14. Technology, Innovation and Supply Chain Management

Interactive Session

IT capability as an Enabler of supply chain Integration and Coordination

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Abstract

This study develops a research model to examine how IT capability influences supply chain integration which then has a positive impact on supply chain coordination. Data were collected from a survey administered to 231 Australian small-to-medium enterprises (SME). The structural equation modelling approach is used to test hypotheses. Findings suggest that supply chain integration is positively affectively by IT capability and can directly impact on supply chain coordination. This study contributes knowledge on understanding how IT helps SMEs to achieve business value in the supply chain context.

Keywords*: IT Capability, Supply Chain Integrations, Supply Chain Coordination, IT Infrastructure, Back-end Integration, Front-end Functionality.*

Introduction

With the monumental expansion in functionalities of commercially available complex software configuration management technology, IT resources have been increasingly referred to as commodity (Zhu & Kraemer 2005). As with most ubiquitous technologies, their adoption is easily duplicated by other firms and often fails to provide a sustained competitive advantage for the adopting firms (Powell and Dent-Micallef 1997). IT adoption is no exception. IT investment may increase operational effectiveness but could no longer guarantee competitive advantage. Not surprisingly, the business value of IT has been challenged (Carr 2003). The ''IT-productivity'' paradox and other anecdotal evidences suggest that the impact of IT on firm performance remains equivocal (Dong, Xu, & Zhu 2009; Lu & Ramamurthy 2011; Zhu & Kraemer 2005).

We explore how IT capability can help firm to create supply chain coordination competence through the development of supply chain integration processes. Following Kohli and Grover (2008), Melville et al. (2004), and Rai et al. (2006), we argue that IT business value can be enhanced when firms embed IT into organizational processes. Building IT capability to support supply chain integration processes, enables organizations to develop firm-specific supply chain activities that are valuable (to their clients), immobile (not lost even a key personnel may leave the firm), and difficult for competitors to imitate, leading to the creation of core competencies and competitive advantage (Javidan 1998). For instance, Rai et al. (2006) have found that integrative information technologies, which enhance information flows along supply chains, contribute to superior customer service performance through supplier partnering and customer relationship building. Likewise Wu et al. (2006) also found that higher order supply chain process capabilities could be developed to generate rents for all partners when information flow is integrated across the chain.

We contend that when a firm's IT resources are strategically harnessed to form IT capability, such as IT infrastructure, back-end integration, and front-end functionality, these IT capabilities have the enabling effect to transform a supply chain integration process, into a hard-to-imitate supply chain

competence, such as coordination. We explore the indirect role of IT capability in value creation which aims to use intermediate-level dependent variables at the operational level to examine how IT investments could lead to competitive advantage (Melville et al. 2004; Wade & Hulland 2004). This study contributes to the IT paradox debate by exploring the process-enabling effects of IT. In this context, we examine the effects of IT capability in terms of IT Infrastructure, back-end integration, front-end functionality on building of supply chain integration and supply chain coordination competency.

Literature Review and Hypothesis Development

In hypercompetitive market, firms collaborating with supply chain channel partners in order to speedily respond to market changes can achieve competitive advantage (Christopher and Towill 2001). Information system (IS) research has been extensively conducted to examine how IT helps firm to achieve business value (Weill et al. 2002; Sambamurthy et al. 2003; Overby et al. 2006; van Oosterhout et al. 2006; Fink and Neumann 2007; Zhang and Sharifi 2007; Goodhue et al. 2009; Lu and Ramamurthy 2011). However, most studies typically explored the IT business value in large organizations with limited attention paid to SMEs. As advancement in IT continues to offer SMEs to conduct businesses with their suppliers/customers, it is important to understand how IT provides SMEs with new avenues to manage their supply chain operations (Lee 2002) as supply chain management has been labelled as "a digitally enabled inter-firm process capability" (Rai et al. p. 226). This study explores the effects of three types of IT capability, namely, IT infrastructure, back-end integration, and front-end functionality, on developing supply chain integration activities which lead to supply chain coordination competence. Coordination is central to supply chain operations (Sanders 2008). Integration, in turn, is the backbone of supply chain coordination (Barratt 2004). A firm's ability to integrate its supply chain operations better than its competitors' hinges heavily on how it coordinates and collaborates with chain members - information exchange, resource sharing, and process integration (Lee 2000). Supply chain coordination is a key to attaining superior performance

