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# The Impacts of Electronic Collaboration and Information Exploitation Capability on Firm Performance

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## Abstract

This study focuses on electronic collaboration based on inter-organizational information systems (IOIS), particularly between dominant buyers and their suppliers. From the suppliers' perspective, we examine ways to achieve higher performance by increasing the extent to which they proactively participate in business activities using IOIS. We propose that electronic collaboration consists of two major activities: electronic information sharing (EIS) and electronic cooperation (ECo). This study investigates the extent of EIS and ECo that suppliers contribute to their development of information exploitation capability (IEC), which enables them to internally utilize information and knowledge created from electronic collaboration. In addition, we test the effects of electronic collaboration activities and IEC on firm performance. We collected surveys from 169 firms and used Structural Equation Model analysis. We found that EIS and ECo are major sources to develop IEC, and that both ECo and IEC lead to improved company performance.

**Keywords:** Electronic Information Sharing, Electronic Cooperation, Information Exploitation Capability

## Introduction

In buyer-supplier relationships, firms with relative power implement IOIS to do business with suppliers that are SMEs (Hart and Saunders 1998). Relatively less powerful firms have to use IOIS to maintain business with powerful firms. Many studies focused on such relationships try to explain key factors to encourage suppliers to adopt IOIS or to discover prior determinants to increase the level of usage (Hart and Saunders 1998, Iacovou et al. 1995). Although these studies focused on the supplier's perspective in a dyadic relationship, they did not explain that suppliers can also obtain benefits and develop capabilities to differentiate them from competitors by participating in electronic collaboration based on IOIS. More recently, a few researchers have recognized the importance of the suppliers' benefits drawn from IOIS, and have verified the evidence that the benefits they can obtain would be increased if suppliers increased their use of IOIS (Mukhopadhyay and Kekere 2002, Subramani 2004).

Nowadays, IOIS is recognized as a general infrastructure, which enables suppliers to transact beyond the boundaries among trading partners. Therefore, IOIS in itself cannot be a unique or proprietary means in creating differential advantages. In order to obtain superior benefits or create differential capabilities by utilizing IOIS, both buyer and supplier make efforts to expand the scope and extent by exploiting IOIS beyond merely adopting it.

This study explores the following objectives: first, we examine suppliers who obtain benefits by proactively engaging in electronic collaboration based on IOIS. In our study, electronic collaboration consists of two major activities: electronic information sharing and electronic cooperation. Electronic information sharing (EIS) refers to the extent to which suppliers

share information for transactions with buyers using IOIS. On the other hand, electronic cooperation (ECo) refers to the extent to which suppliers take part in the decision making process to coordinate common issues related to transactions or deal with emerging problems in the relationships. In this study, we test the effects on firm performance of two activities in electronic collaboration.

Second, we propose the concept of information exploitation capability (IEC), and empirically test its role and impact on firm performance. IEC means the ability to internally exploit information or knowledge derived from electronic collaboration based on IOIS. We posit that IEC plays a mediating role between the electronic collaboration and firm performance. Only a few suppliers can benefit from IOIS. We suggest that if all suppliers make an effort to improve and practice this ability, their performance will improve. Therefore, suppliers have the capability to create differential advantages.

