The Impact of Organizational Contexts on EDI Controls

이상재, 한인구
한국과학기술원 테크노경영대학원

Abstract

The growing popularity of electronic data interchange (EDI) in business operations has led to a growing recognition of the need to implement proper control procedures. The requirements for control systems vary according to organizational context. A research model proposes that the organization, technological, and task characteristics as well as partner attributes affect formal, informal, and automated controls, each of which can be categorized as internal and external controls. Data were gathered from 110 companies that had adopted EDI. IS sophistication and task routineness were significantly associated with the use of formal and automated – both internal and external – controls. Decentralization and partner trust affected the use of internal and external informal controls. The results of this study could help EDI managers or auditors decide the necessary mode of controls for a certain organizational context. In addition, this study would be of interest to EDI practitioners in designing control systems.

Key Words
EDI, organizational contexts, EDI controls

I. Introduction

Electronic Data Interchange (EDI) refers to the direct transmission of data through computers at different sites which would otherwise be sent in printed form. EDI controls need to be designed and maintained to ensure completeness, integrity, accuracy, and timeliness of information while meeting its objectives of service improvement, cost reduction, and improvement of productivity (Chan et al., 1993). It is possible to derive competitive advantage from EDI only if integrity and accuracy are ensured in the EDI procedures. Savings in administrative and operating costs can be wiped out by deliberate or erroneous loss of data during data communication. Organizational costs (e.g., a loss of credit or image as well as market share with its competitive advantage) from data loss or invalid data from accidental acts can be reduced when using appropriate controls (Weber 1988).

The first step in the design of EDI controls is the preliminary review of the organization and management practices to obtain the information necessary for management to make decisions on the necessary controls. The implementation of controls requires resources. The introduction of IS controls need to proceed in view of an organization's requirements for security and integrity. It is inefficient to implement expensive controls in subsystems if the sensitivity and vulnerability of the systems themselves are not high. Since available resources are limited, it is not possible for EDI managers to develop all of the necessary controls. Guidance in control design must be provided so that the cost of implementation is lower than the reduction in expected losses of IS resources or risks. The necessity of various controls may be different according to organizational contingencies.

This study addresses two issues: (1) How can EDI controls be classified? (2) What are the major organizational factors affecting EDI controls? The literature on organization theory as well as IS and EDI controls are reviewed and a research model for EDI control is proposed. The model is tested empirically for Korean companies adopting EDI. A summary of the findings and a list of recommendations for EDI practitioners and researchers are presented. The research model is outlined in Figure 1.

Insert Figure 1 here

II. EDI Controls

EDI controls represent part of the overall organizational control system. The objectives of EDI controls are to ensure that an organization achieves its goals through the implementation of EDI. These controls relate to the management processes to safeguard assets, maintain data integrity, and accomplish organizational goals effectively, while consuming resources efficiently.

There are many ways to classify controls. This study uses three dimensions of EDI controls; formal, informal, and automated controls (see Lee et al. (1998)). Formal control is defined as "written management-initiated" control, while informal control is based on shared beliefs and values developed by members of an organization (Jaworski et al., 1993). Organizations use formal mechanisms such as rules, regulations, and the hierarchy of authority to direct behavior and assess performance (Daft and Steers, 1986). Formal controls such as standards, operational

procedures, process changes, and formal contracts including legal issues with trading partners (e.g., auto makers and providers of auto parts) and Value Added Network (VAN) are the basic elements of EDI systems. Formal controls are supposed to be initiated by management rather than lower level employees and are based on written procedures. Informal controls include the use of values, traditions, employee commitment and social beliefs. Informal controls are initiated by organization members using the members' values, judgments and communications. Automated controls are defined as controls using at least some portion of a computerized system. Automated controls are measured with automated control procedures and methods.

EDI controls may be categorized into internal and external controls. Internal controls deal with internal components of EDI systems such as the application system interface while external controls are involved with external EDI systems such as a VAN or trading partner. Internal controls for EDI systems are established to monitor the internal application systems, like a production system or a sales system, linked to an external network. In an integrated EDI system, minor failures or a short downtime of one system may adversely affect other systems. Internal and external controls are interrelated with each other as internal applications are integrated with external systems of VAN providers and trading partners. A cross-vulnerability exists with systems of VAN service providers or trading partners as a major control deficiency in one EDI system can materially compromise the integrity of the other dependent EDI system due to commonalties in security architectures that cross VAN service providers and trading partners (Marcella and Chan, 1993).

The aforementioned control dimensions can be used to generate a framework of control modes. Internal and external controls can be classified according to two important control dimensions: formality and automation. Table 1 indicates six potential control modes along with their descriptions.

