

DECISION SCIENCES INSTITUTE

An Empirical Study of RFID Adoption in Retail: Using Technology-Organization-Environment Framework

Mithu Bhattacharya
University of Detroit Mercy
bhattami@udmercy.edu

Samuel Fosso Wamba
NEOMA Business School and University of South Africa
Samuel.fosso.wamba@neoma-bs.fr

ABSTRACT

Motivated by the need to understand the antecedents of RFID adoption in retail, this study develops a framework predicting RFID adoption intent. Based on the technology-organization-environment (TOE) framework, this research develops and propose to validate the research framework to examine the influence of twelve contextual factors under four broad categories (technological, organizational, environmental, and value-chain) on RFID adoption in retail.

KEYWORDS: RFID, Adoption, Delphi

INTRODUCTION

Despite extensive research on adoption and diffusion of innovation, adoption of emerging technologies with specific characteristics is still not well understood (Rogers, 1995). Adoption of electronic data interchange (EDI) is an example where generalizations of diffusion theory could not be directly applied and new models were developed to understand the adoption patterns by identifying adoption drivers (Chwelos et al, 2001; Sharma et al, 2008). There are many studies on technology adoption in the field of information systems (IS). The unique characteristics offered by RFID distinguish it from other technologies such as internet and EDI and warrants further investigation around RFID adoption specifically. Many of the studies of organizational adoption of technology have drawn from the work of Tornatzky and Fleishcher's TOE (technology-organization-environment) framework (Tornatzky & Fleischer, 1990; Chwelos et al, 2001; Teo et al, 2004) who grouped factors influencing organizational adoption into technological, organizational, and environmental contexts. Technological context refers to innovation characteristics. The organizational context describes the organization and its characteristics, and the environmental context refers to the surrounding in which an organization conducts its business. It encompasses the industry and dealings with business partners, competitors, and government. Prior RFID adoption studies have not always investigated the three contexts in a comprehensive manner. Most of these have focused on a few factors instead (Brown & Russell, 2007). Additionally, most of the previous studies show the importance of technological factors; however the effects of organizational and environmental factors have been varied across different industrial contexts (Wang et al, 2010). Thus there is still more need to analyze the drivers of RFID adoption in different industrial contexts for a better understanding. This study explores factors that drive RFID adoption, inspired by the TOE framework that draws from multiple theoretical bases. In addition to the basic constructs of the TOE framework, value

chain factors are also studied since RFID technology is primarily used to streamline value chain. Thus technological, organizational, environmental, and value chain adoption factors are investigated to develop the conceptual framework of RFID adoption in retail.

THEORETICAL FOUNDATION

While certain organizational factors along with perceived organizational benefits often enable technology adoption, the absence of enablers can present themselves as inhibitors of adoption. According to the stream of research on organizational technology adoption *technological, organizational, and environmental* factors are identified to be most relevant to the adoption of technologies in general and could be applicable to the RFID technology adoption as well.

(Tornatzky & Klein, 1982) examined the relationship between technological or innovation characteristics and adoption. The 10 characteristics that were found to be most frequently used were relative advantage, complexity, communicability, divisibility, cost, profitability, compatibility, social approval, trialability, and observability. Out of these 10 characteristics, relative advantage, complexity, compatibility, and cost were found to be consistently related to adoption studies. Recent IT adoption studies have also found these variables to be important in the context of adoption of various information technologies (Cooper & Zmud, 1990). One of the first challenges that can be identified in RFID or any new technology adoption is the cost of the physical implementation with regards to hardware and software. Adoption of such infrastructure is of significant cost to the organization. However such technologies also bring cost savings that implementing the technology might bring to an organization which corresponds to the relative advantage of the new technology compared to its predecessor technologies. The issue of complexity can refer to both the complexity of the technology implementation and the technology itself (Gallivan, 2001). Compatibility refers to the deviation from previous ideas, values, or technologies that the new technology supersedes.

