HOW DO B2B PATTERNS SHAPE IOS APPLICATION CAPABILITIES: THE MODERATING EFFECT ON IT CAPABILITY BUILDING

Research-in-Progress

Zhu, Shuting, Southeast University, Nanjing, China, shutingzhu@gmail.com

Tripathi, Arvind, University of Auckland, Auckland, New Zealand, a.tripathi@auckland.ac.nz

Zhong, Weijun, Southeast University, Nanjing, China, zhongweijun@seu.edu.cn

Abstract

In recent years, a growing number of B2B e-businesses are adopting inter-organizational information systems (IOS). IOS enable and facilitate sharing of IT resources and capabilities between two or more organizations. Scholars also agree that information technology (IT) recourses and capabilities are critical for delivering business value of IT. Although, extant literature has mainly focused on the relationship between IT capabilities and firm performance, we believe that it is also crucial to understand the IT capability building processes and examine/explore mechanisms to build IT capabilities from existing IT resources. In this study, IOS application capabilities are proposed as the main factor in creating business value of IT in B2B environment. Moreover, we try to understand the nature of B2B patterns in cooperative relationship, which are likely to moderate the IT capability building process from IOS resources to IOS application capabilities. Research framework and hypotheses are proposed drawing from organizational learning theory and relevant literature. Our work aims to provide insights on how firms build IOS capabilities in cooperative inter-organizational relationships through strategic alignment between IOS resources and B2B patterns.

Keywords: IOS resources, IOS application capabilities, B2B patterns, strategy alignment, organizational learning, moderating effect.

1   Introduction

Inter-organizational information systems (IOS) are built using information technology (IT) to facilitate the creation, storage, transformation, and transmission of information across organizational boundaries (Johnston and Vitale, 1988). To gain advantage in B2B environment, firms are increasingly cooperating with other firms in their network to co-create value (Grover and Kohli, 2012). Consequently, IOS are expected to enable and facilitate inter-organizational network (Chakravarty, et al., 2013; Reimers, et al., 2014), especially for the firms seeking to be agile and innovative (Rai, et al., 2012). In this context, electronic data interchange, supply chain management, customer relationship management, B2B e-business, and other forms of IOS are widely studied, and are regarded as the enabler to gain competitive advantage in multi-firm environment (Johnston and Vitale, 1988; Premkumar, et al., 1997; El Sawy, et al., 1999; Subramani, 2004; Zhu, 2004; Sanders, 2008). As firms move into advanced stages of IOS applications, IS researchers shift their focus to higher levels of organizational capabilities (Pavlou and Sawy, 2010; Rai and Tang, 2010). In this study, we focus on the "root system" (Prahalad and Hamel, 1990; Peppard and Ward, 2004) of IOS application capabilities.

IT-enabled resources/capabilities which are valuable, rare, inimitable and non-substitutable are proposed as great strategic potential resources for sustainable advantage from the resource-based view (Barney, 1991; Bharadwaj, 2000; Ravichandran and Lertwongsatien, 2005; Nevo and Wade, 2010), but literature is thin on how to build IT capabilities from IT resources. Further, the resource-based theory finds its dilemma to explain the source of competitive advantage in open systems and turbulent environments (Pavlou and Sawy, 2010). For example, the path dependency of resources may beget core rigidities to hinder firms adapting to market turbulence (Leonard-Barton, 1992). In this situation, capabilities with dynamic attributes are proposed to address the environmental turbulence by extending, modifying, or reconfiguring the existing resources into new ones that better match the environment (Teece, et al., 1997; Pavlou and Sawy, 2011). Higher order capabilities have been proposed by IS researchers which evolve from zero-order resources (Collis, 1996; Pavlou and Sawy, 2010). However, few studies have explored the capabilities building mechanisms, especially with cooperative strategy and emerging IOS technology. Some scholars have acknowledged the challenges associated with capability building (Pavlou and Sawy, 2006; Wang, et al., 2012). In this paper, we focus on the following research questions:

What are IOS application capabilities? Why are they crucial for current B2B environments? How to build IOS application capabilities from IT and complementary resources?

