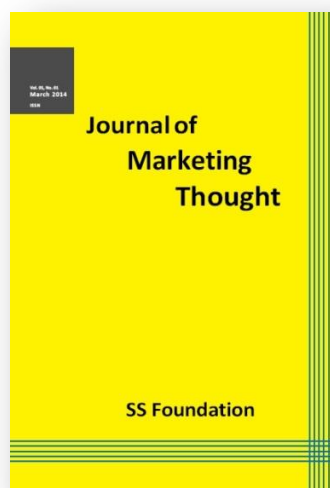


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### “How Does Electronic Data Interchange(EDI) affect the Competitiveness of a Firm’s Supply Chain Management?”

Kyu Min Hwang<sup>a</sup>, Sang Jun Lee<sup>b\*</sup>

a. Ph.D Candidate, Department of Business Administration, Sungkyunkwan University

b. MS Candidate, Department of Business Administration, Sungkyunkwan University

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Kyu Min Hwang, Sang Jun Lee\*

# How Does Electronic Data Interchange(EDI) affect the Competitiveness of a Firm's Supply Chain Management?

**N**owadays, the success of a firm increasingly depends on working efficiently and effectively with others in the supply chain. As such, supply chain management is considered to include activities such as supplier partnerships, outsourcing, cycle time compression, continuous process flow, and information sharing (Li et al., 2006). However, it is extremely difficult to enable and coordinate seamless data flows across organizational boundaries.

An inter-organizational system (IOS) commonly refers to an electronic data interchange (EDI) that conducts inter-organizational exchange of business documentation in a structured, machine-readable form (Vijayasathiy et al., 1997). IOS is an IT-based or human-based information exchange systems that enables collaboration between independent exchange parties (Kumar et al., 1996). Previously, an IOS mainly supported automation of manual processes including ordering, settling acco 10.15577/jmt.2016.03.02.2 and new features, such as information sharing, communication, and collaboration, have now been integrated into IOS (Icasati-Johanson and Fleck 2003).

The IOS is designed to reduce supply chain uncertainty and transaction costs, increase resource utilization, and diffuse products and services into new markets (Malhotra and Gosain and El Sawy 2005). Therefore, firms that implement IOS facilitate collaboration and manage potential conflict through electronic integration (Robey et al., 2008). Still, information systems greatly facilitate interfunctional exchange and promote a joint understanding (Bharadwaj, Bendoly 2007).

Recently, most firms have used EDI to exchange infor-

mation with one another to improve their performance. However, not all of cases have produced positive outcomes. Some implementations may result in high performance and some may not. These different outcomes are mainly the result of technology acceptance, interfirm governance, or the occurrence of unexpected circumstances. This is why information systems have become more important for supply chain management.

Environmental uncertainty and behavioral uncertainty negatively impact transaction costs (Rindfleisch and Heide 1997), and high transaction costs, such as the cost of negotiating and writing contracts and monitoring and enforcing contractual performance, lower the firm's performance. To this end, the contribution of this study is to identify the effect that EDI has in supply chain management when in uncertain environments.

## Conceptual Framework

According to transaction cost theory (Williamson 1985), environmental uncertainty and behavioral uncertainty negatively impact the transaction costs. Human beings have bounded rationality that limits their cognitive capabilities as decision makers, which means they have limited information processing and communication ability (Simon 1957).

Thus, the constraints that the firm faces become problematic in uncertain environments with behavioral uncertainty (Hult, Christopher and Ketchen 2010).

### **Unified Theory of Acceptance and Use of Technology (UTAUT)**

Venkateshet et al., (2003) developed UTAUT by unifying eight acceptance models: theory of reasoned action, technology acceptance model, motivational model, theory of planned behavior, combined TAM and TPB, model of PC utilization, innovation diffusion theory, and social cognitive theory. By combining these theories, they defined four key constructs that influence the behavioral intention of using technology.

