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

Byung-Gon Kim

Department of Office Automation,
Andong Science College, Andong 760-820, Korea
Tel: +82-571-851-3572, E-mail: kbg@andong-c.ac.kr

Dong-Mo Koo

School of Business Administration,
Kyungpook National University, Taegu 702-701, Korea
Tel: +82-53-950-2171, E-mail: pearlkoo@dacom.chollian.co.kr

Abstract

The purpose of this study, based on domestic sample businesses using EDI systems, is to identify success factors, which affect adoption of EDI systems by domestic business entities. And this paper also intends to provide guideline important in the establishment and management of EDI systems based factors identified.

The major contents of this research are as follow. This paper, first, tries to develop conceptual framework based on previous research to identify factors which affect successful adoption of EDI systems. Second, it intends to develop new version of survey questionnaire by referring to various survey questionnaires previously used by similar studies. Third, it also intends to the extent of each factor on the successful adoption and implementation of EDI systems, and examines proposed hypotheses.

I. Introduction

Today, it's quite necessity 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 unlimited 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.

There have been studies to identify important factors which affect successful adoption of Interorganizational Information System(IOIS) and EDI. It's difficult, however, to directly apply these foreign based results, which were studied based mainly on companies in U. S., Britain and other foreign companies. Because various environmental situations and institutions of our country are unique and different from those in other foreign countries.

Accordingly, this research intends to construct and develop research model and survey questionnaire which are pertinent to our business environment and situation, and collect and analyse data, collected domestic companies.

The EDI systems bring such results as increased precision in transactional information between/among businesses, increased information transfer speed through simplified work processes, promoted productivity and work efficiency and so on(Dearing, 1990; Emmelhainz, 1993). As many researchers identified that EDI systems, as a networking technology enhancing efficiency of organization and managerial performance, give many advantages(Benjamin et al., 1990; Scala and McGrath, 1993; Teo et al., 1995), it become increasingly needed and important. In addition, it's also needed for domestic Korean companies to strategically utilize EDI systems and increase external competitiveness by adopting EDI systems in order to actively respond to global environment and unlimited competition.

At the beginning of 1990s appeared studies, which tried to identify major factors affecting successful implementation of IOIS and EDI systems(Grover, 1990; Hwang, 1991; Kym, 1991). But since studies up until now were conducted mainly in their countries such as U. S. and England and others, it's realistically difficult to directly apply to Korean companies. Because various environmental situations and institutions of our country are unique and different from those in other foreign countries. Accordingly, this study intends to construct and develop research model and survey questionnaire which are pertinent to our business environment and situation, and collect and analyse data, collected domestic companies.

The purpose of this research is to identify which factors are affecting Korean businesses successful implementation of EDI systems. More specifically, this research intends, first, analyze data based on such factors as organizational and environmental characteristics, second, to provide guideline considered to be important in establishing and managing EDI systems in organizations.

II. Previous Studies of EDI

According to a recent study which reviewed research trends in EDI systems released lately, foreign studies on EDI until 1997 counted about 50 issued on major academic journals, and doctoral theses on EDI and IOIS, bestowed in the Northern American universities, counted about 36(Lee et al., 1997). About 10 papers were released in MIS related academic journals published in Korea excluding several doctoral theses in Korean universities.

It's very rare to find studies done in Korea which have direct relationship, this research has focused on 3 theses published in international journals and 4 doctoral theses by Korean researchers, which have direct relationship with the purpose of this thesis, as subjects of previous research relevant to the thesis. Among these 7 papers, one paper is doctoral thesis on the adoption and implementation of IOIS, 3 other papers issued on international journals are about the implementation of EDI systems, the remaining 3 papers are doctoral theses on the adoption and implementation of EDI. All of 7 theses are can be classified into two categories; theses on innovation diffusion theories and on the implementation of information systems. Major contents can be summarized as follow:

Runge(1985) investigated a study on

using telecommunications for competitive advantages. Runge's study focused on the analysis of telecommunications based system that played a role in supporting business strategy. Case studies on 35 telecommunication- based information systems linking a firm with its customers were then conducted to identify their facilitating factors. His research is valued in a sense that the thesis, as the first study in this field, provided the direction for future studies.

