

# The Classification of Types of Business-to-Business Electronic Commerce: A Framework Construction

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## Abstract

Based on the degree of information sharing between buyers and suppliers as well as the level of supplier power, we suggested a framework that can be useful for classifying types of business to business (B2B) electronic commerce (EC) in the manufacturing firms. According to this framework, four kinds of B2B EC were theoretically proposed, classified, and empirically confirmed. These four are: an electronic marketplace, electronic procurement, electronic partnerships, and electronic distribution. Many prior studies have investigated and proposed some kinds of B2B EC. However, these studies focused mostly on one or two types of B2B EC, and did not develop or suggest a framework for the classification of forms of B2B EC. The framework constructed in this research can be utilized variously. Specifically, when a firm wants to initiate B2B EC with its suppliers, this framework can help a firm to decide and select an appropriate kind of B2B EC. This framework can also be applied to evaluate whether the proper form of B2B EC has been adopted or not.

**Keywords:** electronic commerce, information sharing, supply-chain performance, suppliers' power, resource-based view, transaction cost theory

## 1. Introduction

In recent years, the use of business-to-business (B2B) electronic commerce (EC) in the manufacturing firms to procure materials and parts from suppliers has become popular. Through EC, manufacturing firms have achieved outstanding performance in redesigning business processes and creating competitive advantages. In general, the types of B2B EC employed by manufacturing firms are grouped into four kinds: an electronic marketplace, electronic procurement, electronic partnerships, and electronic distribution [1]. However, the classification of these four types of B2B EC has never been based on concrete and precise criteria or a specified framework. Instead, the four kinds of EC seem to have been roughly taxonomized and proposed in prior studies. Hackney et al. [2] classified B2B EC into two types: the electronic marketplace and electronic alliances. In some research, the form of the electronic

partnership was not clearly differentiated from electronic marketplace. Thus, they were considered as the same kind of EC [3, 4]. Some other studies did not precisely discriminate electronic procurement from other types of EC. Therefore, in previous research, the boundary between one type of B2B EC and another kind of EC was likely to be obscure [5, 6].

It seems that since there has been no concrete framework, which supports the identification and validation of the types of B2B EC, confusion in the classification of kinds of EC has occurred in prior studies. Previous research has not constructed or developed a framework for the classification of B2B EC but has suggested some kinds of EC. If a framework useful for the identification and taxonomization of kinds of EC is developed, a framework can be employed by manufacturing firms to identify and select an appropriate or required type of B2B EC under their circumstance. Researchers can also utilize the framework to decide, select, and investigate the forms of B2B EC, which best fit their research intention or purpose.

Two broad categories of B2B EC include EC with suppliers and EC with customers. To develop a framework, this study focuses on EC with suppliers since information flows and cooperation through EC with suppliers are prerequisite conditions for value creation in manufacturing firms [7]. For manufacturing firms, which largely depend on outsourcing from suppliers, 80% of production costs are predetermined by main suppliers. Timely new product development, speedy market response, and cost reductions, all vital to a manufacturing firm's survival and prosperity, can be achieved through intensive collaboration with suppliers.

To develop a framework, as classification criteria, this study employs the following two dimensions: degree of information flow between a focal firm and its main suppliers, and suppliers' power. The theoretical bases of adopting these two dimensions as classification criteria are the resource-based theory and transaction cost economics. The principal reasons why manufacturing firms implement B2B EC with suppliers are that they actively want to obtain and utilize their suppliers' knowledge and capabilities; in other words, they want access to their suppliers' resources through information sharing [8, 9]. A Supplier's power also originates from its unique and valuable knowledge and capabilities (i.e., resources) [10].

According to transaction cost economics, when firms trade with partners, they try to choose a control mechanism for inter-firm relationships, which most contributes to the minimization of transaction costs [11]. However, the strength or weakness of a supplier's power affects the amount of the transaction costs incurred in the inter-organizational relationship. Thus, according to the levels of suppliers' power, the relationships with suppliers are differently coordinated and controlled in order to minimize transaction costs [12]. In fact, the manufacturing firm's selection of the type of B2B EC, which works as a control device in the inter-firm relationship [13], may

depend on the firm's degree of usage of the supplier's resources through information sharing as well as the level of the supplier's power, which must be controlled to minimize transaction costs.

In this study, based on both the degree of information exchange (sharing) between partners and the level of supplier power, a framework for the classification of B2B EC was constructed and proposed. Through this framework, we suggest four kinds of B2B EC, which can be adopted by manufacturing firms. Finally, we empirically confirm the framework and demonstrate the four forms of B2B EC.

