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Full Length Research Paper

How to classify the types of inter-organizational relationships in manufacturing firms

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This study empirically examined the relationships among types of inter-organizational relationships (IORs), degrees of inter-organizational learning, trust and collaboration, and appropriate forms of IORs control devices in manufacturing firms. Based on the usage levels of inter-organizational information systems (IOSs) and traditional communication media (TCM) as well as the amount of transaction and management information exchanged between trading partners, the four types of IORs that have been suggested in the research of Choe (2008) were identified. The four types were: traditional market relationships, electronic links, strategic alliances, and virtual organizations. The results of cluster analyses represented the forms of IORs that may be similar to the four types of IORs. According to the results of this study, it was found that the levels of inter-organizational learning, trust and cooperation in electronic links are significantly higher than those in traditional market relationships. However, it was incompletely demonstrated that the degrees of inter-organizational learning, trust and collaboration in virtual organizations are significantly higher than those in strategic alliances. The results also showed that the output and behavior control devices are more utilized in electronic links or virtual organizations than in traditional links or strategic alliances.

Key words: Inter-organizational relationships (IORs), electronic IORs, control mechanisms, inter-organizational information systems, traditional communication media.

INTRODUCTION

A large number of manufacturing firms in various Industries have been entering into a variety of inter-organizational relationships (IORs) to achieve their business objectives. Typical types of traditional IORs include discrete market relationships, internal hierarchical arrangements and strategic alliances (Meer-Kooistra and Vosselman, 2000; Das and Teng, 2001). Strategic alliances are broad-ranging relationships and can encompass joint ventures, franchises, joint research and development (R&D), joint marketing, and long-term outsourcing relationships.

In recent years, however, because of the adoption and use of inter-organizational information systems (IOSs) in manufacturing firms, new forms of IORs have appeared. IOSs are defined as network-based information systems that extend beyond traditional enterprise boundaries (Lu et al., 2006; Lin, 2006). IOSs function to blur the boundaries of today's organizations as they enable information to flow quickly and frequently from one organization to another. IOSs that support inter-organizational communication influence the nature of inter-firm relationships. The resulting different types of IORs are electronic forms, which can be represented as electronic partnerships, electronic market relationships and virtual integration (Son et al., 2005; Wang et al., 2006; Grover and Saeed, 2007).

Many researchers have investigated and proposed appropriate levels of inter-organizational trust and cooperation as well as suitable control mechanisms of IORs under diverse conditions or types of IORs, which are required and must be satisfied for the execution of inter-organizational business and the continuance of IORs (Meer-Kooistra and Vosselman, 2000; Das and Teng, 2001; Langfield-Smith and Smith, 2003; Caker, 2008). Meer-Kooistra and Vosselman (2000), and Langfield-Smith and Smith (2003) conceptually suggested the relationships between levels of inter-organizational trust and three forms of governance

mechanism of IORs. They also explained the contingency factors (i.e., conditions of IORs) that affect the adoption of a specific type of control mechanism. Das and Teng (2001) developed an integrated framework that is useful to identify the relationships among levels of inter-organizational trust, forms of control device, and degrees of risk in strategic alliances. Through case study, Caker (2008) showed that the roles of bureaucratic control are different according to the positions of a firm in IORs, which are classified as dominating or dominated organization.

However, the prior researchers did not separately consider new forms of IORs (such as electronic IORs) in their research of the relationships among types of IORs, levels of inter-organizational trust and cooperation, and forms of control mechanism of IORs. In the study of Choe (2008), based on the usage levels of IOSs or traditional communication media (TCM) as well as the kinds of information communicated between trading partners, types of IORs were classified into traditional and electronic IORs. He suggested the four types of the traditional and electronic IORs (that is, traditional market relationships, electronic links, strategic alliances, and virtual organizations). This study empirically confirms and identifies the four types of IORs. According to the types of the traditional and electronic IORs proposed by Choe (2008), we conceptually represent and empirically demonstrate the required levels of inter-organizational trust and cooperation, the degrees of inter-organizational learning, and the suitable forms of IORs control mechanism.

To identify and suggest the proper forms of governance mechanism in IORs are important research topics, which have been investigated for a long time. The results of this study seem to be very helpful for a firm to find out its types of IORs, and to select appropriate control devices for its IORs. This study also indirectly uncovers the delicate relationships among the adoption of IOSs, trust and formal control, and thus, represents the use degrees of output and behavior control according to the levels of inter-organizational trust or IOSs usage. Moreover, from the results of this research, the relationships between the amount of information exchanged and the learning and between trust and collaboration can be explained to a certain degree.

THEORETICAL BACKGROUND

Information flow and IORs

Various kinds of information must be exchanged between trading partners to perform inter-organizational business effectively and efficiently (Mahama, 2006; Kim et al., 2006). Types of information exchanged between involved firms can be broadly grouped into transaction information and management information (Hart and Saunders, 1998; Hakansson and Lind, 2004). Transaction information that must be communicated in order to perform purchase or supply transactions includes the kinds of information such as order, delivery, receipt, transportation, inventory status and liquidation. However, management information that is mainly utilized for decision making and the control of inter-organizational business activities represents the kinds of information such as cost, quality, product market, new product development and profitability.

The exchange and sharing of information between trading firms are considered as effective mechanisms to achieve efficient coordination or cooperation in IORs (Premkumar et al., 2005; Iyer et al., 2009). It is generally accepted that in the supply channel relationships, operational information must be frequently exchanged between trading firms in order to coordinate supply chain activities through the better understanding of trading partners' decisions and operations. Trading firms coordinate their processes in the supply chain relationships by exchanging information, thereby making them adjust their activities to suit mutual needs. Information exchange between interrelated firms can also enhance cooperation by creating awareness of mutual expectations and capabilities of the parties and by developing shared meaning of action. In a strategic alliance, information sharing helps involved firms align their managers' conceptions of the necessity, possibility and objectives of the alliance. Such an alignment of involved firms puts them in a better position for cooperation within the alliance.

Dekker (2003) suggested that the kinds of information required for the coordination of supply chain activities are different from those required to attain inter-firm cooperation in a specific business area. Transaction information, such as inventory, order and delivery, is exchanged between trading partners to coordinate inter-organizational transactions. Transaction information is generally communicated to coordinate purchase or supply activities between trading firms. Inventory information, when exchanged, can lead to a reduction in the total inventory within a supply chain. Similarly, production planning and delivery schedules can be shared to enhance operational efficiency through the improved coordination of allocated resources and activities across a supply chain.

