similarly, externally-focused IT capability enables external integration by developing durable IT-based linkages with supply chain partners to resolve conflicting interests (Wong et al. 2011; Zhang et al. 2008). IT business spanning capability facilitates the blending of business and IT experience and thus encourage risk sharing and experimentation with IT initiatives (Bharadwaj et al. 1999). As such, firms with high IT business spanning capability can better leverage externally-focused IT capability to exploit and explore opportunities to collaborate with external partners (Lu and Ramamurthy 2011). For example, a firm with high IT business spanning capability will understand its partner’s business process better (Malhotra et al. 2007), which helps firms better integrate each other’s resources and capabilities and align their goals and processes to improve external integration (Roberts and Grover 2012). Accordingly, we propose:

**H6a.** The firm’s IT business spanning capability positively moderates the relationship between internally-focused IT capability and internal integration.

**H6b.** The firm’s IT business spanning capability positively moderates the relationship between externally-focused IT capability and external integration.

**Research Method**

**Sample and Data Collection**

We used a survey to collect data to test our hypotheses. As Chinese firms have become critical players of global supply chains, we chose China as the site to examine the development of SCI practices. Consider our study requires that respondents have related knowledge of IT and SCI, 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 list that included 1000 firms. Among these 1000 firms, we chose automotive, home appliance, and logistic as our focal industries because these industries always involve high utilization rate of IT-enabled SCI due to their need for mass customization and just-in-time delivery (Klein and Rai 2009; Wiengarten 2013; Worren et al. 2002). Consequently, we generated a sampling pool of 650 firms. Following the standard practice of using senior executives as data sources (Flynn et al. 2010), we chose a senior executive from each targeted firm. These senior executives were appropriate respondents because they had a better understanding of their firms’ IT deployment and SCI practices, and also they had the power to direct their firms’ strategic decisions.

We conducted follow-up phone calls after the questionnaires were sent out. We received 235 returned questionnaires, among which 13 incomplete questionnaires were discarded. Thus, we ended up with 222 useful questionnaires and achieved a response rate of approximately 34.15%. 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 any of the constructs including control variables (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=222)

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Percentage%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Respondent titles</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>President, Managing Director, CEO</td>
<td>63</td>
<td>28.4</td>
</tr>
<tr>
<td>Senior VP of Operations, COO</td>
<td>74</td>
<td>33.3</td>
</tr>
<tr>
<td>CIO/CTO</td>
<td>85</td>
<td>38.3</td>
</tr>
<tr>
<td><strong>Industry (IND)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Automotive</td>
<td>81</td>
<td>36.5</td>
</tr>
<tr>
<td>Home appliance</td>
<td>62</td>
<td>27.9</td>
</tr>
<tr>
<td>Logistics</td>
<td>79</td>
<td>35.6</td>
</tr>
<tr>
<td><strong>Ownership (OWS)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State owned</td>
<td>108</td>
<td>48.6</td>
</tr>
<tr>
<td>Privately owned</td>
<td>72</td>
<td>32.4</td>
</tr>
<tr>
<td>Foreign controlled</td>
<td>42</td>
<td>19.0</td>
</tr>
<tr>
<td><strong>Number of employees (SIZE)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 100</td>
<td>41</td>
<td>18.5</td>
</tr>
<tr>
<td>100–500</td>
<td>70</td>
<td>31.5</td>
</tr>
<tr>
<td>500–1000</td>
<td>25</td>
<td>11.2</td>
</tr>
<tr>
<td>1000–2000</td>
<td>31</td>
<td>14.0</td>
</tr>
<tr>
<td>More than 2000</td>
<td>55</td>
<td>24.8</td>
</tr>
<tr>
<td><strong>Number of IT employees (ITSIZE)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ 5</td>
<td>52</td>
<td>23.4</td>
</tr>
<tr>
<td>6–10</td>
<td>48</td>
<td>21.6</td>
</tr>
<tr>
<td>11–15</td>
<td>47</td>
<td>21.2</td>
</tr>
<tr>
<td>More than 15</td>
<td>75</td>
<td>33.8</td>
</tr>
</tbody>
</table>