## **2. Theoretical underpinning**

### **2.1. Resource-based view, transaction cost theory, and types of B2B EC**

The resource-based theory indicates that when firms strategically combine heterogeneous resources, and through this combination create economically valuable, inimitable, and rare resources (e.g., knowledge, skills and physical assets), they can obtain competitive advantages through the utilization of these unique and valuable resources by improving their efficiency and effectiveness [6]. According to the knowledge-based view, which is another facet of the resource-based theory, an organization can share and integrate necessary knowledge resources with its partners through collaborative information flow between the organizations [9, 14]. Inter-firm knowledge sharing or integration is defined as the extent to which a company exchanges and combines valuable insights and know-how about its business-related context or matters with its trading partners [8]. Inter-organizational knowledge sharing and integration can expand and supplement the supply of knowledge resources within an organization, and contribute to its acquisition of creative and distinctive knowledge, which can then lead to the enhancement of organizational competitiveness.

From the knowledge-based perspective, B2B EC has been shown as a key means for creating shared knowledge in the supply chains to respond to various types of uncertainties (e.g., product, technology, and environment) [4, 15]. Inter-organizational information exchange between buyer and supplier firms through EC supports knowledge transfer, sharing, and acquisition vital to improving competitive positioning [16]. Through B2B EC, inter-firm information flows are reinforced, and the strengthened information exchanges between the involved firms give rise to knowledge transfer and sharing among related organizations. However, according to the types of B2B EC, there are considerable differences in the amount of information exchanged between the buyer and supplier firms. Usually, the amount and quality of information shared in the electronic procurement or the electronic partnership are greater and higher than those in the electronic marketplace [17].

Transaction cost economics maintains that in inter-organizational relationships, firms choose the governance and control structures, which can minimize transaction costs incurred between involved companies, and raise the possibility of attaining organizational targeted performance [11]. Transaction costs, also called coordination costs, include the costs of planning, adapting, executing, and monitoring the completion of transaction tasks [18]. In inter-firm relationships, there are two forms of risk represented as relational risk and performance risk, both directly linked to an increase in transaction costs [19]. Relational risk implies the probability and consequences of having a partner who behaves opportunistically. Performance risk indicates the risk of not achieving trading objectives, even when partners cooperate fully. When managers in a firm perceive that there are high levels of both relational and performance risk, they adopt and apply appropriate governance arrangements and mechanisms in a high degree to control these risks and reduce transaction costs.

The purpose of control is to fashion activities in accordance with expectations to ensure the ultimate goals of an organization can be attained. Inter-organizational control devices are defined as a series of regulatory processes that control and coordinate transactional activities of buyer and supplier firms to overcome transaction risks and to achieve the goals pursued by the organization [12]. Inter-firm control mechanisms consist of formal, explicitly designed controls as well as unwritten informal controls [20]. Formal controls are often categorized as either behavior controls or output controls. In contrast, social controls are informal devices that are derived from shared norms, values, and beliefs.

A supplier's strong power gives rise to a high level of transaction risk for the buyer, especially, relational risk. As a result, the transaction costs charged to the buyer firm may increase [20]. If buyers are faced with high levels of trading risks caused by supplier power, they tend to have to pay more in searching partners, contracting with suppliers, and monitoring transactions to successfully obtain their desired objectives. Thus, to reduce transaction costs, the buyer's choice of inter-firm control structure often depends on the strength of the supplier power. Since through B2B EC, inter-organizational transaction activities can be controlled and coordinated, and a minimization in transaction costs can be attained, types of B2B EC are regarded as complex forms of inter-firm control mechanisms [13]. From the transaction cost theory, which contends that firms decide and select types of inter-organizational control devices most contributing to the minimization of trading costs, it is proposed that the buyer firm's choice of EC form considerably depends on the strength or weakness of its suppliers' power, which also affects its transaction costs.

## **2.2. Inter-organizational information exchange and types of B2B EC**

Information exchange between trading firms has been considered an effective

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mechanism to achieve a high degree of cooperation and knowledge sharing in an inter-organizational relationship [9]. Klein and Rai [21] identified three types of information exchanged in the supply chain relationships, which include operational, strategic and competitive information. Operational one relates to information such as inventory, capacity plans, and production schedules. Strategic and competitive information represent forms of information such as margins, costs, demand and markets. The type of information shared between buyer and supplier firms can be broadly grouped into transaction information and management information [22, 23]. Transaction information, which comprises information such as orders, delivery, inventory status, and receipts, is exchanged between trading firms in order to coordinate supply chain activities through better knowing and understanding of trading partners' decisions and operations. On the other hand, management information, such as manufacturing technology, production costs, and new product development, is communicated for strategic collaboration and knowledge sharing in various business projects.