## **Literature Review**

### ***Adoption vs. Strategic Use of the IOIS***

Although a vast number of studies regarding IOIS have been carried out over the last decade, most of them focus on the determinants of IOIS adoption/integration or highlighted dimensions of IOIS use such as volume, diversity, breadth, depth, and scope (Bensaou and Venkatraman 1994, Massetti and Zmud 1996, Teo et al. 2003, Zaheer and Venkatraman 1994). Recognizing that the adoption of IOIS infrastructure is widely in use, firms are making an effort to seek new ways to exploit it strategically beyond simply adopting it. Few studies focused on the exploitation or expansion of the extent of applying the IOIS have emerged. DeSanctis and Poole (1994) suggest that appropriateness, which refers to the patterns of IT use, can lead to diverse outcomes, even when the context of use and underlying technologies are similar. Subramani (2004) asserts that suppliers can obtain higher operational and strategic benefits and competitive performance through greater relationship-specific investments. Specially, he noticed the importance of intangible investments on improving benefits of suppliers, which are divided into two types i.e. business process specificity and domain knowledge specificity. In addition, he suggests that the patterns of IOIS utilization i.e. exploration and exploitation lead to relationship-specific investments. While exploitation is the extension or elaboration of old certainties and its goal is to improve operational efficiencies, exploration is the pursuit of new possibilities and its goal is to learn about the environment and discover novel ways of creating value or solving old problems. Consequently, IOIS use for exploitation is dominant in enabling the creation and deployment of co-specialized business processes, and IOIS use for exploration is dominant in enabling the development and use of specialized domain knowledge.

### ***Firm's Performance***

Suppliers utilizing IOIS as well as the firms implementing it could improve their performance and the scope of gains would go beyond operational level toward strategic level (Mukhopadhyay and Kekre 2002, Subramani 2004). Mukhopadhyay and Kekre (2002) suggest suppliers can obtain operational and strategic benefits through the efforts to enhance the utilization of IOIS. Subramani (2004) verifies that suppliers can acquire operational, strategic, and competitive benefits through the proper combination of IOIS use-exploitation and exploration and relationship-specific intangible investments. Operational benefits are related to achievement of cost-efficiency, creation of new process to reduce redundancy, improvement of existing process, profit increase, etc. On the other hand, strategic benefits are related to how we understand buyers and the market, the creation of new opportunities through the improvement of relationship etc. Competitive benefits refer to enhance market share and sales with trading partners.

### ***Electronic Collaboration***

Prior research has identified a variety of governance mechanisms that protect a firm with relationship-specific investments from opportunistic behavior by its partner (Rindfleisch and Heide 1997). These include formal contracts, pledges, information sharing, supplier verification, joint planning, monitoring, quasi integration, electronic integration, and cooperation (Bensaou 1997, Subramani and Venkatraman 2003). According to Sheu et al. (2006)'s case study, major activities in buyer-seller relationships are indicated as information sharing, inventory systems, supply chain coordination structure, and

IT capabilities. Many researchers have tried to explore the degree of collaborative joint activities in buyer-seller relationships (Bensaou 1997, Heide and John 1990, Subramani and Venkatraman 2003), however they do not consider collaborative joint activities capable to conduct based on IOIS.

This study is in line with previous research and contributes a new form of governance mechanism to transaction-cost theory. This study is an expansion, suggesting the two activities - electronic information sharing and electronic cooperation - in electronic collaboration as a new form of the governance mechanism. We examine whether IOIS could support the collaborative joint activities conducted in online and off-line based relationships. A supplier could increase the opportunity of coordination improvement through information sharing (Hart and Saunders 1997). Economic utility on IOIS and benefits from electronic collaboration can be other clues for explaining operational alliances between buyers and suppliers.

### **Electronic Information sharing**

While exchanges of coordination information like stock, logistics, and production enable suppliers to increase efficiency, exchanges of confidential and exclusive information contribute to create differential advantage (Malhotra et al. 2005). Dyer and Chu (2003) also suggest that confidential, proprietary information sharing (e.g. product design, production cost, business process innovation etc.) is related to the high level of relationship. Bensaou (1997) argues that information sharing can lead to higher collaborative activities in the dyadic relationship.

### **Electronic Cooperation**

In asymmetric dyadic relationships, Subramani and Venkatraman (2003) suggest that suppliers make an assurance of relationship-specific investments and continue to keep business with a buyer having a relative power, by quasi integration and joint decision making which are referred to as the governance mechanisms. Quasi integration is related to the extent to which suppliers' business activities are connected with a buyer, and joint decision-making is related to the extent to which suppliers make a decision jointly about the common issues regarding the exchange. They argue that joint decision making is more effective in protecting the relationship with a buyer.