Insert Table 1 here

III. Organizational Contexts

As EDI becomes increasingly important as a viable alternative way of processing transactions, attention needs to be paid to environmental contexts that affect the successful use of EDI. The organizational context describes the general situational circumstances of an EDI system that affects EDI controls and implementation. Most past EDI studies have used the theories of innovation to identify the factors that influence the adoption and implementation of innovation (e.g., Grover (1993), Iacovou et al. (1995), Ramamurthy and Premkumar (1995)). IS controls interact with contextual factors for the successful implementation of IS.

The decision on the determination of organization contextual variables is based on the following. First, the factors influencing EDI implementation as well as EDI controls are selected. Since this is an early study on EDI controls and the theoretical studies on IS controls are rare, the organizational contexts that affect the implementation of EDI are firstly examined and the ones that affect controls are selected. EDI controls that are related to the organizational contexts are necessary to facilitate EDI implementation success. Second, various categories of variables, industrial, organization (including IS), and task characteristics (these variables are called "organizational contexts" in this study) are included in this exploratory study if they could potentially influence EDI controls and implementation.

Based on a review of the literature on organizational control as well as organizational innovation-implementation and EDI adoption literature, this paper proposes organization characteristics (size, professionalism, decentralization), technological characteristics (IS sophistication, role of IS), task characteristics (interdependence and routineness) and partner attributes (trust) as influential factors in establishing EDI controls.

(1) size

As organizations increase in size, the problems of social controls, coordination, and communication become more intricate (Jaworski, 1988; Yap and Souder, 1993). Large organizations face an exponentially increasing number of information channels, which makes informal controls less effective (Blau and Scott, 1972; Burns and Stalker, 1966; Merchant, 1981, 1984). As organizations increase in size, it is necessary to institute a more formal planning process to ensure the development of an integrated vision for the IS function (Cash et al., 1988; Ward and Whitmore, 1990). In that case, formal controls can provide a consistent set of rules to control large and complex application systems integrated with EDI. Thus, organizational size is positively correlated with the use of formal controls.

The full implementation of automated controls requires extensive expertise and expense (Lawrence, 1988). Large organizations are more likely to be able to afford the costs for automated controls and possess greater technical expertise than smaller firms. Larger firms have more trading partners with diverse operating environments (protocols, line speed, standards, hardware) and higher transaction volumes than smaller companies (Chan et al., 1993). Automated controls are cost-effective for large organizations with high communication complexity due to high transaction volumes and numerous trading partners (Fullerton and Evens, 1989). Thus, automated controls are more appropriate for large companies.

Hypothesis 1-1: The larger the organization, the greater the use of internal and external formal controls.
Hypothesis 1-2: The larger the organization, the greater the use of internal and external automated controls.

(2) professionalism

Specialists' jobs require complex decision-making and high reliance on colleagues for advice. Specialists are not accustomed to standard operating procedures, formal rules and clear standards of performance (Ouchi and Maguire, 1975). They prefer their values

and beliefs to formally established rules in coping with exceptions in their work. The specialists in the IS department including EDI discuss with their peers and rely on their knowledge and intuition to address unexpected problems. Informal controls by professionals are enhanced by their knowledge and skills. As most of them are engaged in jobs demanding creativity, the efficiency and effectiveness of their work would decline if their work were to be unduly constrained. Greater technical knowledge of professionals will help control EDI system in informal way.

A survey by Lawrence (Lawrence, 1988) shows that automated controls - such as integrated test facility - have not yet been fully utilized due to the complexity of computerized systems and lack of technical expertise. For example, concurrent audit techniques, continuous and intermittent simulation (CIS) techniques, and parallel simulation techniques to audit batch processing demand high technical expertise and substantial system implementation. The know-how of IS professionals are strongly needed to solve any technical problems in installing these controls and effectively integrate the controls with existing systems. The implementation of automated controls is facilitated if technical expertise and knowledge regarding EDI and communication technology exist.

Hypothesis 2-1: The higher the degree of professionalism, the greater the use of internal and external informal controls.
Hypothesis 2-2: The higher the degree of professionalism, the greater the use of internal and external automated controls.

(3) decentralization

The diffusion of innovation is facilitated by organic structures normally associated with decentralization which facilitates initiation and testing of new ideas (Russel and Russel, 1992). When EDI staff members have more authority, they are more likely to act on their own judgment and explore novel approaches. When exceptional incidents happen, they communicate with others to draw on their knowledge and skills. Mechanistic and formal organizational controls will not provide favorable conditions to EDI staff members in decentralized organizations as they inhibit free interaction among them to give innovative ideas. Informal controls are needed to facilitate the communication of ideas and implementation of EDI in such decentralized organizations.

