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An Empirical Study on the Factors Influencing RFID Adoption and Implementation

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ABSTRACT

The purpose of this study is to investigate which factors are important for RFID adoption and implementation. This study suggests four influential factors that include nine variables – perceived benefits, perceived costs, standardization, top management support, IT knowledge capability, environmental uncertainty, competitive pressure, inter-organizational cooperation, inter-organizational trust – impacting the intent of RFID adoption and extent of RFID use. Reviewing the literature, this study is suggested a research model and develop four hypotheses to be tested. Data are collected from 171 companies related to the RFID in Korea. The results of hypothesis testing are as follows. First, perceived benefits, standardization, top management support, IT knowledge capability, environmental uncertainty, competitive pressure and inter-organizational cooperation were significantly related to intent of RFID adoption. Second, perceived benefits, standardization, top management support, competitive pressure and inter-organizational cooperation were significantly related to an extent of RFID use. In conclusion, study's limitations and implications were treated.

Keywords: *Adoption, Implementation, RFID (Radio Frequency IDentification), RFID Adoption Process*

INTRODUCTION

RFID (Radio Frequency IDentification) is a wireless frequency of recognition technology that can be used to recognize, trace and identify people, things and animals using radio frequency (RF). RFID system comprises three components: an antenna, RFID tags (transponders) that are electronically programmed with unique information and an RF module (reader) with a decoder (transceiver). RFID will bring about a many changes in manufacturers, distributors and etc.
RFID is still marginally adopted across the globe, and the future of RFID still remains unclear due to limitations in the form of high implementation and operation costs, the lack of standardization, and unawareness of its importance (Smith, 2005).

In addition, it takes a relatively long time for firms to make the adoption decision since it requires them to undertake a fundamental strategic review of their business processes and of their relationships with suppliers and distributors before adopting RFID (Lee and Shim, 2007). In accordance with the importance of the increasing RFID techniques increasing, RFID studies are plentifully advanced. Initially, the RFID research was either a research literature or case study (Kern, 2004, Lai and Hutchinson, 2005, Smith, 2005, Roberts, 2006, Schmitt et al., 2007). Empirical research has been recently announced (Neeley, 2006, Lee and Shim, 2007). But most of the existing research on RFID adoption has been restricted to a dichotomous measure of 'adoption vs. non-adoption' or adoption intention. Because RFID research is still an initial stage, research of the RFID performance, integration and usage is little.

The purpose of this study is to investigate which factors are important for the RFID adoption and implementation.

To better understand these issues, this paper developed a conceptual model for RFID adoption based on technology-organization-environment framework from technology innovation and information systems (IS) literature (Tornatzky and Fleischer, 1990). This study adopted the TOE framework combined with the inter-organizational factors used by Chwelos et al. (2001) to outline four types of adoption influences for RFID technology.

The following section reviews the relevant literature, on which the RFID adoption. First, this study presents a brief overview of RFID technology and RFID adoption. Second, this study presents the research model and develops testable hypotheses for this study based on prior literature. Third, this study describes the research setting and methodology that was used to test the research model along with the presentation of results. In conclusion, this presents the discussion of the results along with their implications and limitations.

LITERATURE REVIEW

RFID Technology

RFID is a means of automatic identification of objects using radio signals and provides improved data collection and handling through greater accuracy, speeds and visibility. RFID has the potential to lower costs of inventory management, supply chain management and retail checkouts.

Neeley (2006) empirically demonstrated that organizational factors, inter-organizational factors, technology-related factors influenced adoption of advanced connective technology such as RFID. Brown and Russell (2007) investigated three contexts in the RFID adoption status: technological context (relative advantage, compatibility, complexity and cost), organizational context (top management attitude, IT expertise, organizational size and

organizational readiness) and environmental context (competitive pressure, external support and change agents).
Lee and Shim (2007) investigated the RFID, suggesting that performance gap, market uncertainty, vendor pressure and perceived benefits had a positive effect on likelihood of adopting RFID in the healthcare industry. Sharma (2007) added inter-organizational factors to examine the RFID implementation process. This paper argued that RFID can be viewed both as an internal as well as an inter-organizational tool. Schmitt et al. (2007) proposed compatibility, cost, complexity, performance, top management support in the context of RFID adoption.

