A Study on the Relationship between Organizational and Environmental Characteristics and Successful Implementation of Electronic Data Interchange Systems in Korea

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■ Abstract ■

The purpose of this study, based on a domestic sample of businesses using EDI systems, is to identify success factors, which affect the implementation of EDI systems by Korean business entities. This paper also intends to provide useful guidelines for the establishment and management of EDI systems. This paper, first, develops a conceptual framework based on previous research to identify factors which affect successful implementation of EDI systems. Second, it integrates the constructs from previous research studies into a single survey instrument. Third, it presents the findings regarding the degree to which each factor influences the successful implementation of EDI systems. It's revealed in the study that such factors as EDI vendor support, EDI education and training, participation by transactional partners, the size of organization, and the level of decentralization among organizational and environmental characteristics influence successful implementation of EDI systems in Korean business environment.

1. Introduction

Today, it is necessary for corporate Korea to strategically adopt, efficiently establish Electronic Data Interchange (EDI) systems, and eventually strengthen external competitiveness in order to actively respond to global environment and borderless competition. This study, a study on how domestic companies successfully establish and apply EDI systems under these circumstances, is judged to be timely and requested by both corporate Korea and academicians.

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Many researchers have promoted the idea that EDI systems as a networking technology can enhance the efficiency of organizational performance (Benjamin et al., 1990 ; Scala and McGrath, 1993 ; Teo et al., 1995). As such, EDI becomes a source of competitive advantage (Bergeron and Raymond, 1997). EDI systems can improve precision in transactional information between/among businesses, increase information transfer speed through simplified work processes and enhance productivity and work efficiency (Dearing, 1990 ; Emmelhainz, 1993 ; Hoogeweegen et al., 1998). Eventually EDI becomes a strategic necessity in order for firms to actively respond to the global environment and unlimited competition (Jones and Beatty, 1998).

Past studies have been performed to identify important factors which affect the successful implementation of Interorganizational Information System (IOIS) and EDI (Lee and Han, 1999). Unfortunately, these studies focused mainly on companies in other countries, especially the U. S. and Britain. It is difficult, therefore, to directly apply these foreign based results to Korean firms because Korean companies might face different environmental situations and have different management practices.

Accordingly, a research model was developed from existing literature on successful EDI implementation, and survey questionnaires were devised using the constructs and items identified in the literature and were used as a data collection instrument in order to examine the Korean situation in detail. This paper presents the theoretical model, the research findings from this study compares the Korean situation with those of other countries which have been identified.

2. Literature Review on EDI

According to a recent literature review on EDI and IOS, there were 50 academic journal articles and 36 doctoral theses written in this subject area since 1997 (Lee et al., 1997). Even though a few of the EDI/IOS papers focused on critical factors affecting successful implementation of EDI, none included Korean firms in the analyses. Below are summarization of several related papers on innovation diffusion and theories in IS implementation. one of them is doctoral thesis on the adoption and implementation of IOIS, 3 other papers shown on international journals are about the implementation of EDI systems, the remaining 3 papers are doctoral theses on the adoption and implementation of EDI. In short, all of these papers can be classified into two categories ; theses on innovation diffusion theories and on the implementation of information systems. Brief review of these articles follows :

Runge (1985) investigated telecommunications for competitive advantage. Runge's study focused on the analysis of a telecommunications-based systems that played a role in supporting firms business strategy. Case studies were conducted on 35 telecommunications-based information systems that connected the firms with their customers. The purpose of the interviews were to identify any facilitating factors. The research was very valuable because it was the first pioneering study in this field and provided the direction for future studies.

Grover (1990), using organizational innovation and IS implementation theory, performed a study to identify factors influencing adoption and implementation of Customer-based Interorganizational Systems (CIOS). This research investigated CIOS,

specifically defined as links to customers, as an innovation. A model is constructed based on significant factors that facilitate the adoption and successful implementation on CIOS. Question-naire data from 220 senior executives were used for the analysis. In the aspect of research method, Grover conducted his research based on econo-metric or multivariate analysis, contrary to pre-vious theses, and integrated variables from various studies done before. His research was extended by Runge (1985) and Kwon and Zmud (1987).

Hwang (1991) conducted the adoption, imple-mentation and impact of EDI systems in the organizations. The major objectives of this re-search are to identify the success factors that explain or predict the successful implementation of an EDI system, and to evaluate the impact of the EDI system on competitive advantage of the organization. This study used a survey-based methodology. His study, an extension of that by Grover (1990), can be differentiated from others in two senses that sample businesses were classi-fied into hub company and non-hub company and that he also measured performance of EDI implementation.

Kym (1991) studied adoption and implementa-tion strategies for customer-oriented electronic data interchange (COEDI). The basic objectives of this research were to construct model that explains firms' performance of COEDI innovation and to test the model's predictive validity and individual factors' contributions to explaining variances in dependent measures. While Gover (1990) approached from perspective of IOIS, Kym (1991) did from that of EDI systems. His research is differentiated from others in the sense that he pioneered to identify relationship between the implementation of EDI systems and

their performances.

Bergeron & Raymond (1992) reported the advantages of electronic data interchange. The purpose of this research was to identify success factors of EDI implementation and the benefits organizational could obtain by using this techno-logy. The success factors found empirically in a field study of 140 Canadian enterprises are the organizational support, the implementation process, the control procedures and the level of EDI integration within the firm. The level of success also depends upon the level of imposition of EDI by partners.

Premkumar, Ramamurthy and Nilakanta (1994) studied implementation of electronic data inter-change. This study, drawing upon research in innovation theory and information systems, exa-mines the relationship between various innovation characteristics and various attributes of diffusion of EDI in organizations. The data for the study were collected from a large-scale field survey of 201 firms in the United States that have im-plemented EDI.