**Measures**

We used 5-point Likert scales, with options ranging from 1 (“strongly disagree”) to 5 (“strongly agree”) to measure the items in the questionnaire. Given this research was conducted in China, the English questionnaire was first translated into Chinese by a team consisting of three researchers from different majors (Van de Vijver and Leung 1997). We also back-translate the Chinese questionnaire into English to keep them equivalent. Most items were adapted from previously validated measures. Specifically, the items used to measure internal integration were adopted from Wong et al. (2011). Items used to measure external integration were adapted from Cai et al. (2010) and Kulp et al. (2004). For example, when measuring internal integration, we asked the respondents to indicate his/her level of agreement with the statements, such as “we have a high level of responsiveness within our firm to meet other department’s needs.”, “we have an integrated system across functional areas under firm control.”, and so on. Furthermore, internally-focused IT capability items were developed from Bharadwaj et al. (1999), Wade and Hulland (2004), and Dale Stoel and Muhanna (2009), whereas items used to measure externally-focused IT capability were adapted from Bharadwaj et al. (1999) and Zhang et al. (2008). For example, we used the items such as “we have technology based links with customers/suppliers.”, and so on to measure the externally-focused IT capability. IT business spanning capability were adapted from Lu and
Ramamurthy (2011). We used subjective, self-reported measures of firm performance by testing the senior executives’ perceptions of their firm’s performance relative to their key competitors (Chen et al. 2004). The items were adapted from Rai et al. (2006) and Paulraj et al. (2008).

We also included several control variables that might affect firm performance, namely, the industry, ownership, firm size, and firm age. Specifically, we used a dummy variable for the industry, namely, automotive, home appliance, and logistic industry. Dummy variables were also used for firm ownership types, namely, state-owned, private-owned, and foreign-controlled. The size of the firm was measured by the number of full-time employees. The firm age was measured as the number of years since founding, by subtracting that year from the year of data collection.

**Analysis and Results**

**Data Analysis Technique**

We used Partial Least Squares (PLS) Graph Version 3.0 to test our research model (e.g., Liang et al. 2007). PLS can estimate the loadings/weights of indicators on constructs and explain the complex relationships among constructs (Fornell and Bookstein 1982). Moreover, PLS is regarded as an appropriate statistical tool for theory exploration (Jöreskog and Wold 1982), which is the case in our study.

**Common Method Bias Test**

All the data this study collected were perceptual and from a single source at the same time, which may incur the issue of common method bias. We 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 70.24% of the variance. Meanwhile, the first construct did not account for the majority of the variance (only 17.93%), indicating that common method bias was not a serious concern. We also followed Liang et al. (2007) and included a method factor associated all the principal constructs’ indicators in the PLS model. The results showed that the substantively constructs explained, on average, 0.688 of the variance, while the average method-based variance of the indicators is 0.005.

**Reliability and Validity**

We employed both CFA and EFA to assess the construct reliability and validity. As shown in Table 2, Cronbach’s alpha ranged from 0.703 to 0.902 and composite reliability ranged from 0.834 to 0.925, which were both higher than 0.70, indicating the good reliability. Furthermore, the items loadings ranged from 0.602 to 0.849, higher than 0.60, and average variance extracted (AVE), which were above the recommended level of 0.50, indicating good convergent validity (Fornell and Larcker 1981).

<table>
<thead>
<tr>
<th>Items</th>
<th>Mean (S.D.)</th>
<th>Loadings</th>
<th>Composite Reliability</th>
<th>Cronbach’s Alpha</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>IIC</td>
<td>3.698 (0.675)</td>
<td>0.731-0.804</td>
<td>0.907</td>
<td>0.847</td>
<td>0.766</td>
</tr>
<tr>
<td>EIC</td>
<td>3.631 (0.777)</td>
<td>0.729-0.849</td>
<td>0.907</td>
<td>0.846</td>
<td>0.765</td>
</tr>
<tr>
<td>IBC</td>
<td>3.614 (0.681)</td>
<td>0.602-0.817</td>
<td>0.876</td>
<td>0.804</td>
<td>0.639</td>
</tr>
<tr>
<td>II</td>
<td>3.743 (0.554)</td>
<td>0.670-0.742</td>
<td>0.834</td>
<td>0.703</td>
<td>0.627</td>
</tr>
<tr>
<td>EI</td>
<td>3.607 (0.627)</td>
<td>0.623-0.779</td>
<td>0.898</td>
<td>0.847</td>
<td>0.688</td>
</tr>
<tr>
<td>FP</td>
<td>3.637 (0.618)</td>
<td>0.674-0.837</td>
<td>0.925</td>
<td>0.902</td>
<td>0.672</td>
</tr>
<tr>
<td>IIND</td>
<td>Single item</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>OWS</td>
<td>Single item</td>
<td></td>
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<td></td>
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<tr>
<td>SIZE</td>
<td>Single item</td>
<td></td>
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</tbody>
</table>