RFID Adoption process

The process of adoption of innovation in organizations has been divided into a variety of phases. Damanpour (1991) suggests innovation adoption as a process consisting of multiple stages: initiation stage, implementation stage. Grover and Goslar (1993) presented the telecommunications technologies as a three-stage: initiation, adoption and implementation. Initiation includes pressure to change and gathering and evaluation of information culminating in the adoption stage. Adoption involves the decision to commit resources to the innovation. The final stage, implementation, includes development and installation activities to ensure that the expected benefits of the innovation are realized (Grover and Golslar, 1993). And Sharma (2007) present the RFID implementation process as a three-stage model with the following stages: RFID evaluation, RFID adoption decision, RFID integration.

Thus, this study applied these existing theories from the adoption and diffusion literature to frame or model of RFID adoption on two stages: adoption stage and implementation stage. In this study, adoption stage includes initiation and adoption decision stage. Namely, in adoption stage, top organizational echelons decide to adopt the

RFID technology and allocate resources to it. In implementation stage, RFID is put into use by organizational members, clients or customers.

CONCEPTUAL MODEL AND HYPOTHESES

Based on technology innovation and RFID adoption discussed above, this paper proposes a conceptual model for RFID adoption stage with organizational resources. This conceptual model posited nine adoption and implementation factors for RFID. The research model is illustrated in Figure 1. It describes the impact of four sets of antecedent factors – technological, organizational, environmental and inter-organizational characteristics – on the adoption and implementation of RFID in Korea.
The technological characteristics considered are perceived benefits, perceived costs, standardization; organizational characteristics are top management support, IT knowledge capability; environmental characteristics are environmental uncertainty, competitive pressure and inter-organizational characteristics are inter-organizational cooperation, inter-organizational trust. The dependent variable is the intent of RFID adoption in adoption stage and the extent of RFID use in implementation stage.

Technological Characteristics

Perceived benefits have been empirically shown to impact information technology adoption. The organization must perceive that the adoption will either resolve existing problems or provide new business opportunities. Generally, a positive relationship exists between perceived benefits and IT adoption.

Cost has been found to be a significant inhibitor to EDI adoption. The cost to install the necessary hardware/software infrastructure and establish electronic linkage with trading partners can be substantial. The cost of integrating the EDI systems with internal IS can also cause concern and inhibit EDI adoption (Premkumar et al., 1997). The cost of subsequent integration which includes the cost of integrating RFID with information and resource management systems, cost of

purchasing new hardware and software, cost of reengineering business processes due to change in work practices, cost of training employees and cost of replacing existing infrastructure may be quite high(Sharma, 2007).

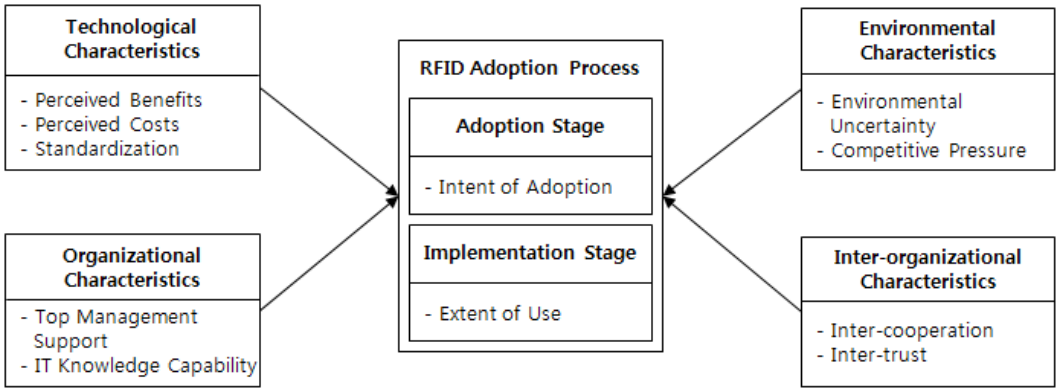

Figure 1 Research Model.