Borrowing from the literature on IT resources/capabilities and organizational learning, we propose a research model and theoretical hypotheses. Our model shows the capability building path from IOS and complementary resources to IOS application capabilities, and proposes that the association is moderated by specific B2B patterns. We suggest that the three-way interactions of IOS resources, complimentary resources and B2B patterns can help firms obtain better "fit" for IOS applications with cooperative strategy. This is a supplementary research to explore the alignment between IS and business strategy (Xue, et al., 2012). While previous research has mainly focused on IT use of exploitation or exploration

(Subramani, 2004; Sanders, 2008), or IT impact on exploitative or explorative practice (Xue, et al., 2012), we empirically test the impact of exploitative or explorative business patterns on IOS application.

2 Theory Background

First, we review literature on IT related resources/capabilities, illustrating the representative views on the relationships between IT/IS resources and capabilities. Next, theories on organizational learning and capability building are reviewed to introduce IOS application capabilities as higher-order reconfiguration capabilities with the nature of dynamics. Drawing from these literature, we propose that the IOS application capabilities building process is developed from IOS and complementary resources under the moderation of B2B patterns.

2.1 IT related resources and capabilities

Our constructs of IOS recourses and IOS application capabilities are developed drawing on the IT related resources and capabilities literature, which are summarized in Table 1.

References	Main constructs	Dimensions
Sambamurthy, et al., 2003	IT investment	Investments in IT, quality of IT infrastructure
	IT capabilities	IT human capital, business partnerships
Melville, et al., 2004	IT resources	Technology resources, IT human resources
	Complementary resources	Organizational resources complementary to IT (organizational structure, policies and rules, workplace practices, culture, etc.)
Ravichandran, Lertwongsatien, 2005	IS resources	IS human capital, IT Infrastructure, IS partnership
	IS capabilities	IS planning sophistication, systems development capability, IS support maturity, IS operations capability
Aral and Weill, 2007	IT assets	Infrastructure, transactional, informational, strategic assets
	IT capabilities	IT competencies (IT skills, IT management quality), IT practices (IT use, digital transactions, Internet architecture).
Pavlou and El Sawy, 2010	IT-leveraging capability	Effective use of PRMS, OMS, CWS
	Dynamic capabilities	Sensing capability, learning or absorptive capability, coordinating capability, integrating capability
Wang, et al., 2012	IT resources	Physical IT infrastructure, technical IT resource, managerial IT resource, relational IT resource
	IT capabilities	IT strategic planning capability, IT development capability, IT use capability, IT management capability
Chakravarty, et al., 2013	IT infrastructure	Physical assets, quality and frequency of updates to all IT-related asset stocks
	IT capabilities	Firm's technical and management skills, IT practices, investments in IT human skills.

Table 1.   IT-Related resources and capabilities

Through literature review, many IS researchers account that IT resources are visible and material resources such as IT infrastructure, hardware, application, IT staff and other physical assets (Melville, et, al., 2004; Ravichandran and Lertwongsatien, 2005; Aral and Weill, 2007; Wang, et al., 2012). On the other hand, IT capabilities mostly refer to skills, relationships, IT practice or effective use (Sambamurthy, et al., 2003; Aral and Weill, 2007; Pavlou and El Sawy, 2010; Chakravarty et al., 2013), which are invisible, knowledge-intensive, and embedded in the application of IT. Nevo and Wade (2010) argued that IT resources and organizational resource realize synergy through compatible and integrative processes. However, empirical studies on the "synergy" process which allows to build invisible IT capabilities from IT resources are thin. Our study aims to fill this gap by examining specifically how IT capabilities are developed from IT resources.