McGowan (1994), approached from perspective of innovation diffusion, studied the extent of implementation of EDI systems. This research attempts to identify factors which explain or predict the extent of EDI implementation within an organization. Eight factors were able to explain much of the variance in extent of EDI implementation : compatibility, organizational size, functional differentiation, training, EDI support, MIS support, vendor support, and customer in-fluence. His research, an extension of that by Grover (1990), included several additional variables, identified through interviews, in addition to those variables adopted from previous research and also have characteristics of having logical de-

ployment of his theory and clarity of his opinions.

3. Research Model and Hypo theses

3.1 Research Model Development

This research develops a model based on various theories such as innovation diffusion, implementation of information systems, implementation of inter-organizational information systems (Grover, 1990), and other studies on the implementation of EDI systems (Hwang, 1991 ; Kym, 1991 ; Bergeron & Raymond, 1992 ; McGowan, 1994). Previous studies discussed up until now mostly have adopted innovation, organizational and environmental characteristics as research variables (Grover & Goslar, 1993 ; Premkumar et al., 1994 ; McGowan, 1994). And factors, which affect the implementation of EDI systems, were classified into two ; technical issues and organizational or managerial issues (Emmelhainz, 1993).

Upon considering and integrating previous research, it's suggested that organizational characteristics as internal factors and environmental characteristics as external factors have more important influences in realizing more successful implementation of EDI systems. Accordingly, this research intends to study the roles of organizational and environmental characteristics as independent variables on successful implementation of EDI systems.

Studies on organizational and environmental characteristics as independent variables were pursued by Grover (1990), Hwang (1991), Bergeron and Raymond (1997), and Grover and Goslar (1993), and McGowan (1994). Organizational characteristics adopted in the study include the size of organization, the level of formalization, decentralization, management risk, education and training, technical expertise, and environmental characteristics include the level of participation by transactional partners, and the level of information of the industry, and industrial cooperation, intensity of competitiveness, and support from vendor etc.
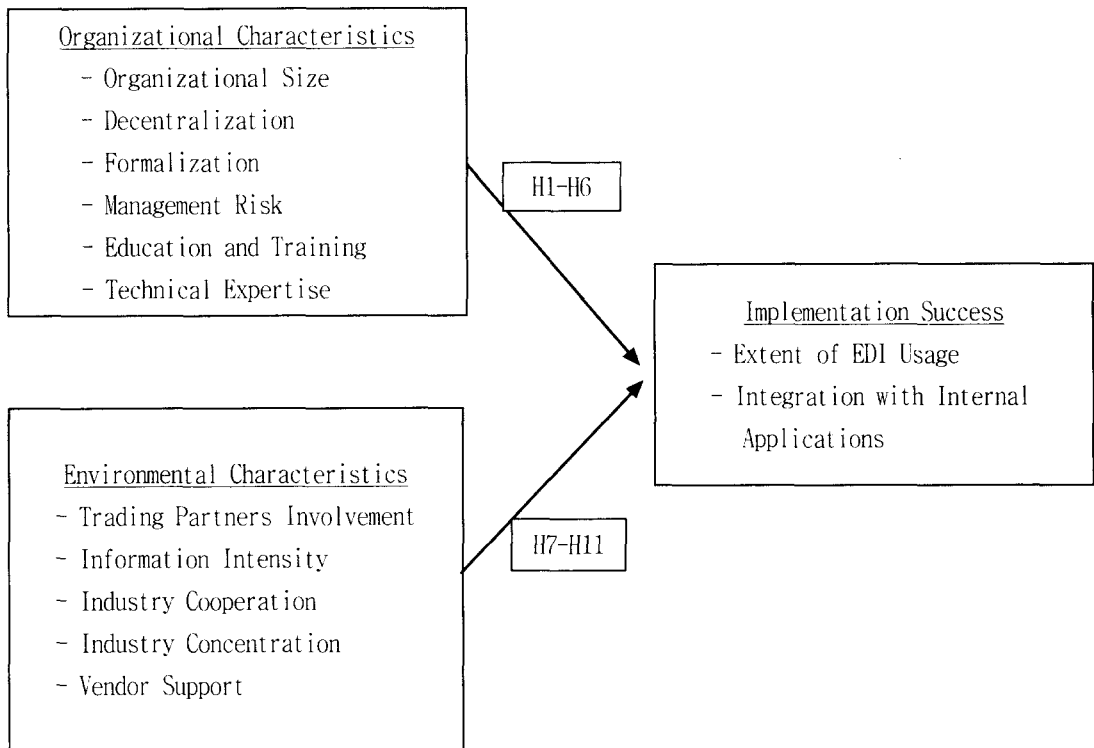
Studies on dependent variables, successful implementation of EDI systems, were extensively done by Grover (1990), Hwang (1991), and McGowan (1994). These researchers in order to measure the level of successful implementation used such measures as the level of implementation, usage, and acceptance, and the level of integration with application systems, and easiness of implementation, innovation of services, and the level of depth and precision of implementation. In this study, the level of EDI usage and integration with application systems were adopted to measure successful implementation of EDI systems. Theoretical background and model derived from review of previous research are found in <Table 1> and <Figure 1>.

3.2 Research Variables and Hypotheses

3.2.1 Organizational Characteristics

(1) Organizational Size

It's suggested that the bigger size of the organization has positive influence on the implementation of EDI systems (Grover, 1990). The rationale is that the bigger the size of the organization, the better communications infrastructure the organization will have needed in

<Figure 1> Research Model

implementing IOIS (Runge, 1985). Mansfield (1968), in explaining characteristics of large and small sized companies, suggested a result that the bigger companies tend to adopt and implement innovation more quickly than small-sized companies.