Standardization is defined as the degree of consistency of standards between the partner organizations within an industry and across industries. With RFID adoption, it is important to achieve interoperability between supply chain partners and to move towards open standards for leveraging cross industry benefits (Sharma, 2007). Kim (2008) found that standardization was a significant factor in adopting RFID technologies.
Thus, based on previous literature and the arguments presented above, the following is hypothesized:

H1. Technological characteristic is significantly associated with RFID adoption stage.

H1-1a. There is a positive relationship between perceived benefits and intent of RFID adoption.
H1-2b. There is a positive relationship between perceived benefits and extent of RFID use.
H1-3a. There is a negative relationship between perceived costs and intent of RFID adoption.
H1-4b. There is a negative relationship between perceived costs and extent of RFID use.
H1-5a. There is a positive relationship between standardization and intent of RFID adoption.
H1-6b. There is a positive relationship between standardization and extent of RFID use.

Organizational Characteristics

Top management support has been empirically shown to impact IT adoption and diffusion studies (Premkumr and Ramamurthy, 1995, Premkumar et al, 1997, Premkumar and Roberts, 1999). Top management support is critical to the optimal management and use of IT resources in organizations. This factor shows the level of commitment from senior management in utilizing information systems to help and organize survival and prosper which includes its willingness to allocate resources for the adoption of the technology (Sharma, 2007). Top management support recognizes strategic opportunities and provides long-term vision, attributes that are critical for successful adoption of an innovation (Premkumar et al., 1997). Top management support and vision has been studied significantly in RFID studies (Brown and Russell, 2007, Sharma, 2007).

Organizational technical capability refers to the level of sophistication of IT usage and IT management in an organization (Icavou et al., 1995, Chwelos et al., 2001). Recent studies found that organizational IT knowledge is a more important dimension of organizational IT knowledge capability than any other dimension. Mehrtens et al. (2001)

found that knowledge among non-IT professional was a significant determinant of organizational IT knowledge capability. Kim (2008) found that technical capability significantly influenced organizational intention to use RFID technology.
Thus, based on previous literature and the arguments presented above, the following is hypothesized:

H2. Organizational characteristic is significantly associated with RFID adoption stage.

- H2-1a. There is a positive relationship between top management support and intent of RFID adoption.
- H2-2b. There is a positive relationship between top management support and extent of RFID use.
- H2-3a. There is a positive relationship between IT knowledge capability and intent of RFID adoption.
- H2-4b. There is a positive relationship between IT knowledge capability and extent of RFID use.

Environmental Characteristics

Environmental characteristics are another force driving organizations to adopt IT. Environmental uncertainty, competitive pressure, industrial pressure, and government policy all serve as pressures on organizations. Empirical studies show that more environmental uncertainty is associated with higher adoption rates (Lee and Shim, 2007). Environmental uncertainty significantly influenced the complete innovation cycle (initiation, adoption, and implementation) (Grover and Goslar, 1993).

A majority of prior studies have shown that competitive pressure has a positive effect on adoption and usage of IT in organizations (Iacovou et al., 1995, Premkumar and Ramamurthy, 1995, Premkumar and Roberts, 1999, Zhu et al., 2003). This would be even more evident if the innovation directly affects the competition. For instance, many

firms adopted EDI due to demand from customers to improve the efficiency of their inter-organizational transactions. This is amply illustrated by the experience of small firms adopting EDI to satisfy the demands of large firms such as Wal-Mart or GM (Premkumar and Roberts, 1999). As another example, Wal-Mart and Target more recently announced their implementation plan for RFID tags in an effort to streamline their supply chain processes, and began to exert pressure on their suppliers to use RFID tags on the products shipped to the retailers (Son et al., 2005).
Thus, based on previous literature and the arguments presented above, the following is hypothesized:

H3. Environmental characteristic is significantly associated with RFID adoption stage.

