

Understanding the role of Interorganizational Systems (IOS) Characteristics on Supply Chain Integration

Research-in-Progress

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Abstract

Interorganizational systems (IOS) serve as the critical role in facilitating integration and development of unique processes across the supply chain. Previous studies on IOS attempted to examine the treatment of IOS at an aggregate level or done inconsistently. It should be noted, however, that the role of specific IOS characteristics on supply chain integration is still elusive. Drawing on the resource-based view, the objectives of this study is to identify what IOS characteristics these systems need to possess for the effectiveness of IOS and examine how these characteristics influence firms' process integration capabilities and then supply chain integration. The expected contributions and implications are discussed.

Keywords

Interorganizational systems (IOS) characteristics, supply chain integration, resource-based view.

Introduction

Supply chain integration is considered as one of critical issues to supply chain management (Chen, Daugherty, & Landry, 2009). Supply chain integration is defined as a firm's objective to attain operational and strategic efficiencies through collaboration among internal functions and with other firms (Rodrigues, Stank, & Lynch, 2004; Stank, Keller, & Closs, 2001). Therefore, supply chain integration must consider both internal and external integration (Bowersox, Closs, & Stank, 1999). The goal of supply chain integration is to achieve effective and efficient flows of products and services, information, money, and decisions, to provide maximum value to the customer (Ben Naylor, Naim, & Berry, 1999; Frohlich & Westbrook, 2001).

IT plays an essential role to facilitate both internal and external integration (Byrd, Pitts, Adrian, & Davidson, 2008; Fugate, Sahin, & Mentzer, 2006; Mentzer et al., 2001). Particularly, interorganizational systems (IOS) act as facilitators of integration and development of unique processes across the supply chain (Lyytinen & Damsgaard, 2011; Sanders, 2007; Subramani, 2004). IOS (e.g., EDI, the Internet, Sabre) are automated information systems, shared by two or more organizations, and designed to link business processes (Bakos, 1991; Steinfield, Markus, & Wigand, 2005). Thus, IOS allow firms to collaborate with their suppliers effectively and enable extensive exchange of information within the supply chain (Sanders, 2007; Subramani, 2004; Wang & Wei, 2007). Previous studies on IOS attempted to examine the treatment of IOS at an aggregate level or done inconsistently. There have been relatively few studies that examined IOS characteristics to illustrate their distinctive contribution to supply chain integration. Understanding these characteristics is essential as it is less likely that all firms would implement the same information systems or purchase the same systems from the same vendors. This heterogeneous environment creates challenges for firms within the supply chain to be connected each other and may lower the effectiveness of these systems. Therefore, IOS that firms within the supply chain intend to adopt must have specific characteristics to allow firms to facilitate collaboration.

Consequently, drawing on the resource-based view, IOS, and the supply chain integration literature, the objectives of this study is to (1) identify what IOS characteristics these systems need to possess to ensure

the effectiveness of IOS, and (2) examine how these characteristics affect firms' process integration capabilities and then supply chain integration.

The remainder of the paper is organized as follows. The next section of this paper, briefly describes the theoretical foundation for the research effort. Following that, the conceptual development and resultant hypotheses are presented. Subsequently, the detailed research methodology is described. Finally, this paper ends up with a discussion of the expected findings, along with the implications for theory and practice.

Literature Review

Resource-based view (RBV)

The resource-based view of the firms prescribes that firm resources are the main driver of firm performance and superior firm performance is attributed to the organization's ability to combine and develop resources and capabilities (Barney, 1991). Adherents of the resource-based view often define resources broadly, including those available resources, knowledge, capabilities, and processes to offer a product to market. Grant (1991) made a clear distinction between resources and capabilities and argued that resources are critical for companies because they allow companies to develop their capabilities. Resources are consist of tangible (e.g., physical plants) or intangible (e.g., knowledge, skills) that facilitate the production and delivery of services (Grant, 1991). Furthermore, Barney (1991) distinguished three types of firm resources: physical, human, and organizational capital resources. Extending the resources-based view to the IS field, IS scholars have identified IT-related resources and IT capabilities to help firms achieve competitive advantages. Previous IS researchers have defined IT resources into three dimensions: IT infrastructures, Human IT resources, and IT-enabled intangibles (Bharadwaj, 2000; Ravichandran and Lertwongsatien, 2005). With the purpose of providing a more comprehensive view for IS scholars, Wade and Hulland's (2004) seminal work suggested three dimensions of IS resoueces: outside-in, spanning, and inside-out.