Note: AVE=Average Variance Extracted.
To assess the discriminant validity, we calculated the square roots of the AVE of each construct and then compared them with the correlations among constructs. As shown in Table 3, the square roots of AVEs for all constructs were greater than the correlations between constructs, which confirmed a good discriminant validity. In addition, some inter-construct correlations were high, which indicated that multicollinearity may be a potential problem. We conducted a multicollinearity test, and found that the highest VIF and the lowest tolerance values were 2.099 (<10) and 0.477 (>0.1), indicating that multicollinearity was not a significant issue in this study (Mason and Perreault 1991).

Table 3. Correlations

<table>
<thead>
<tr>
<th></th>
<th>IIC</th>
<th>EIC</th>
<th>IBC</th>
<th>II</th>
<th>EI</th>
<th>FP</th>
<th>IND</th>
<th>OWS</th>
<th>SIZE</th>
</tr>
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<tbody>
<tr>
<td>IIC</td>
<td>0.875</td>
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<tr>
<td>II</td>
<td>0.488</td>
<td>0.364</td>
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<td>0.792</td>
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<td>EI</td>
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<td>FP</td>
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<tr>
<td>IND</td>
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<td>-0.109</td>
<td>0.018</td>
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<tr>
<td>OWS</td>
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<td>-0.082</td>
<td>-0.014</td>
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<td>-0.084</td>
<td>-0.080</td>
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<td>SIZE</td>
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<td>0.199</td>
<td>0.137</td>
<td>0.220</td>
<td>0.127</td>
<td>0.050</td>
<td>-0.073</td>
<td>NA</td>
</tr>
</tbody>
</table>

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

Structural Model

The results of PLS analysis were shown in Figure 2. The model explained 34.9% of the variance in internal integration, 38.3% of the variance in external integration, and 40.2% of the variance in firm performance. As shown in Figure 2, internal integration had a significant effect on firm performance ($\beta=0.294$, $p<0.001$), which supported H1. It had also been shown that external integration had a positive effect on firm performance ($\beta=0.428$, $p<0.001$), thereby H2 was supported. However, all the control variables were found to be insignificant. As expected, we found internally-focused IT capability had a significant effect on firm performance ($\beta=0.302$, $p<0.001$). Hence, H3 was supported. We also found externally-focused IT capability was positively related to external integration ($\beta=0.280$, $p<0.001$), supporting H4. In addition, we found IT business spanning capability had a positive effect on both internal integration ($\beta=0.310$, $p<0.001$) and external integration ($\beta=0.435$, $p<0.001$), thus supported H5a and H5b.

We also conducted regression analysis to test the hypotheses. The regression results were slightly different in the magnitude of coefficients, but the significance level remained the same. As suggested by Gefen et al. (2000), the regression results might be
In keeping with H6a, we found that IT business spanning capability interacted significantly with internally-focused IT capability to influence internal integration ($\beta=0.210, p<0.05$). The plot, presented in Figure 3, suggested that, although a higher level of internally-focused IT capability was associated with higher internal integration, internally-focused IT capability was likely to be even more effective in influencing internal integration when the firms had high IT business spanning capability. Our results confirmed that internally-focused IT capability had a stronger positive effect on internal integration when the firm’s IT business spanning capability was high ($\beta=0.529, p<0.001$) than when such spanning capability was low ($\beta=0.239, p<0.001$). Thus, H6a was supported. However, the interaction effect between IT business spanning capability and externally-focused IT capability on external integration was not significant ($\beta=0.025, p>0.05$), and thus H6b received no support.