The literature on organizational innovativeness explored the influence of organizational characteristics on adoption decisions (Damanpour, 1991). This perspective emerged as researchers recognized that decisions at the firm level are often too complex to be captured only by an individual's cognitive abilities (Tornatzky & Klein, 1982) and could not be directly addressed with traditional technology adoption and diffusion models (Rogers, 1995).

Organizational factors identified in IT adoption studies are top management support, organizational size, existence of product champions, and availability of resources. Top management attitude and support ensures availability of adequate resources for implementing the innovation (Grover & Goslar, 1993). Studies suggest that providing sufficient resources and creating conducive environment for innovation adoption within an organization comes from the top management and is positively related to innovation adoption and diffusion process (Rogers, 1995; Premkumar & Roberts, 1999). The availability of organizational resources, such as financial, human, and physical was shown to be of significant importance in the adoption decision and implementation success (Depietro et al, 1990). Organizational size has repeatedly been found to influence innovation adoption (Gremillion, 1984).

Also, organizations must be willing to make changes in business processes for benefits to accrue (Kinsella, 2003; Brown & Russell, 2007). Moreover there must be a cultural willingness to move beyond conventional methods and to take risks to ensure innovation adoption (Hoske, 2004).

Organizational innovativeness studies have provided a number of additional determinants that influence adoption of information technologies. However this stream of research assumes that organizational adoption of information technologies is driven by intra-organizational factors that

are independent of environmental context (Zhu et al, 2002). Organizational behavior and strategic management studies, however, provided evidence that organizational technology adoption decision-making was also influenced by contextual environmental factors. This shortcoming of enterprise adoption models led to the examination and integration of environmental factors in enterprise adoption research.

Competitive pressures, vendor influence, and regulatory forces are all environmental factors that could impact an organization's decision to adopt an innovation. Thus, an understanding of the institutional environment in which businesses operate is extremely important. Factors that are external to an organization but influencing its functioning and decision making e.g. governmental push, technology standards development, legal environment, consumer readiness with increasing awareness, technological breakthroughs etc. have been characterized as environmental factors. (Tornatzky & Fleischer, 1990) identified competitive pressure, governmental regulations, and consumer readiness as environmental factors influencing innovation adoption.

The TOE framework is widely accepted since findings from innovation adoption studies are empirically supported and thus consistent with it (Cooper & Zmud, 1990; Thong, 1999). The framework has been used to study adoption of general IT innovation (Chau & Tam, 1997; Zhu et al, 2006a; Zhu et al, 2006b; Lin et al, 2014) as well as specific IT innovation such as EDI (Kuan & Chau, 2001).

The TOE framework is adapted to make it particularly suitable to study RFID adoption process in retail organizations in this study. The goal is to develop a comprehensive RFID adoption conceptual framework. Based on the multiple theories perspective of TOE framework to explain enterprise adoption, there is also an opportunity to develop a single, integrated model that will provide a holistic view on the factors involved in this complex decision. Also, despite the plethora of enterprise adoption studies, only a very small percentage has examined disruptive organizational technologies like RFID. Given the growing importance of RFID technology it is thus critical to examine whether existing models apply, and if not, how they can be modified or extended.

RESEARCH MODEL AND PROPOSITIONS

A wide range of factors has been found in the literature that facilitates or inhibits technology adoption. In this study a few factors that are believed to be important in understanding RFID adoption are investigated. The proposed research framework on RFID adoption identifies and evaluates the antecedents of RFID adoption intention.