To maintain sustained competitive advantage, firms must compete the basis of unique resources that are valuable, rare, imperfectly imitable, and non-substitutable (Barney, 1991). On the other hand, capabilities are routines of action in the use of assets to create, produce, and offer products to a market (Christensen & Overdorf, 2000). Specifically, it refers to a firm's capability to deploy resources using organizational processes. Therefore, a major difference between resources and capabilities is that resources are related to having while capabilities are related to doing that firms can improve effectiveness and efficiency (Bogaert, Martens, & Van Cauwenbergh, 1994). To conclude, the resource-based view relies on the framework of resource -> capability -> sustained competitive advantage. Previous studies have applied the framework of the resource-based view in various contexts to examine how firms' resources and capabilities influence firms' performance. For example, Ray et al. (2005) examined the impacts of IT on the performance of the customer service process across firms and found that tacit, socially complex, firm-specific resources explain variation in process performance across firms and that IT resources and capabilities without these attributes do not. In the supply chain context, Liu et al. (2013) examined the mediating roles of absorptive capacity and supply chain agility on firm performance and found that IT capabilities affect firm performance through absorptive capacity and supply chain agility. Additionally, Daugherty et al. (2009) found marketing/logistics relationship effectiveness as unique resources influence firms' logistics performance through information capability and firm-wide integration.

This paper focuses on elaborating the understanding of how capabilities—specifically, structural IT capabilities (IOS characteristics) and process capabilities—affect supply chain integration.

Supply chain integration

Kahn and Mentzer (1996) indicated that integration should include both interaction and collaboration since interdepartmental integration is a multidimensional process and interdepartmental relationships comprise interaction and collaboration activities. Interdepartmental interaction addresses verbal and documented exchange between departments (Kahn & Mentzer, 1996). Interaction activities include meeting, faxes, teleconferencing, and transmitted of standard documentation, representing a more structured and tangible activities (Kahn & Mentzer, 1996). Interdepartmental collaboration is the

willingness of departments work together and is an affective, volitional, mutual/shared process (Kahn & Mentzer, 1996). Much of earlier studies focused on internal inter-functional integration and emphasized that internal integration is the foundation for external integration. External integration refers to the coordination and collaboration with other supply chain members (Chen, Daugherty, & Roath, 2009; Pagell, 2004) and recognize the importance of establishing close, interactive relationships with customers and suppliers (Flynn, Huo, & Zhao, 2010).

Given the importance of supply chain integration, previous studies have examined a variety of topics to understand the composition of supply chain integration, which factors facilitate it, and the consequences of supply chain integration. For example, drawing on the contingency and configuration approach, Flynn, Huo, and Zhao (2010) examined the impact of supply chain integration and suggested the importance of internal integration and customer integration in improving operational performance. Moreover, emphasizing one dimension of integration, Zacharia, Nix, and Lusch (2009) examined the impact of supply chain collaboration on performance outcomes and found that the collaboration level between supply chain partners positively affected operational and relational outcomes, which in turn positively influenced business performance. In the setting of internal integration, Daugherty, Chen, Mattioda, and Grawe (2009) examined the relationship between marketing and logistics and found that marketing/logistics relationship effectiveness positively influenced information capability and firm-wide integration, which in turn influenced logistics performance. To conclude, supply chain integration allows firms to operate more efficiently and effectively by reducing costs, stock-outs, and lead time and can lead to competitive advantage (Gimenez & Ventura, 2003). Due to the fact that IOS are information systems shared by two or more organizations, the current study focuses on the external dimension of supply chain integration.