![Figure 3. Moderating Effect of IT Business Spanning Capability on Internally-focused IT Capability and Internal Integration](image)

**Mediating Effect Test**

To test the mediating effects of internal and external integration, we followed the casual steps suggested by Baron and Kenny (1986). The independent variables are significantly related to the dependent variables is the first requirement for mediation. As shown in Step 1 in Table 4, the results suggested that both internally-focused IT capability ($\beta=0.277, p<0.001$) and IT business spanning capability ($\beta=0.233, p<0.01$) significantly influenced firm performance, which allow us to move on to the second requirement for mediation. Yet, the relationship between externally-focused IT capability and firm performance was not significant ($\beta=0.111, p>0.05$), which indicated that there was no necessary to test the mediators in the relationship between externally-focused IT capability and firm performance. The second requirement is that the independent variables should be related to mediating variables significantly. As step 2 showed, internally-focused IT capability could significantly influence internal integration ($\beta=0.339, p<0.001$) and IT business spanning capability could influence both internal integration ($\beta=0.312, p<0.001$) and external integration ($\beta=0.399, p<0.001$). To meet the third requirement for mediation, we tested whether the effects of internally-focused IT capability and IT business spanning capability on firm performance would be reduced significantly when internal and external integration were entered. As shown in Step 3, we found that both internal integration ($\beta=0.256, p<0.001$) and external integration ($\beta=0.359, p<0.001$) had significant effects on firm performance, and the effect of internally-focused IT capability ($\beta=0.089, p>0.05$) and IT business spanning capability ($\beta=0.050, p>0.05$) became insignificant. Therefore, internal integration fully mediated the effect of internally-focused IT capability while both internal and external integration fully mediated the effects of IT business spanning capability on firm performance.

Scholars have argued that although the causal steps strategy is useful, it is not necessary to require a significant total effect of independent variable on dependent variable (James et al. 2006). Therefore, we utilized the bootstrapping procedures to reexamine the mediating effects of internal and external integration. According to Preacher and Hayes (2008), an indirect effect is significant at the 0.05 level when the 95% CIs (percentile, BC, and BCa) do not include zero. The bootstrap results were reported in Table 5. The results of indirect effects indicated that internal integration mediated the positive effects of misleading due to its failure to assess measurement error and regression at the same time. Therefore, we primarily rely on PLS results.
internally-focused IT capability on firm performance. The indirect effect was 0.12 (percentile 95% CI [0.07, 0.18], BC 95% CI [0.07, 0.18], and BCa 95% CI [0.07, 0.18]). Similarly, the results indicated that both internal and external integration mediated the positive effects of IT business spanning capability on firm performance. The indirect effect was 0.08 (percentile 95% CI [0.04, 0.14], BC 95% CI [0.04, 0.14], and BCa 95% CI [0.04, 0.14]) and 0.13 (percentile 95% CI [0.07, 0.21], BC 95% CI [0.08, 0.22], and BCa 95% CI [0.08, 0.22]), respectively. Interestingly, although we did not find a significant relationship between externally-focused IT capability and firm performance in Step 1 in the casual steps approach, the bootstrap results indicated external integration mediated the positive effect of externally-focused IT capability on firm performance. The indirect effect was 0.15 (percentile 95% CI [0.10, 0.21], BC 95% CI [0.10, 0.21], and BCa 95% CI [0.10, 0.21]). As the significant total effect of independent variables on dependent variable is not necessary for mediation to occur, we inferred that externally-focused IT capability had the mediation (Preacher and Hayes 2008).

### Table 4. Regression Results for Multiple Mediation

<table>
<thead>
<tr>
<th>Step 1:IVs to DV</th>
<th>Step 2:IVs to Mediators</th>
<th>Step 3:Mediators to DV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm Performance</td>
<td>Internal Integration</td>
<td>External Integration</td>
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<tr>
<td><strong>Control variables</strong></td>
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<td></td>
</tr>
<tr>
<td>IND_1</td>
<td>0.022</td>
<td>0.058</td>
</tr>
<tr>
<td>IND_2</td>
<td>0.019</td>
<td>-0.052</td>
</tr>
<tr>
<td>OWS_1</td>
<td>-0.033</td>
<td>-0.010</td>
</tr>
<tr>
<td>OWS_2</td>
<td>-0.023</td>
<td>0.009</td>
</tr>
<tr>
<td>SIZE</td>
<td>-0.075</td>
<td>0.013</td>
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<tr>
<td><strong>Independent variables</strong></td>
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</tr>
<tr>
<td>IIC</td>
<td><strong>0.277</strong>*</td>
<td><strong>0.339</strong>*</td>
</tr>
<tr>
<td>EIC</td>
<td>0.111</td>
<td>--</td>
</tr>
<tr>
<td>IBC</td>
<td><strong>0.232</strong></td>
<td><strong>0.312</strong>*</td>
</tr>
<tr>
<td><strong>Mediators</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>EI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>0.268</td>
<td>0.310</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.241</td>
<td>0.287</td>
</tr>
<tr>
<td>F</td>
<td><strong>9.772</strong>*</td>
<td><strong>13.739</strong>*</td>
</tr>
</tbody>
</table>

Notes: *p<0.05, **p<0.01, ***p<0.001; IND_1 represents automotive industry, IND_2 represents home appliance industry; OWS_1 represents state ownership, OWS_2 represents private ownership.