The dependent variable is retailer's RFID adoption intent. Intention to behavior is a suitable predictor of behavior since behavior is usually more difficult to measure reliably (Ajzen, 1991). Given the newness of RFID technology, intention which refers to a future behavior is more meaningful than behavior. The three contexts of technology, organization, and environment form the basis for developing the adoption framework and factors relevant to the adoption of RFID within each category are highlighted. A fourth category of value chain context is introduced in the model considering the unique characteristics of RFID and its applicability in a value chain. The contextual factors are synthesized from innovation adoption research that includes work on different kinds of innovation in organizational context, general research on information systems implementation, and research on strategic information systems like inter-organizational systems (IOS) and are put into a testable model for RFID adoption. Please note that experts who support RFID adoption in retail represent actual retail adopters whereas experts who do not support such adoption represent non-adopters in this study. It is assumed

that the behavior of actual adopters and non-adopters of RFID is similar to that of the experts. The justification for the assumption is the mix of the experts from industry as well as academia. It covers a wide range of expert opinions associated with RFID adoption projects at all levels. Thus this study will be discussed in terms of adopters and non-adopters from this point onwards. The differences in profiles of adopters and non-adopters with respect to the four categories of contextual factors provide insight into the variables that are important to adoption. The adoption framework consists of twelve determinants or antecedents that are hypothesized to influence RFID adoption in retail. This study focuses on identifying factors that can predict RFID adoption and thus the relationships among the twelve factors are beyond the scope of this research. The proposed research framework is shown in Figure 1.

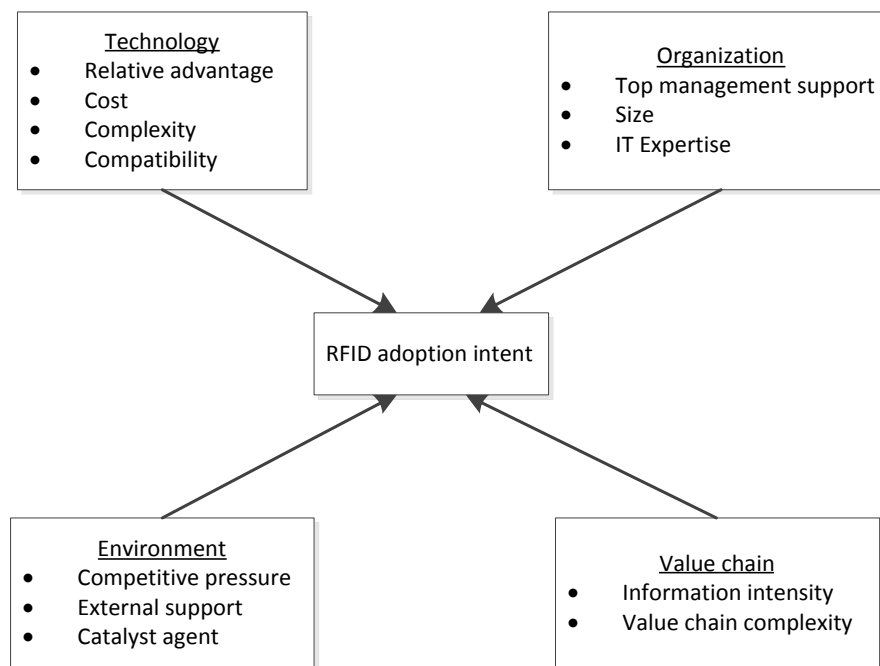


Figure 1. Conceptual framework of RFID adoption

Technological context

Technological factors represent characteristics of an innovation as defined by (Tornatzky & Fleischer, 1990). Several innovation characteristics have been studied as the basis for innovation diffusion research. These characteristics that are found to be used most frequently are relative advantage, complexity, communicability, divisibility, cost, profitability, compatibility, social approval, trialability, and observability (Tornatzky & Klein, 1982). Of these characteristics relative advantage, compatibility, and complexity consistently predicted adoption (Grover, 1993). Cost is also found to be significant in studies of innovation adoption and IT diffusion (Premkumar et al, 1994). Thus these three characteristics along with cost are included in the research framework. Specifically, these four characteristics have been suggested as being

important for RFID adoption (Ranganathan & Jha, 2005; Sharma & Citurs, 2005; Brown & Russell, 2007).

