1-1-2006

An Empirical Study of Organizational Ubiquitous Computing Technology Adoption: the Case of Radio Frequency Identification (RFID) in the Healthcare Industry

Cheon-Pyo Lee

AN EMPIRICAL STUDY OF ORGANIZATIONAL UBIQUITOUS COMPUTING TECHNOLOGY ADOPTION: THE CASE OF RADIO FREQUENCY IDENTIFICATION (RFID) IN THE HEALTHCARE INDUSTRY

By

Cheon-Pyo Lee

A Dissertation
Submitted to the Faculty of
Mississippi State University
in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy
in Business Information Systems
in the Department of Management and Information Systems

Mississippi State, Mississippi

December 2006

AN EMPIRICAL STUDY OF ORGANIZATIONAL UBIQUITOUS COMPUTING TECHNOLOGY ADOPTION: THE CASE OF RADIO FREQUENCY IDENTIFICATION (RFID) IN THE HEALTHCARE INDUSTRY

By

Cheon-Pyo Lee

Approved:

J. P. Shim
Professor of Management and Information Systems
(Director of Dissertation)

Kirk P. Arnett
Professor of Management and Information Systems
(Committee Member)

Merrill Warkentin
Professor of Management and Information Systems
(Committee Member)

Joe Sullivan
Professor of Marketing/Quantitative Analysis/Business Law
(Committee Member)

Robert Otondo
Assistant Professor of Management and Information Systems
(Committee Member)

Barbara A. Spencer
Professor of Management and Information Systems
Director of Graduate Studies in the College of Business and Industry

Danny P. Hollingsworth
Interim Dean of the College of Business and Industry

Name: Cheon-Pyo Lee

Date of Degree: December 9, 2006

Institution: Mississippi State University

Major Field: Business Administration (Management Information Systems)

Major Professor: Dr. J.P. Shim

Title of Study: AN EMPIRICAL STUDY OF ORGANIZATIONAL UBIQUITOUS COMPUTING TECHNOLOGY ADOPTION: THE CASE OF RADIO FREQUENCY IDENTIFICATION (RFID) IN THE HEALTHCARE INDUSTRY

Pages in Study: 128

Candidate for Degree of Doctor of Philosophy in Business Administration

Advances in wireless networking and the Internet move us toward ubiquitous and embedded computing. Ubiquitous and embedded computing enhances computer use by making computers available throughout the physical environment while making them effectively invisible to the user. In the ubiquitous and embedded computing era, computers in the traditional sense gradually fade, and information mediated by computers is available anywhere and anytime through devices that are embedded in the environment.

Radio Frequency Identification (RFID) is one of the key technologies of the ubiquitous and embedded computing era. RFID is a technology used to identify, track, and trace a person or object and enables the automated collection of important business information. RFID minimizes human intervention in the person and object identification

process by using electronic tags and is expected to complement or replace traditional barcode technology. RFID is a highly beneficial technological advancement which ultimately may change the way of doing business.

This study examines the RFID adoption decision process and proposes a model predicting the likelihood of adopting RFID within organizations in the healthcare industry. A considerable number of studies have been conducted regarding organizational information technology (IT) adoption, but the nature of the organizational IT adoption process is still not well understood. It is even posited that the only consistency found in the organizational adoption literature is the inconsistency of research results. The inconsistency of results is partially explained by changes in technological, organizational, and environmental statuses. Therefore, factors explaining traditional IT adoption may not justify RFID adoption and should be revisited and revalidated.

In this study, an organizational RFID adoption model is proposed and empirically tested by a survey using a sample of 865 senior executives in U. S. hospitals. The model posits that three categories of factors, technology push, need pull, and decision maker characteristics, determine the likelihood of adopting RFID within organizations. The relationships between those three categories and the likelihood of adopting RFID are strengthened or weakened by organizational readiness and size.

DEDICATION

I would like to dedicate this dissertation to my family.

ACKNOWLEDGMENTS

I would like to acknowledge the help of my dissertation committee in formulating and executing this dissertation: Dr. J. P. Shim, Dr. Kirk Arnett, Dr. Merrill Warkentin, Dr. Joe Sullivan, and Dr. Robert Otondo. Each member of the committee provided me with helpful guidance and support. In particular, I would like to express my sincere gratitude to Dr. J. P. Shim, my dissertation chair, without whom this dissertation would not have been possible. I also would like to express my gratitude to my wife, Eun-Young, my daughter, Julia, and my family members in Korea for their encouragement and help throughout this process. Finally, I would like to acknowledge the help of the many individuals who participated in this study.

TABLE OF CONTENTS

CHAPTER Page

APPENDIX

LIST OF TABLES

TABLE Page

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Ubiquitous computing refers to the creation and deployment of computing technology in such a way that it is embedded in our natural movements and interaction with our environments (Lyytinen and Yoo, 2002). Ubiquitous computing enhances computer use by making computers available throughout the physical environment, while making them effectively invisible to the user (Weiser, 1993). In the ubiquitous computing era, computers in the traditional sense gradually fade from view, and information and communication mediated by computers are available anywhere and anytime through devices that are embedded in the environment.

Radio Frequency Identification (RFID) is one of the key technologies of the ubiquitous computing era. RFID is a technology used to identify, track, and trace a person or an object without using a human to read and record data and enables the automated collection of important business information (Asif and Mandviwalla, 2005). RFID applications are currently used in many areas including airport baggage handling, electronic payment, retail theft prevention, library systems, automotive manufacturing, parking, postal services, and homeland security (Smith and Konsynski, 2003).