Bensaou (1997) define inter-organizational cooperation as the extent of conducting joint activities in linkage with the transaction. Joint activities include long-term planning, product planning, product engineering, technical support, training and learning etc. IOIS could be a major tool to enable suppliers to coordinate and enhance cooperative activities in the relationship. In our study, we suggest electronic cooperation as one of the key factors in composing electronic collaboration based on IOIS. Electronic cooperation is defined to the extent to which suppliers take part in decision-making process to coordinate common issues associated with transaction or to deal with emerging problems in the relationships.

### ***Information Exploitation Capability***

Cohen and Levinthal (1990) argued that the ability of a firm to recognize the value of new, external information, assimilate it, and apply it to commercial ends is critical to the firm's innovative capabilities, that is, absorptive capacity. They defined the concept of a firm's absorptive capacity and suggested that it is largely a function of the firm's level of prior related knowledge.

Zahra and George (2002) proposed a reconceptualization of absorptive capacity as a dynamic capability pertaining to knowledge creation and utilization that enhances a firm's ability to gain and sustain competitive advantage. They also suggest that absorptive capacity exists as two subsets of potential and realized absorptive capacity. Potential capacity comprises knowledge acquisition and assimilation capabilities, and realized capacity centers on knowledge transformation and exploitation capabilities.

As most of the firms have utilized an IOIS for the exchange with trading partners, the utilization of it in itself couldn't give competitive advantage anymore, and they seek to develop their unique capabilities to differentiate them from competitors. There are emerging studies that find firm's new capabilities in the IOIS field. Dyer and Singh (1998) extend the concept of absolute absorptive capacity of a firm to relationship-specific absorptive capacity created in dyadic relationships. The latter refers to the dynamic capability of a firm to identify valuable knowledge created in the relationships, assimilate it into its unique internal business process, and utilize it to obtain relational advantage. Christiaanse and Venkatraman (2002) offer the concept of expertise exploitation capability which means the ability of a firm to combine external data with internal procedures to generate a distinctive capability

Based on the above studies related to the capabilities, we suggest suppliers could develop information exploitation capability

(IEC) which is the ability to recognize valuable information and knowledge from electronic information sharing and electronic cooperation in electronic collaboration, and to utilize it in decision-making processes or internal operations in order to get better performance. Zahra and George (2002) suggest that internal sources (e.g. related prior knowledge) and various external sources of knowledge (e.g. inter-organizational relationship, licensing contract, R&D consortium etc.) can be sources to develop the absorptive capacity. The more opportunities suppliers are exposed various sources capable to obtain the knowledge, the more they utilize it in developing capabilities. We assume that IEC is affected by two activities in electronic collaboration.

## Research Model and Hypothesis

The research model is developed to examine the electronic collaboration based on IOIS in a dominant buyer-supplier relationship, and focuses on the perspective of a supplier. In such a relationship, does a supplier improve performance by participating in electronic collaboration? Only if a supplier increases the extent of participation in electronic collaboration, could it obtain the higher performance? In this study, we suggest that IEC plays a mediating role between electronic collaboration and firm performance. We contend that a supplier can obtain high performance through the effort to develop the ability to exploiting information and knowledge. The model hypothesizes that the two constructs in electronic collaboration affect the IEC and performance of a firm.

In this model, we don't hypothesize about the direct relationship between EIS and firm performance. There is a limitation for suppliers to increase their performance by just sharing information related to transactions. The exchanges of excessive information without confidential and proprietary information could result in inefficient management of that information. Nevertheless, EIS is a fundamental factor that leads to higher collaborative activity like ECo.