Relative advantage

Relative advantage is defined as the degree to which an innovation is perceived to be better than the idea it supersedes providing greater direct or indirect organizational benefits. Relative advantage has consistently been identified as a predictor of adoption intent in innovation diffusion literature (Premkumar & Roberts, 1999). It has also been considered as the most frequently cited facilitator of RFID adoption (Sharma & Citurs, 2005). Perceived RFID benefits include greater supply chain visibility, increased speed and efficiency of operations, reduced labor costs and improved security, and improved customer service (Kinsalla, 2003; Wu et al, 2006). RFID is expected to provide greater competitive advantages to companies (Ngai et al, 2008; Chao et al, 2007). Thus companies which perceive higher relative advantages in RFID technology are more likely to adopt it. The proposed hypothesis is thus:

H1: Technological factor relative advantage positively influences RFID adoption intent.

Cost

Perceived costs of innovations lead to lower intent to adopt despite the benefits that they provide. Thus benefits must exceed the cost of innovation adoption for decisions to adopt it. Thus cost relative to benefits is an important consideration for most innovation adoption decisions and it is true for RFID adoption as well. According to (Tornatzky & Klein, 1982) technologies that are low in cost are more likely to be adopted. (Premkumar et al, 1994) found cost to be an important variable in EDI adoption. RFID technology is a costly investment for companies involving costs of tags, hardware and software, data management and integration, and reengineering business processes that could inhibit its adoption. Cost has been proposed to be used as a predictor of RFID adoption in several studies (Sharma & Citurs, 2005; Brown & Russell, 2007). Thus companies which perceive higher cost relative to benefits in RFID technologies are less likely to adopt it. The proposed hypothesis is thus:

H2: Technological factor higher cost negatively influences RFID adoption intent.

Complexity

Complexity is defined as the degree to which an innovation is perceived as relatively difficult to understand and use. New technical skills are required to correctly use the innovation that tends to inhibit its adoption (Cooper & Zmud, 1990). Since complexity can be a deterrent to successful implementation followed by use of an innovation, it is usually negatively associated with adoption (Premkumar et al, 1994; Premkumar & Roberts, 1999). Although RFID provides several organizational benefits, the perceived characteristics of the technology is still complex. Managing and integrating large volumes of data generated by RFID system is difficult thus making the potential benefits of the technology unclear. This is one of the major inhibitors of RFID adoption and has been proposed in several RFID adoption studies (Sharma & Citurs,

2005; Brown & Russell, 2007). The diversity of RFID technology available in terms of multiple standards, operating frequencies, tag types and so on makes RFID implementation a very complicated task (Wang et al, 2010). Thus companies which perceive greater complexity in RFID technologies are less likely to adopt it. The proposed hypothesis is thus:

H3: Technological factor complexity negatively influences RFID adoption intent.

Compatibility

Compatibility refers to the degree to which an innovation is consistent with existing values, needs, and practices of the adopting organization (Rogers, 1995). It is an important determinant of innovation adoption because the new innovation can bring significant changes in existing work procedures. It has been widely used as a predictor of adoption in innovation diffusion research (Premkumar & Roberts, 1999). RFID systems bring significant changes in business processes in order to fully utilize its potentials. Companies need to integrate RFID systems with other applications and need to cooperate with value chain partners and thus they will not intend to adopt it if they do not believe that the technology is compatible with their existing practices and infrastructure. Compatibility has been suggested to be used as a predictor of RFID adoption in several studies (Sharma & Citurs, 2005; Brown & Russell, 2007; Wang et al, 2010). Thus companies which perceive greater compatibility in RFID technologies are more likely to adopt it. The proposed hypothesis is thus:

H4: Technological factor compatibility positively influences RFID adoption intent.

Organizational context

Organizational factors represent organizational characteristics that influence innovation adoption decisions. Organizational factors identified in innovation adoption studies are top management support, organizational size, existence of product champions, and availability of resources (Premkumar & Ramamurthy, 1995). The organizational context being extremely relevant to innovation adoption process was shown by (Orlikowski, 1993). These characteristics are suggested to be important for RFID adoption as well (Sharma & Citurs, 2005; Brown and Russell, 2007; Wang et al, 2010). The organizational characteristics of top management support, size, and IT expertise are included in the research model.