RFID is a highly beneficial technological advancement which could eventually change the way of doing business. RFID has the potential to affect business process efficiency and effectiveness as well as product and service value (Rappold, 2003). RFID will reduce production cost, provide accurate inventory management, and improve productivity. Even though initial investment may be expensive, RFID provides longer-term return on investment and future growth potential for any industry (Smith, 2005).

In spite of its tremendous global potential, RFID is still marginally adopted across the globe. 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 (ITU, 2005; 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 (Jones *et al.*, 2005).

This study examines the RFID adoption decision process and proposes a model predicting the likelihood of adopting RFID within organizations. A considerable number of studies have been conducted regarding organizational information technology (IT) adoption, but the nature of the organizational IT adoption process is still not well understood (Looi, 2005). It is even posited that the only consistency found in the organizational adoption literature is the inconsistency of research results (Wolfe, 1994). The inconsistent result is partially explained by changes in technological, organizational, and environmental statuses have changed. Therefore, factors explaining traditional IT adoption may not justify RFID adoption and should be revisited and revalidated. In addition, given the ongoing importance of RFID, it is very important to identify the unique factors that contribute to the likelihood of adopting RFID.

Overview of Radio Frequency Identification (RFID)

Ubiquitous computing and RFID

Advances in wireless networking, the Internet, and embedded systems move us toward ubiquitous computing. The trend toward ubiquitous computing represents much more than a simple change in the way people access and use information. In the end, it will have a profound effect on the way people access and use services, enabling new classes of services that only make sense by virtue of being embedded in the environment (Fano and Gershman, 2002).

Even though mobile computing and pervasive computing are often used interchangeably with ubiquitous computing, they are conceptually different and employ different ideas of organizing and managing computing services (Lyytinen and Yoo, 2002). According to Lyytinen and Yoo, mobile computing is about increasing our capability physically while pervasive computing is about our capability to obtain the information from the environment in which it is embedded. On the other hand, ubiquitous, or embedded, computing builds generic capabilities into computers to inquire, detect, explore, and dynamically build models of their environments (Figure 1).

Ubiquitous computing places considerable requirements on both hardware and software development and support. Currently, numerous technologies including global positioning system (GPS), ultra-wideband (UWB), RFID, and cellular triangulation contribute to building ubiquitous computing. Among them, RFID is considered a key technology of the ubiquitous computing era (Römer *et al.*, 2004).

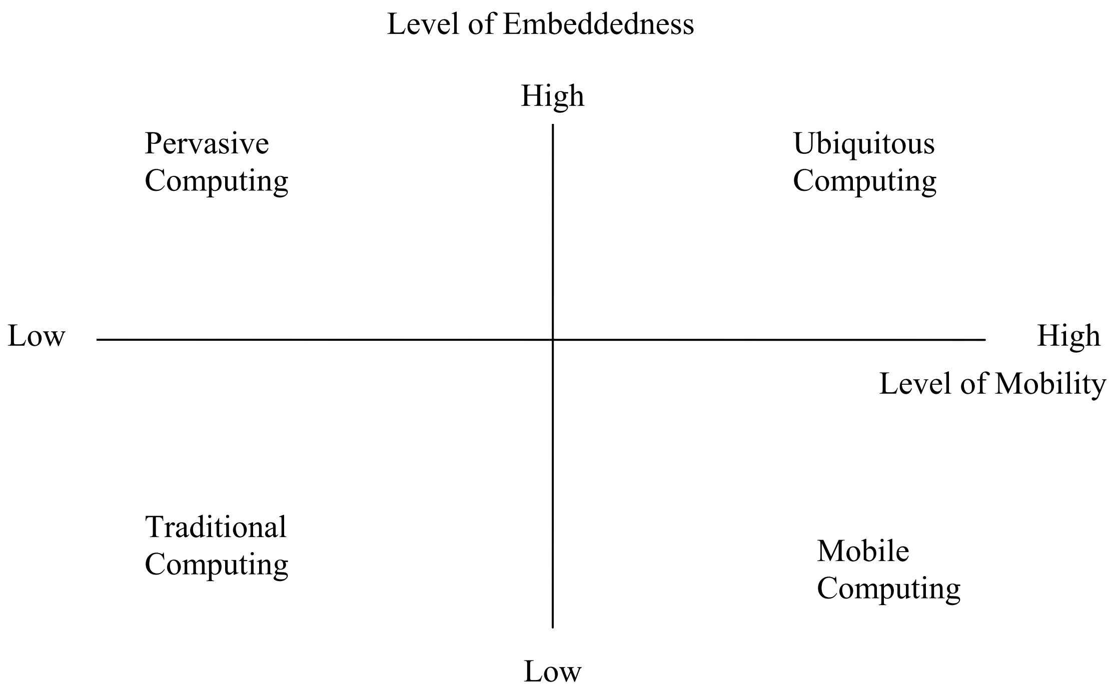


Figure 1 Dimensions of Ubiquitous Computing

Source: Lyytinen, K., and Yoo, Y. (2002). Issues and challenges in Ubiquitous Computing. *Communications of the ACM, 45*(12), 64.

RFID technology has its origins in military applications during World War II, but its commercial applications did not begin to be realized until the early 1980s (See Table 1)(AIM, 2001). The theory of RFID was first proposed in 1948 in a conference, and the first patent for RFID was filed 1973 (Asif and Mandviwalla, 2005). However, the technology and cost only recently became favorable for widespread adoption. The widespread adoption of RFID technology was also enhanced by mandates from large retailers and government organizations such as Wal-Mart and the U. S. Department of Defense. These organizations require all suppliers to implement this technology at the pallet level within the next few years (Asif and Mandviwalla, 2005; Roberts, 2004).