through meeting customer needs (Kim, Cavusgil, & Calantone 2006; Sanders 2008; Vickery et al. 2003). In this study, supply chain integration is defined as an exceptional ability to leverage IT capability to undertake supply chain integration activities to gaining operational efficiencies and fulfilling customer expectations. Supply chain coordination is firm-specific and inimitable (Wu et al. 2006), creating highly differentiated value for firms and their supply chain partners.

A number of studies (Vickery et al. 2003; Wu et al. 2006; Sanders 2008) have examined the relationship between IT and supply chain operations to understand the value creation of IT in supply chain context. Vickery et al. (2003), for instance, found that the integrative impact of IT on customer service was entirely mediated through supply chain integration. Additionally, supply chain integration was found to have no direct effect on financial performance, only an indirect effect mediated through customer service. Wu et al. (2006) found that the effects of a firm's IT capability, in the form of internal and external IT alignment and IT advancement, on its marketing and financial performance were fully mediated by four supply chain capabilities: information exchange, coordination, activity integration and responsiveness. Sanders (2008) assessed how two IT use patterns (exploration and exploitation) by suppliers impact two types of buyer coordination activities (operational and strategic), which, in turn, lead to specific benefits. Sanders (2008) found that using IT for exploitation only enhanced operational coordination, while that for exploration was only effective in improving strategic coordination. The findings demonstrate that suppliers wanting to reap benefits from both operational and strategic coordination would have to invoke the two IT use patterns. Kim et al. (2006) viewed integration with channel members as a two-dimensional process: inter-firm systems integration and inter-firm activity integration. Arguing that inter-firm systems integration is an IS resource that represents technological connectivity between channel members, Kim et al. (2006) studied the mediating role of inter-firm systems integration, rather than activity integration, in transmitting the effects of supply chain communication systems innovations on a firm's channel capabilities, including inter-firm information exchange and coordination. They confirmed that inter-firm systems integration is "a necessary accompaniment to derive an adequate return from applied technological innovation"

(Kim et al. 2006, p. 50). Supply chain integration demonstrates a firm's capability to strategically collaborate demand and supply side processes with its suppliers and customers (Liu et al. 2015). Supply chain integration requires methods, procedures and processes beyond the ability to interact with suppliers and customers online, which is crucial to achieve improved supply chain operational performance (Devaraj et al. 2007).

While firms can build their sustainable competitive advantage by strategically leveraging on valuable, rare, hard-to-imitate, and hard-to-substitute resources, the key to superior performance depends on how these resources are utilized (Peteraf 1993; Javidan 1998). Following this view, we contend that, in the context of supply chain management, building supply chain integration capability requires that firms employ their IT capability to support their routine supply chain integration activities. The repeated adaptation of IT capability to support on-going supply chain integration activities would, overtime, lead to the development of a socially complex, and causally ambiguous, set of hard-to-imitate IT-enabled supply chain coordination competence embedded within organizational processes. These processes would include integration of internal cross-functional IT applications and databases as well as external IT linkages with supply chain partners. We posit that developing IT capability in the form of solid IT infrastructure, superior back-end integration and front-end functionality to support supply chain integration activities would lay the foundation for building supply chain cordination competencies. Figure 1 depicts our conceptual model.

