December 2002

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Abstract

The use of Internet, EDI, and IOS between firms and their suppliers in the supply chain context has given rise to new form of interfirm relationship, called electronic cooperation. Based on IT infrastructure capability framework, transaction cost economics, and information processing theory, this study identifies three capabilities of interorganizational IT infrastructure: (1) technological capability, (2) structural capability, and (3) informational capability. And a model and propositions are presented explaining the relationships between these three capabilities and electronic cooperation.

Keywords: Interorganizational information technology infrastructure, interfirm relationships, electronic cooperation, supply chain.

Introduction

The use of Internet, electronic data exchange (EDI), and interorganizational information systems (IOS) is now becoming an increasingly common way of doing business among organizations in the supply chain. Moreover, there are increasing numbers of studies that view these technologies as interorganizational IT infrastructure (Bensaou and Venkatraman, 1995; Broadbent, et al., 1999; Keen, 1991). Interorganizational IT infrastructure provides a common IT foundation for interfirm businesses and processes (Ross, 1997). It also provides organizations shared IT capabilities that facilitate the exchange of information, goods, and services. Such shared IT capabilities help organizations establish cooperative relationships with their partnering firms in the supply chain. Such IT-guided cooperative relationship, called electronic cooperation (Zaheer and Venkatraman, 1994), between organizations improves performance of organizations in the supply chain.

Studies in both organization and information systems (IS) areas found that there has recently been a move to cooperation between organizations and IOSI has been a significant driving force behind this trend (Bakos and Brynjofsson, 1993; Clemons, et al., 1993; Bakos and Nault, 1997). In practice, organizations, Ford and GM in the automobile industry, for example, have maintained tightly cooperative relationships with their suppliers through the help of interorganizational IT infrastructure.

In IS literature, there are several studies explaining the phenomenon of electronic cooperation. Using an economic approach or combination of economic and socio-political approaches, these studies have identified organizational/interorganizational contextual factors or behavioral/cultural factors (e.g., asset specificity, uncertainty, trust, power) and their consequences on electronic cooperation (Bensaou, 1997; Hart and Sunders, 1998; Massetti, 1991; Son, et al., 1999; Zaheer and Venkatraman, 1994). Another research stream has investigated the use of interorganizational IT infrastructure on electronic cooperation (e.g., Bensaou, 1997; Vijaysarathy and Robey, 1997; Zaheer and Venkatraman, 1994). It suggested that the greater intensity and scope of use of interorganizational IT infrastructure increases the level of electronic cooperation between organizations.

While these studies give us a better understanding on electronic cooperation, there are few studies that explore the capabilities of interorganizational IT infrastructure in formation of cooperative interorganizational relationships. Thus, the objective of this paper is to examine the impact of capabilities of interorganizational IT infrastructure on electronic cooperation.

The Capabilities of Interorganizational IT Infrastructure and Electronic Cooperation

The primary role of interorganizational IT infrastructure is to support the commonality between different IT applications or IT use (CSC Index, 1992) facilitating information sharing across organizations and cross-organizational integration (Darnton and Giacollette, 1992). Interorganizational IT infrastructure facilitates interorganizational communications, provides ready access to data, integrates business processes, and establishes electronic linkages (Ross, 1997). As a result, Interorganizational IT infrastructure improves interfirm relationships by supporting greater automated information processing and providing the opportunity for making information available to trading partners that was previously not accessible, and making information accessible in a more timely way. Interorganizational IT infrastructure enables firms to establish and maintain the relationships required for doing business within and outside the industry.

Broadbent, et al. (1996; 1999) and Weill and Broadbent (1998) identify the capabilities of IOSI as consisting of three dimensions: IOSI services, reach, and range. IT services refer to IT functionality provided IT infrastructure. Reach is described as the locations an organization can link through IT infrastructure. IT infrastructure may support organizations to link their suppliers, customers, or even competitors domestically and internationally. Finally, IT infrastructure defines the range or richness (Evans and Wurster, 1997) of information that can be shared at each level of reach. Low range limits the IT-based information sharing to simple data transfer. The ideal range would allow any IT-generated document, file, or message to be used on any information systems (Keen, 1991).

Literature in interorganizational impacts of IT were also identified several antecedent factors that are likely to influence cooperative interorganizational relationships. Based on information processing theory, Bensaou and Venkatraman (1995) stated that cooperative interorganizational relationships are derived from a number of mechanisms for interorganizational coordination, such as structural mechanisms, technological mechanisms, and process mechanisms. Van de Ven and Ferry's (1980) framework presents the situational, structural, process, and outcome dimensions of interorganizational relationships.