On the other hand, Romeo (1975) proposed that because small-sized companies have more flexibility than larger companies, small companies tend to accept new technologies with more flexibility. He also proposed that larger companies tend to accept innovations more quickly than small-sized companies (Utterback, 1971), even though there are a lot of studies which showed that small and medium-sized companies tend to accept new technologies more flexibly (Muller and Tiltom, 1979 ; Romeo, 1975).

Grover (1993) have revealed in his study on adoption and implementation of telecommunications that the size of the organization positively influences the implementation of telecommunications technologies. According to McGowan (1994) and Hwang (1991), there is positive relationship between the size of the organization and successful implementation of EDI systems. And Dewer and Dutton (1986) also reported that the size of the organization has positive influence on the adoption of innovations. To sum up the previous studies, it's expected that the larger organization tend to adopt EDI systems more easily. Based on this conclusion, it is reasonable to hypothesize that the larger companies more tend to implement EDI systems than smaller companies.

〈Table 1〉 References for Model Constructs

Construct	References
Organizational Size	Mansfield (1968), Romeo (1975), Dewar and Dutton (1986), Hwang (1991), Grover (1993), McGowan (1994)
Decentralization	Hage & Aiken (1970), Zmud (1982), Dewar & Dutton (1986), Grover (1990), Hwang (1991), McGowan (1994), Lee and Han (1999)
Formalization	Cooper & Zmud (1990), Grover & Goslar (1993), McGowan (1994)
Management Risk	McFarlan (1984), Clemons et al. (1986), Hwang (1991), Damanpour (1991), McGowan (1994)
Education and Training	Carter et al. (1987), Grover (1990), Hwang (1991), McGowan (1994), Yang, Wang, and Yoo (1999)
Technical Expertise	Kimberly & Evanisko (1981), Zmud (1983), Dewar & Dutton (1986), Emmelhainz (1988), McGowan (1994)
Trading Partners Involvement	Johnston & Vitale (1988), Hwang (1991)
Information Intensity	Millar (1985), Malone et al. (1987), Grover (1990)
Industry Cooperation	Kwon & Zmud (1987), Emmelhainz (1988), Benjamin et al. (1990), McGowan (1994)
Industry Concentration	Utterback (1974), Kimberly & Evanisko (1981), Gatignon & Robertson (1989), McGowan (1994), Kym & Lee (1997)
Vendor Support	Ettlie & Vellenga (1979), Gatignon & Robertson (1989), Lederer & Mendelow (1990), Holland et al. (1992), McGowan (1994)
Extent of EDI Usage	Grover (1990), Hwang (1991), McGowan (1994), Hart and Saunders (1998), Lee and Han (1999)
Integration with Internal Applications	Hwang (1991), Kim (1998), Lee and Han (1999)

Hypothesis 1 : The larger size of the organization (comparative size of the organization in the same industry) will has positive influence on the level of EDI systems implementation.

(2) Decentralization

It's shown that more simplified decision making processes in the organization have positive influence on adoption and implementation of EDI systems (Hage & Aiken, 1970 : Lee and Han, 1999). Results on the studies on the relationships between decentralization and innovation adoption are mixed (Zmud, 1982 ; Kimberly and Evanisko, 1981). Zmud (1982) reported that the level of decentralization has positive relationship with the adoption of managerial innovations and no relationship with the adoption of technical innovations. According to Dewar and Dutton (1986),

the level of decentralization has positive influence with gradual adoption of innovations and negative influence with radical adoption of innovations.

Grover (1990) investigated that the level of decentralization positively influence the adoption of IOIS and McGowan (1994) also suggested that decentralization of the organization has positive relation with the level of EDI implementation. Damanpour (1991) in his meta analysis found positive relationship between decentralization and innovations. Grover and Goslar (1993) reported that decentralization of the organization has positive influence on the adoption, implementation, and execution of telecommunication technologies. It's expected, therefore, that the more decentralized organization tend to adopt and implement EDI systems. Accordingly, it's hypothesized that the more decentralized companies

have more tendency to adopt EDI systems.

Hypothesis 2 : The level decentralization of the organization has positive influence on the extent of EDI implementation.

(3) Formalization

The level of organizational formalization has negative relationship with the adoption of innovations (Hage & Aiken, 1970 ; Zmud 1982), but has positive relation with the implementation of innovations. Most studies on innovations suggested that the formalization of the organization has negative relationship with the trail of innovations (Grover and Goslar, 1993 ; Hage and Aiken, 1970), but positive relation with the adoption of innovations (Dewar and Dutton, 1986 ; Hwang, 1991) and the implementation of innovations (Cooper and Zmud, 1990 ; McGowan, 1994). It's revealed that highly formalized organizations tended to have difficulties in adopting telecommunications technologies in their early stage.

But according to Grover (1990), the level of decentralization has positive relations with the adoption and implementation of IOIS. Conclusively, it's suggested that the more formalized the processes and methods of doing works are, the more tendency of documentation the regulations and guidances are, and the higher the level of EDI implementation of the organization tend to be. Accordingly, it's viewed in this analysis that the more formalized the organization is, the more the level of EDI implementation of the organization.

Hypothesis 3 : The more formalized organizations have positive influence on the level of implementing EDI systems.

(4) Management Risk

Multiple research revealed that the level of acceptable risk has influence on the adoption of information systems (McFarlan, 1984 ; Clemons et al., 1986). It's seen that the level of acceptance by management is reflected in the decision making process when considering innovative use of information systems. It's expected that the level of acceptable risk will have same influence on the adoption of EDI systems. It's reported that organizations usually adopt EDI systems without considering the effect of EDI on the organization (Emmelhainz, 1988). Damanpour (1991) suggested that the attitude of top management toward change of the organization coincides with the adoption of innovations.