Table 1 The History of RFID

Time Period	Event
1940-1950	RFID invented in 1948
1950-1960	Early explorations of RFID technology. Laboratory experiments.
1960-1970	Development of the theory of RFID. Early field trials.
1970-1980	Explosion of RFID development. Early adopter implementation of RFID
1980-1990	Commercial RFID applications enter mainstream
1990-2000	Emergence of standards. RFID more widely deployed
2000-2010	Innovative applications emerge. Combination with personal mobile services.

Source: AIM. (2001).http://www.aimglobal.org/technologies/rfid/resources/shrouds_of_time.pdf

The most familiar current RFID application is the automated toll-paying systems in highways (Asif and Mandviwalla, 2005). This system has reduced overhead for transport companies and facilitated travel for commuters (ITU, 2005). RFID applications have also been widely used in airport baggage handling, electronic payment, retail theft prevention, library systems, automotive manufacturing, parking, postal services, and homeland security (Smith and Konsynski, 2003). Most recently, RFID applications are used to help to identify natural disaster victims. The US Disaster Mortuary Operational Response Team and health officials in Mississippi's Harrison County were implanting human cadavers with RFID chips in an effort to speed up the process of identifying victims and providing information to families (Kanellos 2005).

RFID technology has many benefits over the traditional bar coding that many firms have become accustomed to using. First, RFID technology is superior to barcode technology in that its user does not need to know where an object or person is and does not need to be close in order to collect the data (Smith and Konsynski, 2003). RFID tags can be read at a distance and do not require line-of-sight. Unlike barcode and magnetic strips mostly used inside store, RFID can also help with the tracking of inventory inside and outside the facility. In addition, RFID technology has read/write capabilities to store and change data and an ability to read many tags simultaneously (Smith, 2005). These features are expected to contribute to the improvement of the efficiency, accuracy, and security of both supply chain and inventory management through cost savings. RFID may also facilitate the improved use of warehouse and distribution center space. Goods will not need to be stored according to product type for manual location because RFID allows them to be stored in the most efficient manner based on size and shape (Jones *et al.*, 2005).

Pilot tests by clothing manufactures in the U. S. have indicated as much as a 7 percent increase in net income when RFID was used due to the greater visibility of the inventory on the shop floor (Jones *et al.*, 2005). Gap, a wardrobe purveyor, also reported a 15 percent sales increase at its RFID-equipped store (McGinity, 2004). Wal-Mart reported that the initial estimated cost savings for RFID-equipped stores include $6.7 billion in reduced labor costs, $600 million in out-of-stock supply chain reductions, $575 million in theft reduction, $300 million in improved tracking through warehousing and the distribution center, and $180 million in reduced inventory holding and carrying costs (Asif and Mandviwalla, 2005).

Components of RFID

RFID technology consists of three components – a tag, a reader, and a computer network (Fanberg, 2004). The key component of an RFID system is the tag itself. The tag contains a microchip with identification data and an antenna for transmitting its data. The readers use radio waves to read the tag, and the data then connects to some type of networked computer system or database in order to process the information.

RFID tags are essentially tiny computers. The most basic simply contain product identification information while the advanced tags include monitors that can be updated with information such as weight, temperature, and pressure. RFID systems are typically classified according to the functionality of their tag (Smith and Konsynski, 2003). For the most part, tags are either active or passive. As such, they are categorized according to the power source used by the tag.

Table 2 Three Types of RFID Tag

Tag	Description
Passive Tag	• Require no power source or battery within the tag. • The tag uses the energy of the radio wave to power its operation. • The least expensive tag. • Shorter Range
Semi-Passive Tag	• Rely on a battery built into the tag to achieve better performance, notably in terms of communication range. • These batteries power the internal circuits of tags during communication. • They are not used to generate radio waves.
Active Tag	• Use batteries for the entire operation, and can therefore generate radio waves even in the absence of an RFID reader. • This is the most expensive tag. • Greater Range

Source: ITU. (2005). http://www.itu.int/osg/spu/ni/ubiquitous/Papers/RFID%20background%20paper.pdf

Instead of a traditional barcode, electronic product codes (EPC) are stored in the RFID tag. Like the barcode, the EPC is a unique number that identifies a specific item in the supply chain and is composed of numbers that identify the manufacturer and product type. However, unlike the barcode, the EPC uses an extra set of digits for a serial number to identify unique items (Lai and Zhang, 2005). Therefore, while barcodes only distinguish among products, the EPC codes are unique to each unit and can provide more detailed information.

In a typical RFID system, RFID tags are attached to objects and send out EPC information when detecting a signal from the tag reader (Lai *et al.*, 2005). Tag readers, based on cellular technology, can scan products as needed so that a system can identify what products are located in a particular physical space. During reading, the signal is sent out continually by the active tag whereas in the passive tag, the reader sends a signal to the tag and listens (Asif and Mandviwalla, 2005). Regardless of whether this reader is a read only or read/write device, it is always referred to as a reader (ITU, 2005). Unlike barcode scanning, line of sight is not required and readers can deal with hundreds of tags at the same time (Smith and Konsynski, 2003).

The data collected by the RFID reader will be sent to backend databases via middleware to be utilized by enterprise systems. To distribute EPC codes quickly and efficiently, the network system, EPCglobal Network, which allows all parties in the supply chain to receive up-to-minute information about product movement, was designed using the Internet Protocol (IP) (Lai *et al.*, 2005). In this system, when any part of a supply chain needs a product or product movement information, a request for particular EPC information can be sent to the Object Name Service (ONS), which provides a global lookup service to translate an EPC into one or more Internet Uniform Reference Locations (URLs). Then, the URLs provide detailed information in a Product Markup Language (PML) format mainly based on eXtensive Markup Language (XML) (Angeles, 2005).