Cooperation, by definition, requires joint efforts or actions taken by independent firms to achieve mutual outcomes or singular outcomes (Anderson and Narus, 1990). Cooperative structure is enabled by highly customized components or integrated subsystems and thus requires high levels of interdependence between organizations. Cooperation in interorganizational relationships has been generally explained as a function of capabilities of interorganizational IT infrastructure and IS literature has called this IT-induced cooperation in interorganizational relationships as electronic integration (Kambil and Short, 1994; Malone and Crowston, 1994; Venkatraman and Zaheer, 1990; Zaheer and Venkatraman, 1994), electronic interdependence (Benasou and Venkatraman, 1995), or information partnership (Konsynski and McFarlan, 1990). Electronic cooperation lays the middle between the electronic markets (transaction-oriented markets such as stock exchanges) and electronic hierarchies (centrally directed interactions within a single firm) (Clemons and Row, 1992). According to Clemons and Row (1992), in electronic cooperation, partnering firms increase resource utilization and add value to the relationships. Electronic cooperation also involves explicit coordination through high relation-specific investment and information processing capabilities (Bensaou, 1997; Dyer, 1996; Son, et al., 1999; Zaheer and Venkatraman, 1994).

Electronic cooperation is measured as the level of an organization's dedication to its partners (Zaheer and Venkatraman, 1994). The transaction volume is most frequently used as a measure of an organization's dedication in the studies based on the transaction cost economic area. In strategic management and marketing area, cooperation is measured by sales volume flowing between dyadic partners as an objective indicator (Dyer and Singh, 1998; Mohr and Spekman, 1994).

Both transaction costs economics and information processing theory are most widely used in IS area in explaining the impacts of IT across organizational boundaries. Zaheer and Venkatraman (1994) argue that the transaction cost perspective that has served as a dominant theoretical anchor in understanding the nature of interfirm cooperation. Information processing view of organizations sees information exchange as a central phenomenon in organizations, and has contributed greatly to the understanding of information exchange behaviors that affect the development and quality of interfirm relationships (Mohr and Sohi, 1996).

By combining these three theoretical perspectives, we identify three capabilities of interorganizational IT infrastructure: technological, structural, and informational capability, and develop a model describing the relationships between these capabilities and electronic cooperation.

A Model of Electronic Cooperation

Electronic cooperation will be determined by the following capabilities of interorganizational IT infrastructure: technological, structural, and informational capability.

Technological Capability

Technological capability represents the provision of shared IT functionality on which IT applications are implemented and used. With the provision of shared IT functionality such as networking connectivity, standards for information exchange, and other supportive functionalities, interorganizational IT infrastructure increases the use of IT in business activities between organizations. The intensity and scope of IT use improves interorganizational interactions and coordination (Bensaou and Venkatraman, 1995). For example, when a retailer wishes to offer EDI-based ordering systems to buyers so that they can order directly, the retailer needs to share IT functionality for EDI connections with buyers, such as network protocols, transaction sets for document exchange, and standards for IT applications for processing transaction data (Riggins, et al., 1994). It also requires the organizations' business processes and human skills to be customized to exploit the technological capability of interorganizational IT infrastructure. As such, interorganizational IT infrastructure influences electronic cooperation in the supply chain by providing IT functionality and requiring customized business processes and human skills to organizations.

However, the consequences of technological capability In this area, success of IOSI is usually influenced by indirect measures such as IT use. IT capability determines the use of IT and the in turn, IT use effects organizational performance such as individual and organizational performance and financial measures. The same approach can be applied into the technological components of IOSI. In other words, technological dimension has impact on the structural and informational dimensions and they, in turn, influence electronic cooperation. Therefore, the technological dimension has moderating effects on electronic cooperation. This explanation is consistent with the findings of Bensaou and Venkatraman's (1995) study. In exploring the relationship between IT and information processing capabilities of organizations, they conceptualize technological dimension as the scope and intensity of IT use in the interorganizational relationships. Rather than IOSI capability itself, the interaction patterns, procedures, and behaviors derived from the use of IOSI can be used to measure organizational performance such as joint decision-making and volume of transactions.

Structural Capability

The structural dimension determines the interaction patterns or structures that characterize an interorganizational relationship. Interaction structures involve rules and procedures, direct contacts, liaison roles, integral roles, and task forces and teams (Daft and Lengel, 1986). These structures have different capacity for interorganizational coordination (Galbraith, 1977; Tushman and Nadler, 1978; Van de Ven, et al., 1976), especially due to their contributions to the nature and scope of linkages established between organizations. In general, structural capability involves the governing mechanisms that characterize interfirm relationships (Van de Ven and Ferry, 1980) by determining variety of interaction patterns between organizations, such as multiplicity, depth, breadth, formalization and centralization of interaction. These patterns direct the flow of information and capture the complex and dynamic information exchange (Mohr and Speckman, 1994). In organization studies, the structure of interfirm interactions have been widely studied as important factors that influence interfirm relationships (Van de Van and Ferry, 1980; Vijayasarathy and Robey, 1997) and as direct correspondence to the nature of electronic cooperation (Choudhury, 1997). Vijayasarathy and Robey (1997) suggest that interaction structure facilitating intensive information exchange and formalizing the interactions reveals positive association to electronic cooperation. As structural capability of interorganizational IT infrastructure support the increased the amount of information exchanged between firms in the supply chain, the equivocality and uncertainty accompanied to their relationships are reduced (Daft and Lengel, 1986) and the opportunity for taking cooperative and coordinated actions in the relationships is also enhanced (Stern and Kaufmann, 1985).