In B2B EC, for a focal firm to efficiently coordinate transaction tasks with its suppliers and to speedily respond to diverse uncertainties, information of high quality, which refers to its accuracy, usefulness, and accessibility, has to be electronically shared between a buyer company and its partners [7, 24]. In an electronic marketplace, transaction information is mainly communicated between buyers and suppliers as in a traditional market. In some cases, the electronic marketplace almost shows characteristics of a traditional market such as short-term relationships and a minimum amount of information sharing [18]. In the cases of electronic procurement and electronic partnerships, existing relationships with supplier firms can become more tightly coupled and continue for a longer period than in the electronic market. Thus, to maintain a close connection between a buyer firm and its partners, the amount of information exchanged in the electronic procurement and partnerships is usually much more than what is exchanged in the electronic marketplace [1, 4].

### **2.3. Supplier's power and types of B2B EC**

Power means the capacity to exert one's will over others in order to realize certain intended benefits [25]. When there are a large number of available suppliers who satisfy almost the same customer requirements, suppliers' power is very weak. Then, customer firms can properly control the transactional relationships with suppliers through simply competitive bidding and not detailed contracts [10]. In this situation (i.e., weak suppliers' power), a combination of behavior and output controls that can be realized by market mechanisms (e.g., bidding and market prices) and rough contracts is sufficient for a buyer firm to manage any opportunistic behavior of its suppliers to achieve its transaction targets. However, if the power of the suppliers is

relatively strong, the transaction risks (i.e., the relational and performance risks) for customer firms certainly increase. Since strong power of supplier firms is usually attributed to their specific capabilities (e.g., bargaining abilities and know-how or skills) and their uniqueness or rarity, buyer's dependence on supplier companies tends to be inevitably reinforced [26]. When the degree of suppliers' power is high and customer firms necessarily depend on powerful suppliers, such firms must sustain close transactional relationships with these suppliers and employ social controls as appropriate inter-organizational control mechanisms [10].

Since a key characteristic of an electronic market is that a buyer's dependence on a supplier is very low and a buyer can easily change trading partners according to its intentions, the power of suppliers may not be as strong [27, 28]. In an electronic procurement, because only the supplier that is unilaterally chosen by the buyer can provide parts or materials to exactly meet the requirements of the buyer, the power of the supplier is relatively weak [29]. In the electronic partnerships, buyer usually contacts and trades with a small number of suppliers that may have unique or rare capabilities. Thus, the buyer's dependence on a few sellers in these transactional relationships is absolutely high [30, 31]. Although the high dependence of the buyers on suppliers gives rise to the considerably strong power of suppliers in electronic partnerships, close collaborative companions' relationships between buyers and a few sellers are formed and tried to be sustained for a long period.

### **3. Research methods**

#### **3.1. Sample and data collection**

Data for this research were drawn from a survey of the current status of B2B EC used in Korean manufacturing firms. In total, 500 organizations were randomly selected from a population of about 1,000 firms that are listed on the Korean stock market. The manufacturing firms listed are medium to large in size and consequently, are likely to have more experience with B2B EC applications than smaller firms. First, the chief production managers or executives of the selected firms were contacted to ask for their participation in the research. At the beginning, 101 organizations responded to the request for information. However, during the survey, 9 firms withdrew from the survey, and as a result, 92 firms were finally included in the study. In order to collect data, this study both administered questionnaires and conducted interviews with the participating firms. Only chief production managers or plant executives were selected as respondents.

The questionnaires used in this study were constructed based on question items developed in previous research. The English questionnaires were translated into

Korean. A bilingual IS professor translated the Korean questionnaires back into English. The translated English was compared with the original English version, and any translation errors were checked and corrected. The Korean questionnaires were distributed to a few plant managers in advance. Through their review, the easiness, clarity, and consistency of the questionnaires were checked. Before mailing the questionnaires, through an initial telephone interview with the respondent, the researcher of this study roughly asked him the firm’s present conditions. The interview included question items, such as the adoption status of B2B EC, the degrees of information sharing between trading firms, and the levels of main suppliers’ power. The results of the first interview generally concurred with the results of the questionnaires response. The questionnaires with a cover letter were mailed to each respondent. A self-addressed stamped envelope was included with the questionnaires to ensure anonymous responses. After distributing the questionnaires, through a second telephone interview, the contents of the questionnaires and the answering methods were explained. The purposes of the second interview were to identify whether the respondents had received the questionnaires and to ask for quick response. The survey was conducted during a 3-month period between October 2013 and January 2014. Table 1 summarizes the sample characteristics according to the industrial type of the firms.