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Kyu Min Hwang

Ph.D Candidate, Department of Business Administration, Sungkyunkwan University

Sang Jun Lee\*, Corresponding Author

MS Candidate, Department of Business Administration, Sungkyunkwan University

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The four constructs of UTAUT are performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkateshet et al., 2003). Performance expectancy is the degree to which an individual believes that using the systems will help him or her to attain gains in job performance; effort expectancy refers to the degree of ease associated with the use of the system; social influence is defined as the degree to which an individual perceives it is important others believe he or she should use the new system; and facilitating conditions is the degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system.

### Electronic Data Interchange (EDI)

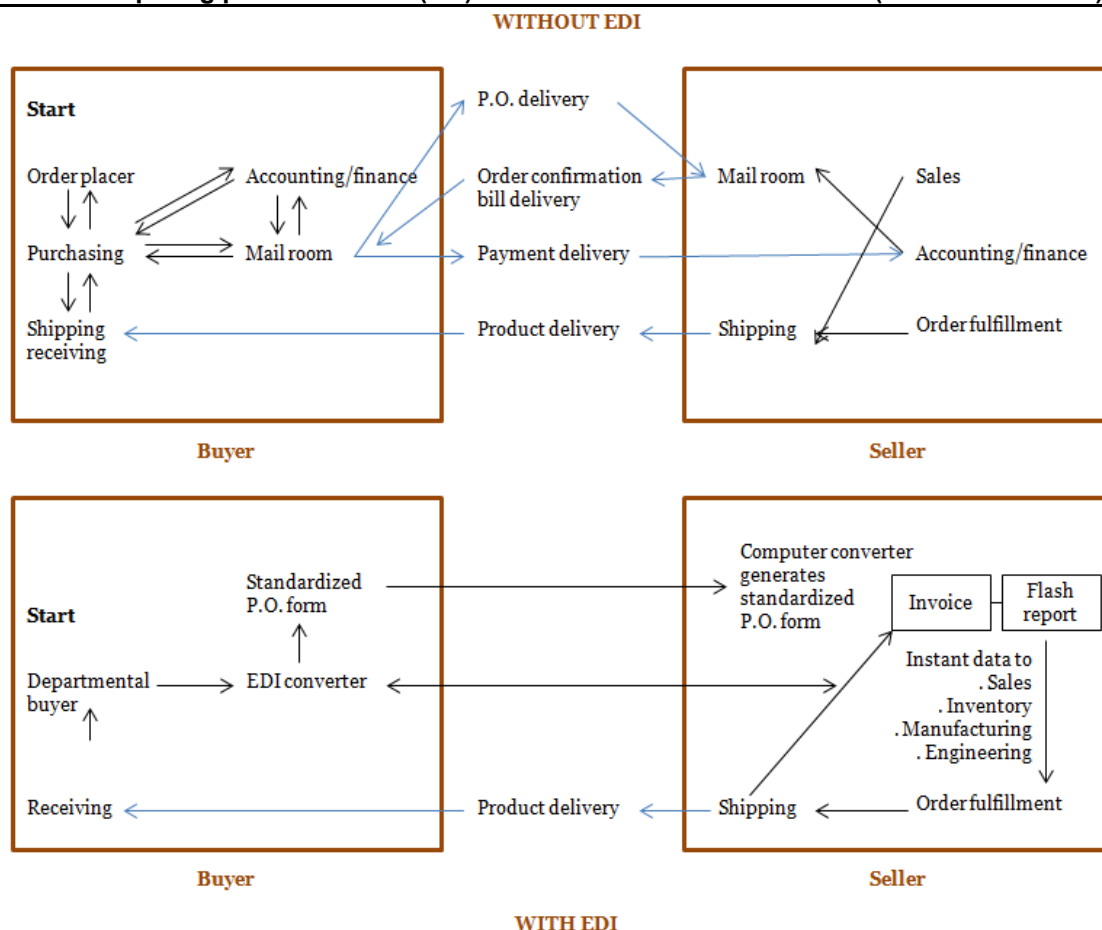
EDI is defined as the computer-to-computer transmission of standardized business transactions (Hill 2002). EDI enables firms to replace traditional modes of document exchange, such as for purchase orders, invoices and so on. EDI formats

the documents according to agreed-to standards and then transmits messages over the Internet using a converter as a translator rather than using e-mail, facsimile or other conventional methods (Vijayasarathy et al., 1997). EDI is an important factor that resolves problems that may occur in a supply chain.