- H3-1a. There is a positive relationship between environmental uncertainty and intent of RFID adoption.
- H3-2b. There is a positive relationship between environmental uncertainty and extent of RFID use.
- H3-3a. There is a positive relationship between competitive pressure and intent of RFID adoption.
- H3-4b. There is a positive relationship between competitive pressure and extent of RFID use.

Inter-organizational Characteristics

Cooperation can be defined as similar or complementary coordinated actions taken by firms in interdependent relationships to achieve mutual outcomes or singular outcomes with expected reciprocation over time (Anderson and Narus, 1990). Heide and John (1990) empirically demonstrated that a manufacturer takes joint actions to a greater extent with a supplier when the relationship is expected to continue into the future. Bensaou (1997) found that cooperation between automakers and their suppliers is positively

associated with the level of IT used between the trading partners in the Japanese automobile industry.

Trust can be viewed as one party's confidence in the reliability and integrity of a trading partner. Inter-organizational trust can benefit partners within a supply chain by improving communication and cooperation and increasing efficiency and accuracy. Neeley (2006) suggested inter-organizational trust in RFID technology adoption. Lancastre and Lages (2006) found that trust was a significant factor of cooperation determinants in an electronic market context.
Thus, based on previous literature and the arguments presented above, the following is hypothesized:

H4. Inter-organizational characteristic is significantly associated with RFID adoption stage.

- H4-1a. There is a positive relationship between inter-organizational cooperation and intent of RFID adoption.
- H4-2b. There is a positive relationship between inter-organizational cooperation and extent of RFID use.
- H4-3a. There is a positive relationship between inter-organizational trust and intent of RFID adoption.
- H4-4b. There is a positive relationship between inter-organizational trust and extent of RFID use.

RESEARCH METHODOLGY

The operation of the remaining research variables was developed especially for this study. In some cases, items were adapted from previously used scales. All perceptual items were measured by seven-point Likert scales representing a range from "strongly disagree" to "strongly agree." Operational definitions of the study instruments are shown in Table 1.

Table 1 Operational Definition of Key Constructs.

Variables	Indicators	Operational definition	Related literature
Perceived benefits	5	Expected benefit from business for organization	Premkumar and Roberts(1999), Son et al.(2005), Sharma(2007)
Perceived costs	4	Expected cost of RFID adoption and implementation	Sharma(2007)
Standardization	4	Level of stable standardization	Sharma(2007)
Top management support	4	Level of top management support and participation	Premkumar and Ramaurthy(1995), Sharma(2007)
IT knowledge capability	4	Level of IT knowledge capability for RFID adoption	Lee and Shim(2007)
Environmental uncertainty	4	The status of not accurately predicting future situations	Agbejule(2005), Son et al.(2005)
Competitive pressure	4	The extent of pressure exerted by the competitive firms	Premkumar and Ramaurthy(1995), Zhu et al.(2003)
Inter-organizational cooperation	4	Level of our firm and partners interaction	Lancastre and Lages(2006), Sanders(2007)
Inter-organizational trust	4	Level of our firm and partners mutual trust	Zaheer and Venkatraman(1995), Son et al.(2005)
Intent to adoption	3	Intent to RFID adoption	Sharman(2007), Son and Benbasat(2007)
Extent to use	4	Level of trading works and use using RFID	Sharma(2007), Chang et al.(2008)

RESULTS AND DATA ANALYSIS

In order to pursue this study, a survey was done from September 27, 2008 until November 10, 2008. The questionnaire was collected by 207 managers and workers from physical distribution and manufacturing companies related to the RFID in South Korea. Of the 207 surveys, 36 which did not fit for the study were discarded and the

remaining 171(adoption stage 101, implementation stage 70) were used for the empirical study. The statistics were analyzed using Excel 2003 and SPSS 12.0.

Table 2 Sample Characteristics.