However, management information is primarily communicated to support and attain inter-organizational cooperation. To increase the degree of strategic cooperation between participating firms in specific business projects, they must exchange types of information that enable them to make collaborative efforts and to facilitate economic judgments regarding investments and strategies. The cost information of trading firms is shared to perform cooperative cost management (Cooper and Slagmulder, 2004; Agndal and Nilsson, 2009). For the cooperation of new product development, and joint R&D, management information such as manufacturing technology and new product development, must be exchanged

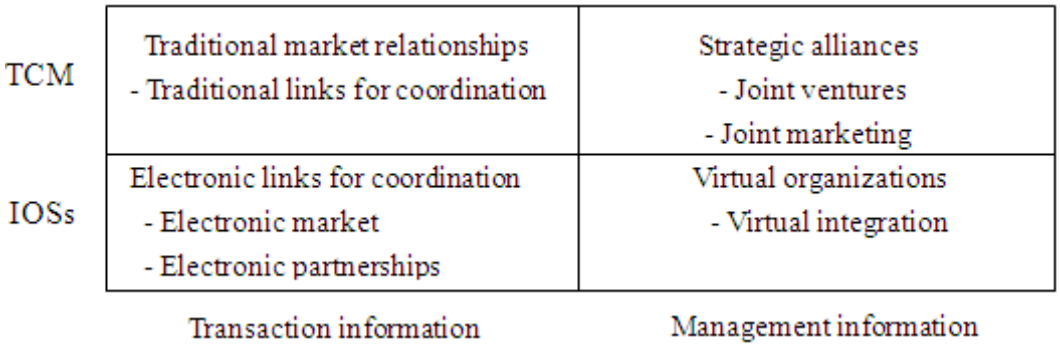

Figure 1. Types of inter-organizational relationships.

between interrelated firms (Langfield-Smith and Smith, 2003; Kajuter and Kulmala, 2005). In order to perform joint-marketing promotions, management information of product marketing and selling must be quickly communicated between trading partners.

Transaction information is primarily exchanged between interdependent firms for the operational coordination of supply chain activities. On the other hand, since joint new product development and R&D, and cooperative cost management are performed to achieve a firm's strategic goals or objectives, management information is mainly communicated among related firms for the strategic collaboration of various business projects. Therefore, according to the kinds of information exchanged, IORs can be classified into two broad types: IORs for operational coordination, and inter-firm relationships for strategic cooperation.

Traditional and electronic IORs

According to the media-richness theory, rich media such as face-to-face meetings and telephone, enable people to interpret and reach agreements about unanalyzable, difficult and complex issues, while lean media such as e-mail and electronic data interchange (EDI) are appropriate for communicating routine activities. However, the interpretive perspective indicates that a person is not merely a passive receptacle, but an intelligent being in a shared social context who can transform whatever lean words and cues he or she receives into an understanding of what the writer meant (Lee, 1994). The interpretive perspective says that according to the degrees of mutual understanding of the message sender and receiver, even e-mail or EDI can readily support the level of richness that the media-richness theory reserves for what it considers to be rich media, such as face-to-face meetings. Therefore, IOSs can replace TCM in the communication of various kinds of information between trading firms.

IOSs are comprised of computer-mediated information and communication technologies such as EDI, e-mail, extranet, and video conferencing (Hsiao, 2003; Albrecht et al., 2005). Due to the use of IOSs in the exchange of information between trading firms, highly integrated IORs have been developed (Nakayama, 2003; Saraf et al., 2007). In various aspects, IOSs-based IORs are strikingly different from IORs based on TCM. Under IOSs-based IORs, the time and cost of information exchange are greatly reduced, and the business processes of interrelated firms are effectively and tightly coupled within the context of long-term relationships. The development of IOSs-based inter-firm relationships can also help participating firms search, filter and match parties relative to each transaction.

TCM can be considered as traditional inter-organizational systems. TCM have supported the formation and continuance of traditional inter-firm relationships such as markets or hierarchies. However, through IOSs, firms can develop electronic inter-firm relationships with their trading partners. Electronic IORs with IOSs are variously referred to as electronic integration, electronic links or electronic partnerships (Son et al., 2005). Thus, according to the usage levels of IOSs or TCM, inter-firm relationships can be grouped into two categories: traditional IORs and electronic IORs. Traditional IORs represent that TCM are mainly applied with inter-firm communication. In terms of electronic inter-firm relationships, IOSs are utilized as the main media in the exchange of information between trading partners.

Types of IORs

The framework to classify the types of IORs, which is based on the usage levels of IOSs and TCM as well as the amount of transaction and management information exchanged between trading partners, was developed and suggested by Choe (2008). In this study, the framework of Choe (2008) is employed to identify the four types of the traditional and electronic IORs. Figure 1 shows the framework and the four types of IORs: traditional market relationships, strategic alliances, electronic links, and virtual organizations.

Traditional market relationships

Traditional market relationships can be formed through discrete market transactions. In these relationships, TCM are mainly utilized for the communication of transaction information between trading partners. Market-based transactions are simply characterized as discrete contracts that represent relatively short-term and bargaining relationships between highly autonomous buyers and sellers, which are designed to facilitate an economically efficient transfer of goods or services (Ring and Van De Ven, 1992). Arm's-length market and spot market relationships belong to traditional market relationships. In both relationships, a minimum amount of information exchange between trading partners is sufficient since the buyer's goal is to fulfill an immediate need at the lowest possible cost. Under these relationships, prices may act as the main coordinating devices by signaling all relevant information to buyers and sellers (Dekker, 2004). Buyers and sellers have only a sales-to-purchasing interface and do not cooperate through multifunctional interfaces to achieve strategic collaborative projects such as new product development and joint cost management.

Electronic links for coordination

Electronic links include electronic market and electronic partnerships (Kim et al., 2005, 2006). In electronic links, the coordination of supply chain activities between trading firms is performed through IOSs. Electronic links reduce coordination costs in the transactions of goods or services between different firms through the frequent and speedy exchange of trading information. The difference between the electronic market and electronic partnerships is the setting of buyer and supplier firms' relationships. In the electronic market, there exist various suppliers and buyers that interact to supply and purchase products. Thus, the electronic market represents multilateral relationships of suppliers and buyers. The relationships of nonspecific suppliers and unspecified customers in the electronic market continue for a relatively short term.