Obstacles for widespread adoption of RFID

The tremendous global potential of RFID is, however, being hindered by several obstacles including high cost, the lack of established international standards, and privacy and security issues (ITU, 2005; Smith, 2005). Among them, the cost of tags is a major constraint to firms in adopting RFID technology, particularly at the individual item level (See Table 3). Although it has been projected that there will be a dramatic reduction in the price of the tags over the next few years, the current cost is still prohibitive for many routine applications (ITU, 2005). As of 2005, low-end tags sell for 7 to 10 cents and readers cost between $1,000 and $3,000, depending on the features in the device (RFID, 2006). This cost would not be such a problem if they were only going to be used for higher priced items, such as clothing, electronics, and other consumer durables. However, for low-cost goods, the current price of RFID tags is still going to make the item tracking economically impracticable and will be the main barrier to the adoption of this technology (Smith, 2005).

Table 3 Costs related to RFID

- The cost of the tag itself
- The cost of applying tags to products
- The cost of purchasing and installing tag readers
- System integration costs
- The cost of training and reorganization
- The cost of implementing application solutions

Source: Smith, H., and Konsynski, B. (2003). Developments in Practice X: Radio Frequency Identification (RFID) - An Internet for Physical Objects. *Communications of the Association for Information Systems, 12*, 301-311

The lack of established international standards of RFID technology also delays its adoption (ITU, 2005; Lai *et al.*, 2005). There are currently no globally agreed upon standards, and there are literally dozens of manufacturers of tags and readers utilizing multiple frequencies and specifications (Twist, 2005). There are two main types of RFID standards being developed (ITU, 2005). The first is RFID frequency and protocols for the communication of readers as well as tags and labels, which are typically being dealt with by international standard-setting bodies, such as the European Telecommunication Standards Institute. The second is the standardization of data formats placed on these tags and labels. In North America, there are standards such as Global Tag (GTAG), American National Standard Institute's NCITS-T6 256-1999 and some ISO standards (ITU, 2005). In the Asia-Pacific region, China has announced that it will develop its own national standard for RFID, in the 900 MHz band (ITU, 2005; Lai *et al.*, 2005). The lack of standards means that organizations will be forced to incur high costs to ensure compatibility with multiple readers and tags, and it is difficult for most firms to commit the significant resources if they do not know whether their suppliers and customers will be using a compatible technology (Twist, 2005).

In addition, the concern of privacy has become a major problem to those who adopt RFID in the retail industry. Consumer advocacy groups have raised privacy issues about RFID technology (See Figure 2). The concerns revolve around consumer privacy and fears that if RFID technology is adopted at the individual item level, it could be used to allow retailers to obtain information about customers and to track their movement without their knowledge (Jones *et al.*, 2005). Security has also become a major issue in implementing RFID since identification information on passive RFID tags can be easily stolen (Smith, 2005). Finally, the extreme popularity of bar coding may be an obstacle in the way of RFID adoption since RFID would require significant financial investment and mind-set changes to those who have become accustomed to bar coding (Smith, 2005).

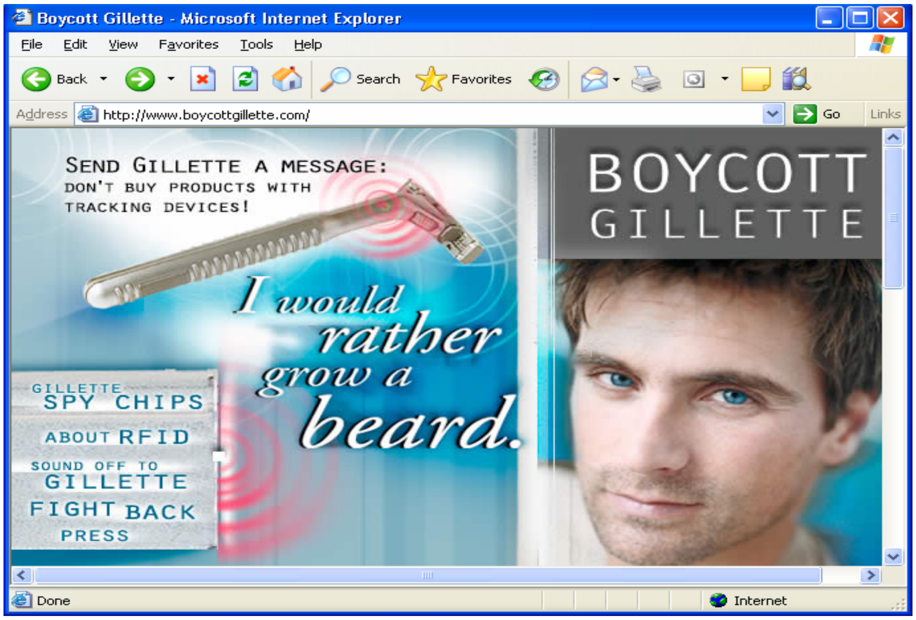


Figure 2 RFID Product Boycott Website
(http://www.boycottgillette.com)

Statement of the Problem

Rapid advances in information technology (IT) have provided enormous opportunities for organizations to reshape internal operations and their relationships with their suppliers, customers, and even competitors. The adoption and diffusion of these ITs have been a central concern for many researchers and practitioners. Researchers interested in this perspective have developed analytical and empirical models which describe and/or predict the adoption decision and extent of diffusion of IT within organizations.