2.2   Organizational learning and capability building

Organizational learning is considered as a series of organizational actions to describe the transformative process (Argyris and Schön, 1978), and it has been seen as the underlying mechanism in capability building (Collis, 1996). Andreu and Ciborra (1996) revealed the fundamental process that transformed resources into capabilities. They declared that the capability building process was a learning process by nature that can be described and understood by organisational learning. IT was embedded in the capabilities during the capability development. Similarly, Peppard and Ward (2004) agreed that capability could be achieved through evolution from resource endowments, and dependent on learning process. They explored IS capabilities in detail, and proposed that the development and acquisition of IS capabilities were affected by the underlying philosophy of firms' strategic decision making. Moreover, in dynamic capability literature, organizational learning is seen as the crucial application and management process for capability development (Teece, et al., 1997; Zollo and Winter, 2002). Organizational learning could develop and regulate the practice rules or routines to build capabilities (Collis, 1996; Winter, 2002). According to Zollo and Winter (2002), dynamic capabilities evolved by organizational learning. Aral and Weill (2007) suggested moving away from monolithic conceptualizations of IT toward a disaggregated view of IT assets and organizational IT capabilities as mutually reinforcing system. They assumed specific asset and capability synergies could exist, but left the investigation of such relationships in future work. Nevo and Wade (2010) insisted that IT assets combined with organizational resource could generate strategic potential through realized synergy. They also emphasized the enabling process from resources to capabilities.

The previous studies pointed out the synergies or path from resources to capabilities, but few explore the building mechanism empirically. IS researchers also pointed out the nature of capability is effective use of resources inherited from organizational learning, and capabilities building process is shaped by specific resource positions and evolution path which adopted or inherited. According to these theoretical findings, we consider that the evolution of IOS application capabilities are driven by the alignment between IS and business strategy, and built on the IOS and complementary resources through inter-organizational learning process endued with distinct dynamic attributes. Strategy alignment is assumed as the environmental driver for capability building, while organizational learning is the underlying mechanism for capabilities evolution. Thus, the specific B2B patterns in cooperative relationships (March,

1991; Mei and Xu, 2013) are accounted to moderate the capability building process. In fact, building IOS application capabilities represents the inter-organizational learning process which integrate the IT and complementary resources driven by the B2B cooperative strategy.

3   Hypotheses Development

Based on the foregoing discussions on IT resources/capabilities and the evolution mechanism of capabilities as organization leaning, we propose that IOS application capabilities with the nature of dynamic capabilities of integration and reconfiguration, are built on the application process to exploit or explore IOS and complementary resources. The capability building path is moderated by exploitative or explorative B2B patterns. Figure 1 shows our research model.
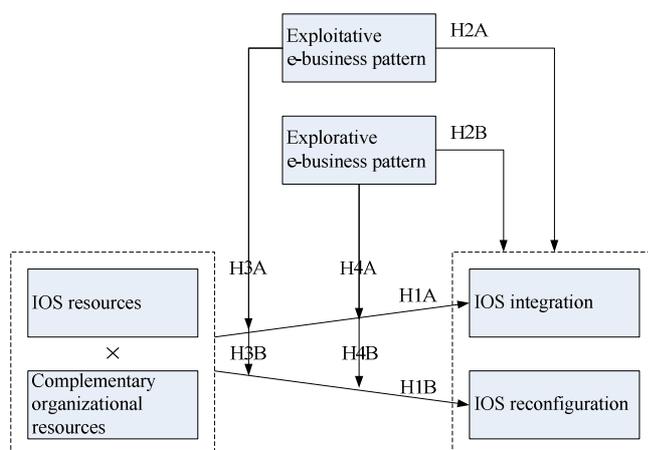

Figure 1. Research model

3.1   IOS application capabilities

New IT capabilities are called to stress the multi-firm environment (Grover and Kohli, 2012). Application capabilities are regarded as the ultimate step in technology absorption (Roberts, et al., 2012) to create synergy between IT and complementary organizational resources.

Saraf, et al. (2007) propose IS application capabilities as sets of organizational variables of management processes. In this paper, we define IOS application capabilities as firm's ability to respond swiftly to the requirement of exploitation and exploration of cooperative B2B practice with efficiency, flexibility, innovation, and quality through integration and reconfiguration of IT and complementary resources (Saraf, et al., 2007; Rai and Tang, 2010; Pavlou and El Sawy, 2011). They are higher order than resources with the attributes of dynamics capabilities (Pavlou and El Sawy, 2010). Dynamic capabilities are considered as firm level abilities to integrate, build, or reconfigure internal and external resources to address rapidly changing environments, thereby facilitating firms to achieve innovative forms of competitive advantage given the path dependencies and market positions (Teece, et al., 1997). Therefore, application capabilities can be regarded as firm's processes to integrate, reconfigure, gain and release resources to match or even create market opportunities (Eisenhardt and Martin, 2000; Saraf, et al., 2007).

