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# The impact of inter-organizational information systems-enabled external integration on capabilities of buyer–supplier dyads

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ABSTRACT

Increasingly, firms are adopting two major supply chain management initiatives: to undertake external integration with supply chain partners and to implement inter-organizational information systems (IOSs). However, academic researchers have not adequately investigated effects of these types of initiatives. Using empirical data from 154 buyer–supplier dyads, we examined the direct and indirect effects (through external integration) of IOS usage on capabilities of buyer– supplier dyads. We found that external integration plays a mediating role in the relationship between IOS usage and capabilities of buyer– supplier dyad. This is the first study to investigate the effects of IOS usage and external integration on capabilities of buyer–supplier dyad.

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## 1. Introduction

Supply chain integration (SCI) can improve supply chain performance (Srinivasan, Mukherjee, & Gaur, 2011). SCI comprises internal integration within a firm and external integration (EI) with key supply chain partners (Frohlich & Westbrook, 2001; Schoenherr & Swink, 2012). Firms have gained substantial benefits by using various inter-organizational information systems (IOSs) to collaborate with their supply chain partners (Saeed, Malhotra, & Grover, 2011; Wang & Wei, 2007).

This study investigates the benefits of IOS-enabled external integration at the buyer–supplier dyadic level. Investigating this issue is important because prior researchers have reported inconsistent results. For example, some studies show that external integration with supply chain partners (EI) results in benefits such as lesser inventory, better customer service, lower cost, shorter new product development time, better delivery performance, better flexibility, better product quality, improved material flows, and ultimately superior financial results for the buyer firm (e.g., Flynn, Huo, & Zhao, 2010; Frohlich & Westbrook, 2001; Rozenweig, Roth, & Dean, 2003; Wong, Boon-itt, & Wong, 2011). Yet, some research found that SCI does not improve performance (Bask & Juga, 2001; Christopher & Juttner, 2000; Fabbe-Costes & Jahre, 2008). Moreover, several studies caution that improvements realized by buyer firms may come at the expense of their supplier units (e.g., Cousins & Menguc, 2006; Nyaga, Whipple, & Lynch, 2010). If asymmetry truly exists, it will lead to deterioration in the relationships among initially cooperating supply chain participants and eventually end up in an open conflict among participants (Radhakrishnan, David, Hales, & Sridharan, 2011). Therefore, it is imperative to investigate whether external integration at the buyer– supplier dyadic level provides benefits.

Similarly, researchers found that IOS facilitates information sharing among supply chain partners (Frohlich & Westbrook, 2001; Hill & Scudder, 2002; Saeed et al., 2011; Subramani, 2004; Vickery, Jayaram, Droge, & Calantone, 2003). IOS is defined as an information system (IS) shared by two or more organizations (Cash & Konsynski, 1985). Prior IOS studies suggest that IOS usage improves performance of buyer firms (e.g., Hill & Scudder, 2002; Liu, Wei, Ke, Wei, & Hua, 2016; Premkumar, 2000; Qrunfleh & Tarafdar, 2014; Subramani, 2004; Xue, Ray, & Sambamurthy, 2013). Despite such positive evidence, sometimes buyer firms benefit most and at the expense of their smaller suppliers (Hart & Saunders, 1997; Ghosh & John, 1999; Mukhopadhyay & Kekre, 2002). The

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asymmetric performance improvements make it unclear whether IOS usage improves the performance of the buyer–supplier dyad.

Performance benefits of EI and IOS usage should be measured at the dyadic level, but business performance of firms may be influenced by other factors that are beyond the scope of supply chain management, making the issue more complex (Chen & Paulraj, 2004; Lambert & Pohlen, 2001). These difficulties make it important to investigate measures other than business performance to establish the effectiveness of IOS usage and EI. We propose examining the impact of IOS usage and EI on joint capabilities of the buyer–supplier dyad. Capabilities are strengths experienced in the areas of cost capability, product quality, delivery reliability, and process flexibility (Radhakrishnan, Sridharan, David, Davis, & Moore, 2008).

Therefore, this study addresses the following major research questions:

1. Does IOS usage have a significant direct and indirect (through external integration) impact on the capabilities of a buyer–supplier dyad?
2. Does external integration with supply chain partners have a significant direct impact on capabilities of buyer–supplier dyad?

We restrict our study to external integration with the largest buyer unit. The largest buyer unit refers to the external customer unit that purchases a major end product in terms of dollar value (Dong, Carter, & Dresner, 2001). This means that we are considering only the dyadic relationship with the largest buyer unit and not dyadic relationship with all buyer units.