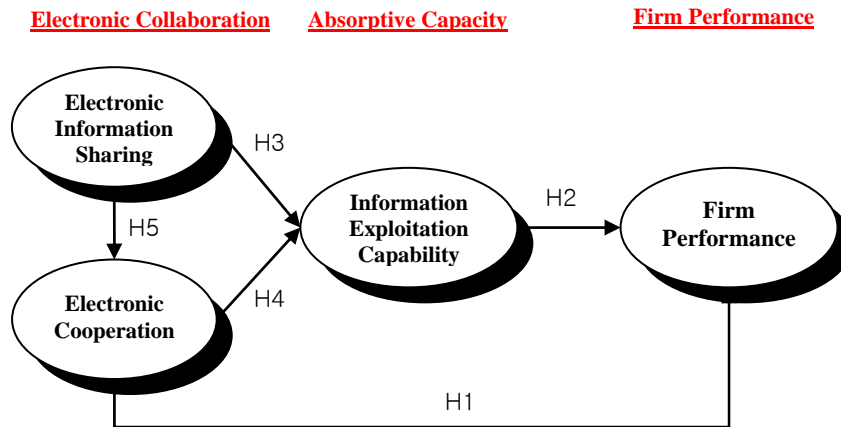


Figure 1. Electronic Collaboration with IOIS

Malhotra et al. (2005) conceptualized a firm's absorptive capacity in buyer-supplier relationships as a mediator variable between activities for information exchange and a firm's outcomes such as operational efficiency and knowledge creating. According to Malhotra et al. (2005), the firm's outcomes obtainable from the relationships depends on its' capability to acquire, assimilate, transform, and exploit various information created through capability platform, which includes integrative inter-organizational process mechanisms, partner interface directed information systems, and information. They asserted the importance of IT infrastructure and integrative inter-organizational processes (e.g., joint decision making, inter-organizational process modularity, and standard electronic interfaces), in developing a firm's absorptive capacity.

Based on prior research, we expect that IEC could play a mediating role between collaborative joint activities -electronic information sharing and electronic cooperation- and a firm's performance. In other words, the external information created from electronic collaboration activities could be a source of developing higher capability of the suppliers in vertical buyer-supplier relationships over competitors.

This assertion is in accord with studies of Cohen and Levinthal (1990), Dyer and Singh (1998), and Zahra and George (2002).

They emphasized that internal and external information could be a source of developing various capabilities of a firm. Besides, to exchange information drawn in buyer-seller relationships, it can be beneficial to develop information sharing activities and common integrative efforts using IOIS as a major common infrastructure.

In this study, we propose five hypotheses as following:

- H1: The greater the electronic cooperation based on IOIS in a buyer-supplier relationship, the greater the positive effect on the performance of a firm.
- H2: The higher the capability of information exploitation within a firm, the better the performance of the firm.
- H3: The more the sharing of electronic information based on IOIS in a buyer-supplier relationship, the higher the information exploitation capability of a firm.
- H4: The greater the electronic cooperation based on IOIS in a buyer-supplier relationship, the higher the information exploitation capability of a firm.
- H5: The greater the electronic information sharing in a buyer-supplier relationship, the higher the cooperation of a firm.

## Methodology

### *Instrument development*

A seven-point Likert scale (from strongly disagree to strongly agree) was utilized to measure the questions regarding E-Collaboration, IEC, and performance. Operationalization of the constructs is shown in Table 1.

**Table 1. Measurement Items and Related Prior Researchers**

Constructs		Items	Researchers
Electronic Information Sharing	inf1	The extent to which a firm exchanges operational information with IOIS.	Dyer and Chu (2003), Nishiguchi (1994), Selnes and Sallis (2003), Subramani and Venkatraman (2003)
	inf2	The extent to which a firm exchanges product related information (e.g. product specification, technology, design, stock) with IOIS.	
	inf3	The extent to which a firm exchanges a variety of information from a transaction with IOIS.	
	inf4	The extent to which a firm exchanges information from an IOR with IOIS.	
Electronic Cooperation	ra1	The extent to which a firm participates jointly in a decision making process to solve problems that happens in a transaction with a dominant buyer using IOIS.	Heide and John (1990), Subramani and Venkatraman (2003), Bensaou (1997)
	ra2	The extent to which a firm coordinates transactions jointly with a dominant buyer using IOIS.	
	ra3	The extent to which a firm copes with problems that happened from a transaction with a dominant buyer jointly using IOIS.	
	ra4	The extent to which a firm performs efficient exchange with a dominant buyer using IOIS.	
Information Exploitation Capability	cap1	The extent to which a firm can perform key business processes effectively when utilizing information obtained from IOIS.	Christiaanse and Venkatraman (2002), Zahra and George, (2002), Malhotra et al. (2005)
	cap2	The extent to which business processes can be operated efficiently by a firm utilizing information obtained from IOIS.	
	cap3	The extent to which a firm makes important decisions within utilizing information obtained from IOIS.	
	cap4	The extent to which a firm makes a plan or a strategy utilizing information obtained from IOIS.	
Firm Performance	per1	The extent to which a firm can perform order and delivery management utilizing IOIS.	Subramani (2004), Mukhopadhyay and Kekre (2002)
	per2	The extent to which a firm can manage transactions efficiently utilizing IOIS.	