Type of industry	Chemical	Machine	Automobile	Electronic	Textile	Food	Paper & pulp	Nonmetal	Metal	Rubber	Total
No. of firms	19	15	18	13	4	3	3	5	10	2	92
No. of employees	Below 100	100 - 300	300 - 500	500 - 1,000	1,000 -	Total					
No. of firms	13	20	19	15	25	92					

Table 1. Sample characteristics

### 3.2. Measurements

#### 3.2.1. Inter-organizational information exchange

Inter-organizational information exchange indicates the degrees of information sharing between a buyer firm and its main suppliers for the execution of its transactions. Based on the four items' measures developed by Cheng [16], it was measured on a seven-point Likert-type scale that ranged from 'strongly agree' to

'strongly disagree'. The four subjective measurement items include frequent exchange, always sharing, exchanging all kinds of information, and sharing of proprietary information.

### *3.2.2. The levels of main suppliers' power*

The levels of suppliers' power were measured by the three items, which were developed and validated in the studies of Son et al. [23] and Cheng [16]. Respondents answered the extent to which they agree or disagree with each item. A seven-point Likert-type scale was used to measure the degrees of power. The three subjective measurement items are main supplier authority (power) in decisions, transactions, and EC adoption.

### *3.2.3. The degrees of B2B EC adoption*

The degrees of B2B EC adoption represent the usage degrees of the electronic marketplace, procurement, partnerships, and distribution for manufacturing firms to purchase parts or materials from their main suppliers. Based on the objective measures of Barua et al. [32] and Dedrick et al. [5], the usage degree in each kind of B2B EC was objectively measured by the purchasing ratio of each type of B2B EC (i.e., purchasing volume of each kind of B2B EC for the year 2013 was divided by the total purchasing volume for the year 2013). Respondents provided the purchasing ratios for each types of B2B EC. The degrees of B2B EC adoption in manufacturing firms were calculated by the summation of the purchasing ratios of the electronic marketplace, procurement, partnerships, and distribution.

### *3.2.4. Supply-chain performance of a firm*

Supply-chain performance implies the degrees of improvement or reduction in transaction tasks and costs through B2B EC. The four question items, which were developed by Hartono et al. [33] and Wang et al. [14], were utilized to measure it. The levels of supply-chain performance were measured on a seven-point Likert-type scale, anchored by 'strongly disagree' and 'strongly agree'. The four subjective measurement items include costs and time reductions, and improvement of transaction tasks and response capabilities.

## **3.3. Framework for the classification of types of B2B EC**

### *3.3.1. Framework development*

The types of B2B EC can be identified, decided and selected based on the degrees of



information exchange needed between manufacturing firms and their suppliers. Since B2B EC is a means to respond to various uncertainties and severe competition through information or knowledge sharing [9, 34], the required or actual amount of information flow between buyers and sellers itself certainly reflects the adoption necessity of a specific kind of B2B EC. In responding to increased uncertainties in products, technologies, markets or demands, and other environments, inter-organizational information flows must be activated. Thus, an appropriate type of B2B EC, which can satisfy the needed amount of information exchange between buyers and suppliers, has to be employed and implemented by the involved firms. Supplier firm power, which is attributed to supplier importance, uniqueness, and buyer's dependence, positively affects the increase in transaction risks for a buyer firm [26]. This increase in risks incurs a large amount of trading costs for a buyer. In the view of transaction cost economics, since B2B EC acts as a complex inter-firm control mechanism to lower transaction risks and reduce trading costs, according to the level of supplier's power, different kinds of B2B EC must be adopted to control the transactional relationship with the supplier firm.