A supply chain consists of the flow of materials, information, money and services from raw materials, through manufacturing, to the end users (Rainer et al., 2014). Thus, firms in the supply chain increasingly concentrate on improving their core competencies and their flexibility. To accomplish these objectives, they rely on having a healthy relationship with their exchange partners, rather than depending only on themselves (Rainer et al., 2014).

Supply chain management improves processes from acquiring raw material that a firm uses until goods are delivered to end users (Rainer et al., 2014). This means that planning, organizing, and optimizing activities occur along the supply

**FIGURE1**  
**Comparing purchase order (PO) fulfillment with and without EDI (Rainer et al. 2014)**



<sup>1</sup> Interpersonal relationships are conceptualized as the degree to which a close and personal relationship exists between boundary personnel in the transacting organizations (Marsden and Campbell 1984; Uzzi 1997).

chain, mainly focusing on coordinating with exchange partners (Lee et al., 2004). One of the most important coordination mechanisms in supply chain management is information sharing among the members of a common supply chain.

Previous studies have stated the economic advantages of using EDI (Kumar et al., 1996; Scala et al., 1993), including a reduction in inventory costs, improved accuracy and speedy communication, increased market share, and elimination of labor-intensive tasks. EDI minimizes data entry errors, shortens message length, secures messages, reduces cycle time, increases productivity, and improves customer service (Rainer et al., 2014).

Figure 1 compares the process of fulfilling a purchase order with and without EDI. By more effectively and efficiently exchanging information within the value chain, the EDI helps established firms achieve both lower transaction and production costs (Vijayasarathy et al., 1997). EDI also improves inter-firm relationship and leads to a higher satisfaction and performance (Vijayasarathy et al., 1997). All of the economic advantages of EDI are dependent upon the effects of EDI on the relationships among the partners (Vijayasarathy et al. 1997).

### **Transaction costs**

Transaction costs are the costs of negotiating and writing contracts and monitoring and enforcing contractual performance (Williamson 1975). The transaction efficiency is achieved by reducing the costs of negotiation, of monitoring the partner, and of enforcing the exchange partner to do what was promised (Bowen and Hones 1986).

Internal transactions can also generate costs when measuring the performance of the exchange partner because exchange parties may spend time to gather information and evaluate the performance of partners.

### **Environmental uncertainty**

Environmental uncertainty has been viewed as a major problem in an organization (Buchko 1994). Environmental uncertainty is defined as a perceived inability to accurately predict an organization's environment due to a lack of information or an inability to distinguish between relevant and irrelevant data (Millikan 1987) regarding a firm's external environment, such as competitor's actions, technology, and consumer's tastes and preferences (Flynes et al., 2004). These changes require the firm to develop capabilities to adapt and understand the environment. A firm needs to reshape the strategies and use different rules to adapt to uncertain environments (Srinivasan, Mukherjee, and Gaur 2011).

The decision makers in a firm have restricted cognitive capabilities and bounded rationality. Even decision makers that mean to be rational face limitations due to their limited information processing and communication abilities (Simon 1957). Thus, firms feel uncertainty when they face changes in the environment. External uncertainty is viewed as a feature of market failure (Klein S. et al., 1990). This failure is caused by information asymmetry which provides exchange parties an opportunity to take advantage of information advantage and behave opportunistically (Klein S. et al., 1990).

When a firm acts opportunistically in the supply chain,

the exchange parties face trading difficulties (Wathne et al., 2000), and this generates transaction costs. External uncertainty is an environmental unpredictability where the environment shifts in unforeseen ways. In an uncertain environment, exchange transactions occur less smoothly than in stable environments (Anderson and Schmittlein 1984). As environmental uncertainty increases, different expectations and goals develop regarding future participation (Artz, Brush 2000), and each firm is likely to desire different contract terms to protect the firm.