	per3	The extent to which a firm can decrease re-input or correct errors of data input.	
	per4	The extent to which a firm can improve processing of an order.	

### Data Collection

To empirically test the proposed research model and hypotheses, we conducted both internet-based and paper-based surveys simultaneously on the suppliers using an IOIS implemented by a dominant buyer. Our target was the representative or the person in charge of the transactions with the buyer. At the beginning, we contacted the representative managing the suppliers in buying companies to get information about them. We asked managers in buying companies to encourage suppliers to take part in this survey. The managers sent emails to their suppliers, containing a hyperlink to the website for the online survey. In online survey, we received responses from 113 organizations. Simultaneously, we were conducting a paper-based survey on the representatives of suppliers. As a result, we received 56 responses. A total of 169 responses were used for analysis.

### Results

The research model and five hypotheses presented earlier were tested collectively using the structural equation modeling (SEM) approach, also verified by SPSS LISREL 8.54.

#### Demographics and descriptive statistics

The sample comprised small and medium-sized firms: 35.8 percent of the firms had less than 10 employees and about 59 percent of the firms had less than 30 employees. By industry, 22 percent of the firms were part of electronics industry, 17.3% were part of the machine/metal/steel industry, 16.7% were part of the wholesale and retail industry, and 14.3% were part of the construction industry. The means, standard deviations, Cronbach's a, AVE, and correlations of the constructs are in Table 2.

**Table 2. Descriptive Analysis, Cronbach's a, and Correlations**

Construct	Items	Mean	SD	Cronbach's a	$\sqrt{AVE}$	Inter-Construct Correlations(phi matrix)			
						EIS	ECo	IEC	Per
EIS	4	5.037	1.131	0.902	0.839	1			
ECo	4	4.649	1.197	0.915	0.870	0.73	1		
IEC	4	4.951	1.128	0.920	0.898	0.67	0.69	1	
Per.	4	5.075	1.147	0.912	0.877	0.64	0.56	0.59	1

<note. SD: standard deviation, Per.: Firm Performance>

#### Evaluating the Measurement Model

Four multiple-item constructs –electronic information sharing, electronic cooperation, information exploitation capability, firm performance- were subject to confirmatory factor analyses (CFA) using LISREL 8.54. The validity of the constructs was assessed in terms of unidimensionality, convergent validity, internal consistency, and discriminant validity. Table 3 presents the results of CFA and goodness of fit indices for the measurement model. Except for the RMR index, which was slightly higher than the criterion of .05, all indices were above their criterion levels. Standardized Factor loadings of items to corresponding constructs range from .73 to .93. Besides, all factor loadings are significant at p<0.01 level, and all AVE values are greater than the .5 cutoff point, indicating satisfactory convergent validity (see Table 3).

Discriminant validity was assessed by Chin (1998)' way, comparing AVE with the shared variance among the latent variables. As shown in Table 2, the square root AVE for each construct is greater than the correlation of the construct with any other constructs, so the measurement model displays discriminant validity. Discriminant validity indicates the extent to which a given construct is different from other constructs, the measures of the constructs are distinct, and the indicators load on appropriate construct (Messick 1980).