		<b>Suppliers' power</b>	
		Low	High
<b>Information exchange</b>	High	Electronic procurement	Electronic partnerships
	Low	Electronic marketplace	Electronic distribution

Figure 1. A framework for the classification of types of B2B EC

In this study, it is suggested that for the focal firm to identify and choose a proper type of B2B EC, both the degree of inter-organizational information exchange and the level of supplier's power must be considered because information sharing relates to the effectiveness of EC and the supplier's power is primarily connected with the efficiency of EC. According to the degree of inter-firm information flow or the main suppliers' power, manufacturing firms may pursue different kinds of B2B EC. Thus, based on the level of information exchange between a buyer firm and its main

suppliers as well as the strength or weakness of the main suppliers' power, a framework that represents proper forms of B2B EC adopted by manufacturing firms can be developed and proposed. Figure 1 shows the framework and the four types of B2B EC: an electronic procurement, electronic marketplace, electronic partnerships, and electronic distribution.

### *3.3.2. Electronic marketplace*

When both the necessity to communicate information between buyer firms and their suppliers and the degree of supplier's power are low, an appropriate kind of B2B EC for the buyer and supplier is the electronic marketplace. In the electronic marketplace, prices act as the main coordinating devices by signaling all relevant information to buyers and suppliers. Buyer firms also can utilize the behavior and output controls through simple contracts to regulate transactional relationships with many non-specific suppliers [12]. In manufacturing firms that adopt the electronic marketplace, the stage of their products in the product life cycle is apt to be more mature one. Accordingly, their manufacturing strategies are likely to be mass production oriented and focused on the production of standardized goods that only need the communication of basic information.

### *3.3.3. Electronic procurement*

Manufacturing firms can employ an electronic procurement in cases where a high degree of information exchange between buyers and suppliers, which is caused by a high level of uncertainty in the markets or demands and technologies, is required as well as the degree of suppliers' power is low. Through electronic procurement, buyer firms, which take the initiative, can select the best vendors from a large number of suppliers and control them with behavior and output control mechanisms. The large amount of information that flows between buyer firms and their suppliers in electronic procurement contributes to the buyers' realization of the competitive benefits of B2B EC such as quick coordination of transactional tasks, integration of transaction processes, and acquisition of novel knowledge [16]. Buyer firms' frequent communications with their sellers give rise to increased levels of inter-organizational trust [16]. Thus, buyers can partially utilize trust-based social control devices to regulate transactional relationships with suppliers.

### *3.3.4. Electronic partnerships*

Manufacturing firms can adopt the electronic partnerships when a large amount of inter-organizational information exchange is necessitated by various kinds of uncertainty in the environment, and the level of suppliers' power is high. The

manufacturing firms that employ type of electronic partnerships may produce highly customized products and be very dependent on a few suppliers to provide specific parts or materials. Accordingly, buyer firms must closely collaborate with a few suppliers for the execution of their production. In these partnerships, behavior and output controls through complex contracts are not sufficient for the regulation of inter-firm relationships with suppliers. Instead, in electronic partnerships, to sustain close collaborative relationships with a few suppliers, trust-based social controls are a prerequisite.

3.3.5. *Electronic distribution*

Electronic distribution is characterized by suppliers' very strong power as well as a very low necessity to share information between buyers and suppliers. Buyer firms can choose electronic distribution when both the amount of information exchanged between buyers and their vendors is small, since they produce almost standardized products, and the degree of environmental uncertainty is very low. In this case, supplier firms take on the authority to sell and distribute the parts or materials demanded by buyers. In electronic distribution, manufacturing firms can employ behavior and output controls through detailed contracts as control mechanisms with suppliers, and can supplement the controls through a small amount of information sharing. Actually, electronic distribution may be offered to buyer firms, and the buyers cannot construct or develop it themselves. They can only decide whether or not to participate in the electronic distribution.

4. **Data analyses and results**

4.1. **Reliability and validity**

Item analyses were performed with Cronbach alpha coefficients for all multi-item scale measurements. All alpha coefficients were above 0.8, which is satisfactory for the reliability of a multi-item scale.

Items	1	2	3	4	Eigen value	% of variance	Alpha coefficient
Supply-chain performance	0.90	0.94	0.94	0.88	3.5	35.0	0.95
Information exchange	0.72	0.81	0.88	0.81	2.6	26.6	0.83
Suppliers' power	0.93	0.93	0.75	-	1.8	18.3	0.87

\* Factor loadings below 0.4 were not presented.

Table 2. Results of reliability and validity test

Principal component analysis with a varimax rotation was used to verify the construct validities of the questionnaire items. Using a 0.4 criterion for significant item loading on a factor, the results show that all items within each index are represented by a single factor. The results of the factor analysis are presented in Table 2.