We construct IOS application capabilities as second order of IOS integration and IOS reconfiguration (Langdon, 2006; Saraf, et al., 2007; Rai and Tang, 2010; Pavlou and El Sawy,

2011). IOS integration describes the extent to which IOS applications of the focal firm work as a functional whole in conjunction with its business partners', while IOS reconfiguration is the ability to quickly and economically coordinate related resources to adapt IOS applications to changing business requirements. IOS application capabilities are sets of specific and identifiable processes which are idiosyncratic for their building path from merging IOS and organizational resources. Some empirical studies have confirmed the positive association between IT resources and capabilities (Ravichandran and Lertwongsatien, 2005; Pavlou and El Sawy, 2006), also their complementarities (Zhu, 2004). Therefore, we hypothesize that:

Hypothesis 1A. *IOS resources and complementary organizational resources positively interact to impact IOS integration.*

Hypothesis 1B. *IOS resources and complementary organizational resources positively interact to impact IOS reconfiguration.*

3.2 Cooperative B2B patterns

While business practice are categorized as either exploitation or exploration drawing on organization learning theory (March, 1991), business strategies of firms involve two distinctive processes of exploitation and exploration (Xue, et al., 2012). Accordingly, cooperative B2B patterns are characterized as exploitative or explorative (Mei and Xu, 2013). Exploitative B2B pattern is defined as the extension or elaboration of old certainties, whose goal is to improve operational efficiencies with consistency, such as increased standardization, tighter process controls, and reduced manual intervention (Subramani, 2004; Sanders, 2008). Explorative B2B pattern is defined as the application to streamline activities with flexibility and speed, which helps in innovative strategies to reassess current approaches and develop novel solutions (Subramani, 2004; Sanders, 2008). Previous studies emphasized the role of IOS on firms' exploration and exploitation practice (Tippins and Sohi, 2003; Kane and Alavi, 2007; Xue, et al., 2012), but few examined the effect of exploitative or explorative B2B pattern on IOS application practice.

Peppard and Ward (2004) suggested that IS applications align with the chosen business strategies. In the exploitative e-business pattern, firms use their existing knowledge and process to enhance operational efficiency (Benner and Tushman, 2003). This pattern drives IOS applications to increase standardization and compatibility for inter-organizational process integration or knowledge sharing (Saraf, et al., 2007). It relies more on IOS integration than reconfiguration so as to direct firm investment and related resources to form IOS integration. Therefore, we hypothesize that:

Hypothesis 2A. *Higher IOS integration than IOS reconfiguration is associated with exploitative e-business pattern.*

In the explorative pattern, firms search for new knowledge, develop new products and services for emerging customers and markets to enhance the innovation performance (Benner and Tushman, 2003), which require flexible and real-time architecture of IOS application. This business pattern will directly affect IOS reconfiguration with the function of open systems and component design which could meet the business strategy requirement. Therefore, we hypothesize that:

Hypothesis 2B . *Higher IOS reconfiguration than IOS integration is associated with exploitative e-business pattern.*

3.3   IOS and B2B patterns alignment

IT applications in B2B process are effected by environmental moderators (Sinkovics and Kim, 2008), and IOS applications are supposed to be aligned with IOS resources and B2B patterns. Further, we test the moderating effect of specific e-business patterns on IOS capabilities building path in B2B environment. It has been argued that higher order capabilities are featured with dynamic attributes which are the best practices of organization operations responding to the changing environment (Leonard - Barton, 1992; Collis, 1996; Teece, et al., 1997; Zollo and Winter, 2002). According to processes-positions-paths paradigm, inter-organizational processes could deliver competitive advantage through practice of coordination, integration, learning and reconfiguration (Teece, et al., 1997). IOS integration and reconfiguration thus can be regarded as organizational and strategic routines which path dependent on continuous investment and organizational learning process. Learning mechanisms of exploitation and exploration guide the evolution of IOS applications capabilities. In current business environment, the evolution is driven by cooperative B2B patterns. Through the moderation process, firms achieve alignment between IT, complementary resources and cooperative B2B strategy. What's more, firms build high order IOS capabilities through deeper interactions. Thus, we examine the moderating effect of B2B patterns by three-ways interaction of IOS resources, organizational resources and e-business patterns on IOS application capabilities building.