Grover (1990) proposed that the acceptable level of risk by top management has correlation with the adoption of IOIS. It's reported that the level of acceptable risk has positive influence on the adoption of EDI systems (Hwang, 1991) and the level of implementation of them (McGowan, 1994). In other words, it can be said that if the top management can respond to changes in organizational structure or information technologies, he can make it easy to adopt and implement EDI systems. Therefore, it's suggested in this analysis that the ability of the top managers to control managerial works and reduce risks will increase the possibility of adopting and implementing EDI systems.

Hypothesis 4 : The higher level of ability of the top management will have positive influence in the realization of EDI systems.

(5) Education and Training

User education and training are considered as

important factors that reduce resistance of users to changes and eventual success of the systems adopted. Carter et al. (1987) found that education and training affect successful implementation and efficient use of EDI systems. There will be higher possibility of successful implementation of EDI systems through systematic and efficient education programs for inside users. Carter et al. explain why user education affects successful implementation of EDI systems as follow. First, user education reduces inside resistance during the implementation process and promotes system understanding and facilitates implementation process. Second, training makes it possible to use the EDI systems, after the EDI establishment.

According to Grover (1990), it's surveyed that EDI education and training for customers affect successful implementation of customer-oriented Interorganizational information systems. McGowan (1994), Hwang (1991), and Yang, Wang, and Yoo (1999) found that EDI education and training positively affect successful implementation of EDI systems. It's hypothesized that long lasting and long-term education and training on EDI systems will positively affect the level of EDI implementation.

Hypothesis 5 : Higher user education and training will positively affect the implementation of EDI systems.

(6) Technical Expertise

It's found that technical expertise of technicians in the organization has positive influence on the adoption and implementation of innovations (Kimberly & Evanisko 1981). If there are many technical experts in the organization, it's easier to adopt innovations (Dewar and Dutton, 1986).

Zmud (1983) reported that technical expertise is very effective in explaining increased level innovations. Emmelhainz (1988) suggested that capability and supports of MIS are important factors in EDI implementation. Even though there are many organizational and managerial advantages in adopting EDI, businesses are required to have technical elements.

McGowan (1994) suggested that there is positive correlation between the existence of experts in IS department and the level of EDI implementation. It's concluded that higher level of technical expertise owned by inside experts and the existence of experts in IS department contribute to successful implementation of EDI. Accordingly, it's suggested in this analysis that higher level of expertise of IS specialists will lead to higher possibility of successful implementation of EDI.

Hypothesis 6 : Higher level of expertise of IS specialists will lead to higher possibility of successful implementation of EDI in the organization.

3.2.2 Environmental Characteristics

(1) Trading Partners Involvement

It's reported that the level of participations by trading partners and export-related institutions during the establishment stage has important influence on successful implementation of EDI systems (Hwang, 1991). Partners participation during the implementation makes it possible to reflect requirements from trading partners, and to balance partners requirements and system characteristics. And active participation by users and partners increases satisfaction and reduces systems reconfiguration (Johnston & Vitale, 1988).

Hwang (1991) reported that higher participa-

tion by users and trading partners and related institutions during establishment affects successful implementation of EDI systems. So it's suggested that participation by partners and transaction related institutions promotes successful implementation of EDI systems.

Hypothesis 7 : Higher participation by trading partners and related institutions during establishment will affect on the extent of implementing EDI systems.

(2) Information Intensity

The level of information of industry, environmental characteristics related to the implementation of EDI systems, refers to the extent of information of goods and services in industry. Porter and Millar (1985) suggested that information intensity on a particular merchandise can be strategically heightened through applied information technologies and orders and uses of goods in this kind are complex and require high density information when sold. Malone et al. (1987) expressed similar opinions that explanation on goods produced by companies and industries with higher information requirements is more complex and more information is needed when goods are sold.

Grover (1990) suggested that goods produced by companies with IOIS require more information than those produced by companies without them. Generally, it's said that the higher the level of information on goods in the organization, it is more likely to have higher consciousness on EDI and higher possibility to adopt and diffuse.

Hypothesis 8 : Higher level of information owned by companies in an industry will positively affect the implementation of EDI systems.

(3) Industry Cooperation

Kwon and Zmud (1987) developed a research model based on procedures of innovation adoption, in which they used organizations inter-dependence. They defined organizations inter-dependence as the degree to which an organization has a program sharing ideas or resources with other organizations. Benjamin, De Long, and Scott-Morton (1990) found that industries with more standards in their work processes and trade transactions are more likely to adopt EDI standards.

Emmelhainz (1988) pointed out industry cooperation as one of many variables affecting EDI implementation. And McGowan (1994) viewed that cooperation in the same industry positively influences EDI implementation. So it's hypothesized that higher level of cooperation in an industry supports positively EDI implementation.

Hypothesis 9 : Higher level of cooperation in an industry will positively influence EDI implementation.

(4) Industry Concentration

It's concluded from literature review that the level of competition in an industry has strong correlation with the adoption of innovations. High level of concentration in an industry induces more resources for innovation. As a result, it's revealed that high level of concentration creates more innovations, which subsequently explains the correlation between two factors (Utterback, 1974 ; Gatignon & Robertson, 1989).

Grover (1990) and Hwang (1991) found that industries with high level of concentration are more likely to adopt and implement IOIS and EDI systems. Kym and Lee (1997) proposed that higher concentration level in an industry leads to

higher possibility of adopting and implementing EDI. It's viewed in this analysis that the higher the concentration level companies in an industry have for goods and services, the more likely they adopt and implement EDI systems.