Interorganizational systems (IOS)

IOS are typically built around shared (having similar functionality), or common IT capabilities that facilitate the creation, storage, transformation and transmission of information across organizational boundaries (Johnston & Vitale, 1988). Previous research on IOS address three primary areas: (1) factors influencing organizational adoption of IOS (Chau & Hui, 2001; Pavlou, 2002; Teo, Wei, & Benbasat, 2003); (2) the impact of IOS on governance over economic transactions (Choudhury, 1997; Wareham, 2003); and (3) the consequence of adopting IOS (Edwards, Peters, & Sharman, 2001; Howard, Vidgen, & Powell, 2003; Sanders, 2007). Most of studies belonging to the first category rely primarily on Rogers' (2003) theory of diffusion of innovations and related theories of technology acceptance and adoption. Factors such as competitive pressures, business partner power, and support from the initiator were found to influence the adoption of IOS (Chau & Hui, 2001; Kuan & Chau, 2001; Ramamurthy, Premkumar, & Crum, 1999). Studies associated with the impact of IOS on governance draw considerably on transaction cost theory (Williamson, 1985). Most of these studies support the argument that IOS contributes to reduce product complexity, lower external search costs, and therefore permit a greater use of market-based mechanisms (Brynjolfsson, Malone, Gurbaxani, & Kambil, 1994; Choudhury, Hartzel, & Konsynski, 1998). Finally, studies of IOS consequences use a broad array of theories such as the resource-based view (Barney, 1991), resource dependency (Pfeffer, 2003), or relational exchange theory (Heide, 1994). Some benefits of adopting IOS include improved ordering, delivery, and productivity (Fearon & Philip, 1999; Ramamurthy et al., 1999). Although prior studies have covered a wide range of topics, there have been relatively few studies that examine how IOS characteristics affect supply chain integration. Thus, the current study tends to fill in this gap by discussing how IOS characteristics influence firms' process integration capability and in turn facilitate supply chain integration.

Research Model and Hypotheses

The research model of this study is shown in Figure 1. The current study posits that two characteristics of IOS –IT integration and IT flexibility– determine firms' process integration capabilities, which in turn influence supply chain integration. There are three major components in this model. The first component emphasizes IOS characteristics. The second one focuses on the focal firm's process integration capability. Given the fact that SCM is a boundary-spanning activity, previous studies suggest the process view to examine topics associated with supply chain integration (Chen, Daugherty, & Landry, 2009; Chen,

Daugherty, & Roath, 2009). Thus, this study considers two process integration capabilities to examine how these capabilities impact supply chain integration.

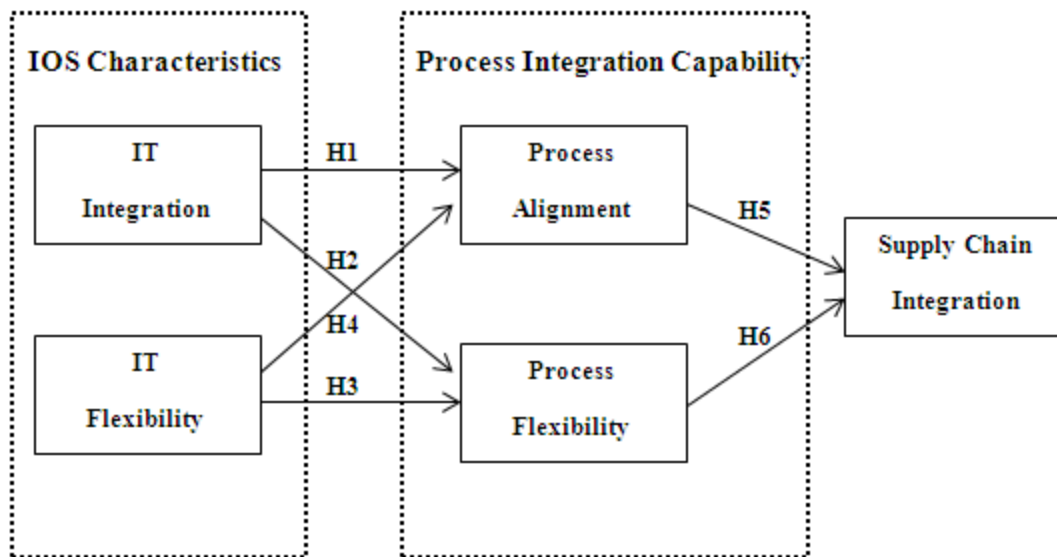


Figure 1. Research Model

Definition of key concepts

IT integration: The ability of a firm integrate data, communication technologies, and transaction and collaboration applications with its supply chain partners (Barua, Konana, Whinston, & Yin, 2004; Broadbent, Weill, & St. Clair, 1999).

IT flexibility: The ability of a firm to extend and recombine IT resources with its supply chain partners (Byrd & Turner, 2000; Ciborra, 1996; Duncan, 1995).