Hypothesis 3-1: The greater the degree of decentralization, the greater the use of internal and external informal controls.

(4) IS sophistication

EDI relies on the existing IS infrastructure to integrate with internal applications (Sullivan, 1985). EDI can be implemented more easily in the presence of highly computerized IS functions for accounting, payment, inventory management, and production controls. As IS becomes more sophisticated (for example, the size of an EDP department becomes large or the demand for the IS function becomes high), the use of formal controls expands. A superior corporate data management is necessary to provide integrated and consistent EDI controls (Chan et al., 1993). The higher the sophistication of EDI, the stronger is the tendency of management for the proactive formal controls on system development and maintenance.

An advanced IS demands controls different from traditional methods due to a smaller paper audit trail and decreased segregation of duties. It is more difficult to control distributed, automated, high-tech systems with manual techniques. Unless mistakes are detected, they will propagate swiftly into other systems. It is necessary to identify system errors before they affect other systems. For this reason, advanced controls (such as concurrent control techniques or simulation tools) are embedded in the application system and recognize errors as the processing is being performed (Aggarwal and Rezaee, 1994; Ahituv and Lee, 1984; Hansen and Hill, 1989). Thus, automated controls are effective for sophisticated IS which is linked with EDI.

Hypothesis 4-1: The higher the level of IS sophistication, the greater the use of internal and external formal controls.
Hypothesis 4-2: The higher the level of IS sophistication, the greater the use of internal and external automated controls.

(5) role of IS

If the present and future strategic importance of IS is high, management will be more committed to IS planning and controls. In this situation, the quality of the planning process for IS should be higher (Premkumar and King, 1994). If IS has a strategic role in the organization, management may recognize the importance of planning and controls of EDI and invest more resources to implement the strategic system and establish formal planning and control systems due to a concern regarding a possible loss of competitiveness caused by a control failure.

Even small errors in the strategic IS may severely affect the credit of a company and lower its competitiveness. Only after a company ensures completeness, accuracy, and data security in each of its transactions, they can gain a competitive advantage from EDI implementation. In this environment, the security department will be given greater authority to ensure the security of strategic IS (Straub, 1988). The high position of the security and audit departments makes it easier to get management support for implementing automated controls. Further, the high expenses for the installation of automated controls are justified for a strategic IS. With the growth of the strategic importance of EDI, the IS function will support the expenses required for automated controls to prevent and correct errors.

Hypothesis 5-1: The greater the role of IS, the greater the use of internal and external formal controls.
Hypothesis 5-2: The greater the role of IS, the greater the use of internal and external automated controls

(6) task interdependence

According to Perrow (1967) and Thompson (1967), task interdependence is "the extent to which departments depend on one another for the exchange of resources and information to

accomplish their work." It is difficult to control the interactions between interdependent departments in a predetermined way. There is less reliance on standardization, rules, and procedures to guide the workflow under this organizational structure (Daft and Steers, 1986). The problems of controls are compounded when different functional units are interdependent and require coordinated effort (Dalton, 1971; Otley, 1980).

The implementation of EDI usually affects a number of functional areas within an organization including accounting, purchasing, transportation, and marketing simultaneously (Emmelhainz, 1990). Mistakes must be detected as promptly as possible before they affect the workflow of other departments. It is difficult to control the EDI process where the activities of one department affect other departments immediately. Detail guidelines hardly exist to solve complex interaction between, for instance, production and ordering departments. Hence, the cross-vulnerability of these departments will lead to the development of informal controls. In order to monitor efficiently interdependent task processes, more informal controls are likely to be required.

Hypothesis 6-1: The higher the level of the task interdependence, the greater the use of internal and external informal controls.

(7) task routineness

Routine technologies are characterized by low variety, high analyzability, standard procedures, and few exceptions (Perrow, 1967). A prime candidate for conversion to EDI is a company that handles a large volume of standardized transactions (Marcella and Chan, 1993). EDI is more effective for repetitive transactions than for unstructured ones (Emmelhainz, 1990). As tasks become more routine, the implementation of formal controls becomes effective (Jaworski et al., 1993). As the routineness of EDI tasks increases, formal EDI controls are appropriate because these tasks are amenable to standard operating procedures, formal rules and clear standards of performance.

The nature of tasks influences management procedures. Managers stress efficiency where activities can be measured quantitatively and are well defined (Daft and Steers, 1986). This leads to automation of work processes. For example, production departments and assembly lines are examples of routine processes. In most cases, the processes linking these departments are automated. Automated controls can promote both effectiveness and efficiency in such an environment.