An uncertain situation results in firms protecting themselves through various means. For instance, they may want different contract terms that result in higher negotiating costs. Thus, when firms feel environmental uncertainty, they tend to incur higher transaction costs than when in stable environments. We therefore propose

**H1: Environmental uncertainty brings high transaction costs.**

### **Behavioral uncertainty**

Behavioral uncertainty is also known as internal uncertainty, and it comprises a performance evaluation problem (Rindfleisch and Heide 1997). When performance cannot be easily evaluated, it is inefficient to use markets because it is hard to define rewards (Anderson 1985). Organizations can reduce problems by monitoring behavior and using an evaluation of such as the basis of rewards. However, performance can be difficult to assess at the individual level when responsibility is shared by a team (Anderson 1985).

Within a firm, behavioral uncertainty occurs for a couple of reasons (Anderson and Schmittlein 1984). First, it is infeasible to accurately record an individual's performance. When records are measured and recorded at the team level, it is difficult to measure the individual's performance. Second, performance itself cannot be a simple, readily measurable item. When performance is not easy to evaluate, imperfect input measures and a manager's subjective judgment are preferable.

Opportunism is defined as self-interest seeking with guile (Williamson 1985). This includes but is not limited to more blatant forms such as lying, stealing, and cheating. More generally, opportunism refers to incomplete or distorted disclosure of information, especially when performing "calculated efforts to mislead, distort, disguise, obfuscate, or otherwise confuse" (Williamson 1985). Opportunism is inherent in many transactions and is also an important assumption underlying the theory of transaction costs. When a firm feels behavioral uncertainty, the firm is exposed to a risk of opportunism (Heide and John 1990), and thus, the firm might seek measures to reduce the risk of opportunism.

It is difficult to observe the output measures when a firm feels behavioral uncertainty. Then, the relationship between the inputs and outputs becomes ill-understood (Anderson E. et al., 1986). When this happens, a firm can not only monitor the input accurately, but can also precisely evaluate the output. According to the degree of such behavioral uncertainty, a firm is exposed to a risk of opportunistic exploitation (Heide and John 1990). Opportunistic behavior increases transaction costs, including monitoring costs. In sum,

transaction costs increase as behavioral uncertainty increases.

**H2:** Behavioral uncertainty brings high transaction cost.

### **The Performance of Supply Chain Management**

Supply chain management has been described in various forms, and its activities generally comprise six categories, including supply chain integration, information sharing, supply chain characteristics, customer service management, geographical proximity and JIT capability (Tan et al., 1998; Li et al., 2006).

The short-term objectives of SCM are primarily to increase productivity and reduce inventory and cycle time, and the long-term objectives are to increase market share and profits for all members of the supply chain (Li et al., 2006). Basically, a firm should be concerned with reducing or even elimination uncertainties to achieve its goal and meet objectives (Van Der Vorst et al. 1998).

EDI, a specific form of inter-organizational systems, has the potential to significantly influence business operations by exchanging business documents in a number of industries and providing substantive tangible and intangible benefits to participating firms (Ramamurthy et al., 1999). Therefore, those who use EDI to communicate with each other bring about a higher performance than those who do not use EDI. Thus, success is influenced by the extent to which EDI is diffused and used (Ramamurthy et al., 1999).

In transaction cost theory, the purpose of a firm is to minimize the sum of total production and transaction costs (Williamson 1985). For that, a firm requires deeper, more cooperative responses that are available through conscious, deliberate, and purposeful coordination within a firm (Leiblein 2003). Without such coordination, a firm will face a high level of transaction costs, such as when negotiating

and writing contracts and monitoring and enforcing contractual performance. Thus, those transaction costs will negatively impact the performance of the firm. Thus,

**H3:** High transaction cost will negatively affect performance.

The competitive environments somehow forces a firm to facilitate EDI adoption. The use of EDI improves data timeliness, information lead time and decision process time (Van Der Vorst, et al. 1998).