Process alignment: The ability of a firm to coordinate interdependence activities and optimize operations with its supply chain partners (Clark & Stoddard, 1996; Subramani, 2004).

Process flexibility: The ability of a firm to adapt to its supply chain partners and to adjust its product and service offerings in collaboration with its partners (Gosain, Malhotra, & El Sawy, 2004; Shapiro & Varian, 1998; Young-Ybarra & Wiersema, 1999).

Supply chain integration: The objective of a firm to attain operational and strategic efficiencies through collaboration among internal functions and with other firms (Rodrigues et al., 2004; Stank, Keller, & Closs, 2001).

Research hypotheses

Given the importance of IT-enabled information sharing in the supply chain, data compatibility has become an important issue to ensure the effectiveness of IOS (Dong, Xu, & Zhu, 2009; Edwards et al., 2001; Richey, Adams, & Dalela, 2012). Data compatibility is the extent to which the IOS allows the same formats, conventions, and metrics to be used by the firm and its supply chain partners (Saeed, Malhotra, & Grover, 2011). Firms that tend to adopt IOS must ensure that they and their partners have resolved differences in both the syntax and the semantics of the data and reconciled differences in the standard for data exchange (Barua et al., 2004). IT integration reflects tight linkages between the trading partners' IT infrastructures (Rai, Patnayakuni, & Seth, 2006) and enables a firm to share information, coordinate activities, and align processes with its partners (Grover & Saeed, 2007). Therefore,

H1: IT integration is positively associated with process alignment.

Process flexibility reflects the degree to which the firm responds to fluctuations in the volume and type of products the market demands and adapts to its supply partners. To achieve process flexibility, firms and

their supply chain partners require mutual adjustment in terms of their plans for sourcing, manufacturing, distribution, and logistics (Gligor & Holcomb, 2012; Lee, 2004). IT integration can facilitate mutual adjustment as it enables a firm to exchange rich information in real time with its supply chain partners (Rai et al., 2006). Therefore, H2 is posited as:

H2: IT integration is positively associated with process flexibility.

Mutual adjustment between the focal firm and its supply chain partners also can be facilitated by IT flexibility. IOS with the attribute of IT flexibility allow firms to reconfigure their current IT infrastructures and also extend IT functionality rapidly to meet the emergent collaboration needs. In addition, IT flexibility also allows the firm to accommodate the heterogeneity in IT and process standards across its base of existing and new partners (Gosain et al., 2004). Thus,

H3: IT flexibility is positively associated with process flexibility.

IT flexibility allows the firms within the supply chain to coordinate interdependence activities more effectively and efficiently as it enables the firms to adapt processes with their supply chain partners as necessary over time (Rai & Tang, 2010). In addition, because IOS with the attribute of IT flexibility enable the firms to reconfigure their current IT infrastructures more quickly, firms can leverage IOS to optimize operations with their supply chain partners more efficiently. Thus, H4 is hypothesized as:

H4: IT flexibility is positively associated with process alignment.

Process alignment provides a firm with the ability to collaborate closely with partners (Dyer & Singh, 1998; Subramani, 2004; Zaheer, Gulati, & Nohria, 2000). The firm achieves process alignment with its supply chain partners through an open channel to share operational, tactical, and strategic information (Rai et al., 2006). Information sharing is essential to supply chain integration as it allows retailers, manufacturers, and suppliers to improve forecasts, synchronize production and delivery, coordinate inventory-related decisions, and develop a shared understanding of performance bottlenecks (Chen, Daugherty, & Roath, 2009; Min et al., 2005). Consequently, process alignment provides the firm the capability to establish routines and operating procedures to coordinate processes efficiently with its supply chain partners and to learn how to improve their processes. The goal of supply chain integrate is to attain operational and strategic efficiencies through collaboration among internal functions and with other firms (Rodrigues et al., 2004; Stank, Keller, & Closs, 2001). Thus,

H5: Process alignment is positively associated with supply chain integration.

In order to survive in a dynamic environment, firms need to sense environmental change rapidly and adjust their value chain activities frequently because of changes in demand and to access valuable knowledge and resources that they themselves cannot replicate in a timely manner (Shapiro & Varian, 1998). Process flexibility allows firms to capture emerging opportunities by adjusting their supply chain partners and their market offerings in collaboration with their supply chain partners (Gosain et al., 2004). Thus, firms with higher process flexibility allow them to respond to customers' preferences and environment uncertainty more efficiently (Gosain et al., 2004; Young-Ybarra & Wiersema, 1999) and therefore facilitate collaboration with their supply chain partners. Thus, H6 is posited as:

H6: Process flexibility is positively associated with supply chain integration.