Hypothesis 7-1: The higher the level of the task routineness, the greater the use of internal and external formal controls.
Hypothesis 7-2: The higher the level of the task routineness, the greater the use of internal and external automated controls.

(8) partner trust

Many important issues in the implementation of EDI are related to the coordination with trading partners and VAN service providers to facilitate message communication. Trust prevents, reduces or eliminates opportunism and requires less formal rules and standards (Zaheer and Venkatraman, 1995). When the level of trust between buyers and suppliers is high, the partners will be less inclined to exert controls in the relationship (Andaleeb, 1995). Trust may reduce the need for formal contracts which are costly to write, monitor and enforce, as they rely on psychological contracts (Bromiley and Cummings, 1991). The reliance on trust lowers the cost of negotiation. The partners may establish cooperative IORs (Interorganizational Relations) without the use of formal contracts and safeguards (Ring and Van de Ven, 1994). As trust is further affirmed, informal controls are more used, as they may complement or substitute for formal contractual safeguards.

Hypothesis 8-1: The greater the level of partner trust, the greater the use of internal and external informal controls.

IV. Research Methodology

4.1 Data Collection

Questions about controls can be answered reliably only by the companies which have implemented EDI comprehensively. 2000 companies were selected from publicly available company databases (through Chollian network service). Among these companies, the companies which are likely to have implemented EDI comprehensively were contacted to check their level of EDI implementation.

Structured interviews were used as the main data collection method. The interview provides the opportunity to aid the respondents in their interpretation of the questions, and allows flexibility in determining the sequence and wording of the questions. One or two EDI managers simultaneously participated in the interview. They were believed to have sufficient knowledge about EDI implementation.

The data used in validating the research model were gathered as part of a larger investigation concerning EDI controls (see Lee et al. (1998)). The survey instrument was verified first by interviewing EDI practitioners from each firm. Ten interviews with practitioners were conducted and a final review was made by four IS professors. A total of 110 usable responses were received from EDI staff or managers. The unit of analysis is individual EDI adopting company. The number of large companies is greater than that of small companies. Large firms are able to invest resources to integrate and control EDI more easily than small firms, therefore, EDI user firms are expected to be large.

4.2 Measures, Measurement Reliability, and Validity

Measures for the research variables are summarized in Table 2. Measures of industry, organizational attributes, task characteristics, and partnership attributes were adapted from previous literature. A multiple 7-point Likert-type scale represented each variable except size and two items among six for IS sophistication. Size was measured by the total number of employees and annual sales while

the total number of IS staff and the annual IS budget were included as indicators of measuring IS sophistication. Measures for six modes of EDI controls were constructed separately. Formal and automated control measures were newly developed through a synthesis of various sources (Chan et al., 1993; ISACA, 1990; Jamieson, 1994; Marcella and Chan, 1993). Informal control measures were based on several former studies including Jaworski et al. (1993).

Insert Table 2 here

Reliability and validity tests were performed for the collected data (we eliminated the related tables due to the limitation of manuscript pages.)

A reliability analysis was conducted and the items (i.e., PROF2 for professionalism, TROUT2 for task routineness) with "low-to-total" correlations (the correlation between the item and the variable) were deleted. One item each for professionalism, the role of IS, and task routineness were eliminated to increase Cronbach's alpha. All scales exceed 0.6 after deleting low-to-total correlated items, which shows moderate to high reliability.

Content validity is concerned with the representativeness of the content of the measure for the universe of the property being measured. In this study, the measures are based on previous work and pretested by both practitioners and four IS professors to enhance the content validity of the instrument.

Construct validity was assessed using convergent and discriminant validity. Convergent validity can be tested using principal component factor analysis. All variables except IS sophistication and the role of IS have one factor. IS sophistication and the role of IS are divided into two factors. Although it is technically desirable to treat them as separate factors, it may be acceptable to aggregate them as a single construct if there exists sufficient theoretical justification. This approach has been used extensively in IS research (Ives et al., 1983; Tait and Vessey, 1988).

Discriminant validity testing can be accomplished by comparing correlations among variables with Cronbach's alpha. Gaski and Nevin (1985) have suggested that if the correlation between one variable and another is lower than each variable's coefficient alpha, it indicates a good discrimination. No correlation between variables was as high as the coefficient alpha of the individual variable.

V. Data Analysis and Results

Table 3 presents a series of regression analyses with the six modes of EDI controls as dependent variables and the organizational contexts as independent variables. The effect of each organizational context on EDI controls could be examined while controlling for the effects of the other independent variables through multiple regression analysis. All the regression equations turn out to have significant F ratios. In other words, the collective explanatory power of the dependent variables is statistically significant.