Insert Figure 1 about here

IT infrastructure is a firm's ability to deploy computer and communication technologies, shareable technical platforms in order to share information, to exploit business opportunities, and to be agile in responding to changes in the environment and business strategy (Rai & Tang, 2010). Bharadwaj (2000) contended that IT infrastructure provides not only a solid platform upon which firms could leverage IT to conduct business activities but also an agile and flexible technology structure (e.g., integrated database) to respond to customer demands and market changes for business development.

Zhu and Kraemer (2005) argued that e-business is unlikely to become an integral part of the value chain if firms lack appropriate IT infrastructure to readily and efficiently distribute necessary information for e-business operations. In fact, both Lin and Lin (2008) and Zhu and Kraemer (2005) have found that the effect of IT infrastructure on firm performance increases with the level of sophistication of the former. Firms with integrated IT infrastructure capability can avoid limitation of supply chain fragmentation which could constrain information flows and activity coordination, thereby achieving supply and demand process integration. Accordingly, we hypothesize that:

H1: IT infrastructure is related positively to supply chain integration.

The value of IT capability lies in providing visibility, traceability, and real-time information sharing between firms and their suppliers and customers (Sanders, 2008). The prowess of this contribution hinges primarily on two IT development outcomes: how well different databases are integrated to enable cross-functional and multi-layer querying (back-end integration); and how well the cross-functional and multi-layer linkages are transformed into a user-friendly, easy-to-use, customer-centric operations system (front-end functionality) (Zhu, 2004). According to Zhu and Kraemer (2005, p.67), back-end integration refers to a firm's ability to link Web applications with back-office databases and facilitates information sharing along the value chain, and front-end functionality refers to a firm's ability to "provide product information to consumers on the Internet, facilitate transaction processing, and enable customization and personalization". Back-end integration and front-end functionality can be regarded as a firm's IT capability (Zhu and Kraemer, 2005). Creating synergistic effects through front-end functionality capability and back-end integration is a tangible path to developing supply chain integration (Zhu, 2004; Zhu and Kraemer, 2005). A technically sound back-end integration can increase transactional efficiencies, lower operation costs, and create business value for the focal firm as well as improve supply chain integration processes and efficiency (Zhu and Kraemer 2005). Dong et al. (2009) also contended that back-end integration drives collaborative connections among supply chain partners, enhances information processing, integration and coordination to facilitate cross-functional and multi-layer querying, superior back-end integration and front-end functionality are expected to enhance the

flow of information among supply chain partners (Vickery et al. 2003), adding value to such activities as information processing, exchange and integration (Wu et al. 2006), collaborative planning, forecasting, and replenishment (Kim et al. 2006), and transactions among supply chain partners (Dong et al. 2009). Therefore, we posit that:

H2: Back-end integration is related positively to supply chain integration.

H3: Front-end functionality is related positively to supply chain integration.

In the context of supply chain operations, supply chain coordination demonstrates a firm's ability to coordinate and collaborate effectively with channel partners (Sanders 2008; Cao and Zhang 2011). Typically, supply chain coordination that can be advantageously enhanced by supply chain integration would include joint production planning and sales forecasting as well as process integration with suppliers, distributors, and customers (Johnson et al. 2007), joint resource planning and work scheduling (Kim et al. 2006). The routinization of these activities facilitated by a robust set of IT infrastructure and integrated, seamless back-end and front-end functionality is a necessary precursor to building supply chain agility. Likewise, a set of IT-enabled supply chain collaboration activities also brings many other benefits to the supply chain, including lower inventory, faster respond times, and greater speed-to-market (Lee 2004). In addition, supply chain collaboration simplifies organizational work flow and reduces lead times with suppliers (Barratt 2004). This leads us to our next two hypotheses:

H4: Supply chain integration is related positively to supply chain coordination.