**Table 3. Results of Confirmatory Factor Analysis**

Constructs	Items	SFL	t-value	SMC	Composite Reliability	AVE	Fit Indices
Electronic Information Sharing	inf1	0.73	-	0.54	0.904	0.704	$\chi^2=110.02$ df=59 p=0.000 GFI=0.91 RMR=0.07 RMSEA=0.08 AGFI=0.86 CFI=0.99 NFI=0.97
	inf2	0.84	10.93	0.71			
	inf3	0.89	11.61	0.80			
	inf4	0.88	11.45	0.77			
Electronic Cooperation	ra1	0.87	-	0.75	0.903	0.757	
	ra2	0.89	15.15	0.79			
	ra3	0.85	14.16	0.73			
Information Exploitation Capability	cap2	0.87	-	0.75	0.926	0.807	
	cap3	0.90	16.25	0.81			
	cap4	0.93	17.01	0.86			
Firm Performance	per1	0.79	-	0.63	0.909	0.769	
	per3	0.93	13.78	0.87			
	per4	0.90	13.34	0.81			

<note. ra4, cap1, per2 deleted, SFL: standardized factor loading, SMC: squared multiple correlations, AVE: average variance extracted, df: degree of freedom >

### Testing the Structural Model

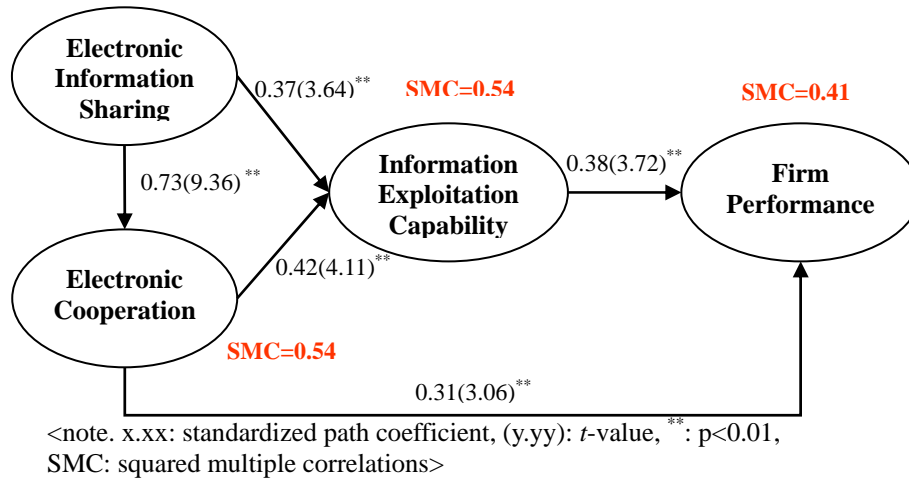
We tested the research model shown in Figure 2 by structural equation modeling (SEM). Standardized paths and various model-fit indices are shown in Table 4. We verified that our model has a good fit with the empirical data. In addition, the dependent variable, firm performance, has a significant  $R^2$  of 41 percent, meaning that 41 percent of the variance can be explained by the three factors.

As a result of path analysis, first, information exploitation capability (path=0.38,  $t=3.72$ ,  $p<.01$ ) and electronic cooperation (path=0.31,  $t=3.06$ ,  $p<.01$ ) were found to have positive and significant paths leading to performance of the firm. Second, electronic information sharing (path=0.37,  $t=3.64$ ,  $p<.01$ ) and electronic cooperation (path=0.42,  $t=4.11$ ,  $p<.01$ ) both were found to have positive and significant paths leading to information exploitation capability. Third, with regard to the relation of electronic information sharing and electronic cooperation, electronic information sharing (path=0.73,  $t=9.36$ ,  $p<.01$ ) was found to have a positive and significant path to electronic cooperation.