Top management support

Top management support is crucial for innovation adoption decisions. The decisions made by the top management are likely to impact organizational growth and development because higher management level has greater influence upon strategic decisions (Carpenter et al, 2004). Top management support is defined as the degree to which the values of the management are in favor of the new innovation adoption thus creating a supportive climate and providing

adequate resources for its adoption (Useem, 1993; Kwon & Zmud, 1987; Teo et al, 2004). Top management support is very critical for RFID adoption since RFID implementation requires adequate resources, process reengineering, and overcoming employee resistance to change (Hoske, 2004; Wang et al, 2010). Thus companies which receive greater top management commitment towards RFID technologies are more likely to adopt it. The proposed hypothesis is thus:

H5: Organizational factor top management support positively influences RFID adoption intent.

Size

Organizational size has been shown to impact innovation adoption by several studies (Premkumar & Roberts, 1999; Delone, 1981; Rogers, 1995). Large organizations typically have slack resources to experiment with a new innovation and then make an informed adoption decision (Premkumar & Roberts, 1999). Size has been suggested as an important predictor of RFID adoption in several studies (Brown & Russell, 2007; Wang et al, 2010). Thus companies which are larger in size are more likely to adopt RFID technology. The proposed hypothesis is thus:

H6: Organizational factor organizational size positively influences RFID adoption intent.

IT Expertise

Technological resources represented by appropriate technology infrastructure and skilled people are critical for innovation adoption. Companies that do not have adequate IT expertise may be unaware of new technologies or may not be in a position to deploy them. IT expertise has been used as an important variable predicting adoption in innovation diffusion research (Premkumar & Roberts, 1999; Kwon & Zmud, 1987). It has been suggested to be used in RFID adoption studies as well since the presence of adequate IT expertise may reduce costs and efforts to integrate RFID technologies with existing systems (Sharma & Citurs, 2005; Brown & Russell, 2007). Thus companies which have greater IT expertise are more likely to adopt RFID technology. The proposed hypothesis is thus:

H7: Organizational factor IT expertise positively influences RFID adoption intent.

Environmental context

Factors external to a firm but influencing a firm's functioning influences organizational adoption of new innovations. Tornatzky & Fleischer (1990) identified competitive pressure, governmental regulations, and consumer readiness as environmental factors influencing innovation adoption. Competitive pressure, external support, and existence of catalyst agents such as government influence and development of standards are some of the factors within the environment context

that have been used in general innovation diffusion research and specific RFID adoption studies (Premkumar & Roberts, 1999; Ranganathan & Jha, 2005; Sharma & Citurs, 2005, Orlikowski, 1993; Brown & Russell, 2007). These three environmental factors are included in the research framework.

Competitive pressure

Competitive pressure refers to the degree to which an innovation is adopted in the firm's industry. It is perceived to be positively influencing innovation adoption in an organization (Premkumar & Roberts, 1999; Kuan & Chau, 2001). RFID technologies provide several organizational benefits that lead to competitive advantage and is thus of immense interest to several firms particularly retailers. A firm without RFID technology may experience more pressure when more competitors have adopted it. Competitive pressure is suggested to be used as a predictor of RFID adoption in several studies (Brown & Russell, 2007; Sharma et al, 2008; Wang et al, 2010). Thus companies which experience greater competitive pressure are more likely to adopt RFID technology. The proposed hypothesis is thus:

H8: Environmental factor competitive pressure positively influences RFID adoption intent.

External support

External support represents the availability of support for implementing and maintaining an innovation from outside of the firm. Vendor and third party service provider support and support from powerful business partners positively influences innovation adoption as organizations are more willing to invest even if they do not have internal expertise to handle it. External support has been used as a determinant of adoption in innovation diffusion research (Delone, 1981; Kwon & Zmud, 1987). It is suggested to be used as a predictor of RFID adoption in several studies (Brown & Russell, 2007; Wang et al, 2010). Thus, companies which experience greater external support are more likely to adopt RFID technology. The proposed hypothesis is thus:

H9: Environmental factor external support positively influences RFID adoption intent.