Research Methodology

This study will combine qualitative and quantitative methods to better understand the complex relationship between IOS characteristics, process integration capability, and supply chain integration. The current study will focus on the manufacturing industry. Manufacturing firms need to manage transactions and coordination with material suppliers, contract manufacturers, logistic providers, and downstream suppliers (Subramani, 2004). Therefore, emphasizing the manufacturing industry provides an appropriate context to examine the relationship between IOS characteristics and supply chain integration.

Case-based interviews at two firms will be initially conducted to validate the conceptualization of IOS characteristics and refine the instrument. A structural protocol will be followed in conducting the case studies, including a process and a set of questions that will categorize into different sections (e.g., business

context, process integration capability, IOS applications, and supply chain integration). The first one case study will include interviews with high-level managers with the responsibility of both purchasing activities and managing IT. In the second case study, managers in charge of purchasing and supply chain activities will be the targets for interviews.

An extensive literature review will be conducted to cover the content domain of each IOS characteristic, process integration capability, and supply chain integration. Measurement items from previously validated scales will be used when available. The survey instrument will be pretested with individuals from industry and academics who are familiar with IOS and supply chain integration. The items with initial purification will be presented to two case companies as described above. The respondents will be asked to clarify ambiguous and problems that occur in these items. This process will help to validate items that will be used in the second part of data collection.

In the second part of data collection, multiple online surveys will be administered. Three leading supply chain professional development associations – APICS, Council of Supply Chain Management Professionals, and Institute for Supply Management – will be contacted to get the membership lists. The dyadic relationship between the buyer and supplier will be the unit of analysis. The dyadic approach has been used extensively in previous supply chain studies because this approach could represent the most comprehensive view in the supply chain context. From the membership lists, the respondents will be asked to select an ongoing relationship with a supplier through which a particular component that is important to their production process is purchased. Logistics/supply chain executives will be the major target of the survey.

In order to achieve appropriate response rates, this study will follow Dillman's (2000) total design method for distributing the online survey. Respondents will be contacted by email and invited to participate in the research. The email will include a link to the on-line survey. An email reminder will be sent approximately 10 days after the first email. A second email reminder will be sent approximately one month later.

This study will compare early versus late response waves across items and key demographic variables for each survey sample to assess the potential non-respondent bias. The study will conduct T-test and ANOVA analysis for early and late responses. As an attempt to control for common method bias, the design of procedures (a cover letter and separating the items) and statistical controls (Harman one-factor test) will be conducted. Partial least squares (PLS) analysis will be used to validate hypotheses presented in the study.

Conclusions

IOS serves the essential role to facilitate integration and develop unique processes across the supply chain. Although previous studies on IOS have considered a wide range of topics, there are relatively few studies that focused on IOS characteristics to examine their distinctive contribution to supply chain integration. Thus, the objective of this study is to develop a theoretical perspective for gaining further insights into the role of IOS characteristics in supply chain integration. Given the fact that SCM is a boundary-spanning activity, consistent with prior studies, this study focuses on the process view to examine the relationship between IOS characteristics and supply chain integration.

Specifically, this study highlights the rich interplay between two IOS characteristics in the forms of IT integration and IT flexibility and two process integration capability in the form of process alignment and process flexibility. This study posits that the impacts of IOS characteristics on supply chain integration are mediated by firms' process integration capability. Due to the complex relationship between IOS characteristics and supply chain integration, the current study will combine qualitative and quantitative methods to better investigate this area. This combined approach will help us to represent a more comprehensive view of the role of IOS characteristics on supply chain integration.

Through the conceptualization of IOS characteristics, process integration capability, and supply chain integration, this study will have substantial implications for both research and practice. This study will contribute to the IS field's understanding of what IOS characteristics these systems need to possess to ensure the effectiveness of IOS in facilitating supply chain integration, representing a step forward in the IOS literature. This study will also have important practical implications for IT executives and top

management for better understanding their IOS investments and leveraging the effectiveness of IOS in supply chain integration.

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