Insert Table 3 here

IS sophistication and task routineness are significantly related to the reliance on internal and external formal controls. The establishment of formal controls can be strongly affected by the recognition of risks by management. Internal organizational factors such as IS sophistication and task routineness indicate the vulnerability of the system if appropriate controls do not exist. When management recognizes the vulnerability of the system due to sophisticated IS resources and a large volume of transactions to be processed at high speed, they perceive relative advantages of the establishment of formal controls in user applications and external networks. If tasks are highly repetitive and structured, formal controls such as standardized procedures can greatly contribute to improvement of system utilization.

Size is significantly related to the use of external formal controls. Large firms tend to have formalized relationships with trading partners due to the large number of trading partners and transactions. The extent of internal formal controls are, however, more related to the characteristics of IS and inner processes rather than mere size of organization. Large organizations that have simple EDI applications may not need many internal formal controls; however, external formal controls by VAN or trading partners may be more necessary for large organizations that have trading partners with diverse operating environments (in protocols, line speed, standards, hardware) and higher transaction volumes than small companies.

Decentralization and partner trust significantly affect the reliance on internal and external informal controls. EDI staff members have a different extent of risk recognition, sense of responsibility, experience, and interaction with their colleagues according to the extent of the authority they are given and the trust they have in relation with trading partners. This reliance on informal controls tends to increase as they further delegate organizational authority to members. Management of EDI adopters experience the ability of departments or trading partners to deliver or even work "outside" the existing terms of formal procedures or interorganizational agreements; their reliance on informal controls deepens even more when organization is more decentralized. Informal understanding of acceptable behavior stems from a reliance on trust; informal controls compensate for the absence of formal rules and contracts. EDI adopters depend mainly on the use of informal controls and rely on trading partners to provide communication controls when they highly trust them.

Size, IS sophistication, and task routineness are significantly related to the use of internal and external automated controls. The implementation of automated controls such as integrated test facility and concurrent audit technique can only be successful when enough IS resources are provided. In addition, a large volume of transactions is necessary to make the implementation of automated controls in inner applications and VAN cost-effective. Large organizations and organizations with sophisticated IS and highly routine processes can afford the high cost and expertise

required for the implementation of automated controls and this subsequently makes the system more beneficial.

The role of IS fails to affect the use of internal and external formal controls. Professionalism does not affect the use of internal and external automated controls. Professionalism has a significant effect only on internal informal controls. The technical expertise of professionals is used to implement the internal informal controls. Professionalism fails to affect the use of external informal controls and this indicates the extent of education EDI staff members have received does not influence the establishment of external informal controls; EDI staff members appear to trust the security and integrity of external networks provided by trading partners or VAN and do not have much concern with external controls. As the number of EDI documents and trading partners increases, EDI adopters rely more on the expertise of communication controls by VANs or "hub" companies rather than on controls developed by themselves; the controls that are provided by VAN become cost-effective with additional peripheral services. The knowledge and expertise of EDI adopters become less important in implementing external controls; companies allow VAN to provide sophisticated external control systems (e.g., conversions between different trading partners' environments, provision of varied protocol and access methods).

The implementation of formal or automated controls is affected more by technical characteristics such as IS sophistication and task routineness rather than professionalism and role of IS. The insignificant effect of the role of IS and professionalism on EDI controls can be partially explained by the influence of external factors on the implementation of EDI. The role of IS and professionalism in organization may not influence the use of EDI controls in a situation where much of the work processes for EDI implementation becomes structured and formalized by the influence of external trading partners and VAN service providers. This is often the case in Korea. Korean companies have been using EDI for less than 5 years and the state of their implementation is under strong external influence from trading partners and VAN service providers. Additionally, Korean companies have not recognized the seriousness of exposure that is present when using EDI. Since they have little experience of computer abuse, they have less concern that fraud, disruptions to production, and intentional manipulation of operations in EDI systems may lead to impaired customer service, inappropriate decision making, loss of market shares and financial loss. Positive managerial attitude toward IS does not always lead to extensive efforts to control EDI. Management tends to concentrate on improving short-term effectiveness and efficiency; hence they are likely to invest more resources on integrating and expanding EDI but less on controls to enhance security and integrity. This may be due to the fact that the effects of control are not realized swiftly.

The low explanatory power of task interdependence on controls can be partially due to the fact that companies use EDI controls intensively for each of the EDI tasks although not all five EDI tasks are interdependent with each other. Some companies may use EDI for different groups of tasks; the tasks within a single group may be highly interdependent even while intergroup activities are only loosely linked. For instance, manufacturing companies used EDI in trade procedures such as import / export authorization or tariff procedures as well as in financial applications such as electronic fund transfer or receiving invoices from suppliers. The interdependence between trade and financial applications may be low although the interdependence among trade procedures or financial applications is high, respectively. In this situation, it is difficult to examine the relation between task interdependence (which is the average interdependence among every pair of tasks) and the use of informal controls.