This work contributes to theory and practice in three ways. First, it focuses on the impact of the usage of IOS (both traditional and open-standard IOS) and external integration initiatives (with largest buyer) on capabilities of buyer–supplier dyad. Second, it theorizes the role of relationship-specific external integration initiatives in generating value from IOS usage. Third, the results of this study can be used to guide budget development for IOS usage because costs can vary based on whether direct or indirect effects are found.

We organize the rest of this paper as follows. In the next section, we review the different perspectives used by the operations management (OM) and information system fields and synthesize the two literature streams. Then, we present the theory leading to the hypotheses. In the research method section, we describe the process followed to empirically test the hypotheses. We then discuss the results of the study. Finally, we describe the implications of our findings for both research and practice.

## 2. Review of major research streams

Prior researchers in the operations management and information systems fields have adopted different perspectives in addressing IOS-enabled external integration.

### 2.1. OM stream

Studies on SCI recognized that there are two types of integration – internal integration within firms and external integration with supply chain partners. Several studies showed that integration is beneficial for buyer firms. Benefits include reductions in manufacturing and overhead cost, product quality, manufacturing flexibility, on-time delivery, process efficiency, inventory turns, customer service, product innovation, agility, and financial performance (Droge, Jayaram, & Vickery, 2004; Flynn et al., 2010; Frohlich & Westbrook, 2001; Rozenweig et al., 2003; Schoenherr & Swink, 2012; Swink, Narasimhan, & Wang, 2007; Vickery et al., 2003; Wiengarten, Pagell, Ahmed, & Gimenez, 2014; Wong et al., 2011; Yu, Jacobs, Salisbury, & Enns, 2013). Despite positive evidence of performance benefits of SCI for focal firms, some argue that SCI is not an effective strategy for improving performance. For instance, Bask and Juga (2001) suggested that semi-integrated supply chain strategy is a better approach than "all-embracing" supply chain integration. Bagchi, Ha, Skjoett-Larsen, and Soerensen (2005) reported a negative relationship between external integration and logistics cost, on-time delivery, and return rate for buyer firms. Power (2005, p.261) concluded that SCI does not always offer all the promised benefits. Das, Narasimhan, and Talluri (2006) showed that there exists an optimal set of external integration practices and any deviations from it led to deterioration in operational performance. Fabbe-Costes and Jahre (2008), after a detailed literature review, concluded that a higher degree of SCI does not always improve performance.

Furthermore, some studies pointed out at asymmetric performance improvements in integrated supply chains. For instance, Holmberg (2000), using a case study of a Swedish home-furnishing supply chain, showed that the self-centered attitude of downstream firms becomes a barrier to supplier performance improvement. Vinas (2001) reported that buyer firms derive more benefits in integrated supply chains. Moberg and Speh (2003) empirically showed that buyer firms derive performance benefits at the expense of supplier firms by adopting questionable business practices that lower the level of trust and commitment that supplier firms have on the buyer firms in a long run. Lee (2004) pointed out that the buyer firms derive more performance benefits while collaborating on VMI (an external integration) initiative. Fawcett and Magnum (2002), using data from field study interviews with buyer and supplier firms, reported that performance asymmetry exists and buyer firms derive all benefits and pass on only risks to supplier firms. Cousins and Menguc (2006) showed that there is no significant relationship between external integration and supplier firms' operational performance (total cost reduction, delivery schedule, quality improvement, conformance to specifications, time to market, and process improvement). Nyaga et al. (2010) showed the differences in buyer and supplier firms perspectives in collaborative relationships. Buyer firms focus more on relationship outcomes while supplier firms try to safeguard their transaction-specific investments.

In summary, it is unclear whether integration results in benefits for the overall buyer–supplier dyad. Therefore, it is imperative to investigate if there are benefits of external integration at the buyer–supplier dyadic level and not at the buyer firm level.

### 2.2. Information systems stream

IOS systems include EDI, Internet-based EDI, supply chain management systems, SRM, CRM, e-procurement systems, open-standard IOS (that uses Extensible Markup Language (XML) or Javascript Object Notation (JSON) data interchange formats), and other inter-organizational process automation systems (Bagchi et al., 2005; Craighead, Patterson, Roth, & Segars, 2006; Croom, 2005; Fawcett, Magnan, & McCarter, 2008; Magal & Word, 2012; Nurseitov, Paulson, Reynolds, & Izurieta, 2009; Qrunfleh & Tarafdar, 2014; Saeed et al., 2011; Sodero, Rabinovich, & Sinha, 2013; Zhu, Kraemer, Gurbaxani, & Xu, 2006).

EDI provides a common platform for the exchange of business documents either using value-added networks or over the Internet (Zhu et al., 2006). Some studies reported a positive relationship between EDI usage and firm level performance in terms of reduction in cycle time, order-processing costs, inventory levels, shipment discrepancies, delivery performance, and customer service

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