Grover(1990), based on organizational innovation and IS implementation theory, performed a research about factors influencing adoption and implementation of Customer-based Interorganizational Systems (CIOS). This research investigates 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. Questionnaire data from 220 senior executives was used for the analysis. In the aspect of research method, Grover conducted his research based on econometric or multivariate analysis, contrary to previous theses, and integrated variables from various studies done before. His research extended those by Runge(1985) and Kwon and Zmud(1987).

Hwang(1991) conducted the adoption, implementation and impact of EDI systems in the organizations. The major objectives of this research 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 differentiated from others in two senses that sample businesses were classified into hub company and non-hub company and

he also measured performance of EDI implementation.

Kym(1991) studied adoption and implementation 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 measure. 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 technology. 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 in the firm.

Premkumar, Ramamurthy and Nilakanta (1994) studied implementation of electronic data interchange. This study, drawing upon research in innovation theory and information systems, examines 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 implemented EDI.

McGowan(1994), approached from perspective of innovation diffusion, studied the extent of implementation of EDI systems. This research attempts to

identify the factors which explain or predict the extent of EDI implementation within an organization.

III. Research Model and Hypotheses

1. Research Model Development

This research developed a research model based on various theories of 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 characteristics,organizational characteristics, 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).

But this study, after reviewing all the variables studied previously, intends to classify organizational characteristics and environmental characteristics. The research model of this study is illustrated in Figure 1.

```
┌─────────────────────────────────┐
│  Organizational Characteristics │
│  - Organizational Size          │
│  - Decentralization             │
│  - Formalization          H1-H6 │
│  - Management Risk              │
│  - Education and Training       │
│  - Technical Expertise          │
└─────────────────────────────────┘
                                      ┌──────────────────────────┐
                                      │  Implementation Success  │
                                      │  - Extent of EDI Usage   │
                                      │  - Integration with      │
                                      │    Internal Applications │
                                      └──────────────────────────┘
┌─────────────────────────────────┐
│  Environmental Characteristics  │
│  - Trading Partners Involvement │
│  - Information Intensity         │
│  - Industry Cooperation   H7-H11│
│  - Industry Concentration       │
│  - Vendor Support               │
└─────────────────────────────────┘
```
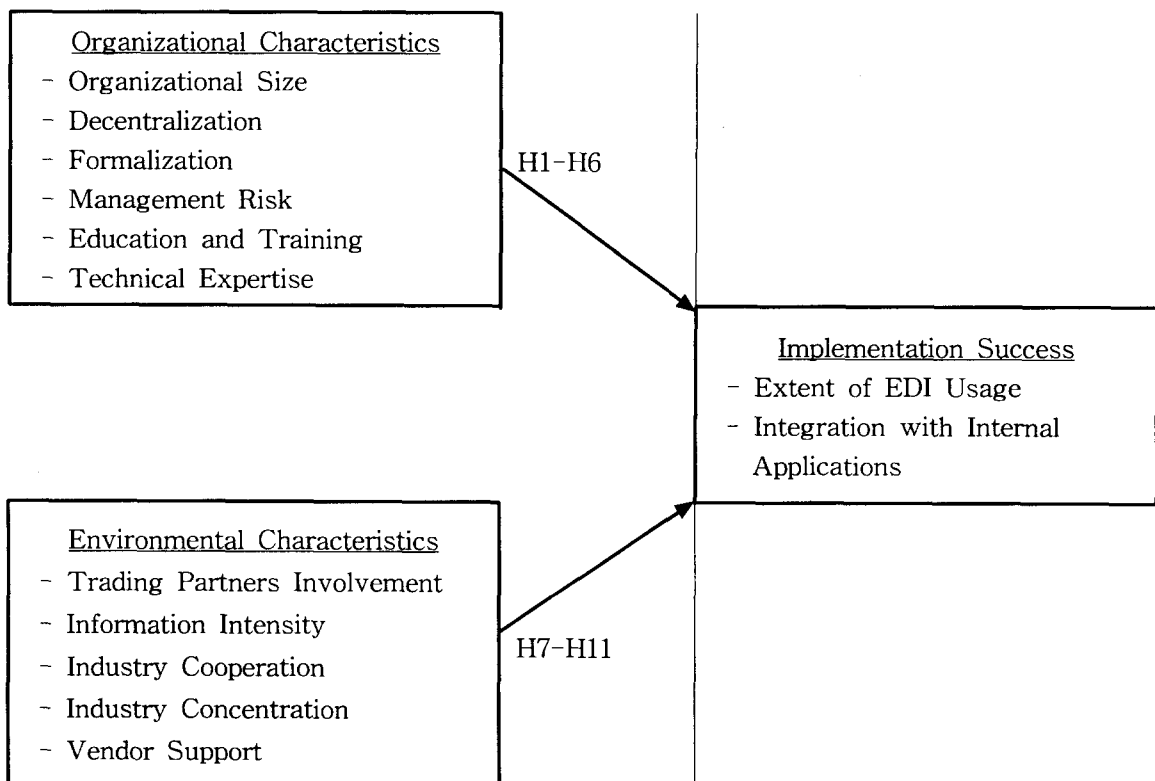
Figure 1. Research Model