However, electronic partnerships exist in a bilateral setting, which represents a dyad relationship between a supplier and a customer (Bakos, 1991). In electronic partnerships, existing relationships with customer and supplier firms can become more tightly coupled and continue for a longer period than in the electronic market (Kim et al., 2005-6). Because of the shorter continuance and the multilateral form of relationships between trading firms, the amount of transaction information exchanged in the electronic market is much smaller than that in electronic partnerships. In the electronic market, IOSs are generally utilized as a means of on-line selling or purchasing and billing, with which search-related information such as product offerings, prices and liquidation information are mainly exchanged between trading firms (Soh et al., 2006).

However, electronic partnerships are characterized by information flow integration and electronic integration in a supply chain (Kim and Umanath, 2005; Patnayakuni et al., 2006). An integrated information flow across the supply chain implies that a high degree of information symmetries and information sharing between trading firms can be attained and sustained through IOSs. An integrated information flow represents various types of information about events, stocks, flow and outcomes in a supply channel that can be exchanged to coordinate supply chain activities and achieve performance improvement. The competitive benefits of the coordination through information flow integration are expected to result in reduced operating costs, improved productivity and operational efficiency.

Electronic integration is another facet or result of information flow integration (Patnayakuni et al., 2006). Electronic integration is the integration of the business processes of two or more independent firms through the exploitation of the capabilities of computer and communication technologies. Closer electronic integration of business decisions and operations between trading partners can be achieved with the active utilization of information being exchanged. Accordingly, in electronic links, the electronic market can be simply differentiated from electronic partnerships according to the amount of transaction information shared between trading partners.

Strategic alliances

Strategic alliances are inter-firm cooperative arrangements aimed at achieving the strategic objective of the partners (Das and Teng, 1998). Strategic inter-firm relationships stem from a general perception that they enable firms to secure valued resources and technology at potentially lower risk than corporate acquisitions (Ireland et al., 2002). In these relationships, the substantial exchange of knowledge and information that results in joint learning occurs between participating firms. Through strategic relationships, complementary but scarce resources or capabilities of the involved firms are combined, and as a result, unique new products, services or technologies are jointly created.

Virtual organizations

Virtual organizations rely on electronic networks (such as IOSs) that enable faster information or knowledge distribution and communication beyond an individual firm's boundaries (Scott, 2000). Through virtual organizations, a firm can form strategic partnerships with its networked firms to exploit their complementary knowledge and capability in executing cooperative projects such as joint new products development and R&D (Jarvenpaa et al., 2004). In virtual organizations, the

formation of strategic partnerships is not based on contracts or organizational forms, but on information and networks. Virtual organizations can electronically connect firms in value chains that range from the producers of raw materials to the end customer. Firms collaborating in virtual organizations exchange strategic and confidential information and knowledge through IOSs, and ultimately, these exchanges lead to inter-organizational learning. Firms in virtual organizations can access and obtain key resources such as managerial and technological know-how that are not jointly owned, without having to purchase them.

The Trade Development Board of Singapore electronically integrated the interrelated organizations on the trade value chain through EDI, and constructed the virtual business networks (Teo et al., 1997). The participants in the virtual networks include public-sector agencies for international trade, traders, intermediaries (e.g., shipping agents and air cargo agents), financial institutions, and port and airport authorities. With these virtual networks, the traders were able to obtain various kinds of trade information and knowledge, and value-added services from other participants of the networks. The efficiency and effectiveness of trade administration processes for the traders were also highly enhanced. As a result, the competitiveness of the traders was strengthened, and this competitiveness brought increased trade volume.

HYPOTHESES SUGGESTION

Inter-organizational learning, trust and cooperation

The organizational learning process is roughly composed of three stages: information collection, interpretation and learning (action taken) (Daft and Weick, 1984). The provision or collection of information is the first step of organizational learning. Information is a flow of messages or meanings, which might add to, restructure or change knowledge. Information is a necessary medium or material in organizational learning for knowledge creation (Nonaka, 1994). Thus, types of information exchanged between trading firms also give rise to inter-organizational learning (Scott, 2000; Christiaanse and Venkatraman, 2002). The communication of management information, such as manufacturing technology and new product development, facilitates the creation and transfer of organizational knowledge in participating firms for cooperative projects. The exchange of transaction information contributes to the creation of new knowledge that is used for resolving the problems in the supply chain.

In general, IOSs allow more information to be communicated between trading partners in the same amount of time, and decrease the cost of this communication dramatically. In electronic IORs, a large amount of information is exchanged between trading firms more quickly and more frequently than in traditional IORs. Therefore, based on the foregoing arguments the following hypotheses can be suggested:

H_1: The degree of inter-organizational learning in electronic links is higher than that in traditional market relationships.
H_2: The degree of inter-organizational learning in virtual organizations is higher than that in strategic alliances.

Trust is simply defined as a willingness to make oneself vulnerable to potential harm from another party (Gallivan and Depledge, 2003). The degree of inter-organizational trust is positively influenced by the frequency of interaction and communication between both firms involved (Tomkins, 2001). The recurrent interaction and communication of information help both involved parties learn about each other's intentions and actions, and this learning can lead to the building of trust between both parties. The communication of information also provides ways or routes, from which partners further develop common values and norms (Das and Teng, 1998). This sharing of values and beliefs between both parties contributes to the building of inter-organizational trust.

In traditional market relationships, if one party to the relationships does not faithfully fulfill a contract, another party can be easily chosen without high switching costs, since there are many other firms that can be used to replace that party for those transactions. The market-based relationships are also characterized by a minimum amount of information exchange between trading firms. Thus, the level of trust between suppliers and customers is relatively low. However, IOSs can enable a firm to communicate a large amount of information or knowledge frequently and quickly with its trading partners. In electronic links, the frequent, speedy and timely sharing of information between trading firms contributes to the formation of a moderate or high degree of inter-organizational trust (Jarvenpaa et al., 2004). Therefore, based on this reasoning, the following hypothesis can be proposed:

H_3: The degree of inter- organizational trust in electronic links is higher than that in traditional market relationships.

Strategic alliances are characterized by incomplete contracting, as it is neither possible nor practical to develop contracts that completely specify all of the potential outcomes of the interactions between both parties (Dekker, 2004). Therefore, in strategic alliances, there is the risk of a partner not cooperating in good faith (such as opportunistic behavior by the partner), in addition to the usual risk of unsatisfactory business performance (such as the consequences that alliance objectives are not achieved). Since trust between both parties can reduce the degree of risk perceived and it can serve as an alternative control device of IORs, a moderately high level of inter-organizational trust is required

in strategic alliances (Gulati, 1995). In virtual organizations, strategic collaboration depends on high levels of mutual trust to encourage the continuation and growth of a successful relationship. Through the frequent flow of information and knowledge between both parties and the resulting inter-organizational learning, very high levels of trust can be developed and formed, and the degree of risk perceived by both parties can also be lowered (Wang et al., 2006; Grover and Saeed, 2007). From the above arguments, the following hypothesis can be proposed:

H_4: The degree of inter-organizational trust in virtual organizations is higher than that in strategic alliances.