#### 4.2. Empirical demonstration of the validity of a framework

With a cluster analysis, this study classified sample firms according to the levels of inter-organizational information sharing and suppliers' power. In the current study, the cluster analysis provides groups of companies that are similar in terms of the degrees of inter-organizational information exchange and main suppliers' power. In the cluster analysis, we used the hierarchical agglomerative method to form clusters because it generates non-overlapping clusters and has been the dominant method. For the sorting or linkage rules, Ward's method was chosen since this technique optimizes minimum variance within clusters. We also used the squared Euclidean distance as the proximity measure.

Stage	82	83	84	85	86	87	88	89	90	91
Coefficient	31.0	36.3	42.8	49.9	57.2	72.6	103.1	141.8	188.7	285.4
Increasing rate of coefficient	-	17.0	17.9	16.6	14.6	26.9	42.0	27.5	33.0	51.2
No. of cluster	10	9	8	7	6	5	4	3	2	1

Table 3. Distance coefficients of cluster analysis

Based on the values of information sharing between buyers and their main suppliers as well as their main suppliers' power, a cluster analysis was performed to find four clusters of organizations: the electronic marketplace, electronic procurement, electronic partnerships, and electronic distribution. In addition, the mean scores of information exchange and suppliers' power were calculated for each cluster. A critical issue in cluster analysis is to determine the optimal number of clusters. While there are formal decision rules to guide this process, heuristics are commonly used. A formal approach in determining the most appropriate number of clusters is to examine the distance coefficient. The distance coefficient is presented in table 3. The points at which the distance coefficient suddenly jumps indicate suitable stages in the clustering sequence for analysis.

In Table 3, the distance coefficient increases greatly at two points - between the fifth and sixth clusters, and between the fourth and fifth clusters. This implies that the six-cluster and five-cluster solutions may be appropriate points for analysis. To show various cases in the combination of the degrees of inter-organizational information sharing and suppliers' power, the six-cluster solution can be selected. The six-cluster result provides suitable data to examine the variations in inter-organizational information exchange and main vendors' power. Therefore, the six-cluster solution is used in the analysis. The mean values of variables within each cluster are presented in table 4, along with the Kruskal-Wallis test results ( $\chi^2$  values) for each clustering variable. The  $\chi^2$  scores indicate that statistical differences exist for the individual variables across clusters.

Ite ms	A(n=19) E-market- place	B(n=10) E-distri- bution	C(n=27) E-procur- ement	D(n=15) E-market- place	E(n=8) E- partner- ships	F(n=13) E-procur- ement	$\chi^2$
IIE	3.7(4)	2.8(5)	4.1(3)	2.5(6)	5.9(1)	5.5(2)	67.9 <sup>a</sup>
SP	1.8(6)	5.2(2)	3.6(3)	2.5(4)	6.0(1)	2.3(5)	70.2 <sup>a</sup>

- The numbers are mean scores, and the numbers in parentheses are rankings.
- IIE: Inter-organizational information exchange, SP: suppliers' power, a:  $p < 0.01$ .

Table 4. Results of cluster analysis (Kruskal-Wallis test)

Since in this study, a seven-point Likert-type scale was used for the measurements of inter-organizational information sharing and suppliers' power, the middle score (i.e. four-score) can be employed as the common dividing point with which the levels can be roughly classified into two groups: high and low. In the case of cluster E, the mean values of inter-organizational information exchange and sellers' power are higher than the middle point. Thus, cluster E may represent firms that prefer the electronic partnership. In the case of cluster B, the mean value of inter-organizational information sharing is lower, but that of suppliers' power is higher than the middle score. Accordingly, B shows the manufacturing firms adopting the electronic distribution. However, in the cases of clusters C and F, the mean values of information exchange between buyers and sellers are higher, but those of vendors' power are lower than the middle point. The firms of clusters C and F may prefer and pursue the electronic procurement. In clusters A and D, the mean values of inter-organizational information sharing and suppliers' power are considerably lower than the middle score. Thus, clusters A and D may indicate manufacturing firms adopting the electronic marketplace.

Cluster Items	Cluster D	Cluster E	Cluster C	Cluster E	Cluster B	Cluster D	Cluster B	Cluster C	Cluster B	Cluster E
Information exchange	8.0	18.5	11.2	18.5	14.2	12.2	7.9	23.0	5.5	12.0
	U=0.0 <sup>a</sup>		U=75.0 <sup>b</sup>		U=63.0		U=9.5 <sup>a</sup>		U=0.0 <sup>a</sup>	
Suppliers' power	8.0	18.3	10.0	2.2	20.5	8.0	31.5	14.3	7.0	8.9
	U=0.0 <sup>a</sup>		U=0.0 <sup>a</sup>		U=0.0 <sup>a</sup>		U=24.5 <sup>a</sup>		U=58.0	

- The numbers are mean ranks, a: p<0.01, b: p<0.05.
- D: e-marketplace, B: e-distribution, C: e-procurement, E: e-partnerships.