2. Research Hypotheses

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

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

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

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

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

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

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

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

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

H 10 : Higher competition level among companies in an industry will positively affect

the level of implementation of EDI systems.

H 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. 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 1.

4. Measurement of Variables

This thesis empirically investigates, based on responses collected through survey questionnaires, which factors are affecting the successful implementation of EDI systems in Korean companies. 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 such factors as the extent of EDI usage and integration with internal application systems. More specific variables are summarized in Table 2.

Table 1. 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 Support	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 2. 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
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

IV. Data Analysis and Results

1. Data Collection Method

Using mail, FAX, and E-mail, survey questionnaires 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 excluded from the analysis. Classified return rates are summarized in Table 3.

Table 3. 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 & Clothing	95	41	2	43.2
Electric & Electronic	90	43	3	47.8
Machinery & Metal	37	15	0	40.5
Beverages & Foods	30	13	0	43.3
Bubber & 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

2. Validity and Reliability Test

Table 4. Factor Analysis on Organizational Characteristics

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

Table 5. Factor Analysis on Environmental Characteristics

Items in the Survey	Information Intensity	Vendor Support	Partners Involvement	Concentration
- Level of information of customers	■	.13006	.09637	.14298
- Supplier substitutability	■	.13816	-.05262	.22957
- Level of dependence on information	■	-.10132	.18151	-.04995
- Level of support by vendors	.12737	■	.17610	-.00015
- Level of technical support by vendor	-.00731	■	.21220	.05854
- Level of pai..ipation by partners	.06884	.13931	■	.11449
- Level of advisement by partners	.16986	.41112	■	.06295
- Level of price competition	.04739	..01411	-.02383	■
- Level of competition for quality	.23364	.04625	.22486	■
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

Table 6. Factor Analysis on Dependent Variables

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

The reliability of 11 independent variables used in this analysis was tested using SPSSWIN, a well-known statistical package, and is summarized in Table 7. 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(a). Third, it's revealed the reliability of 9 variables except 2 irrelevant variables showed was over 0.6.

Table 7. 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

3. Correlation Analysis

The level of correlation among variables were investigated in this analysis using independent variables adopted in the realization of EDI systems. 11 variables, which were shown as valid and reliable, were adopted to investigate correlation and multicolinearity, and whether regression analysis are meaningful. The result of correlation analysis is summarized in Table 8.

Table 8. 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

4. Examination of Hypotheses

To investigate effects on the level of EDI implementation, all 9 variables were input as independent variables, which is 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 9 and Table 10. 9 research hypotheses except 2 with low validity and reliability, can be summarized as follow.

Table 9. 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	.2055	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	.2356	3.429	.0007***			
	Partners Involvement	.1268	1.897	.0593*			

* : p < 0.10　　** : p < 0.05　　*** : p < 0.01

Table 10. 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	.1649	2.495	.0134**	.19590	11.99862	.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	.0584*			
	Partners Involvement	.1674	2.228	.0270**			

* : p < 0.10　　** : p < 0.05　　*** : p < 0.01

5. Results of the Practical Analyses

To investigate the level of influences of all independent variables on EDI implementation, all 14 independent variables were input in regression analysis. The results of the analyses done previous section are summarized in Table 12.