Definitions of cooperation focus on the process by which groups and organizations come together, interact, and form psychological relationships for mutual gains or benefits (Smith et al., 1995). Strategic collaboration implies the willingness of partner firms to pursue mutually compatible strategic benefits in the alliance, rather than to act opportunistically. Cooperation is usually comprised of the coordination of activities and the sharing of the benefits that emerge from this cooperation (Browning et al., 1995). The inter-organizational trust and information sharing positively affect the formation of a cooperative relationship between participating firms (Mahama, 2006). Inter-organizational trust is a prerequisite condition for the development of inter-organizational cooperation. Inter-organizational trust reduces the ambiguity and uncertainty with the actions or behaviors of partners, and so, cooperative or productive activities of both parties can take place (Jarvenpaa et al., 2004). The trustworthiness formed between both parties provides one party with an optimistic anticipation of the behavior of another party in IORs. This optimistic expectation leads one party to have a more cooperative relationship with another party.

If a firm faces the behavioral uncertainty arising from the actions of a partner firm, a firm cannot be motivated to cooperate with a partner firm. The information exchange between trading partners reduces this behavioral uncertainty, and enhances the transparency of partner's behavior by making its behavior more visible (Son et al., 2005). The information sharing between both firms increases the predictability of satisfactory cooperative behaviors of both parties, and contributes to the formation of a high level of inter-organizational trust. In traditional market relationships, the relations between customers and suppliers continue for a relatively short period, and the amount of information shared between trading firms is at a minimum level. Thus, the degree of inter-organizational cooperation in traditional links may be relatively low. However, in electronic links, a large amount of information is exchanged between trading firms, and the degree of inter-organizational trust is moderately high. Hence, the following hypothesis can be proposed:

H_5: The level of inter-organizational cooperation in electronic links is higher than that in traditional market relationships.

In virtual organizations, because of the electronic communication effect of IOSs, the amount of information shared between involved firms is much more than in strategic alliances. In the degree of inter-organizational trust, the levels of virtual organizations may be higher than those of strategic alliances. Accordingly, the following hypothesis can be suggested:

H_6: The level of inter-organizational cooperation in virtual organizations is higher than that in strategic alliances.

Control mechanisms of IORs

Control devices are generally viewed as a process of regulation and monitoring for the achievement of organizational goals (Das and Teng, 2001). Control mechanisms of IORs reduce and eliminate the uncertainty or risks of partners' actions, which typically include the risk of opportunistic behaviors by partners and the risk of unsatisfactory business performance of partners. Control devices are classified into three kinds: output control, behavior control, and social or trust-based control (Dekker, 2004). Output control devices specify outcomes to be realized by a firm's partners and monitor the achievement of their performance targets. Behavior control focuses on the process, which turns appropriate behavior into desirable output. Behavior control devices rely on the establishment and utilization of formal rules and procedures to monitor and reward desirable performance of partners. Social or trust-based control aims at reducing the discrepancies in goal preferences of involved firms through the construction of common beliefs and values.

In traditional market relationships, since the products or services exchanged tend towards the nonspecific, and can be transacted among many trading firms, the basic control mechanism for these transactional relationships is a discrete contract (Ring and Van De Ven, 1992). However, other control devices that can be used by customer firms comprise the regular measurement and evaluation of the quantity and quality of suppliers' output, and the regulation of suppliers' behaviors through the establishment of standards and procedures (Meer-Kooistra and Vosselman, 2000).

There exist two opposite views on the relationships between inter-organizational trust and the usage of formal control mechanisms: substitutive and complementary or interactive perspectives (Das and Teng, 2001; Dekker, 2004; Velez et al., 2008; Vosselman and Meer-Kooistra, 2009). A substitutive relationship indicates that trust is a substitute for output and behavior control devices in the management for appropriation concerns of partners (Gulati, 1995; Gulati and Singh, 1998). According to the substituting view, it is asserted that trust and formal control are inversely related, and so, more

trust results in less use of formal control mechanisms and vice versa. Furthermore, this perspective suggests that the extensive usage of output and behavior control seems to have a damaging impact on relational trust, since the active use of them may imply a lack of belief in the partner's goodwill or competence.

A complementary relationship, on the other hand, represents that trust and formal control devices are additively related (Langfield-Smith, 2008). Thus, an increase in the level of either trust or formal control simply moves to a higher level of governance of IORs. The complementary view suggests that the usage of output and behavior control mechanisms can enhance the trusting relationship between trading firms by objectively providing a track record about the partners' consistent behaviors and performance, and thus, by lowering the possibility and severity of transaction risk.

According to the interactive perspective, it is asserted that since the elimination or absorption of behavioral uncertainty of trading firms is the common goal of trust and formal control, they do not just substitute or complement, but interact to achieve this objective (Velez et al., 2008; Vosselman and Meer-Kooistra, 2009). An interaction view accounts for the interrelated dynamics of trust and governance. In the early stage of IORs, formal control devices can foster conditions that favor and build inter-organizational trust. However, under the interaction relationship, it is assumed that the newly established level of trust between trading partners needs other forms of control mechanism, and subsequently, the new types of formal control constructed produce the increased level of relational trust. As it were, control positively affects the development of inter-organizational trust, and trust produces new forms of control device. This circular or interactive relationship between trust and control continues until the common goal of them, which is the elimination of transaction risk, is perfectly obtained.

In prior research, the substitutive view has never been empirically demonstrated. A few studies (Mahama, 2006; Nicolaou and McKnight, 2006; Velez et al., 2008) empirically confirmed and showed the positive relationships between trust and governance mechanisms. In the study of Mahama (2006), it was found that output control devices are positively related with socialization processes, through which the perception of fairness and trustworthiness between involved firms can be developed and shaped. Nicolaou and McKnight (2006) empirically suggested that both the control transparency, which is measured by the usage degrees of behavior control, and the outcome feedback, which implies the use of output control, have a positive impact on the formation of trusting belief between customers and suppliers. Through case study, Velez et al. (2008) found that even when the trust between trading partners is well established, the use of formal control does not harm, but can build and enhance it. Thus, based on the previous research, it can be represented that generally, there exist complementary or interactive relationships between trust and control mechanisms.