Method

The samples in this study were 1,119 Australian SMEs. The respondents. The founders or CEOs of SMEs are the specific respondents as they can provide reliable overviews on IT development in the companies. We focus on SMEs because they are a dominant part of the Australian economy (OECD 2015).Of 1,119 online survey issued, a total of 231 responses were obtained (20.6% response rate). Measurement items were developed based on the literature. All constructs were assessed with seven-

point Likert scale ranging from Strongly Disagree (1) and Strongly Agree (7). IT infrastructure was measured via a three-item scale adapted from Lin and Lin (2008). Back-end integration was measured via the three-item scale adapted from Zhu and Kraemer (2005). Front-end functionality was measured via a four-item scale adapted from Zhu and Kraemer (2005). Supply chain integration was measured via a three-item scale adapted from Wu et al. (2003) and Kim et al. (2006). Supply chain coordination was measured via a three-item scale adapted from Cao and Zhang (2011). Control variables include firm age, firm size, and industry type. In this study, founders or CEOs of SMEs are the specific respondents because they can provide reliable overview on their companies' IT development.

Results

Our data analysis shows a good model fit in AMOS 25: $\chi^2(97)=188.606$, $\chi^2/df=1.944$, CFI=.952, TLI=.953, SRMR=.059, RMSEA=.055. The structural model demonstrates support for all hypotheses. Specifically, both IT infrastructure (b=0.18, p<0.01) and back-end integration (b=0.43, p<0.001) have positive and significant effects on supply chain integration, which supported H1 and H2. Front-end functionality is positively related to supply chain integration (b=0.25, p<0.005), which supported H3. Supply chain integration has a positive impact on supply chain coordination (b=0.49, p<0.001), which supported H4. The squared multiple correlation (SMC) values show that this model accounts for 52% of the variance in supply chain integration and 24% of the variance in supply chain coordination. None of the control variables have any significant effect on market responsive agility in our model, despite their expected influence.

Discussion

This study examines the process-enabling role of IT capability within the context of supply chain operations and explores the building paths of supply chain integration and coordination competence using Javidan's (1998) capability-competency-core competency framework. Our results demonstrate that good quality of IT capability contributes positively to both supply chain integration and coordination. These results confirm the process-enabling role IT capability in augmenting the

capability-competence building process in supply chain operations. Following Zhu et al. (2004), this research posits that IT capability comprises three key components: IT infrastructure, back-end integration, and front-end functionality. Findings of this study suggest that the outcome of the synergistic interactions of these three components is with functionalities that permit multi-party queries to provide visibility, traceability, and real-time information to all supply chain members. IT infrastructure equips supply chain members to be in a state of constant information-readiness. Back-end integration and front-end functionality empower supply chain members to collaboratively respond to customer needs in a timely and coordinated manner, thus supporting supply chain integration activities. The end result is a tangible display of supply chain coordination competency among all supply chain partners. In information-intensive supply chain operations, this study highlights the process-enabling role as the value contributions of a firm's IT capability.

These findings have a number of implications in research as well as business practice. In a theoretical sense, this study has empirically demonstrated the causal paths underpinning the transformation of IT capability into IT-enabled supply chain processes. Rather than treating IT capability as a second-order multidimensional construct, we have explicitly explored the effects of three IT capability dimensions on supply chain integration. SME managers should not only develop a solid IT infrastructure to build reliable information systems but also integrate IT applications within and across supply chain partners/customers to transform firms to IT-enabled companies. This research contributes to supply chain management literature by incorporating information systems with operations management. The results provide new insights into the business value of IT capability in the supply chain context. SME managers should understand where the real business value of IT investment can be created in supply chain management area. Managers need apply IT capability to IT-enabled supply chain integration and coordination competence so that SMEs can achieve the benefits of IT capability.

This study acknowledge limitations associated with the use of the self-report performance measure. Although this research carefully constructs measures to account for this issue, future research may seek objective performance indicators to test the robustness of findings. This study also acknowledge limitations associated with common method bias inherent in cross-sectional designs. Future work could focus on longitudinal data to provide further insight into the processes of IT capability and supply chain interation and coordination required by SMEs.

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Figure 1. Research Model