In the Table, accepted implies that all dependent factors are all statistically significant, partly accepted means that 1 or 2 factors among 3 are significant, rejected implies that all 3 dependent factors are not statistically significant. The analytical results are summarized as follow.

Table 12. Analysis Summary of All Variables

Categories	Variables	EDI Usage	EDI Integration	Hypotheses (α=0.05)
Organizational Characteristics	Size		.165***	H1 : partly accepted
	Decentralization	.206***		H2 : partly accepted
	Formalization			H3 : rejected
	Management Risk			H4 : rejected
	Education and Training	.285***	.159**	H5 : accepted
Environmental Characteristics	Trading Partners Invelvement	.127**	.167**	H7 : accepted
	Information Intensity			H8 : rejected
	Industry Concentration			H10 : rejected
	Vendor Support	.235***	.146**	H11 : accepted

Note : 1. * : $p < 0.10$ ** : $p < 0.05$ *** : $p < 0.01$
2. Values of each cell are regression coefficients

V. Conclusions

The summarization of all results of this research is as follow. The results of regression analysis using all independent variables are provided.

It's suggested that factors such as participation of trading partners, education and training, and vendor support positively affected EDI usage and integration with internal applications.

It's shown that two factors decentralization and organizational size partly affected to successful implementation of EDI systems.

On the other hand, it's revealed that factors such as formalization, management risk position, information intensity, and industry concentration did not affect to the implementation of EDI systems.

We can derive several temporary conclusions from our analysis. First fact we revealed in this analysis is 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 close cooperation system in their transactions, and traded under mutual trust.

Second, it's necessity for companies to establish close relationship with trade partners or related institutions in order to successfully implement EDI systems. This implies that work cooperation among companies is very important in order to use efficiently telecommunications like EDI.

Third, when adopting hardwares and softwares, companies have to take their compatability of with previously adopted systems into consideration, which, in turn, makes it easy to connect them with previous systems and prevent latent problems.

Fourth, it's 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 mere facilitated.

Fifth, it's also suggested that education and training are needed in order 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.

References

1. Benjamin, R. I., de Long, D. and Scott Morton, M. S., "Electronic Data Interchange: How Much Competitive Advantage?", *Long Range Planning*, Vol. 23, No. 1, February 1990, pp. 29-40.

2. Bergeron, F. and Raymond, L., "The Advantages of Electronic Data Interchange," *Data Base*, Vol. 23, No. 4, Fall 1992, pp. 19-31.

3. Carter, J. R., Monczka, R. M., Clauson, K. S. and Zelinski, T. P., "Education and Training for Successful EDI Implementation," *Journal of Purchasing and Materials Management*, Summer 1987, pp. 13-20.

4. Dearing, B., "The Strategic Benefits of EDI," *The Journal of Business Strategy*, Vol. 11, No. 1, January-February 1990, pp. 4-6.

5. Emmelhainz, M. A., *EDI : A Total Management Guide*, 2nd ed., Van Nostrand Reinhold, New York, 1993.

6. Kym, H. G. and Lee, H. J., "Research on Factors Influencing Adoption of EDI in Korean Companies," *Journal of the Operations Research and Management Science Society*, Vol 22, No. 1, 1997. pp. 159-187.

7. Lee, D. M. Chung, K. S. and Kim, B. G., "Electronic Data Interchange Systems Research : Methodologies and a Cumulative Tradition," *Korean Management Science Review*, Vol. 14, No. 2, 1997. pp. 19-45.

8. McGowan, M. K., *The Extent of Electronic Data Interchange Implementation: An Innovation Diffusion Theory Perspective*, Unpublished Ph. D. Dissertation, Kent State University, 1994.

9. Premkumar, G., Ramamurthy, K. and Nilakanta, S., "Implementation of Electronic Data Interchange : An Innovation Diffusion Perspective," *Journal of Management Information Systems*, Vol. 11, No. 2, Fall 1994, pp. 157-186.

10. Runge, D. A., *Using Telecommunications for Competitive Advantage*, Unpublished Ph. D. Dissertation, Oxford University, England, 1985.