Under electronic links or virtual organizations, through the frequent and speedy interactions and communication, which are caused by the adoption of IOSs, tighter linkages between trading firms are enabled and actually formed, and thus, a firm can work more closely and efficiently with fewer partners or suppliers (Dedrick et al., 2008). If the tightly coupled relationships between involved firms are developed and the number of suppliers is reduced, the frequency of transactions with a few partners necessarily increases and the degree of interdependence between trading firms is also greatly heightened (Kim et al., 2005-6; Grover and Saeed, 2007). Both the high level of transaction frequency and the high degree of interdependence may intensify control problems in IORs, such as coordination requirements in transactions and the appropriation concerns of partners, and so, they can lead to the increased use of the outcome and behavior control devices (Langfield-Smith and Smith, 2003; Dekker, 2004).

Accordingly, the active usage of IOSs in firms' trades, which can give rise to high transaction frequency as well as high interdependence between trading partners, may require more utilization of formal control, and this phenomenon can be referred to as 'the electronic effects on the use of output and behavior control'. The electronic effects also imply that when IOSs are employed in business transactions, a large amount of information about the partners' behavior and performance can be easily and quickly communicated. Considering both the complementary or interactive relationship between trust and formal control, and the electronic effects, formal control devices may be more adopted and utilized in electronic links or virtual organizations than in traditional market relationships or strategic alliances. Thus, based on these arguments, the following hypotheses can be proposed:

H_7: Output and behavior control are more utilized in electronic links than in traditional market relationships.
H_8: Output and behavior control are more utilized in virtual organizations than in strategic alliances.

RESEARCH METHOD

Sample and data collection

Data for this study were drawn from a survey of the current status of IORs and IOSs usage in Korean manufacturing firms. 500 organizations were randomly selected from a population of approximately 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 IOSs applications than smaller firms. First, the chief factory managers (executives) of the selected firms were contacted to ask for their participation in the research. In the beginning, 131 organizations responded to requests for information. However, during the survey, 8 firms withdrew from the survey because they were unwilling to be clear

Table 1. Sample characteristics.

Type of industry	Chemical industry	Machine industry	Auto-mobile	Electronic Industry	Textile	Food	Paper and pulp	Non-metal	Metal industry	Rubber	Total
No. of firms	16	20	25	24	7	6	3	14	7	1	123
No. of employees	Below 100		100 - 300		300 - 500		500 - 1,000		1,000 -		
No. of firms	19		35		34		22		13		123

about the state of their IORs and IOSs usage. As a result, 123 firms were finally included in the study.

In order to collect data, questionnaires were administered to the participating firms. We pre-tested our Korean questionnaires by asking four professionals in the information systems areas to assess its logical consistency, ease of understanding and sequence of items, etc. Based on the collected comments, we made several minor modifications in the wording and readjusted the item sequence. For the validation of the questionnaires, a pilot study was also conducted with the production managers of seven manufacturing firms. Through the pilot test, the instrument was refined again to improve respondents' comprehension and to adapt the questions they found unclear.

Only chief factory managers (executives) were selected as respondents since they well understand the utilization of IOSs, the exchange of information and their firm's IORs. Before mailing the questionnaires through telephone contact with the respondent, mailing was confirmed. After telephone notification (which is about one or two days later), a questionnaire with a cover letter was mailed to each respondent. A self-addressed stamped envelope was included with the questionnaire to ensure anonymous responses. After distributing the questionnaire (about one week later), through the second telephone contact, the contents of the questionnaire and the answering methods were explained. The survey was conducted during a five-month period between September 2008 and January 2009.

To test non-response bias, the final sample was partitioned into two groups of early and late responses. The non-response bias was then examined through a t-test. The results showed no significant differences between the two groups regarding the number of employees ($t = 0.83$, $p = 0.40$), sales volume ($t = 1.27$, $p = 0.21$), TCM usage ($t = -0.72$, $p = 0.46$), and IOSs usage ($t = 1.22$, $p = 0.22$). Table 1 summarizes the sample characteristics according to the industrial type of the firms.

Measurements

Transaction and management information

Sixteen question items suggested in prior research (Hart and Saunders, 1998; Hakansson and Lind, 2004; Cooper and Slagmulder, 2004) were utilized to measure transaction and management information. The question items for transaction information include types of information about order, delivery, receipts, transportation, production planning, production progress, inventory status, and liquidation. The questionnaires for management information comprise kinds of information about cost, quality, product markets, profitability, manufacturing technology, new product development, product selling, and other management consulting. Respondents were asked to indicate on a seven-point Likert-type scale, anchored by 'no amount of information' and 'very large amounts of information', the amount of information that is exchanged with the major trading firms.

IOSs and TCM

IOSs are comprised of e-mail, EDI, video conferencing, Web, extranet, and electronic market (Hsiao, 2003; Albrecht et al., 2005). TCM include telephone, facsimiles, letters and face-to-face meetings (Suh, 1999; Wijayanayake and Higa, 1999). The degree of usage for each medium in the exchange of information was measured on a seven-point Likert-type scale that ranged from 'never use' to 'highly use'.

The degree of inter-organizational learning

The direct results or final phase of organizational learning are changes in shared mental models or changes in the organizational paradigm (Lee et al., 1992; Virany et al., 1992). Therefore, the degree of inter-organizational learning can be measured by the degree of change in the shared mental models between the involved firms. Based on the measures of Vandenbosch and Higgins (1995), five items to measure the changes in shared mental models about inter-organizational businesses were used. They are: belief about or understanding of inter-organizational businesses, staying close to, increasing focus in, testing assumptions about, and improving insights and creativity for inter-organizational businesses. Changes of shared mental models were measured on a seven-point Likert-type scale.

The degree of inter-organizational trust

Inter-organizational trust was measured by the four items, which were developed and validated in the study of Lee and Lim (2003). Respondents answered the extent to which they agree or disagree with each item. A seven-point Likert-type scale was used to measure trust. The four items include mutual trust, expectation of a fair deal, doing business without conflict, and attainment of mutual objectives.

The level of inter-organizational cooperation

We used the three items that were developed by Nakayama (2003) to measure the extent of collaboration between the involved firms. It was measured on a seven-point Likert-type scale, and measured in two ways: joint decision-making and mutual assistance. The mutual assistance represents an individual firm's help and its partners' aid.

The degree of use of output and behavior control mechanisms

Output control is divided into two kinds: financial output control and non-financial output control (Mahama, 2006). Financial output control includes cost targets, financial targets and the amount of cost saving, and the questionnaire items of non-financial output control are delivery time, specifications of products or services and

quality levels. Behavior control was measured by the three items, which include rules or regulations, procedures and ex-ante planning (Das and Teng, 2001; Dekker, 2004). Output and behavior controls were measured on a seven-point Liker-type scale that ranged form 'never use' to 'highly use'.