Hypothesis 10 : Higher competition level among companies in an industry will positively affect the level of implementation of EDI systems.

(5) Vendors Support

In their studies on the implementation of IOIS, Runge (1985) and Grover (1990) found positive correlations between successful implementation of information systems and technical supports from hardware and software providers. It's assumed that more supports and participation by EDI related vendors increase possibility of successful implementation of EDI systems. Technical supports from EDI vendors are very important factors in the implementation of manufacturing technologies (Ettlie & Vellenga, 1979). Lederer and Mendelow (1990) observed that monitoring EDI vendors can be a coping strategy in IS in order to promote technology.

Gatignon and Robertson (1989) suggested that vertical coordination was positively associated with EDI adoption. It's observed that technical experts are needed in successful implementation of EDI as a form of technical innovation (Holland, Lockett, and Blackman, 1992). McGowan (1994) suggested that technical supports from EDI vendors have positive correlation with the implementation of EDI systems. It's hypothesized that higher technical supports from EDI vendors in the process of EDI systems implementation will lead to more successful implementation.

Hypothesis 11 : Higher technical supports from

EDI vendors in the process of EDI systems implementation will have more positive influence on the extent of implementing EDI systems.

3.3 Operationalization of Variables

Because it's not possible to measure variables only through conceptual definitions, it's reasonable to operationalize and measure variables based on developed survey questions. Operationalization of variables are done based on literature reviews. Operationalizations of 11 independent variables and 2 dependent variables are summarized in <Table 2>.

3.4 Measurement of Variables

Based on responses collected through survey questionnaires, this thesis empirically investigates which factors are affecting the successful implementation of EDI systems in Korean businesses. Independent variables include organizational and environmental characteristics, all of which are expected to have correlations with successful implementation. And dependent variables, the successful implementation of EDI systems, are measured using two factors : the extent of EDI usage and integration with internal application systems. More specific variables are summarized in <Table 2>. Variables including 2 dependent variables, the level of integration with internal application, the extent of EDI Usage are measured 5-point Likert-type bipolar scales.

4. Data Analysis and Results

4.1 Data Collection Method

Using mail, FAX, and E-mail, survey question-

<Table 2> Operationalizations of Variables

Variables	Operationalizations
Organizational Size	The size of a company in the industry
Decentralization	The level of participation in decision making process and the level of decision making by its members
Formalization	The level of autonomy, control, and the existence of regulations on work process
Management Risk	Managers tendency to accept changes in organizational structure and new technologies, and to invest in the adoption of new information technologies
Technical Expertise	Level of knowledge owned by IS staffs on EDI technologies Number of technical experts in the organization
Vendor Supports	Technical supports by EDI vendors in implementing EDI
Training and Education	Level of formal and lasting EDI training and education, Level of pertinence of EDI training and educational structure and contents
Trading Partners Involvement	Level of participation and advisement from partners in the establishment stage
Information Intensity	Substitutability of suppliers, information requirement on goods and services, Level of inter-dependence between company and customer
Industry Cooperation	The extent companies accomplish their shared objectives, Whether there are EDI standards in an industry
Industry Concentration	Level of price competition in an industry Level of quality competition for their goods and services in an industry
Extent of EDI Usage	Extent of transaction using EDI, usage frequency, stability of EDI
Integration with Internal Applications	Level of integrity with applications previously used

<Table 3> Measurements of Research Variables

Variables	Measurement Items
Organizational Size	1. Size of firm in an industry
Decentralization	1. Level of participation by lower level of managers in decision making 2. Level of delegated power to process before authorization from superiors 3. Level of power to decide by employee himself 4. Number of participation in decision making when adopting new policy
Formalization	1. Level of power to organize in his discretion what employee wants to do 2. Level of employee's power to process his work in his own way 3. Level of regular checks or monitors on regulation violation 4. Existence of regulations applied when regular works are processed
Management Risk	1. Level of acceptance of changes by top management in organizational structure, labor, and technologies 2. Level of acceptance by top management of H/W, S/W, and other technologies not acceptable to the organization 3. Level of top management intention to invest in applications software, N/W technologies
Education and Training	1. Level of formalized training and education on EDI 2. Level of sufficient and lasting training and education on EDI 3. Relevance of contents and structure of training and education with EDI requirements
Technical Expertise	1. Level of knowledge of IS staffs on EDI related technologies 2. Number of technical experts
Trading Partners Involvement	1. Level of participation by transaction partners in all stages of EDI establishment 2. Level of advisement by transaction partners in all stages of EDI establishment
Information Intensity	1. Level of information customers own when making purchases 2. Supplier substitutability 3. Level of information on products and services by other companies in the industry 4. Level of dependence on information by company and customer

<Table 3> Continue

Variables	Measurement Items
Industry Cooperation	1. Existence of shared objectives shared by companies 2. Existence of developed industry standards
Industry Concentration	1. Level of price competition 2. Level of competition for quality
Vendor Support	1. Level of support by EDI vendors 2. Level of technical support by EDI vendors in the establishment of EDI
Extent of EDI Usage	1. Extent of EDI application with trade partners and related institutions 2. Level of safeness of works done by EDI 3. EDI users use frequency of EDI systems
Integration with Internal Application	1. Level of integration EDI systems with other applications systems 2. Number of applications systems usable without processing using EDI

<Table 4> Classified Return Rates of Survey Questionnaires

Industry	Total Sample	No. of Retrieved	No. of Excluded	Rate of Return
Trade	120	40	3	33.3
Textile and Clothing	95	41	2	43.2
Electric & Electronic	90	43	3	47.8
Machinery and Metal	37	15	0	40.5
Beverages and Foods	30	13	0	43.3
Bubber and Paper	22	11	0	50.0
Petroleum & Chemical	29	17	1	58.6
Others	32	14	1	43.7
Total	455	194	10	42.63

naires were sent to 455 Korean companies with EDI systems. Among 455, 194 questionnaires were retrieved. 184 questionnaires were used in the analysis and 10 of them were discarded because some contained too many unanswered items, and some answered unsincerely. And questionnaires from companies with less than 1 year experience in EDI operations were also excluded from the analysis. Classified return rates are summarized in <Table 4>.