Classification		Adoption stage	Implementation stage
	Adopter/non-adopter	Non-adopter 101(59.1%)	Adopter 70(40.9%)
Industry	Manufacturing	71(70.3%)	45(64.3%)
	Distribution	25(24.7%)	20(28.6%)
	Other	5(5.0%)	5(7.1%)
	Total	101((100%)	70(100%)
Number of employees	Less than 100	22(21.8%)	5(7.1%)
	101 through 500	26(25.7%)	12(17.1%)
	501 through 1,000	20(19.8%)	20(28.6%)
	1,001 through 3,000	26(25.7%)	16(22.9%)
	More than 3,000	7(7.0%)	17(24.3%)
	Total	101(100%)	70(100%)
Annual sales	Less than US$100 billion	15(14.8%)	6(8.6%)
	US$100 through US$500 billion	8(8.0%)	4(5.7%)
	More than US$500 billion	78(77.2%)	60(85.7%)
	Total	101(100%)	70(100%)

The characteristics of the sample are shown below in Table 2. There are 101 non-adopters and 70 adopters. In adoption stage, manufacturing industry is composed of 71 companies, which is 70.3% over all. There are 25 distribution companies which takes 24.7% of the industries. In the number of employees, there are 26 companies (25.7%) that have the 101 to 500 employees and 26 (25.7%) companies have 1,001 to 3,000 employees. In annual sales, 78 companies (77.2%) had more than US $500 billion.

In implementation stage, manufacturing industry is composed of 45 companies, which is 64.3% over all. There are 20 distribution companies which takes 28.6% of the industries. In the number of

employees, there are 20 companies (28.6%) that have the 501 to 1,000 employees and 17 (24.3%) companies have more than 3,000 employees.

Table 3 Results of Validity and Reliability Test.

Variables	Item	Factor loading	Cronbach's α	Variables	Item	Factor loading	Cronbach's α
Perceived benefits	PB1	.848	.903	Competitive pressure	CP1	.841	.867
	PB2	.837			CP2	.792	
	PB3	.800			CP3	.776	
	PB4	.708			CP4	.718	
	PB5	.604					
Perceived costs	PC1	.867	.851	Inter-organizational cooperation	IC1	.839	.894
	PC2	.817			IC2	.807	
	PC3	.804			IC3	.726	
	PC4	.750			IC4	.638	
Standardization	S1	.891	.950	Inter-organizational trust	IT1	.904	.951
	S2	.872			IT2	.872	
	S3	.870			IT3	.855	
	S4	.808			IT4	.798	
Top management support	TM1	.762	.857	Intent to adoption	IA1	.969	.952
	TM2	.743			IA2	.959	
	TM3	.703			IA3	.939	
	TM4	.512					
IT knowledge capability	KC1	.881	.918	Extent to use	EU1	.901	.875
	KC2	.877			EU2	.893	
	KC3	.840			EU3	.840	
	KC4	.668			EU4	.780	
Environmental uncertainty	EU1	.859	.928				
	EU2	.827					
	EU3	.817					
	EU4	.788					

Table 4 Summary of Hypotheses.

Independent variable	Dependent variable	R^2	Beta	*t*	Sig.	Result
Perceived benefits	Intent of adoption	.326	.413	4.253	.000***	Supported
Perceived costs			-.123	1.340	.183	Not supported
Standardization			.197	2.231	.028**	Supported
Perceived benefits	Extent of use	.290	.285	2.439	.017**	Supported
Perceived costs			-.020	-.187	.852	Not supported
Standardization			.343	2.931	.005***	Supported
Top management support	Intent of adoption	.468	.582	7.073	.000***	Supported
IT knowledge capability			.184	2.242	.027**	Supported
Top management support	Extent of use	.105	.274	2.111	.039**	Supported
IT knowledge capability			.088	.675	.502	Not supported
Environmental uncertainty	Intent of adoption	.389	.205	2.542	.013***	Supported
Competitive pressure			.551	6.848	.000***	Supported
Environmental uncertainty	Extent of use	.200	.069	.569	.571	Not supported
Competitive pressure			.412	3.393	.001***	Supported
Inter-Cooperation	Intent of adoption	.081	.316	2.502	.014**	Supported
Inter-Trust			-.053	-.421	.674	Not supported
Inter-Cooperation	Extent of use	.168	.291	2.413	.019**	Supported
Inter-Trust			.197	1.629	.108	Not supported

Significance level: * : p<0.1 ** : p<0.05 *** : p<0.01

In annual sales, 60 companies (85.7%) had more than US $500 billion. The measurement mode for the constructs was created and tested using factor analysis and reliability analysis. Results of validity and reliability test are shown in Table 3.