ANALYSES AND RESULTS

Reliability and validity

Item analyses were performed with Cronbach alpha coefficients for all multi-item scale measurements. All alpha coefficients were above 0.69, which is considered to be satisfactory for the reliability of a multi-item scale. The Alpha scores were 0.78 (IOSs), 0.69 (TCM), 0.92 (transaction information), 0.90 (management information), 0.93 (learning), 0.85 (trust), 0.74 (cooperation), 0.83 (financial control), 0.89 (non-financial control), and 0.92 (behavior control). Principal component analysis with a varimax rotation was used to verify the construct validities of the questionnaire items. Four separate joint factor analyses for IOSs and TCM, types of information exchanged, inter-organizational learning, trust and cooperation, and control devices of IORs were carried out to acquire a more stable solution by increasing the ratio of the sample size to the number of items.

Using a 0.4 criterion for significant item loading on a factor, the results show that in the case of IOSs and TCM, two factors with Eigen values greater than one were extracted. Factor 1, which is composed of e-mail, EDI, video conferencing, Web, extranet, and electronic market, represents IOSs. Factor 2 is comprised of telephone, facsimiles, letters and face-to-face meetings. Thus, its title is TCM. In terms of the types of information exchanged, item 10 (production progress) in Factor 1 was replicated with the items of Factor 2. Thus, item 10 was removed. In the second factor analysis, no items were replicated. Factor 1 includes order, delivery, receipts, transportation, quality, inventory, production planning and liquidation. Hence, the title of Factor 1 is transaction information. Factor 2 is comprised of questionnaire items regarding management information. In Table 2, in the cases of inter-organizational learning, trust and collaboration, and control devices, each factor exactly represents each construct. The results of this final factor analysis are presented in Table 2.

Discriminant validity involves a lack of relationships among measures that should not theoretically be related. In terms of discriminate validity, following Fornell and Larcker's (1981) approach, it is needed to show that the average variance extracted for each construct exceeds the squared correlation between that construct and any other construct. Table 3 shows that the average variances extracted (the diagonal elements) of each pair of constructs are greater than the squared correlations (the off diagonal elements).

Since all the measures were collected using a single instrument, the possibility of common method variance was tested using Harmon's one-factor test (Podsakoff and Organ, 1986). A principal components factor analysis on the 46 questionnaire items yielded 10 factors with Eigen values greater than 1.0, which accounted for 72.1% of the total variance. Because several factors, as opposed to a single factor, were identified, and because the first factor did not account for a majority of the variance, a substantial amount of common method variance does not appear to be present. The Eigen values and percentage of variances are presented in Table 4.

The four types of IORs and their characteristics

With a cluster analysis, this study classified sample firms according to the amount of information exchanged and the usage level of IOSs or TCM. In the current study, a cluster analysis provides groups of companies that are similar in terms of the amount of information exchanged and the usage levels of IOSs and TCM. However, since various types can be presented in the IORs of a firm, the results of a cluster analysis cannot exactly demonstrate the four forms. Therefore, we performed two cluster analyses: one for types of traditional links and electronic links, and a second for strategic alliances and virtual organizations. In the cluster analysis, we used the hierarchical agglomerative method to form clusters because it generates non-overlapping clusters and it has been the dominant method (Aldenderfer and Blashfield, 1984). 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.

Traditional market relationships and electronic links

Based on the values of IOSs, TCM and transaction information, a cluster analysis was performed to find two clusters of organizations: traditional links and electronic links. In addition, the mean scores of IOSs, TCM and transaction information 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. This is presented in Table 5. The points at which the distance coefficient suddenly jumps indicate suitable stages in the clustering sequence for analysis.

In Table 5, the distance coefficient increases greatly at three points – between the fifth and sixth clusters, between the fourth and fifth clusters, and between the third and fourth clusters. This implies that the five-cluster, four-cluster and three-cluster solutions may be appropriate points for analysis. Considering that three variables were utilized in the cluster analysis, the four-cluster result provides suitable data to examine the variations in IOSs, TCM and transaction information. Therefore, the

Table 2. Factor loadings of research variables (varimax rotation).

Variable: IOSs and TCM	Factor 1	Factor 2	Variable: Information	Factor 1	Factor 2	Variable: Learning, trust and cooperation	Factor 1	Factor 2	Factor 3	Variable: Control devices	Factor 1	Factor 2	Factor 3
1		0.79	1		0.69	1	0.88			1			0.74
2		0.78	2	0.82		2	0.89			2			0.89
3		0.64	3	0.79		3	0.89			3			0.81
4		0.62	4	0.89		4	0.85			4		0.76	
5	0.59		5	0.72		5	0.82			5		0.89	
6	0.70		6	0.72		6		0.72		6		0.85	
7	0.65		7	0.59		7		0.84		7	0.87		
8	0.71		8		0.68	8		0.83		8	0.91		
9	0.82		9	0.69		9		0.83		9	0.81		
10	0.67		10	0.72		10			0.67				
			11		0.73	11			0.78				
			12		0.76	12			0.85				
			13		0.77								
			14		0.84								
			15		0.77								
Eigen value	2.9	2.2		5.0	4.6		3.9	2.8	2.0		2.6	2.4	2.3
% of variance	29.1	22.1		33.6	30.7		32.6	23.3	17.3		29.1	27.1	25.8

* Factor loadings below 0.4 were not presented.

four-cluster solution is used in the analysis. The mean values of variables within each cluster are presented in Table 6, along with the Kruskal-Wallis test results (χ^2 values) for each clustering variable.

In Table 6, in the case of B, a large amount of transaction information is exchanged (the mean value is 6.4). Compared with the means of IOSs in C and D, the mean score of IOSs in cluster B is relatively high. If only a large amount of transaction information exchanged and a relatively high degree of IOSs use are considered, the firms of the B illustrate electronic links. In cases of clusters C and D, the rank or means of transaction information exchanged are rather high, and the usage levels of IOSs are very low (the mean values are 2.6 and 2.7). While, the use levels of TCM are relatively higher than those of IOSs. Thus, cluster D may not simply represent the traditional market relationships, which require a minimum amount of information exchange, but the traditional partnerships that are characterized by the close collaboration between trading firms through the communication of a large amount of transaction information with TCM and are equivalent to the electronic partnerships in electronic links. In cluster C, both the amount of transaction information exchanged and the usage degree of TCM are considerably lower than in cluster D. Hence, cluster C seems to show a middle form between traditional market relationships and traditional partnerships.