4.2 Profile of the Research Sample

4.2.1 Industry Representation

Yearly sales of the responded companies were surveyed based on 1997 figures. The major characteristics of sales figures are summarized in <Table 5>. 58% of respondent companies, that is, 113 entities out of total 194 entities fall $ 8~42 million and $ 83.1~417 million range groups, which implies most responded businesses are medium-sized businesses.

Surveys completed by businesses with EDI systems operated less than a year were discarded in the analysis. As can be seen in <Table 5>, 50% of responded businesses have used EDI systems as short as a year and as long as less than 2 years. This data displays that most domestic businesses are in their starting points in time in their EDI systems utilization.

⟨Table 5⟩ Yearly sales, and period of EDI use of businesses responded

Yearly sales (1997)			Period of EDI use		
Yearly Sales ($ in million)	No. of Businesses	Rate (%)	Period of use (months)	No. of Businesses	Rate (%)
Less than 8	27	13.9	Less than 11	0	0.0
8~42	63	32.5	12~24	97	50.0
42.1~83	26	13.4	25~36	66	34.1
83.1~417	50	25.7	37~48	29	14.9
417.1~833	14	7.2	Over 49	2	1.0
Over 833.1	14	7.2			
Total	194	100	Total	194	100

⟨Table 6⟩ Distribution of departments and positions of respondents

Departments			Positions		
Departments	No. of entities	Rate (%)	Positions	No. of entities	Rate (%)
Computing Dept.	27	13.9	Staff	55	28.4
Trade & Export	68	35.0	Section Chief	26	13.4
Sales	20	10.3	Lower Manager	66	34.0
Purchasing	20	10.3	Division Director	30	15.5
General Dept.	12	6.2	Under Director-General	9	4.6
Managerial Dept.	24	12.4	Director General	7	3.6
Finance	13	6.7	Director in BOD	1	0.5
Others	10	5.1			
Total	194	100	Total	194	100

4.2.2 Characteristics of respondents

The departments respondents are belonged to are summarized in <Table 6>, which shows that various business entities are participated in the survey. The <Table 6> shows the names of the departments are different according to their business sizes and the departments which use EDI systems are different in different businesses. The almost frequent respondents are belong to departments related to export and international trade affairs. This is because most documents processed by EDI systems are connected to international trade.

The survey questionnaires are sent to heads of departments and experts who take charge of EDI systems or have expertise in EDI systems. The positions respondents take are summarized in the <Table 6>, which implies that most respondents are lower level managers and a few of general managers are observed. This is mainly because operations and applications of EDI systems are managed mostly by lower level managers, and general managers take more work load than lower level managers.

4.3 Validity and Reliability Test

4.3.1 Validity Tests

Factor analysis was set up to produce factors above eigen value 1. The results of factor analysis on organizational characteristics are summarized in <Table 7>. As we can see in the Table, 4 factors are resulted, which implies that variables are valid. Variables in formalization were originally 4 items, but alpha coefficients of 2 variables were too low (alpha = 0.2651) and excluded form

<Table 7> Factor Analysis on Organizational Characteristics

Items in the Survey	Decentralization	Training	Management Risk	Formalization
- Participation by employee	**.85812**	.00102	.16614	-.01341
- Delegated power to process	**.82670**	.02746	.02787	.09297
- Decision by employee himself	**.76829**	.05778	.23332	.05725
- Number of participation	**.76472**	.18064	.22144	-.05678
- Level of formalized training	.07102	**.88019**	.09782	.10243
- Level of lasting training	.09482	**.87591**	.06359	.03192
- Relevance of training contents	.04030	**.80437**	.18777	.02481
- Level of acceptance of changes	.17362	.13350	**.86214**	.12441
- Level of acceptance of technologies	.16713	.11043	**.84690**	-.13322
- Level of intention to investment	.34660	.19791	**.65388**	.25584
- Organization power of employee	-.02550	.08955	-.13562	**.81759**
- Employee's power to process	.08530	.03093	.30645	**.67259**
Eigen Value	4.06462	2.01781	1.29362	1.15259
Percent of Variation (%)	33.9	16.8	10.8	9.6
Cumulative Percent of Variation (%)	33.9	50.7	61.5	71.1

* Originally Organizational Characteristics consist of 6 factors. Among them, firm size is single measurement.

<Table 8> Factor Analysis on Environmental Characteristics

Items in the Survey	Information Intensity	Vendor Support	Partners Involvement	Concentration
- Level of information of customers	**.75090**	.13006	.09637	.14298
- Supplier substitutability	**.74896**	.13816	-.05262	.22957
- Level of dependence on information	**.73999**	-.10132	.18151	.04995
- Level of support by vendors	.12737	**.87021**	.17610	-.00015
- Level of technical support by vendor	-.00731	**.86682**	.21220	.05854
- Level of participation by partners	.06884	.13931	**.90540**	.11449
- Level of advisement by partners	.16986	.41112	**.75724**	.06295
- Level of price competition	.04739	.01411	-.02383	**.89594**
- Level of competition for quality	.23364	.04625	.22486	**.80687**
Eigen Value	2.95418	1.67113	1.15770	.85696
Percent of Variation (%)	32.8	18.6	12.9	9.5
Cumulative Percent of Variation (%)	32.8	51.4	64.3	73.8

the analysis. As a result, since all factor loadings were above 0.6, all variables were considered to be important in the analysis. Among 4 factors, the validity of decentralization factor was especially high.