Table 5. Differences between two clusters (Mann-Whitney test)

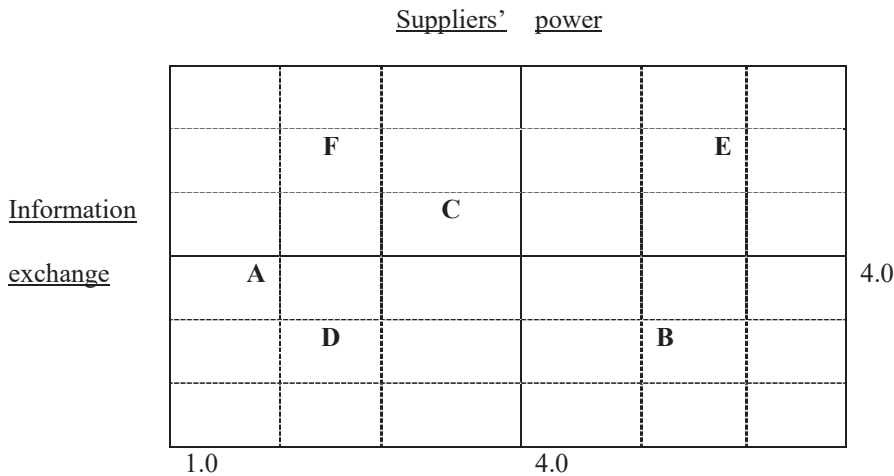


Figure 2. Location of each cluster on the grid (types of B2B EC)

In terms of inter-organizational information exchange and main sellers' power, the differences between E (electronic partnerships) and C (electronic procurement), and between E and D (electronic marketplace), were examined using the Mann-Whitney test and were found to be significant at the 5% or 1% level. Between B (electronic distribution) and D (electronic marketplace), no significant difference was shown in inter-organizational information sharing, but the score of suppliers' power in B was significantly higher than that of D. Comparing B with C (electronic procurement) shows that the degree of inter-organizational information exchange in C was significantly higher than that of B, but in suppliers' power, that of B was

significantly higher. For the criterion variables between E (electronic partnerships) and B, information sharing in E was significantly higher, but no significant difference was observed in suppliers' power. The results from these comparisons between clusters are represented in Table 5. Figure 2 shows the location of each cluster on the grid of the degrees of information exchange and suppliers' power. These results seem to support the assertion that types of B2B EC adopted by manufacturing firms are generally grouped into the four kinds. From these results, it is also confirmed that the framework developed in this study can be useful for the classification and identification of types of B2B EC.

### **4.3. Characteristics of the four types of B2B EC**

In Table 6, the mean scores of organizational size and age, adoption ratios (%) in each types of B2B EC, total adoption ratio of B2B EC, and supply-chain performance in each cluster are presented, and can be compared across clusters. In this study, size is the number of employees of the firm in the year 2013 and the organizational age is measured by counting the years elapsed since the founding of the firm. In the clusters F and C pursuing the electronic procurement, the organization size is relatively larger than those of the other clusters. This result seems to show that in Korean manufacturing firms, the largest companies usually have strong authority over their suppliers, and thus, they may prefer the electronic procurement. In cluster F, the adoption ratios of both electronic procurement and B2B EC are the highest, and these highest ratios may reflect the sufficient resource capabilities of the largest firms, and also their first ranking in supply-chain performance.

Cluster C, which has the second rankings in organizational size and adoption ratios of an electronic procurement and total B2B EC, shows a third order in supply-chain performance. In cluster E, which belongs to a group of the electronic partnership, organization size and age are the smallest, while the actual adoption ratio of the electronic partnership is the highest. The ranking of cluster E in supply-chain performance is second. Suppliers may have stronger power over the buyers in cluster E, which is the smallest in size. Thus, in cluster E, buyers are likely to employ electronic partnerships, which can bring close cooperation with suppliers through trust-based social controls as well as a large amount of inter-organizational information sharing. In the cases of clusters A, B, and D, which are groups of the electronic marketplace or electronic distribution, actual adoption ratios are 2 - 9%, and usage ratios of B2B EC and supply-chain performance are also relatively low or poor. From these results, it is assumed that a high adoption ratio of an appropriate kind of B2B EC and a high total usage ratio of B2B EC can contribute to the improvement of supply-chain performance.