Several prior studies have identified many factors that are possible determinants of organizational adoption of IT. Although many variables have been identified as important in determining IT adoption, researchers have indicated that the findings of these prior studies were not consistent, except for a few empirically supported variables (Kimberly and Evanisko, 1981; Wolfe, 1994). This may be explained by some problems in prior organizational IT adoption studies including: 1) poor conceptualization and operationalization of the dependent variables as a simple dichotomous variable (adoption or rejection), 2) lack of distinction between the types of innovations, 3) failure to recognize the complex interactions of vested interests in the decision-making systems, and 4) use of unreliable and non replicable research methods that lack statistical power (Wilson *et al.*, 1999).

Additionally, there are a number of variables and categories that have been found empirically to be related to adoption behavior, but there is little in the way of evidence to suggest (1) which categories are most important in the sense of explaining variability in adoption behavior, (2) the relative explanatory power of each category, or (3) whether the relative importance of the variables may depend on the type of innovation under consideration (Kimberly and Evanisko, 1981). Finally, a model proposed for certain IT may not justify other ITs since technological, organizational, and environmental statuses have changed. Therefore, factors explaining the IT adoption in prior studies cannot just be borrowed and used but should be revisited and revalidated for an emerging new technology. The present study offers remedies to the deficiencies noted in the literature.

Purpose of Study

The purpose of this study is to examine the adoption decision process within healthcare organizations and to propose a model predicting the likelihood of adopting

RFID. Specifically, this study investigates the underlying motivations and driving forces behind the adoption of RFID using the theory of technology-push and demand-pull. There are a number of variables and categories that have been found empirically to be related to adoption behavior, but there is little in the way of evidence to suggest the origin or motivation behind the adoption. This study also investigates the role of organizational readiness and climate in the organizational adoption context. More specifically, this study tries to answer the following research questions:

1. What is the driving force behind the adoption of RFID?
2. Which categories of adoption factors are most important in the sense of explaining variability in adoption behavior?
3. What characteristics of an organization contribute to its adoption behavior?
4. What are the roles of organizational readiness in the context of RFID adoption?

Research Methodology

Survey research is the predominant methodology in this study. In conducting a survey, the investigator elicits opinions, attitudes, and beliefs of a sample group regarding some issues of interest. The data will collected through questionnaires. The survey method allows researchers to study and describe large populations fairly quickly at a relatively low cost (Babbie, 2004). It has been used successfully to test hypotheses, describe populations, develop measurement scales, and build theoretical models in research across a wide variety of domains.

The sample in this research consists of decision makers including Chief Executive Officers (CEOs), Presidents, Chairmen, Chief Medical Officers (CMOs), and IT executives in 865 U. S. hospitals. IT executives in hospitals include Chief Information Officers (CIOs), Chief Technology officers (CTOs), VPs in Technology, and Directors of IT. Although the applicability of findings in one sector to those in another is clearly problematic, it is believed that concentration of the research focusing on one sector may help to identify and isolate factors that clarify the nature of the phenomenon and increase an ability to control for key organizational and environmental confounds (Kimberly and Evanisko, 1981; Menon *et al.*, 2000). Thus, this dissertation concentrates on the health sector to identify the relative contribution of each factor to an explanation of observed variability in the model. A web-based survey was used to collect data, and a pilot study was conducted before the final questionnaires were administered to the subjects.

The data obtained for this study was tested for reliability and validity. Then the causal structure of the proposed research model was tested using Structural Equation Modeling (SEM) and hierarchical regression. SEM is an advanced statistical method that allows optimal empirical assessment of a structural (theoretical) model together with its measurement model and is increasingly being used in IS research for the causal modeling of complex, multivariate data sets in which the researcher gathers multiple measures of proposed constructs (Gefen *et al.*, 2000). The structural model consists of a network of causal relationships linking multiple constructs while the measurement model links each construct with a set of indicators (typically questions) measuring that construct. SEM is superior to traditional statistical methods (e.g., factor analysis, regression, and path analysis) because it assesses the measurement model within the context of the structural model (Gefen *et al.*, 2000).

Organization of Research

This dissertation consists of six chapters with appendices. The next chapter provides the review of the related literature emphasizing the areas of organizational information technology adoption and IT in the healthcare industry. Based on the literature review, a research model and hypotheses are developed and presented in Chapter 3. Chapter 4 is then devoted to methodological issues including data collection, instrument development, assessment of reliability, and validity of constructs. Results of the hypotheses developed in Chapter 3 are reported in Chapter 5. This chapter summarizes the models which identify the key predictors of the adoption and non-adoption decision of RFID. Chapter 5 also discusses the findings and offers explanations for the empirical results. Finally, contributions of the current study to the literature and implications for practitioners are presented in Chapter 6. This chapter also identifies the limitations of this study and then concludes with directions for future research.