From the primary data (n=171), the regression analysis was examined to test the relationships between technical, organizational, environmental, inter-organizational characteristics and intent of

adoption and extent of use. SPSS 12.0 to analyze the proposed model. Significant results were found. Table 4 shows the results of hypothesis testing. Perceived benefits, standardization, top management support, IT knowledge capability, environmental uncertainty, competitive pressure and inter-organizational cooperation were significantly related to intent of RFID adoption. And perceived benefits, standardization, top management support, competitive pressure and inter-organizational cooperation were significantly related to an extent of RFID use. But perceived costs and inter-organizational trust did not have any significant effect on the intent of RFID adoption and extent of RFID use.

CONCLUSIONS

This study examined the impact of various technological, organizational, environmental, and inter-organizational characters on the adoption and implementation in the context of RFID. Based on research in IT innovation adoption and IOS, research model was developed. The results of the analysis are as follows. First, adoption stage shows that perceived benefits, standardization, environmental uncertainty, competitive pressure, and inter-organizational cooperation have a significant effect on the intent of RFID adoption. Second, implementation stage shows that perceived benefits, standardization, competitive pressure, inter-organizational cooperation have a significant effect on the extent of RFID use.

This study is based on the following proposed managerial implications. First in this study, RFID's not introduced company adoption and the implementation of enterprise-level companies' standardization of both the degree and inter-organizational cooperation have some influence on RFID adoption and implementation. In RFID rather than the important information systems in the internal organization, because it is an inter-

organizational information system, if it is not standardized then business to business transactions won't be accomplished smoothly. Therefore, RFID is cooperation between organizations and in order to perform these tasks standardization efforts will continue.
Second, those un-introduced RFID companies' adoption stages are environmental characteristics or environmental uncertainty and competitive pressures so there was intent to increase the introduction of RFID. Because information technology environment is very uncertain and competitive there is a need to recognize innovative information technology such as RFID and to introduce it more positively. And in a very rapidly changing environment of the company's adoption stage, RFID's corporate survival and competitive pressure is to be introduced as a new innovation called "RFID". Therefore, RFID skill developers and RFID consultants should introduce to companies the importance of environmental factors.

Limitations and future research issues can be summarized as follows. First, it is difficult to say that the sample is enough to be the representative of the population. Second, because the sample of this study was mostly of manufacturers, it may be limited if you to analyze the difference between other industries. Third, the research has insufficient organizational resources, the many researches are necessarily about organizational resources in RFID study.
Future studies using performance research are also needed to help understand organizational level RFID adoption and better implementation.

REFERENCES

Agbejule, A., The Relationship between Management Accounting Systems and Perceived Environmental Uncertainty on Managerial Performance: A Research Note, *Accounting and Business Research*, 35(4), 2005, 295-305.

Anderson, J.C. and Narus, J.A., A Model of the Distributor-Manufacturer Working Relationships, *Journal of Marketing*, 54(1), 1990, 42-58.

Bensaou, M., Inter-organizational Cooperation: The Role of Information Technology: An Empirical Comparison of U.S. and Japanese Supplier Relations, *Information Systems Research*, 8(2), 1997, 107-124.

Brown, I. and Russell, J., Radio Frequency Identification Technology: An Exploratory Study on Adoption in the South African Retail Sector, *International Journal of Information Management*, 27(4), 2007, 250-265.

Chang, M.K., Cheung, W., Cheng, C.H. and Yeung, J.H.Y., Understanding ERP System Adoption from the User's Perspective, *International Journal of Production Economics*, 113(2), 2008, 928-942.

Chwelos, P., Benbasat, I. and Dexter, A.S., Empirical Test of an Electronic Data Interchange Adoption Model, *Information Systems Research,* 12(3), 2001, 304-321.