In the case of A, a small amount of transaction information is exchanged, and the usage levels of TCM and IOSs are very low. Thus, the firms of A may belong to the type of traditional market relationships. They are always likely to use a traditional arm's-length market to procure the necessary materials and products. In terms of inter-organizational learning, the difference between B (electronic links) and D (traditional partnerships) was examined using the Mann-Whitney test and was found to be significant at the 5% level (the Mann-Whitney U is 480.5). The difference in learning between B and A (traditional

Table 3. Average variances extracted.

Construct	Transaction information	Management information	TCM	IOSs	FOC	NOC	Behavior control	OL	Trust	Cooperation
Transaction information	0.66	-	-	-	-	-	-	-	-	-
Management information	0.36	0.83	-	-	-	-	-	-	-	-
TCM	0.13	0.15	0.64	-	-	-	-	-	-	-
IOSs	0.26	0.15	0.01	0.73	-	-	-	-	-	-
FOC	0.04	0.08	0.00	0.09	0.67	-	-	-	-	-
NOC	0.22	0.16	0.02	0.30	0.26	0.69	-	-	-	-
Behavior control	0.06	0.04	0.00	0.15	0.22	0.34	0.72	-	-	-
OL	0.26	0.18	0.08	0.19	0.05	0.21	0.08	0.62	-	-
Trust	0.02	0.04	0.02	0.00	0.08	0.06	0.15	0.00	0.45	-
Cooperation	0.04	0.15	0.03	0.02	0.16	0.06	0.15	0.10	0.23	0.49

FOC: Financial output control, NOC: Nonfinancial output control, OL: Organizational learning.

Table 4. The Eigen values and percentage of variances.

Factor	1	2	3	4	5	6	7	8	9	10	Total
Eigenvalues	5.4	4.9	4.8	3.3	2.9	2.8	2.6	2.1	2.0	1.9	-
Percentage of variances	11.9	10.8	10.4	7.2	6.4	6.3	5.8	4.6	4.5	4.2	72.1

Table 5. Distance coefficients of first cluster analysis.

Stage	113	114	115	116	117	118	119	120	121	122
Coefficient	85.9	92.8	106.4	120.8	137.8	159.1	200.9	243.9	357.7	497.3
Increasing rate of coefficient	-	8.0%	14.6	13.5	14.0	14.9	26.7	21.4	46.6	-

market relationships) was also significant at the 1% level. This result confirms the fact that in electronic links, because of the speedy and frequent ex-change of transaction information through IOSs, the level of learning is higher than that in traditional market relationships. Hence, H1 is supported.

In the case of inter-organizational trust, there was no significant difference between B and D, while the difference between B and C (that is, middle form) was significant at the 5% level. The significant difference in trust at the 10% level between B and A was also observed (the Mann-Whitney U is 215.5). The significant differences between B and C or A in trust may be caused by

Table 6. Results of cluster analysis (traditional links and electronic links).

Cluster	A (traditional market relationships; N=9)	B (electronic links; N=36)	C (middle form; N=38)	D (traditional partnerships; N=40)	χ^2
Transaction information	2.7(4)	6.4(1)	5.0(3)	6.1(2)	68.3 [a]
TCM	2.0(4)	4.0(2)	3.8(3)	4.9(1)	48.2 [a]
IOSs	1.7(4)	4.7(1)	2.6(3)	2.7(2)	75.1 [a]
OL	3.1(4)	5.4(1)	4.5(3)	4.9(2)	26.8 [a]
Trust	4.7(3)	5.1(1)	4.5(4)	5.0(2)	8.7 [b]
Cooperation	4.2(4)	5.0(1)	4.7(3)	4.9(2)	8.3 [b]
FOC	4.0(3)	4.9(1)	4.0(3)	4.1(2)	19.0 [a]
NOC	3.8(4)	5.9(1)	4.6(3)	5.1(2)	32.4 [a]
Behavior control	4.8(3)	5.6(1)	4.5(4)	5.0(2)	14.4 [a]

The numbers are mean values, and the numbers in parentheses are rankings. a: $p<0.01$, b: $p<0.05$; FOC: Financial output control, NOC: Nonfinancial output control, OL: Organizational learning.

Table 7. Distance coefficients of second cluster analysis.

Stage	113	114	115	116	117	118	119	120	121	122
Coefficient	107.7	118.6	132.7	147.6	166.0	189.2	222.5	264.3	341.4	537.6
Increasing rate of coefficient (%)	-	10.1	11.8	11.2	12.4	13.9	17.6	18.7	29.1	-

the differences in the amount of transaction information exchanged. Thus, these results support Hypothesis 3, which suggests the higher degree of inter-organizational trust in electronic links than in traditional links.

In terms of inter-organizational cooperation, the degree of collaboration in cluster B is the highest. However, the differences among B, C and D were not significant. Between B and A (traditional market relationships), the difference in cooperation was significant at the 10% level (the Mann-Whitney U is 100.5). Thus, H_5 is partially accepted. This result implies that the level of inter-organizational cooperation is likely to be influenced by both inter-organizational trust and the amount of information exchanged.

In output and behavior control, the results show that the usage levels in cluster B (electronic links) are significantly higher than those in other clusters. The differences in the financial and non-financial output control between B and D (traditional partnerships) were significant at the 1% level. The significant difference in behavior control at the 5% level between B and D was also found (the Mann-Whitney U is 503.0). From these results, Hypothesis 7 is supported. Hence, it seems to be demonstrated that the relationship between inter-organizational trust and the usage of formal control mechanisms is not substitutive but complementary or interactive one.

Strategic alliances and virtual organizations

Based on the values of IOSs, TCM and management information, the cluster analysis was employed to identify two clusters of strategic alliances and virtual organizations. According to the distance coefficients in Table 7, the five-cluster, four-cluster and three-cluster solutions seem to be appropriate points for analysis. We use the four-cluster solution in the analysis, since it provides sufficient data to investigate the variations in IOSs, TCM and management information. Table 8 shows the mean scores of variables within each cluster, along with the Kruskal-Wallis test results for each clustering variable.