In particular, when firms choose exploitative business pattern, the investment and resources are guided to build IOS integration to improve inter-organizational process efficiencies with consistency, which is facilitating in integrating inter-organizational processes and sharing knowledge to improve operational efficiency. On the other hand, the development of IOS reconfiguration is hindered in this e-business pattern, especially with close process coupling (Saraf, et al., 2007) in cooperative relationship. Thus we hypothesize that:

Hypothesis 3A . *The interaction effect of IOS resources and complementary organizational resources on IOS integration is positively moderated by exploitative e-business pattern.*

Hypothesis 3B . *The interaction effect of IOS resources and complementary organizational resources on IOS reconfiguration is negatively moderated by exploitative e-business pattern.*

IOS integration and IOS reconfiguration represent efficiency and innovation respectively, which are conceptually considered at odds with each other (Xue, et al., 2012). The constructs of IOS application capabilities reflect the paradox between the need for adaptability in inter-organizations links versus the need to maintain rich integration (Gosain, et al., 2004). Although both constructs are essential for that IOS application capabilities could balance firms' need to maintain adaptable inter-organizational electronic links, meanwhile, they help firms gain sufficient richness to support business innovation. When firms make the appropriation for capabilities development, if one side construct tends to be emphasized and fostered, the other side seems to be weakened at the same time. For example in explorative business pattern, IOS reconfiguration is prospective to deliver the innovative strategic goal and is stressed more than IOS integration by the explorative pattern, thus we propose that:

Hypothesis 4A . *The interaction effect of IOS resources and complementary organizational resources on IOS integration is negatively moderated by explorative e-business pattern.*
Hypothesis 4B . *The interaction effect of IOS resources and complementary organizational resources on IOS reconfiguration is positively moderated by explorative e-business pattern.*

4   Research Methodology

Empirical research is in progress. The measurement instrument is designed and reported in Table 2. Sample test is conducted to estimate the instrument's reliability and validity. Large-scale survey data is collecting with government support, mainly from manufacturing firms (Zhu and Kraemer, 2002). In the next step, hierarchical regression analysis will be used to assess the main effects and three-ways interaction effects (Rai and Tang, 2010; Rai, et al. 2012). Moderating effect will be measured using the methodology recommended by IS researchers (Dedrick, et al., 2008; Xue, et al., 2012). Further theoretical and practical implications will be proposed based on the empirical findings.

Constructs		Measurements	References
Second level	First level		
IOS application capabilities	IOS integration	IOSI1: data access, IOSI2: seamless connection, IOSI3: information exchange; IOSI4: databases aggregation, IOSI5: interoperable applications, IOSI6: systems compatibility.	Saraf, et al., 2007; Rai and Tang, 2010; Pavlou and El Sawy, 2010.
	IOS reconfiguration	IOSR1: systems adaption, IOSR2: extension, IOSR3: standardization, IOSR4: modular components, IOSR5: recombination, IOSR6: reusability, IOSR7: speed.	
B2B business pattern	Exploitative pattern	ELOI1: order process, ELOI2: invoice and accounts, ELOI3: purchase, ELOI4: manufacture, ELOI5: shipment and delivery, ELOI6: warehouse stock and inventory.	Subramani, 2004; Sanders, 2008.
	Explorative pattern	ELOR1: sales trends, ELOR2: customer preference, ELOR3: form new processes/functions, ELOR4: new product/service development, ELOR5: new product manufacturing, ELOR6: create new opportunity.	
	IOS resources	ITRS1: network infrastructure, ITRS2: communicate technology, ITRS3: database, ITRS4: application systems, ITRS5: support teams.	Ravichandran, Lertwongsatien, 2005.
	Complementary resources	CPOR1: cooperative contract, CPOR2: relationship, CPOR3: commitment, CPOR4: trust, CPOR5: loyalty.	Melville, et al., 2004; Rai, et al., 2012.

Table 2.   Constructs and the measurements

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