Catalyst agent

Catalyst agents external to organizations include vendors trying to sell a new innovation, government and industry bodies promoting its adoption, and increased general awareness and thus acceptance and readiness with innovation maturity (Teo et al, 2004; Brown & Russell, 2007). Existence of such catalyst agents could positively influence RFID adoption decisions and has been suggested in literature (Brown & Russell, 2007; Sharma et al, 2008). Thus companies

which experience greater external catalyst agents are more likely to adopt RFID technology. The proposed hypothesis is thus:

H10: Environmental factor catalyst agent positively influences RFID adoption intent.

Value chain context

Value chain context is critical for RFID adoption because the primary use of RFID is to streamline the value chain through improved visibility that could lead to savings for the adopting organization. Information intensity in the value chain and value chain complexity are the two variables in this group that are included in the research model.

Information intensity

Information intensity refers to the degree to which information is present in a product or service thus requiring more information to order or use those (Wang et al, 2010). The more information intensive is a value chain, the more suitable it is for enhancement with new innovation (Grover, 1993; Porter & Miller, 1985; Ranganathan & Jha, 2005). It has been suggested to be a determinant factor in RFID adoption (Ranganathan & Jha, 2005; Wang et al, 2010). Thus companies which sell information intensive products or services are more likely to adopt RFID technology. The proposed hypothesis is thus:

H11: Value chain factor information intensity positively influences RFID adoption intent.

Value chain complexity

Value chain complexity refers to the degree of complexity in the value chain of the adopting organization in terms of dealing with too many value chain partners and tremendous uncertainty. It is an extension of the concept of system complexity inhibiting adoption of new technologies (Grover & Gosler, 1993). It has been suggested to be a significant predictor of RFID adoption (Ranganathan & Jha, 2005). Thus companies which conduct businesses in complex value chain environments are more likely to adopt RFID technology. The proposed hypothesis is thus:

H12: Value chain factor value chain complexity positively influences RFID adoption intent.

RESEARCH METHODOLOGY

A mixed methodological perspective is used in this research. Mixed method is appropriate because RFID adoption is still at its infancy. This study uses sequential explanatory mixed methods design, consisting of two distinct phases (Creswell et al, 2003). In the first phase, the qualitative textual data is collected to identify key determinants of RFID adoption. Research results from the extensive content analysis have been published earlier in peer reviewed

journals and conference proceedings. In the second phase, a quantitative Delphi technique is used to collect numerical data using a questionnaire to help develop and test theory. The priority in this design is given to the quantitative Delphi method, because the quantitative research represents the major aspect of data collection and analysis in this study, focusing on in-depth explanations of quantitative results. The qualitative component goes first in the sequence and is used to reveal the key research issues that need investigation. The quantitative and qualitative methods are integrated at the beginning of the quantitative phase while developing the Delphi study questions based on the results of the qualitative phase.

PROPOSED DATA ANALYSIS FOR TESTING THE PROPOSITIONS

The data from the Delphi study will be the primary data used for this research. The data collected from Delphi study will be analyzed using the SPSS (Statistical Package for Social Science) software version 17.0. SPSS is widely used for conducting statistical analyses, manipulating data, and generating tables and graphs to summarize data. Descriptive statistics such as means and standard deviation and multivariate discriminant (MDA) analysis methods will be used to test the proposed hypotheses and develop the research model.