Items	Cluster A	Cluster B	Cluster C	Cluster D	Cluster E	Cluster F	$\chi^2$
Organizational size	665.8(4)	468.5(5)	700.0(2)	674.2(3)	390.6(6)	2,271.6(1)	12.9 <sup>b</sup>
Organizational age	38.6(1)	34.0(4)	32.6(5)	37.5(2)	29.6(6)	34.4(3)	0.87
Adoption ratio of e-marketplace (%)	7.8(3)	5.1(5)	7.0(4)	9.2(2)	4.8(6)	12.4(1)	2.69
Adoption ratio of e-distribution (%)	3.4(2)	3.2(3)	2.5(4)	1.8(6)	2.2(5)	4.3(1)	1.88
Adoption ratio of e-procurement (%)	13.1(3)	8.3(6)	21.8(2)	8.4(5)	11.0(4)	33.7(1)	9.82 <sup>c</sup>
Adoption ratio of e-partnerships (%)	21.7(5)	31.5(2)	22.5(4)	13.7(6)	33.0(1)	24.0(3)	4.41
Adoption ratio of B2B EC	46(5)	48.1(4)	53.8(2)	33.1(6)	51(3)	74.4(1)	-
Supply-chain performance	3.5(5)	3.3(6)	3.8(3)	3.6(4)	4.0(2)	4.7(1)	5.59

The numbers are mean scores, and the numbers in parentheses are rankings, b:  $p < 0.05$ , c:  $p < 0.1$ .  
A & D: e-marketplace, B: e-distribution, C & F: e-procurement, E: e-partnerships.

Table 6. Differences of characteristics among clusters (Kruskal-Wallis test)

## 5. Conclusion and discussion

In this study, based on the degree of information sharing between buyers and sellers, and the level of suppliers' power, we suggested a framework that is useful for classifying types of B2B EC in manufacturing firms. According to the framework, four kinds were proposed and empirically confirmed: the electronic marketplace, electronic procurement, electronic partnerships, and electronic distribution. In terms of the characteristics of each type, the size and the adoption ratio of total B2B EC of



firms employing electronic procurement were the largest and highest. In manufacturing firms belonging to the group of electronic procurement, when their actual adoption ratio of electronic procurement was highest, their supply-chain performance was also represented as the highest ranking. The result that the size of the companies adopting electronic procurement is the largest shows that big Korean firms have a superior position to their suppliers, and this large firms' feature (i.e., superior power) is generally consistent with the classification criterion of electronic procurement.

In this study, it was observed that the size of the firms employing electronic partnership is the smallest. This result seems to indicate that Korean small firms have a relatively weaker position to their suppliers, and accordingly, as a competitive strategy, they pursue close collaborations with their suppliers to utilize their partners' knowledge and capabilities. The result of this study also showed that when the actual adoption ratio of electronic partnership in companies belonging to the group of electronic partnership is the highest, the ranking of their supply-chain performance is relatively high. In manufacturing firms belonging to the group of the electronic marketplace or electronic distribution, actual adoption ratios were not high, and rather, the adoption ratios of the electronic partnership in these companies were relatively high. The rankings of supply-chain performance in these firms were also not high. From these results, it is assumed that if the actual adoption ratio of an appropriate type of B2B EC is very low, this low adoption ratio may be associated with a decrease in supply-chain performance. In the case of organizational age, there were no meaningful differences. Many previous studies have investigated and proposed some kinds of B2B EC. However, they mostly focused on one or two types of B2B EC, and did not develop and suggest a framework for the classification of forms of B2B EC.

The framework constructed in this research can be utilized in various ways. When a firm wants to introduce B2B EC with its suppliers, this framework helps the firm to decide and select the appropriate kind of B2B EC. The framework can also be applied to evaluate whether a proper form of B2B EC has been adopted or not. In addition, the framework can be employed and utilized in future studies. The discordance between the required type of B2B EC and the actually adopted form of B2B EC and the negative effect on supply-chain performance can be empirically examined in future research. With the framework, kinds of B2B EC can be identified, and influence factors for the adoption of each types of B2B EC may be investigated. In future research, a more advanced classification framework useful for the detailed groupings in each of the four types of B2B EC can be developed and proposed.

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