VI. Conclusions and Implications

The purpose of this study is to study the impact of organizational contexts on EDI controls. This investigation extended previous work in organizational control and innovation-diffusion by applying the concepts IS controls, especially in the context of EDI. IS sophistication and task routineness are significantly associated with the use of internal and external formal controls. Decentralization and partner trust affect the use of internal and external informal controls. Size, IS sophistication, and task routineness are significantly related to the use of internal and external automated controls.

6.1 Implications for Practitioners

The results of the study provide some insights on organizational context that necessitate the effectiveness of specific modes of EDI controls. For instance, organizational contexts such sophisticated IS and routine task environment are important to determine the level of internal and external formal controls while decentralized organizational structure and high partner trust demands internal and external informal controls. Large organizations and organizations with high professional expertise require external formal and internal informal controls, respectively. Size, IS sophistication, and task routineness are related to volume, complexity of transactions, and the speed of processing, respectively; EDI adopters with these organizational contexts demand automation of controls for control effectiveness; the benefits of automated EDI controls vary across such organizational contexts as size, IS organizations, and task routineness. These benefits are related to decreased occurrence of irregularities or errors.

The tasks of designing control systems, as performed by EDI auditors are difficult and unstructured, as there exists no normative model of EDI controls. EDI auditors often use past experience or their professional knowledge to determine how EDI systems are controlled in certain organizational contexts, as EDI controls depend on organizational contexts. EDI auditors often use analogies from their previous experience to design controls; however, the effectiveness of this reasoning process is greatly limited by the lack of normative models of EDI controls as well as their cognitive and situational limitations. EDI auditors must

determine which controls are necessary from the viewpoint of cost-benefit effectiveness. Many alternative forms of controls may exist, and many organizational contexts affect the design of controls. It is difficult to establish if-then rules explaining the choice of controls in some organizational contexts, as the benefits of controls are hard to measure quantitatively. The results of the study can help auditors analyze organizational contexts and recommend the controls that are needed in a given situation; they then can concentrate their limited IS resources to design and effectively implement these controls. The quality of the processes of determining and evaluating required controls in an organizational context can be improved based on the empirically validated relationship between organizational context and EDI controls in this study. The implementation level of internal and external formal and automated controls can be adjusted in order to satisfy the efficiency control objective.

The results of the study can attract management to invest appropriate resources to specific EDI controls demanded in their organizational context. Unless the new controls are validated, organizations will be reluctant to install them. Some may think that the controls will slow system response time and utilization, or that the costs outweigh the benefits to system integrity. A major obstacle to the control development arises from cultural factors. Management is accustomed to traditional methods such as paper audit trails, segregation of duties, and hand-written signatures rather than technical controls, which are often embedded in the EDI system. The changeover to new controls may require a new regulatory system to be enforced. Management can overcome some resistance from user departments or trading partners and encourage the implementation of EDI controls more proactively than before based on the results of this study.

6.2 Implication for Researchers and Limitations

The results of the study also have significant implications for researchers. In light of the fragmented and scant nature of the literature that addresses factors for IS controls, a specification of the linkages between organizational contexts and EDI controls can provide a useful framework for future research. The contingent controls framework may be generalized with appropriate modification in research variables for other IS controls (e.g., partner relations may be excluded to explain controls in internal IS). There may exist other variables that affect the use of EDI controls; a more exhaustive model is needed to examine and identify various organizational contexts that affect EDI controls using a large base of data in future studies.

The dimensions of EDI controls can be further studied. Other control dimensions may include the objectives of controls. It is difficult to apply a single set of measures for EDI controls to the respondent organizations, which have developed EDI systems that have different purposes and requirements. For instance, accuracy of information is important in a JIT (Just-In-Time) system while confidentiality of information is critical in financial applications. The controls for authorization (e.g., cryptography, message authentication code, access control software) are different from the controls for accuracy (e.g., edit check, syntactic check, error logging). The former checks that all related software and data are protected against unauthorized disclosure or change during transmission or storage while the latter ensures accuracy and completeness during input, process, and output stage of processing transactions. Dimensions and measures of controls need to be developed to reflect distinct control objectives.