CONCLUSION

The purpose of this study is to investigate RFID technology adoption in retail and to examine the effects of technological, organizational, environmental, and value chain variables on the level of RFID adoption. The technological variables that are examined include relative advantage, cost, complexity, and compatibility. The organizational variables that are examined include top management support, organizational size, and IT expertise. The environmental variables that are examined include competitive pressure, external support, and catalyst agent. And finally, the value chain variables that are examined included information intensity and value chain complexity. Multivariate discriminant function analysis (MDA) is proposed to be used to develop a conceptual framework for predicting the adoption of RFID in retail. When the data analysis will be complete and the propositions are tested, the proposed research model can be verified. The research model then can be used as a framework for future studies. Future research that is envisioned from this ongoing study is to test this generic framework for understanding RFID adoption process of other industries like healthcare, pharmaceuticals, logistics etc. The findings from the complete study can provide deep insights and enhance understanding of the RFID adoption process in retail industry. The findings can also aid in drawing meaningful managerial conclusions and suggest ways to move forward with RFID adoption.

REFERENCES

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human. Decision Processes*, 50(2), 179-211.
- Brown, I., & Russell, J. (2007). Radio frequency identification technology: An exploratory study on adoption in the South African retail sector. *International Journal of Information Management*, 27(4), 250-265.

Carpenter, M.A., Gelekkanycz, M.A., & Sanders, W.G. (2004). Upper echelons research revisited: antecedents, elements, and consequences of top management team composition. *Journal of Management*, 30(6), 749-778.

Chau, P.Y.K., & Tam, K.Y. (1997). Factors affecting the adoption of open systems: an exploratory study. *MIS Quarterly*, 21(1), 1-24.

Chao, C.C., Yang, J.M, and Jen, & W.Y. (2007). Determining technology trends and forecasts of RFID by a historical review and bibliometric analysis from 1991 to 2005. *Technovation*, 27(5), 268-279.

Chwelos, P., Benbasat, I., & Dexter, A.S. (2001). Research report: Empirical test of an EDI adoption model. *Information Systems Research*, 12(3), 304-321.

Cooper, R.B., & Zmud, R.W. (1990). Information technology implementation research: a technological diffusion approach. *Management Science*, 36(2), 123-139.

Creswell, J.W, Plano Clark, V.L, Guttman, M., & Hanson, W. (2003). Advanced mixed methods research designs, in: A. Tashakkori and C. Teddlie (Eds.). *Handbook on mixed methods in the behavioral and social sciences*, 209-240. Thousand Oaks, CA: Sage Publications.

Delone, W.H. (1981). Firm size and characteristics of computer use. *MIS Quarterly*, 4(4), 51-61.

Damanpour, F. (1991). Organizational Innovations: A meta-analysis of effects of determinants and moderators. *Academy of Management Journal*, 34(3), 555-590.

Depietro, R., Wiarda, E., & Fleischer, M. (1990). The context for change: Organization, technology and environment. In L. G. Tornatzky, & M. Fleischer (Eds.). *The processes of technological innovation*, Lexington, MA: Lexington Books, 151-175.

Gallivan, M. (2001). Organizational adoption and assimilation of complex technological innovations: Development and applications of a new framework. *The Data Base for Advances in Information Systems*, 32(3), 51-85.

Gremillion, L. L. (1984). Organization size and information system use: An empirical study. *Journal of Management Information Systems*, 1(2), 4-17.

Grover, V. (1993). An empirically derived model for the adoption of customer-based inter-organizational systems. *Decision Sciences*, 24, 603-640.

Grover, V., & Goslar, M.D. (1993). The initiation, adoption and implementation of telecommunication technologies in US organizations. *Journal of Management Information Systems*, 10(1), 141-163.

Hoske, M. (2004). RFID: Adoption increases despite costs. *Control Engineering*, 51(7), 46-47.

Kinsella, B. (2003). The Wal-Mart factor. *Industrial Engineer*, 35(11), 32-36.