Informational Capability

Informational capability of interorganizational IT infrastructure refers to richness of interactions between organizations in that it determines the diversity of information exchange and the quality of information exchange. Interorganizational IT infrastructure that enables organizations to handle a number of distinctive information types (e,g, a variety of data types and business transaction formats), helps them to manage diversified information issues that occurred in exchanging a broad range of information. Without

IOSI's support for diversity of information exchange, organizations will confront internal information conversion issues, which can complicate and overwhelm their business transaction processes. Therefore, information diversity supports free and frequent communications with the minimum obstacles and consequently facilitates quicker joint decision-making between organizations.

In addition, when interactions between organizations involve highly embedded organizational and technical resources and capabilities, interfirm relationships require high quality of information exchange (i.e., accuracy, timeliness, adequacy, and credibility of information exchange activities) (Nohria and Eccles, 1992). Poor quality of information exchange often causes incomplete and inaccurate interactions and leads to feeling of frustration (Daft and Lengel, 1986). Poor quality of information exchange leads organizations to be reluctant to contact their partners.

Information exchange quality is expected to reduce or eliminate misunderstandings that may arise on account of errors in information exchange due to inaccurate, incomplete, and late information transmission of organizations' intentions. Therefore, it reduces the extent of conflicts in organizations (Vijayasarathy and Robey, 1997) and improves electronic cooperation between organization in the supply chain, in terms of frequency of contact and transaction volume.

Especially in interorganizational relationships area, information quality is considered as critical signal for future intentions and interpreted as an overt manifestation of more subtle phenomena such as trust and commitment (Mohr and Spekman, 1991). As a medium to manifest such intentions, interorganizational IT infrastructure, supporting quality of information exchange, is necessary ingredient for the pursuit of cooperative activities. For organizations to carry on coordinated activities in a cooperative manner, quality of information exchange comes into play (Stern and Kaufman, 1985).

A Conceptual Model and Propositions

We offer a model integrating three capabilities of interorganizational IT infrastructure and electronic cooperation, as shown Figure 1. The model incorporates the notion that the structural and information capabilities moderate the effects of technological capability on electronic cooperation in terms of frequency of contact and transaction volume. Frequency of contact as behavioral performance also directs the financial performance (i.e., transaction volume) between firms in the supply chain. Therefore, the structural and information capabilities have direct impact on frequency and transaction volume and their impacts on transaction are also mediated by frequency.

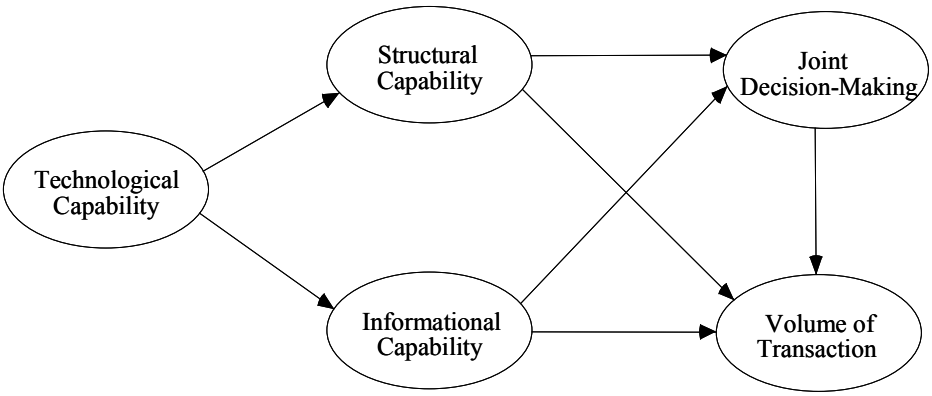

Figure 1. Conceptual Model

Based on the proposed model, the following propositions are presented:

Proposition 1: Technological capability of interorganizational IT infrastructure is related to structural capability.
Proposition 2: Technological capability of interorganizational IT infrastructure is related to informational capability.
Proposition 3: Structural capability of interorganizational IT infrastructure is related to frequency of contact.
Proposition 4: Structural capability of interorganizational IT infrastructure is directly related to transaction volume.
Proposition 5: Informational capability of interorganizational IT infrastructure is directly related to structural capability.

Conclusion

Many organizations are increasingly adopting interorganizational IT infrastructure to establish and maintain closer cooperative relationships with their partners in the supply chain. With such business environment, it is important to distinguish the capabilities of interorganizational IT infrastructure that help firms in the supply chain contribute to have good relationships with their partners. This study proposes a model and propositions explaining the relationships between capabilities of interorganizational IT infrastructure and electronic cooperation. By providing an understanding about the influence of IT capability beyond organizational boundaries, this study will provide researchers guidelines about the role of interorganizational IT infrastructure on interorganizational relationships in the supply chain context. Each path in the model can be tested by experiments.

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