The results of factor analysis on 5 environmental characteristics are summarized in <Table 8>. It's revealed that 4 factor solutions were valid. It's because all reliable variables after test-retest examinations were adopted. And the validity of industry cooperation was too low and excluded in the analysis. Factor loadings were high (above 0.6) enough for analysis. The validity of Information Intensity variables were rated highest.

The results of factor analysis on dependent variables are summarized in <Table 9>. As we can see in the Table, 2 factors are resulted, which implies that all dependent variables are valid. As a result, since all factor loadings were above 0.6, all variables were considered to be important in the analysis.

〈Table 9〉 Factor Analysis on Dependent Variables

Items in the Survey	Extent of EDI Usage	Integration with Internal Applications
- EDI usage with trading partners	**.85224**	.15056
- Safeness of works done by EDI	**.78118**	.17950
- Use frequency of EDI systems	**.70904**	.19082
- Integration of EDI with applications	.15481	**.88904**
- Number of applications systems	.23861	**.85543**
Eigen Value	2.52801	1.00563
Percent of Variation (%)	50.6	20.1
Cumulative Percent of Variation (%)	50.6	70.7

〈Table 10〉 Reliability Tests of Research Variables

Categories	Variables	No. of Variables	Reliability Coefficient (Cronbach's Alpha)
Organizational Characteristics	Decentralization	4	.844
	Formalization	4 (2 items excluded)	.619
	Management Risk	3	.808
	Education and Training	3	.835
	Technical Expertise	2	.417
Environmental Characteristics	Trading Partners Involvement	2	.762
	Information Intensity	4	.650
	Industry Cooperation	2	.082
	Industry Concentration	2	.697
	Vendor Support	2	.771
Implementation Success	Extent of EDI Usage	3	.720
	Integration with Internal Applications	2	.750

4.3.2 Reliability Tests

The reliability of 11 independent variables used in the analysis was tested using SPSSWIN, a well-known statistical package, and is summarized in <Table 10>. To summarize it, first, among 11 independent variables, 2 variables, technical expertise (alpha = 0.417) and industry cooperation (alpha = 0.082), were revealed as irrelevant. Second, since the reliability of 2 formalization variables of organizational characteristics was too low (alpha = 0.265), two among 4 were excluded, which subsequently resulted in reliability of 0.619 (α). Third, it's revealed the reliability of 9 variables except 2 irrelevant variables shown was over 0.6.

4.4 Correlation Analysis

The level of correlation among variables was investigated in this analysis using independent variables adopted in the realization of EDI systems. 9 variables shown as valid and reliable were adopted to investigate correlation and multicolinearity, and whether regression analysis is meaningful. The result of correlation analysis is summarized in <Table 11>. All variables are not closely correlated with coefficients below 0.5. The regression analysis shows that admissible error values are above 0.5 and VIF values were also below 2.00. Accordingly, it's shown that multicolinearity does not exist among indepne-

〈Table 11〉 Correlations among Independent Variables

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Size (1)	1.00 .00								
Decentralization (2)	-.049 .243	1.00 .00							
Mgt Risk (3)	.086 .112	.459 .000	1.00 .00						
Formalization (4)	.022 .378	.419 .000	.344 .000	1.00 .00					
Information Inten. (5)	.163 .011	.256 .000	.326 .000	.136 .027	1.00 .00				
Concentration (6)	.151 .016	.184 .005	.159 .012	.074 .015	.283 .000	1.00 .00			
Training (7)	.227 .000	.166 .009	.315 .000	.178 .006	.303 .000	.087 .109	1.00 .00		
Vendor Support (8)	.109 .061	.149 .018	.309 .000	.178 .006	.175 .007	.064 .183	.456 .000	1.00 .00	
Partners Involve. (9)	.199 .002	.129 .033	.227 .000	.197 .003	.232 .000	.188 .004	.407 .000	.467 .000	1.00 .00

Note : Upper figures represent coefficients and lower figures p-values

dent variables.

4.5 Examination of Hypotheses

To investigate effects on the level of EDI implementation, all 9 variables were input as independent variables, which is considered to be better method to examine hypotheses than that of using each characteristics for each effect. So multiple regression analysis was adopted by congregating all independent variables.

To identify which variables affect how much for the implementation of EDI systems, 9 independent variables were input for 2 different dependent factors : extent of EDI usage, integration with internal application systems. The results are summarized in <Table 12> and <Table 13> 9 research hypotheses except 2 with low validity and reliability, can be summarized as follow.

First, to investigate the hypothesis 5, 7, 11

that education and training, trading partners involvement and vender supports will affect to the successful implementation of EDI systems, regression analysis was performed. The analysis implied that 3 factors, education and training, trading partners involvement and vender support statistically significant at $p<0.05$, affecting the successful implementation of EDI systems. Accordingly, it's revealed that education and training, trading partners involvement and vender support will positively affect the successful implementation of EDI systems. Hypothesis 5, 7 and 11 were accepted.

Second, the hypotheses 1 and 2 that the organizational size, decentralization will positively affect EDI implementation were statistically significant ($p<0.01$), and implied that these variables partly affected EDI implementation. Accordingly, 2 variables were partly accepted.