CHAPTER II

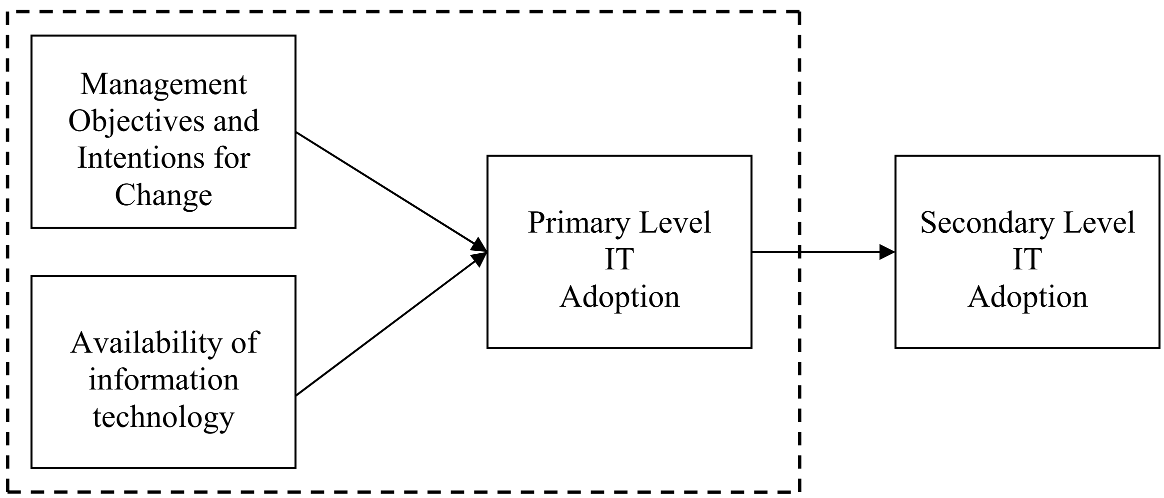
LITERATURE REVIEW

Two Stages of IT Adoption

Information technology (IT) adoption is defined as the process through which individuals or other decision-maker units pass from first knowledge of an IT, to forming an attitude toward the IT, to a decision to adopt or reject, to implementation of the IT, and to confirmation of this decision (Rogers, 1983). Zaltman *et al.* (1973) examined IT adoption within organizations and proposed that the adoption process often occurs in two stages - a firm level decision to adopt the innovation (primary level adoption), and subsequent implementation, which includes individual adoption by users (secondary level adoption). Figure 3 summarizes the IT adoption process. That is, managers identify objectives to change some aspect of their business and seek available innovations which may fit their objectives. Then, the primary level adoption decision is made. Once the primary level adoption decision has occurred, secondary (or individual) level IT adoption is followed.

Individual Level Information Technology Adoption

Numerous models on secondary level (or individual level) information technology (IT) adoption have been introduced to explain how users decide to adopt a particular IT, including the theory of reasoned action (TRA), the theory of planned behavior (TPB), and the technology acceptance model (TAM) (Venkatesh *et al.*, 2003).



Note: Dotted line denotes the focus of this study

Figure 3 The Process of Innovation Adoption

Adapted from Gallivan, M. J. (2001). Organizational Adoption and Assimilation of Complex Technological Innovations: Development and Application of a New Framework. *The DATA BASE for Advances in Information Systems, 32*(3), 51-85.

TRA is one of the most fundamental theories of human behavior and suggests that people act in accordance with their intention, which is influenced by attitudes toward behavior and subjective norms (Fishbein and Ajzen, 1975). Attitudes are the individual's (positive or negative) feelings about performing the target behavior, and subjective norms are the person's perceived social pressure to perform or not perform the behavior (Fishbein and Ajzen, 1975). TPB extends TRA by adding a third variable, perceived behavior control, and suggests that the more resources and opportunities individuals think they possess, the greater the likelihood for these individuals to behave accordingly (Ajzen, 1991). This third variable in TPB is different from other variables in that it directly influences actual usage behavior in addition to influencing intention (Ajzen, 1991).

The TAM has been a major stream of individual level technology acceptance research (Agarwal, 2000) and has been used to explain a wide range of technologies. According to TAM, behavioral intention to use a new IT is primarily the product of a rational analysis of its desirable perceived outcomes, namely perceived usefulness and perceived ease of use. Therefore, unlike TRA, TAM does not include the attitude construct in order to better explain intention parsimoniously (Venkatesh *et al.*, 2003). These two belief variables positively related to acceptance behavior and have received strong empirical support in explaining variation in acceptance intention and behavior (i.e.,Venkatesh *et al.*, 2003).

Recently, Venkatesh *et al.* (2003) reviewed eight different user acceptance models and formulated the Unified Theory of Acceptance and Use of Technology (UTAUT) based on conceptual and empirical similarities across models. UTAUT posits that four key constructs, performance expectancy, effort expectancy, social influence, and facilitating conditions, along with the possible intervention of four moderators, gender, age, experience, and voluntariness of use, influence behavioral intention and subsequent usage of information technologies. One of the contributions of UTAUT to IS research is that it integrates the fragmented theory on individual IS acceptance into a unified theoretical model that captures the essential elements of eight previously established models. In addition, UTAUT significantly increases the predicting power (R^2) of user acceptance models. While TAM and other previously established models hardly explain more than 40% of the variance in use, UTAUT explains as much as 70 percent of the variance in use (Venkatesh *et al.*, 2003).

Organizational Level Information Technology Adoption

Organizational level IT adoption research focuses on understanding the adoption and diffusion process of the adopting organization (Lai and Guynes, 1997). Researchers using this perspective have developed analytical and empirical models which describe and/or predict the adoption decision and extent of diffusion of IT within an organization. Such models mostly focus on the attributes of the innovation and propose relationships between these attributes and the antecedents and consequences of adoption (Chwelos *et al.*, 2001).

Prior literature has identified many variables that are possible determinants of organizational adoption of an IT. Although many variables have been identified as important in determining IT adoption, researchers have indicated that the findings of these prior studies were not consistent, except for a few empirically supported variables (Wolfe, 1994) . Additionally, although researchers often strive toward developing a unifying research model, some researchers question the possibility of developing a unifying theory of innovation adoption and diffusion that can apply to all types of innovation (Kimberly and Evanisko, 1981). They argue that a unifying theory might be inappropriate in view of the fundamental differences between types of innovations (Lai and Guynes, 1997).