Specifically, the environment in Korea may affect the causal relation between organizational contexts and controls. It is necessary to analyze data collected from other countries in order to control the effects of economic, political, and cultural situations. Any attempt to generalize the findings to EDI systems in different countries need to be pursued with care and caution. The EDI system in Korea is rapidly growing and the results of this study may reflect unique characteristics of Korean companies. For example, the implementation of EDI in some industries in Korea has been supported by a government agency that monopolizes the provision of services associated with international trade. Their implementation of EDI relies substantially on a VAN that is managed by the government. Korean companies do not currently prepare communication controls with trading partners and rely on the VAN to provide these controls. In addition, there is generally less computer abuse and disputes between partners so it is difficult to justify the investment of controls in order to reduce computer abuse. This is a reflection of Korean culture that does not place much importance on formal contracts and agreements in anticipation of possible disputes from errors and system failures. The partners believe such problems will not arise in their own network. However, as EDI is rapidly spreading in Korea, system failures or abuses will lead to an increased recognition of external formal controls.

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Tables and Figures

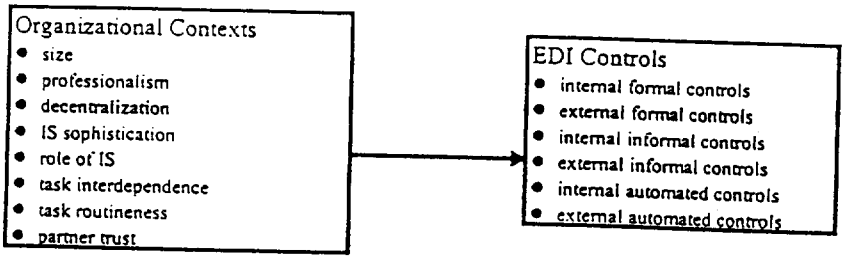

Figure 1: Research Model

Table 1: EDI Controls in this Study

Control Classifications	modes of controls	Description
formal controls	internal formal controls	procedures used to protect internal applications from errors and unauthorized access and to ensure that message generation is accurate and secure
	external formal controls	procedures used by VAN service providers or trading partners to ensure security and integrity of communication
informal controls	internal informal controls	risk recognition, sense of responsibility, experience, and interaction among colleagues by IS members and users
	external informal controls	risk recognition, sense of responsibility, experience, and interaction among colleagues in order to prepare for threats and cross-vulnerabilities occurring from communicating with VAN service providers and trading partners
automated controls	internal automated controls	automated routines used to detect and correct errors during input, process, and output of data and access control and authentication software used to protect EDI systems from unauthorized access and computer abuse.
	external automated controls	automated control measures for system integrity and security that are provided by VAN service providers and trading partners for system integrity and security

Table 2: Items for research variables

Classification	variables	items	adapted from
organization characteristics	size	total sales (SIZE1) number of employees (SIZE2)	Grover (1993) Runge (1985)
	professionalism	the proportion of professional staff members with the educational backgrounds in communication and IS (PROF1) the number of professional staff members that have received graduate course in communication and IS (PROF2)	Corwin (1975) Daft and Becker (1978)
	decentralization	the degree to which participation of subordinates in company decision making is encouraged (DEC1) the degree to which employees can make their own decisions (DEC2) the extent of concentration of decision making authority (DEC3)	Aiken and Hage (1971) Corwin (1975)
	IS sophistication	number of EDP staff (SOP1) IS budget (SOP2) percentage of administrative applications (SOP3) planning and control by steering committee (SOP4) user involvement in the development of IS (SOP5) the percentage of the budget in management controls and strategic planning (SOP6)	Cheney and Dickson (1982) Raymond (1990)
	role of IS	impact of shutdown of computer center (ROL1) feasibility of manual work processing (ROL2) development of systems for cost reductions and productivity improvement (ROL3) development of systems to provide new ways to compete (ROL4) studying the impact of new IS technologies and areas of application (ROL5) development of IS applications that are vital for long-term strategic objectives (ROL6)	Premkumar and King (1994)
task characteristics	task interdependence	extent to which performance depends on other tasks (TINT for five tasks: ten sub-items)	Goodhue and Thompson (1995) Jaworski et al. (1993)
	task routineness	perception of routineness in performing task (TROUT1 for five tasks: TROUT-1, TROUT-2, TROUT-3, TROUT-4, TROUT-5) ease in processing tasks due to clear job definition and description (TROUT2 for five tasks: TROUT2-1, TROUT2-2, TROUT2-3, TROUT2-4, TROUT2-5)	
partner attributes	trust	degree of mutual trust between trading partners (TRS1) trust in the benefit of trading partner's decision (TRS2) expectation of fair deal from partner (TRS3)	Mohr and Spekman (1994) Zaheer and Venkatraman (1995)
controls	internal formal controls	system change control by authorization (IFC1) integrity check of the message before processing in the application (IFC2) transaction log for the possible errors and collapse (IFC3) appropriateness of system login procedures using password (IFC4) integrity check after generating EDI messages (IFC5) authentication of trading partners after receiving EDI messages (IFC6)	Chan et al. (1993) ISACA (1990) Jamieson (1994) Marcella and Chan (1993)
	external formal controls	back up and recovery plan by VAN & trading partners (EFC1 & EFC2) retransmission after correcting erratic messages by VAN & trading partners (EFC3 & EFC4)) dispute reconciliation procedures by VAN & trading partners (EFC5 & EFC6)) access control on network by VAN & trading partners (EFC7 & EFC8) mailbox access control by VAN (EFC9)	