Third, the hypotheses 3, 4, 8 and 10 that Formalization, management risk, information intensity,

〈Table 12〉 Regression Results between EDI Usage and Independent Variables

Dependent Variables	Independent Variables	Regression Coefficients	t value	Sig. of t	R-square	F value	Sig. of F
Extent of EDI Usage	Size	.0626	1.053	.2937	.35393	26.98071	.0000***
	Decentralization	.2355	3.525	.0005***			
	Management Risk	.0162	.238	.8118			
	Information Inten.	-.0240	-.388	.6985			
	Concentration	-.0154	-.260	.7952			
	Formalization	.0811	1.268	.2063			
	Education · Training	.2845	4.265	.0000***			
	Vendor Supports	.2256	3.429	.0007***			
	Partners Involvement	.1368	1.897	.0493**			

** : $p < 0.05$ *** : $p < 0.01$

〈Table 13〉 Regression between EDI Integration and Independent Variables

Dependent Variables	Independent Variables	Regression Coefficients	t value	Sig. of t	R-square	F value	Sig. of F
Integration with Internal Applications	Size	.1849	2.495	.0034***	.23373	20.13137	.0000***
	Decentralization	.0729	1.117	.2654			
	Management Risk	-.0451	-.656	.5125			
	Information Inten.	-.0091	-.134	.8932			
	Concentration	-.0798	-1.220	.2241			
	Formalization	.0730	1.111	.2679			
	Education · Training	.1595	2.124	.0349**			
	Vendor Supports	.1457	1.904	.0484**			
	Partners Involvement	.1674	2.228	.0270**			

** : $p < 0.05$ *** : $p < 0.01$

industry concentration will positively affect EDI implementation were not statistically significant, resulting in rejection of 4 hypotheses proposed.

6. Results of the Practical Analyses

To investigate the level of influences of all independent variables on EDI implementation, all 9 independent variables were input in regression analysis. The results of the analyses done previous section are summarized in 〈Table 14〉. In the Table, 'accepted' implies that 2 dependent factors are all statistically significant, 'partly accepted' means that 1 or 2 factors among 2 are significant, 'rejected' implies that 2 dependent factors are not statistically significant. The an-

alytical results are summarized as follow.

First, regression analyses on each independent factor after all dependent variables were gathered in one factor showed that 3 hypothesis was accepted, 2 hypotheses were partly accepted, and 4 hypotheses were rejected at $\alpha = 0.05$.

Second, education and training, trading partners involvement and vender supports affected 2 dependent variables, EDI usage level and EDI integration level at $\alpha = 0.05$. It's these two variables that are the most important in the implementation of EDI systems.

Third, it's resulted that factors such as formalization, management risk, information intensity, industry concentration did not affect the implementation of EDI systems of organizations.

Fourth, it's shown that organizational size in-

〈Table 14〉 Analysis Summary of All Variables

Categories	Variables	EDI Usage	EDI Integration	Hypotheses (α=0.05)
Organizational Characteristics	Size		.185**	H1 : partly accepted
	Decentralization	.236***		H2 : partly accepted
	Formalization			H3 : rejected
	Management Risk			H4 : rejected
	Education and Training	.285***	.160**	H5 : accepted
Environmental Characteristics	Trading Partners Involvement	.137**	.167**	H7 : accepted
	Information Intensity			H8 : rejected
	Industry Concentration			H10 : rejected
	Vendor Support	.226***	.146**	H11 : accepted

Note : 1) ** : $p < 0.05$, *** : $p < 0.01$
2) Values of each cell is regression coefficients

fluenced in promoting the level of integration of EDI systems with applications systems in the organization. It's also revealed that decentralization positively affected EDI usage level.

5. Conclusions

The analytical results are summarized as follow. First, education and training, trading partners involvement and vender support affected 2 dependent variables, EDI usage level and EDI integration level at α=0.05. It's those variables such as education and training, trading partners involvement and vender support that are the most important in the implementation of EDI systems.

Second, it's suggested that such factors as formalization, management risk, information intensity, industry concentration did not affect the implementation of EDI systems of organizations. The results implies that the Korean business environment is quite different from that in other countries, esp. from that in US. Korean companies may not see EDI implementation as competitive weapon, and not realize the real value of information. These can be explained by

under-globalization of Korean businesses compare to businesses in other advanced countries. And manager may not appreciate the value of information, which is considered to lower risk. Most general managers in Korea are not specialized managers, but owner-managers, which is not the case in advanced countries.

Third, it's shown that organizational size influenced promoting the level of integration of EDI systems with applications systems in the organization. It's also revealed that decentralization positively affected EDI usage level.

Based on these results, we now can derive several temporary conclusions.

First, it's revealed in this analysis that Korean companies derived close cooperation with cooperative partners, banks, customs offices using EDI systems. In other words, Korean companies with higher implementation level of EDI systems have closer cooperation system in their transactions, and traded under mutual trust.

Second, it's also suggested that it's easy to implement for companies with simplified stratification rather than companies with more complex and larger decision making processes. The reason behind this is that it's possible for them

to make adoption decisions easy and fast when deciding the adoption of new technologies like EDI systems, and work processes are more facilitated.

Third, it's also revealed that education and training are needed to promote understandings on EDI systems and apply EDI systems in work processes. Without precise understandings on EDI systems, it would result in serious problems in applying the systems and could not derive enough benefits from the systems compare to the investment in EDI systems.

One of the weaknesses of this study is that this thesis does not include some of major factors, identified as important in successful implementation of EDI systems in Korea. Those factors are assumed to have important influences in EDI implementation in domestic business environment. Those neglected factors are mainly related to business practices such as transaction without proper documentations, rebates, and payment methods (i.e. payment by promissory notes) etc.

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