### Table 5. Bootstrapping Methods Test

<table>
<thead>
<tr>
<th>Internal Integration: 95% CI (lower/upper)</th>
<th>External Integration: 95% CI (lower/upper)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effect</td>
<td>Percentile</td>
</tr>
<tr>
<td>IIC</td>
<td>0.12</td>
</tr>
<tr>
<td>EIC</td>
<td>--</td>
</tr>
<tr>
<td>IBC</td>
<td>0.084</td>
</tr>
</tbody>
</table>

Note: CI, confidence intervals; BC, bias corrected; BCa, bias corrected and accelerated; 5000 bootstrap samples.
Discussion

Our findings provide the empirical evidence for the theoretical relationships among IT capability, SCI, and firm performance, which yields a rich set of insights. First, our research findings reveal that internal and external integration can positively affect firm performance. As much of the existing research on SCI does not include internal integration (Cai et al. 2010; Cao and Zhang 2011), this finding highlights the critical importance of both internal and external integration in enhancing firm performance (Flynn et al. 2010; Wong et al. 2011). This is also consistent with the perspective of TSEF that the more swiftly and evenly the information and material flow move both within and across organizational boundaries, the better performance the firm has (Schmenner 2001; Schmenner and Swink 1998).

Second, our results provide support for theoretical arguments on how different IT capability enables different SCI. Consistent with the Day’s (1994) classification of capabilities, we find internally-focused IT capability enables internal integration. Externally-focused IT capability improves external integration. While IT business spanning capability facilitates both internal and external integration. This findings indicate that different IT capability have different focus, which would leverage different SCI for generating firm value (Mithas et al. 2011; Mithas et al. 2012; Wade and Hulland 2004). More interestingly, we also find IT business spanning capability positively interacts with internally-focused IT capability in influencing internal integration while not significantly interacts with externally-focused IT capability in affecting external integration. One possible explanation is that IT business spanning capability highlights mutual trust and respect between IT and other business functions, which is particularly important for the firm to leverage internally-focused IT capability for implementing internal integration (Zhao et al. 2008; Zhao et al. 2011). While for firms with high externally-focused IT capability, they would develop strong IT-enabled social integration (Joshi et al. 2010). Such social integration can facilitate the cross-firm socialization essential for external integration, which may substitute for the role of interaction effect of IT business spanning capability on (Kim 2006). Indeed, Lu and Ramamurthy (2011) indicate that tightly coupled IT and business could limit the firm to reactively support the business initiatives, and thus may not generate complementarity with externally-focused IT capability for external integration.

Finally, our study reveals that internal and external integration can fully mediate the impacts of three types of IT capability on firm performance. Specifically, internally-focused IT capability is mediated by internal integration, externally-focused IT capability is mediated by external integration, while IT business spanning capability is mediated by both internal and external integration. This finding reinforces the perspective of TSEF that IT capability influences firm performance through its positive impacts on internal and external integration by generating swift and even information flow both within and across organizational boundaries. This result is also consistent with previous findings that the relationship between IT capability and firm performance is not direct and should take into account the mediating effects of business processes (Ho-Chang et al. 2014; Liu et al. 2013; Mithas et al. 2012).

Implications and Limitations

The current research makes three major theoretical contributions. First, IS research is enriched by distinguishing different dimensions of IT capability. In the existing literature, the measurement of IT capability have been done either at an aggregate level, or inconsistently (Lu and Ramamurthy 2011; Roberts and Grover 2012; Tippins and Sohi 2003). To complement these studies, we refine the conceptualization of IT capability in terms of three dimensions based on the Day’s (1994) framework, which is in response to Santhanam and Hartono’s (2003) call for developing theoretically-based multidimensional IT capability. Although this framework has been conceptually proposed in IS area (e.g., Dale Stoel and Muhanna 2009; Wade and Hulland 2004), our study is among the first to conceptualize IT capability by capturing all the three dimensions (Dale Stoel and Muhanna 2009) and further empirically explore the differential impacts of the three types of IT capability on different types of SCI and thereby firm performance.