Damanpour, F., Organizational Innovation: A Meta-Analysis of Effects of Determinants and Moderators, *Academy of Management Journal*, 34(3), 1991, 555-590.

Grover, V. and Goslar, M.D., The Initiation, Adoption, and Implementation of Telecommunications Technologies in U.S. Organizations, *Journal of Management Information Systems*, 10(1), 1993, 141-163.

Heide, J.B. and John, G., Alliances in Industrial Purchasing: The Determinants of Joint Action in Buyer-Supplier Relationships, *Journal of Marketing Research*, 27(1), 1990, 24-36.

Iacovou, C.L., Benbasat, I. and Dexter, A.S., Electronic Data Interchange and Small Organization Adoption and Impact of Technology, *MIS Quarterly*, 19(4), 1995, 465-485.

Kern, C., Radio-Frequency-Identification for Security and Media Circulation in Libraries, *The Electronic Library*, 22(4), 2004, 317-324.

Kim, S.H., An Empirical Study of Factors Influencing Organizational Intention to Use RFID Technology and the Moderating Effect of Presence of Champions, *Journal of Business Research*, 23(3), 2008, 139-171.

Lai, V.S. and Guynes, J.L., A Model of ISDN (Integrated Services Digital Network) Adoption in U.S. Corporations, *Information & Management*, 26(2), 1994, 75-84.

Lancastre, A. and Lages, L.F., The Relationship between Buyer and a B2B e-Marketplace: Cooperation Determinants in an Electronic Market Context, *Industrial Marketing Management*, 35(6), 2006, 774-789.

Lee, C.P. and Shim, J.P., An Exploratory Study of Radio Frequency Identification (RFID) Adoption in the Healthcare Industry, *European Journal of Information Systems*, 16(6), 2007, 712-724.

Mehrtens, J., Cragg, P.G. and Mills, A.M., A Model of Internet Adoption by SMEs, *Information & Management*, 39(3), 2001, 165-176.

Neeley, C.K.R., *Connective Technology Adoption in the Supply Chain: The Role of Organizational, Inter-organizational and Technology-Related Factors*, Ph. D. Dissertation, University of North Texas., 2006.

Premkumar, G. and Ramamurthy, K., The Role of Inter-organizational and Organizational Factors on the Decision Mode for Adoption Inter-organizational Systems, *Decision Science*, 26(3), 1995, 303-336.

Premkumar, G. and Roberts, N., Adoption of New Information Technologies in Rural Small Business, *Omega*, 27(4), 1999, 467-484.

Premkumar, G., Ranamurthy, K. and Crum, M., Determinants of EDI Adoption in the Transportation Industry, *European Journal of Information Systems*, 6(2), 1997, 107-121.

Roberts, C.M., Radio Frequency Identification (RFID), *Computers & Security*, 25(1), 2006, 18-26.

Sharma, A., *Strategic, Institutional and Radicalness Factors in the Evaluation, Adoption and Early Integration of RFID: An Empirical Investigation of Current and Future Adopters*, Ph. D. Dissertation, Emory University, 2007.

Smith, A. D., Exploring Radio Frequency Identification Technology and Its Impact on Business Systems, *Information Management & Computer Security*, 13(1), 2005, 16-28.

Son, J.Y., Narasimhan, S. and Riggins, F.J., Effects of Relational Factors and Channel Climate on EDI Usage in the Customer-Supplier Relationship, *Journal of Management Information Systems*, 22(1), 2005, 321-353.

Tornatzky, L.G. and Fleischer, M., *The Processes of Technological Innovation*, Lexington Books, Lexington, MA, 1990.

Zaheer, A. and Venkatraman, N., Relational Governance as an Inter-organizational Strategy: An Empirical Test of the Role of Trust in Economic Chang, *Strategic Management Journal*, 16(5), 1995, 373-392.

Zhu, K., Kraemer, K. and Xu, S., Electronic Business Adoption by European Firms: A Cross-Country Assessment of the Facilitators and Inhibitors, *European Journal of Information Systems*, 12(4), 2003, 251-268.