	internal informal controls	recognition of possible propagation of errors from one system to another (IIC1) recognition of the importance of their responsibility (IIC2) ability to judge peer's errors in their tasks by experience (IIC3) ability to cope with the errors effectively by experience (IIC4) interaction with seniors or peers to cope with problems in their tasks (IIC5)	Jaworski et al. (1993)
	external informal controls	recognition of the effect of errors in VAN & trading partners (EIC1 & EIC2) recognition of importance of interorganizational cooperation (EIC3 & EIC4) processing nonroutine problems between VAN & trading partners by experience (EIC5 & EIC6) recognition of importance of items in the agreement between VAN & trading partners (EIC7 & EIC8) interaction between VAN & trading partners to process message errors (EIC9 & EIC10)	
	internal automated controls	programmed integrity check before processing in application systems (IAC1) applying access control software on critical application and files (IAC2) automated data integrity check before transmission of EDI messages (IAC3) automated authentication of trading partners using message code (IAC4)	Chan et al., (1993) ISACA (1990)
	external automated controls	automated transaction log for EDI messages by VAN & trading partners (EAC1 & EAC2) error message tracing and error reporting by VAN & trading partners (EAC3 & EAC4) digital signatures(message authentication code) provided by VAN & trading partners (EAC5 & EAC6) provision of various protocol function by VAN (EAC7) provision of various EDI document standard by VAN (EAC8)	Jamieson (1994) Marcella and Chan (1993)

Table 3: Multiple regression results

(a) dependent variables = formal controls

(*** p<.01, ** p<.05, * p<.1)

dependents / independents	internal formal controls				external formal controls			
	beta	standard Error	t value	p value	beta	standard Error	t value	p value
CONSTANT	2.5985***	.7655	3.394	.0005	1.1872*	.8700	1.365	.0877
size	.1538	.1275	1.207	.1152	.2314*	.1449	1.597	.0567
IS sophistication	.4708**	.2399	1.963	.0262	.5780**	.2726	2.120	.0182
role of IS	.0432	.1133	.381	.3520	.1592	.1288	1.236	.1097
task routinness	.4320***	.0914	4.727	.0000	.3933***	.1039	3.787	.0002
R^2	.2494				.2297			
Adjusted R^2	.2203				.1998			
F	8.5571***				7.6776***			
Sig. F	.0000				.0000			

(b) dependent variables = informal controls

(*** p<.01, ** p<.05, * p<.1)

dependents / independents	internal informal controls				external informal controls			
	beta	standard Error	t value	p value	beta	standard Error	t value	p value
CONSTANT	1.5119**	.6596	2.292	.0122	2.5547***	.6651	3.841	.0001
professionalism	.1212*	.0798	1.520	.0659	.0400	.0805	.497	.3103
decentralization	.2812***	.1045	2.691	.0042	.1645*	.1054	1.561	.0620
task interdependence	.0035	.0609	.058	.4769	-.0340	.0614	-.554	.2905
partner trust	.3709***	.1208	3.071	.0014	.3773***	.1218	3.098	.0013
R^2	.2225				.1383			
Adjusted R^2	.1901				.1024			
F	6.8665***				3.8529***			
Sig. F	.0001				.0060			

(c) dependent variables = automated controls

(*** p<.01, ** p<.05, * p<.1)

dependents / independents	internal automated controls				external automated controls			
	beta	standard Error	t value	p value	beta	standard Error	t value	p value
CONSTANT	3.7469***	.6790	5.518	.0000	2.1125***	.6313	3.346	.0006
size	.2647**	.1452	1.823	.0306	.2597**	.1350	1.924	.0286
professionalism	.0360	.0916	.393	.3976	.0286	.0851	.336	.3689
IS sophistication	.8483***	.2942	2.884	.0024	.6710***	.2735	2.453	.0080
task routineness	.1745**	.1016	1.718	.0444	.3583***	.0944	3.794	.0002
R^2	.2108				.2641			
Adjusted R^2	.1799				.2352			
F	6.8115***				9.1493***			
Sig. F	.0001				.0000			