Second, this study provides a fine-grained insight into the mediating effect of SCI on the relationship between IT capability and firm performance, which enriches our understanding of the underlying mechanism through which IT capability improves firm performance (Liu et al. 2013; Mithas et al. 2012). The existing studies primarily focus on second-order latent IT capability (Lu and Ramamurthy 2011) or IT management capability (Mithas et al. 2011), our study adopts the theoretical lens of RBV and TSEF and
clealy specify what and how different types of IT capability both independently and interdependently improve firm performance through different SCI. By considering both internal and external integration, our research provides a more complete understanding of the underlying enabling process between internally-focused IT capability, externally-focused IT capability, and IT business spanning capability and firm performance.

Third, from a theoretical perspective, our study extends the applicability of the TSEF to the IT-enabled SCI by incorporating the RBV. Although the TSEF has been widely used to examine the issues in operations management (OM) area, such as service sector (Schmenner 2004) and hospitals (Devaraj et al. 2013), its ability to shed light on the business value of IT capability especially in the supply chain context had yet to be well exploited (Cottelee and Bendoly 2006). Our study integrates the RBV and the insights between IS and OM (Boyer and Swink 2008) and further lends support to the roles of both internal and external integration in fully mediating the relationships between three types of IT capability and firm performance, and thus extending the TESF.

Furthermore, our research also offers some practical implications for managers. Specifically, our findings help managers realize that justifying IT investments based on the immediate impacts of general IT capabilities on firm performance is not appropriate. To enhance performance through IT investment, firms need to diffuse their IT applications into both internal business processes and external supply chain activities to achieve superior firm performance. More importantly, this study suggests that it is critical for managers to develop different types of SCI to leverage the value of different types of IT capability. In particular, internally-focused IT capability should be developed for internal integration and externally-focused should be developed for external integration first and, in turn, improving firm performance, whereas IT business spanning capability may be leveraged by both internal and external integration for superior firm performance. In addition, managers should notice that IT business spanning capability can also positively moderates the relationship between internally-focused IT capability and internal integration. That means, firms want to achieve higher business value from internally-focused IT capability should also develop their IT business spanning capability accordingly.

Evaluating the contributions along with its limitation is of primary importance. First, the current research tests the hypotheses with cross-sectional data. A longitudinal study may help provide additional insights by involving time-effect among the research constructs, such as explicitly measuring the swift and even flow construct. By collecting data of IT capability, SCI, and firm performance in the different time, we can more convincingly test the causality between IT capability, SCI, and firm performance. In addition, a longitudinal design can also reduce common method bias (Podsakoff and Organ 1986). Second, this study applied the single respondent as the source of survey data. Although an additional analysis had been conducted to confirm that no significant differences on internal integration and external integration had been found among the President, Managing Director, CEO (63 samples), Senior VP of Operations, COO (74 samples), and CIO/CTO data sets (85 samples), different positions may undertake different roles in firms and thus may possess different perspectives regarding the supply chain integration issues. Meanwhile, a firm’s strategic decisions, such as IT capability configuration and SCI, usually involve a group of executives. Thus, collecting data from multiple informants in the top management team would be helpful to enhance the robustness of the research results. Finally, the demography of the respondents in this study may limit the generalizability of our findings. We focus our study in the context of emerging economy of China, which has unique cultural, economic, and institutional features. As such, researchers and practitioners should be cautious when generalizing the findings of the current study to other contexts.

Conclusion

Drawing upon the RBV and TSEF, this study examines how different types of IT capability impact firm performance through different types of SCI, which sheds new light on the understanding of the underlying influential mechanisms of IT capability. We propose that the impact of the three types of IT capability on firm performance can be mediated by the different types of SCI. We find internal integration mediates the impact of internally-focused IT capability, external integration mediates the impact of externally-focused IT capability, while both internal and external integration can mediate the impact of IT business spanning capability. Furthermore, we also find the IT business spanning capability can positively moderate the impact of internally-focused IT capability on internal integration. These research findings not only enhance our understanding of the different underlying influential mechanisms through which the
different types of IT capability improve firm performance (Mithas et al. 2011) but also address the call for exploring the internal dynamics among IT capabilities (Kim et al. 2011). We hope this study opens future research and advances theory to further explore the nature and dynamics of “IT productivity paradox”.

Acknowledgements

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