**Table 4. Fit Indices of the Structural Model**

Goodness of Fit Indices	Absolute Fit Indices				Parsimonious Fit Indices			Incremental Fit Indices		
	$\chi^2(p,df)$	GFI	RMR	RMSEA	$\chi^2/df$	AGFI	PNFI	NFI	NNFI	CFI
Desired Levels	-	$\geq 0.9$	$\leq 0.1$	$\leq 0.08$	$\leq 3.0$	$\geq 0.8$	$\geq 0.6$	$\geq 0.9$	$\geq 0.9$	$\geq 0.9$
Structural Model	127.61 (0.00, 60)	0.90	0.11	0.08	2.13	0.84	0.75	0.97	0.98	0.98





**Figure 2. The Structural Model**

### Testing mediating effect of IEC

In order for the fully mediated model to be accepted, it must meet the following criteria: (a) the independent variable has an effect on the mediating variables, (b) the mediating variables have effects on the dependent variable, and (c) the effect of the independent variable on the dependent variable is eliminated or substantially reduced when the effects of the mediating variables are controlled (Baron and Kenny, 1986). “If the relation between the independent variable and the dependent variable controlling for the mediator is zero, the data are consistent with a complete mediation model. If the relation between the independent variable and dependent variable is significantly smaller when the mediator is in the equation (Step 3) than when the mediator is not in the equation (Step 1), but still greater than zero, the data suggest partial mediation (Frazier et al. 2004, p.128).” To test the mediating role of IEC between EIS and ECo, and firm performance, we employed multiple hierarchical regression procedures, the method outlined by Baron and Kenny (1986) and Frazier et al. (2004). We summarized the results of mediation testing in Table 5.

**Table 5. Result of Testing Mediation Effect**

	Step	Relationship	$\beta$	$p$	Adjusted $R^2$	$R^2\Delta$	F(Sig.)	Result
EIS → IEC → Firm Performance	Step1	EIS → IEC	.623	.000	.384	-	105.676(.000)	○
	Step2	EIS → Firm Performance	.616	.000	.376	-	102.122(.000)	○
	Step3	EIS	.431	.000	.427	.054	63.574(.000)	○ (Partial Mediation)
		IEC → Firm Performance	.298	.000				
ECo → IEC → Firm Performance	Step1	ECo → IEC	.640	.000	.406	-	115.825(.010)	○
	Step2	ECo → Firm Performance	.515	.000	.260	-	60.146(.000)	○
	Step3	ECo	.258	.000	.352	.095	46.589(.000)	○ (Partial Mediation)
		IEC → Firm Performance	.401	.000				

### Conclusions and Implications

Based on the results of the empirical testing, we suggest several important implications regarding IOIS exploitation for both researchers and practitioners. The key finding is that suppliers can improve their performance and develop unique capability

like IEC to differentiate them from competitors, by participating in electronic collaboration based the IOIS.

First, this study contributes to mounting evidence that suppliers can benefit by engaging in electronic collaboration based on the IOIS initiated by dominant buyers. Prior researchers give an emphasis on verifying the benefits which buyers can obtain by initiating an IOIS, and encouraging their suppliers to adopt it in order to streamline the transactions. However, our results show that suppliers make efforts proactively to increase the extent of electronic information sharing and electronic cooperation so as to improve their performance, not just on using an IOIS for the transaction. Although electronic information sharing in itself doesn't have a direct impact on increasing the performance of suppliers, it is a fundamental activity that leads to a higher level activity like electronic cooperation and information exploitation capability.

Second, we have also shown evidence that information exploitation capability of suppliers could be a source for attaining competitive advantage. Information exploitation capability couldn't be imitated, transferred, and substituted by other competitors because the capability is embedded in specific operations of individual suppliers. Researchers conducting their studies based on the resource-based view (e.g. Wade et al. 2004, Mata et al. 1995) assert that firms should try to develop the unique capability in order to create and sustain long-term competitive advantage.

Finally, researchers can study various activities in electronic collaboration and examine different capabilities, especially by focusing on the perspective of the suppliers using the IOIS. Another interesting area for research will be the factors facilitating electronic collaboration between buyer-supplier relationships. Furthermore, motivating and cultivating information exploitation capability of a firm will be a promising research issue.

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