In Table 8, in the case of cluster H, a considerable amount of management information is exchanged (the mean is 4.9), and the use level of TCM is considerably higher than that of IOSs. Thus, the firms of cluster H may belong to the type of traditional strategic alliances. The mean score of IOSs in cluster G is much higher than that of the IOSs for cluster H. In cluster G, a large amount of management information is communicated (the mean value is 5.3). The high degree of IOSs usage and the exchange of a large amount of management information are the main characteristics of virtual organizations. Hence, the firms in cluster G seem to be near the form of virtual organizations. In the case of F, the amount of management information communicated is a little small, and the usage level of IOSs is high. However, the use degree of TCM in cluster F is not low. It is likely that the firms of F belong to the type of a low degree of virtual organizations (semi-virtual organizations). In cluster E, the amount of management information exchanged is small, and the usage levels of TCM and IOSs are also low. The firms of cluster E may be more or less

Table 8. Results of cluster analysis (strategic alliances and virtual organizations).

Cluster	E (weak strategic alliances; N=42)	F (semi-virtual organizations; N=13)	G (virtual organizations; N=31)	H (traditional strategic alliances; N=37)	χ^2
Management information	2.8(4)	3.2(3)	5.3(1)	4.9(2)	91.2 [a]
TCM	3.4(4)	4.5(2)	4.2(3)	4.7(1)	29.1 [a]
IOSs	2.2(4)	4.6(1)	4.5(2)	2.5(3)	86.0 [a]
OL	4.2(4)	5.3(1)	5.2(2)	4.9(3)	14.5 [a]
Trust	4.7(3)	4.7(3)	5.1(1)	5.0(2)	4.2
Cooperation	4.4(4)	4.7(3)	5.1(1)	5.0(2)	9.1 [b]
FOC	3.9(4)	4.8(1)	4.7(2)	4.2(3)	12.6 [a]
NOC	4.3(4)	5.7(2)	5.9(1)	5.0(3)	36.9 [a]
Behavior control	4.5(4)	5.6(1)	5.4(2)	5.0(3)	14.2 [a]

The numbers are mean values, and the numbers in parentheses are rankings. a: $p<0.01$, b: $p<0.05$; FOC: Financial output control, NOC: Nonfinancial output control, OL: Organizational learning.

independent or they may belong to the type of weak strategic alliances.

The degree of learning in cluster G (virtual organizations) is higher than that in cluster H (traditional strategic alliances). However, the difference between G and H was not significant. Between G and E (weak strategic alliances), there was significant difference in learning at the 1% level (the Mann-Whitney U is 380.0). Thus, Hypothesis 2 is partially supported. In the case of inter-organizational trust, the difference between G and H was non-significant, but the significant difference at the 10% level between G and E was observed (the Mann-Whitney U is 430.5). Hence, Hypothesis 4, which suggests the higher degree of inter-organizational trust in virtual organizations, was partially accepted. The reason for this inconsistent result may be that in traditional strategic alliances, moderately high levels of trust between both parties are required and can actually be formed.

In inter-organizational cooperation, only the difference between G and E was significant at the 1% level (the Mann-Whitney U is 406.5). Thus, Hypothesis 6, which represents the higher degree of inter-organizational collaboration in virtual organizations, was partially supported. In Table 8, compared with those of cluster F, the degrees of trust and collaboration in G are significantly higher (that is, the differences in trust and collaboration between G and F were significant at the 10% level). Thus, it seems that as the type of IORs becomes forms of virtual organizations, the higher levels of inter-organizational trust and cooperation are required and realized.

In terms of output and behavior control, the usage levels of cluster G (virtual organizations) are significantly higher than those of H (traditional strategic alliances). The difference in non-financial output control between G and H was significant at the 1% level. In financial output and behavior control mechanisms, the significant differences at the 10% level between G and H were found (the values of Mann-Whitney U are 418.0 and 427.0, respectively). The results support Hypothesis 8, which proposes a greater utilization of output and behavior control in virtual organizations than in strategic alliances. Hence, it may be demonstrated that there exist both the complementary or interactive relationship between trust and control, and the electronic impact on the use of formal control.

DISCUSSION

This study considered electronic IORs in the empirical examination of the relationships among types of IORs, degrees of inter-organizational learning, trust and collaboration, and appropriate forms of control device of IORs. Based on the usage levels of TCM and IOSs as well as the amount of transaction and management information exchanged, four types of IORs were identified. The four types are: traditional market relationships, electronic links, strategic alliances, and virtual organizations. Through cluster analyses, we empirically found forms of IORs that may be similar to the four types of IORs. According to the results of this study, it was observed that the degrees of inter-organizational learning, trust and cooperation in electronic links are significantly higher than those in traditional market relationships. Thus, it is concluded that in electronic links, the speedy and frequent communication of a large amount of transaction information through IOSs contribute to the development and formation of high levels of inter-organizational learning, trust and collaboration.

However, there were no significant differences in trust and cooperation between electronic links and traditional partnerships, under which trading firms communicate a large amount of transaction information through TCM,

and so, the desired moderately high degrees of inter-organizational trust and collaboration are really developed. It was also found that outcome and behavior control mechanisms are more utilized in electronic links than in traditional links. The highest usage levels of formal control devices in electronic links can be explained with both the complementary or interactive relationship between trust and control, and the positive electronic effects on the use of governance mechanism.

This research showed that in inter-organizational learning, trust and cooperation, the differences between virtual organizations and traditional strategic alliances are not significant, while there are considerable differences between virtual organizations and weak strategic alliances. These results indicate that in strategic alliances, the degrees of learning, trust and collaboration as similar as those in virtual organizations may be required to perform inter-organizational cooperative businesses and to continue their IORs. The traditional strategic alliances also can be implemented with the close mutual understanding, trust and cooperation, and thus, there were no significant differences between virtual organizations and strategic alliances in the levels of inter-organizational variables. The results of this study demonstrated the higher usage levels of formal control in virtual organizations than in strategic alliances. Considering the non-significant difference in trust between virtual organizations and traditional strategic alliances, the more utilization of outcome and behavior control in virtual organizations may be originated from the electronic impact on the use of governance mechanisms.

Case study is another research approach to confirm the differences between virtual organizations and strategic alliances. Through case study, case firms, the type of which IORs is congruent with the forms of virtual organization or strategic alliance, can be selected. By comparing the case firms of virtual organizations with the cases of strategic alliances, the differences in the degrees of inter-organizational learning, trust and cooperation, and the usage levels of control mechanisms of IORs can be investigated and identified. To classify the four types of IORs, the two dimensions (that is, the usage levels of IOSs and TCM, and the amount of transaction and management information exchanged) were employed. With multiple regression analyses, the effects of the two dimensions on the levels of inter-organizational variables can be examined. Through these analyses, the changes in the levels of inter-organizational variables can be estimated and predicted as the type of IORs becomes a form of electronic IORs.

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