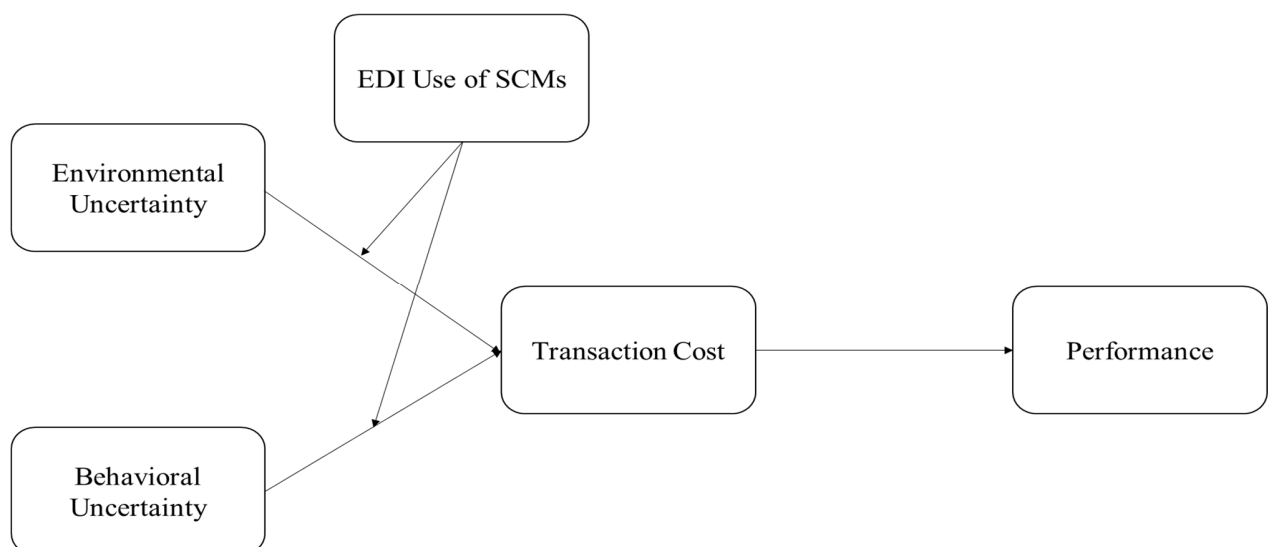
Although environmental uncertainty negatively impacts performance, the use of EDI allows the firm to improve its competitiveness through real-time control. Since data timeliness, information lead time and decision process time improve, forecast errors also decrease. A reduction in lead time by 50% has been determined to results in a reduction of the forecast error by 50% (Van Der Vorst et al., 1998). Thus, the adoption of EDI will moderate the negative impact of environmental uncertainty on performance.

Behavioral uncertainty is a result of the performance of an individual that cannot be easily evaluated within a firm. EDI is an information sharing system, and it is the easiest way to identify and track down the information flow (Dearing 1990). EDI helps the firm identify who has responsibilities for certain job, and in this way, the firm can measure, accurately record and reward individual performance to reduce behavioral uncertainty. Therefore, EDI will reduce the negative impact of behavioral uncertainty on performance.

**H4:** The use of EDI will reduce (mediate) the negative impact of environmental uncertainty on performance.

**H5:** Use of EDI will reduce (mediate) the negative impact of behavioral uncertainty on performance.

**FIGURE2**  
**Uncertainty, EDI use, Transaction Cost, Performance Research Model**



## Conclusion

Firms that simultaneously explore two ways of using IT in their supply chain management may face undesirable uncertainties. They may face a managerial challenge or a technical risk due to the limitation in their search activities (Lavie and Rosenkopf 2006). This research uses two IT-based methods to show the mediating effect between environmental uncertainty, behavioral uncertainty and transaction costs as well as the moderating effect of using EDI on the effect of environmental uncertainty on transaction costs.

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