In response to the lack of a unifying theory of innovation adoption, numerous studies have tried to include as many of the distinctive characteristics of context as possible in the development of an organizational IT adoption theory (Tornatzky and Fleischer, 1990). A number of researchers have attempted to identify these contexts. Among them, Kwon and Zmud (1987) classified these contexts in five broad categories: individual, structural, technical, task-related factors, and environmental factors. Rogers (1983) proposed three contexts including individual (leader) characteristics, internal organizational structural characteristics (such as centralization, complexity, formalization, interconnectedness, organizational slack, size), and external organizational characteristics (e.g. system openness). Kimberly and Evanisko (1981) also identified three clusters of predictors of innovation adoption – characteristics of organizational leaders, characteristics of organizations, and characteristics of environmental context. Finally, Tornatzky and Fleischer (1990) conceptualized the context of technological innovation as consisting of three elements – organizational context, technological context, and environmental context – that influence the technological innovation decision.

According to Tornatzky and Fleischer (1990), organizational context factors refer to those variables affecting the organizational structure that the organization could adjust or change to suit its change environment. On the other hand, technological context factors represent the perceived characteristics of the IT innovation. Finally, environmental factors refer to those that create threats as well as opportunities for an organization and usually beyond the control of management. This framework has been empirically tested by many studies and has been found useful in understanding the adoption of technological innovations (Table 4).

Table 4 Studies in Technological Innovations Adoption

Source	Determinants	Area Studied	Finding(s)
Iacovou *et al.* (1995)	External pressure Perceived benefits Organizational readiness	EDI	The result of their research suggested that a major reason for adopting EDI is external pressure (trading partners).
Chwelos *et al.*(2001)	Readiness External pressure, Perceived benefits	EDI	Perceived benefits, external pressure, and readiness are positively related to the intent to adopt EDI.
Mehrtens *et al.* (2001)	Perceived benefits Organizational readiness External pressure	Internet	Internet adoption was influenced by three major factors: perceived benefits, organizational readiness, and external pressure.
Wang and Tsai (2002)	Benefits and costs Organization Environment	Electronic Commerce	Perceived costs, perceived benefits, readiness, product variety, exchange safety and competitive pressure have a significant impact on the decision to adopt e-commerce
Lee and Cheung (2004)	Organizational readiness Perceived benefits Environmental factors	Internet Retailing	Organizational readiness, perceived benefits of Internet retailing, and environmental factors are found important to adopt Internet retailing.
Gordon and Pearson (2004)	Organizational readiness, External pressure, Perceived ease of use, Perceived usefulness, Perceived strategic value	E-commerce	Perceived ease of use, compatibility, and external pressure were found to be statistically significant as determinant of e-commerce adoption.

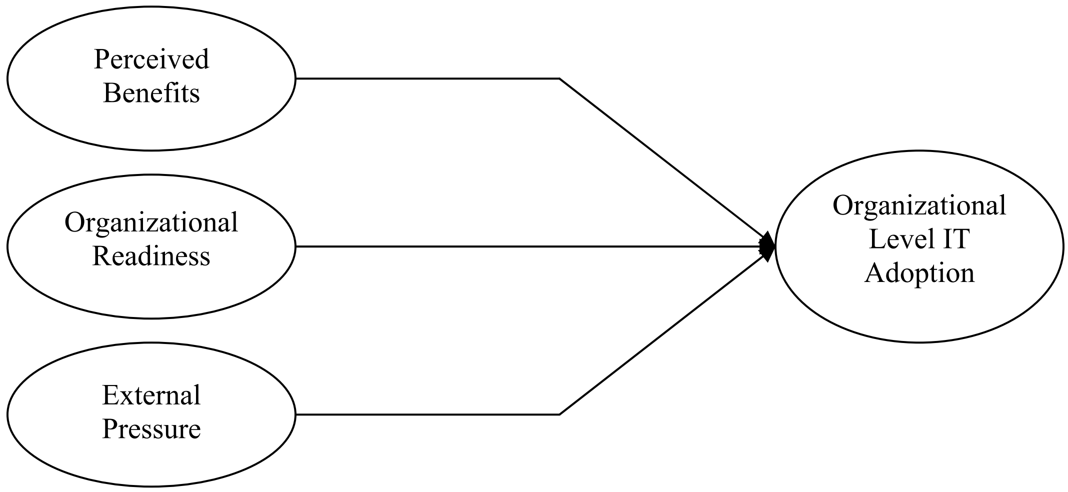


Figure 4 Organizational EDI Adoption Model

Source: Iacovou, C. L., Benbasat, I., and Dexter, A. S. (1995). Electronic data interchange and small organizations: Adoption and impact of technology. *MIS Quarterly, 19*(4), 465-485.

Iacovou *et al.* (1995), for example, proposed perceived benefits, organizational readiness, and external pressure, each of which represent technological, organizational, and environmental context, as factors influencing the adoption of electronic data interchange (EDI) (Figure 4). The result of their research suggested that a major reason for adopting EDI is external pressure (trading partners). Kuan and Chau (2001) also determined the factors influencing the adoption of EDI using a technology, organization, and environment framework. In their research, the technology factors incorporated perceived direct and indirect benefits of EDI, and the organization factors consisted of perceived financial cost and perceived technical competence. The environment factors were similar to external pressure in Iacovou *et al.* (1995) but included a new variable: perceived government pressure. The result suggested that perceived indirect benefits were not found to be a significant factor. Mehrtens *et al.* (2001) also examined Internet adoption by the research model proposed by Iacovou et al. (1995). All three of these factors were found significant to an organization's Internet adoption. In their research, they also found that though the majority of the factors have similar titles, the definitions and the details of each factor were significantly different in prior studies. The detail of each context factor is addressed in this section.