-
- Kuan, K.K.Y., & Chau, P.Y.K. (2001). A perception-based model for EDI adoption in small businesses using technology-organization-environment framework. *Information and Management*, 38(8), 507-521.
- Kwon, T. H., & Zmud, R.W. (1987). Unifying the fragmented models of information systems implementation. In Boland, & Hirscheim (Eds.). *Critical issues in information systems research*.
- Lin, T.C., Ku, Y.C., & Huang, Y.S. (2014). Exploring top managers' innovative IT (IIT) championing behavior: Integrating the personal and technical contexts. *Information & Management*, 51, pp. 1-12.
- Ngai, E.W.T., Moon, K.K.L., Riggins, F.J., & Yi, C.Y. (2008). RFID research: An academic literature review (1995-2005) and future research direction. *International Journal of Production Economics*, 112(2), pp. 510-520.
- Orlikowski, W. (1993). CASE tools as organizational change: Investigating incremental and radical changes in systems development. *MIS Quarterly*, 17(3), 309–340.
- Premkumar, G., & Roberts, M. (1999). Adoption of new information technologies in rural small businesses. *Omega International Journal of Management Science*, 27, 467–484.
- Premkumar, G., Ramamurthy, K., & Nilakanta, S. (1994). Implementation of electronic data interchange: an innovation diffusion perspective. *Journal of Management Information Systems*, 11(2), 157-186.
- Premkumar, G., & Ramamurthy, K. (1995). The role of interorganizational and organizational factors on the decision model for adoption of interorganizational systems. *Decision Sciences*, 26(3), 303-336.
- Porter, M.E., & Miller, V.E. (1985). How information gives you competitive advantage. *Harvard Business Review*, 63(4), 149-160.
- Ranganathan, C., & Jha, S. (2005). Adoption of RFID technology: An exploratory examination from supplier's perspective. *Proceedings of the eleventh American conference on information systems*, Omaha, USA, 2195–2199.
- Rogers, E.M. (1995). *Diffusion of innovations* (4th edition). New York: The Free Press.
- Sharma, A., & Citurs, A. (2005). Radio frequency identification (RFID) adoption drivers: A radical innovation adoption perspective. *Proceedings of the eleventh American conference on information systems*, Omaha, USA, 1213–1218.
- Sharma, A., Thomas, D., & Konsynski, B.R. (2008). Strategic and institutional perspectives in the evaluation, adoption and early integration of radio frequency identification (RFID): An empirical investigation of current and potential adopters. *Proceedings of the 41st Annual Hawaii International Conference on System Sciences*, Waikoloa, Big Island of Hawaii, HI, 1-10.

-
- Teo, T., Chan, C., & Parker, C. (2004). Factors affecting e-commerce adoption by SMEs: A meta-analysis. *Proceedings of the 2004 Australasian conference on information systems*, Hobart, Australia, paper 54.
- Thong, J.Y.L. (1999). An integrated model of information systems adoption in small business, *Journal of Management Information Systems*. 15(4), 187-214.
- Tornatzky, L. G., & Klein, N. (1982). Innovation characteristics and innovation adoption implementation: A meta-analysis. *IEEE Transactions on Engineering Management*, 29(February), 28-45.
- Tornatzky, L.G., & Fleischer, M. (1990). *Process of technological innovation*. Lexington, MA, Lexington Books.
- Useem, M. (1993). Management commitment and company policy on education and training. *Human Resource Management*, 32(4), pp. 411-434.
- Wang, Y.M., Wang, Y.S., & Yang, Y.F. (2010). Understanding the determinants of RFID adoption in the manufacturing industry. *Technological Forecasting & Social Change*, 77, 803-815.
- Wu, N.C., Nystrom, M.A., Lin, H.A., & Yu, H.C. (2006). Challenges to global RFID adoption. *Technovation*. 26(12), pp. 1317-1323.
- Zhu, K., Kraemer, K. L., & Xu, S. (2002). A cross-country study of electronic business adoption using the technology-organization-environment framework. *International Conference on Information Systems*. Paper 31.
- Zhu, K., Kraemer, K.L., & Xu, S. (2006a). The process of innovation assimilation by firms in different countries: a technology diffusion perspective on e-business. *Management Science*, 52(10) (2006) 1557–1576.
- Zhu, K., Dong, S., Xu, S.X., & Kraemer, K.L. (2006b). Innovation diffusion in global contexts: Determinants of post-adoption digital transformation of European companies. *European Journal of Information Systems*, 15(6), 601-616.