Characteristics of IT

Characteristics of an information technology have been frequently used in the research on organizational IT adoption. According to Rogers (1983), the adoption of IT is related to the attributes of the innovations as perceived by potential adopters. Five attributes, including relative advantage, compatibility, complexity, observability, and trialability, are suggested to influence organizational adoption of IT (Table 5). The relative advantage of a new IT has been found to be one of the best predictors of the rate of adoption of an innovation. Specifically, the IT adoption decision in the business-to-business market is a result of the search for and prospects of relative advantages (Webster, 1969). "Perceived benefits" has closely corresponded to "relative advantage" in prior technology innovation studies.

Two basic types of perceived benefits exist: direct and indirect. Direct benefits are those benefits that create operation savings related to the internal efficiency of the organization. Indirect benefits or opportunities are those that are caused by the impact of the technology on the business processes and relationships. The perceived benefits, including economic incentives, of adopting the innovation should exceed that of alternatives if organizations are to consider adopting (Anderson and Narus, 1999).

The compatibility of an IT is also positively related to its rate of adoption. The more an IT is compatible with the current situation of a potential adopter and his needs, the more probable it is the innovation will be adopted. Regarding the complexity of an IT, it is negatively related to its rate of adoption (Rogers, 1983). The trialability of an innovation and its observability are expected to be positively related to the rate of adoption of the innovation (Rogers, 1995). Rogers argued that these five attributes represent the main determinants that explain 49% to 87% of the variance in the rate of adoption. Quite a number of innovation adoption studies have used Rogers's attributes as their theoretical basis. For example, Moore and Banbasat (1991) developed an instrument which can measure the various perceptions of adopting an information technology. However, some researchers pointed out that Rogers' diffusion model is generally inadequate in explaining the factors influencing many IT adoptions since it ignores factors both within and outside an organization (Looi, 2005).

Table 5 Innovation Characteristics

Innovation Characteristics	Definitions
Relative Advantage	The degree to which the innovation is perceived as better than the idea it supersedes
Compatibility	The degree to which an innovation is perceived as being consistent with the existing values, experiences, and needs of potential adopters.
Complexity	The degree to which an innovation is perceived as difficult to understand and use
Trialiability	The degree to which an innovation may be experimented with on a limited basis
Observability	The degree to which the results of an innovation are visible to others.

Source: Rogers, E. M. (1983). *Diffusion of Innovations* (3 ed.). New York: The Free Press.

In a meta-analysis, Tornatzky and Klein (1982) also identified 10 characteristics which had been addressed the most frequently in the 105 articles they reviewed. These included the five characteristics identified above by Rogers, plus cost, communicability, divisibility, profitability, and social approval. In their discussion, Tornatzky and Klein noted that communicability was closed related to observability, and divisibility to trialability.

Characteristics of Organization

Many studies found that the characteristics of organizations are significant determinants of organizational IT adoption (Iacovou *et al.*, 1995; Tornatzky and Klein, 1982). Some organizational characteristics frequently identified in prior studies include organization size (Bajwa and Lewis, 2003), organization readiness (Iacovou *et al.*, 1995), and organization structure (Lai and Guynes, 1997).

Organizational Size

Organization size has been proposed as an significant antecedent of adoption in many innovation and IT studies (Bajwa and Lewis, 2003; Kennedy, 1983). In the meta-research of the effects of organization size on innovation adoption, Damanpour (1992) found a positive relationship between organization size and innovation adoption. In addition, he found that 1) size is more positively related to innovation in manufacturing and profit-making organizations than in service and non-profit-making organizations, 2) the association between size and innovation is stronger when a non-personnel or a log transformation measure of size is used than when a personnel or a raw measure of size is used, 3) types of innovation do not have a considerable moderating effect on the relationship between size and innovation, and 4) size is more strongly related to the implementation than to the initiation of innovations in organizations.

For the most part, it has been convincingly argued that larger, resource-rich organizations are more able to afford the cost of IT innovations and have higher ability to handle risk (Dewar and Dutton, 1986). However, the results of research investigations have been somewhat inconclusive. While some innovation studies suggest a positive relationship between organization size and adoption behavior (Moch and Morse, 1977), a negative relationship between size and adoption behavior has also been reported (Mohr, 1969). For example, Ein-Dor and Segev (1978) asserted that small businesses face substantially more barriers to adoption of IS and are less likely to adopt IS than large businesses. Iacovou *et al.* (1995) also argued that small firms resisted becoming EDI-capable because of the (1) limited impact that IT had on small firms due to under-utilization and lack of integration, (2) low levels of IT sophistication, and (3) weak market positions of small firms and the network nature of the technology.

Research on early adopters of group support system (GSS) indicated that larger organizations are more likely to adopt GSS than smaller organizations (Straub and Beauclair, 1988). Lai and Guynes (1997) also found that the organizations most likely to be receptive to ISDN are large companies with more slack resources and actions to infuse IT. However, Grover and Goslar (1993) found no significant relationship between organization size and the initiation, adoption, and implementation of telecommunication technologies in US Organizations. Nijssen and Grambach (2001) also found that firm size did not have a positive effect on the level of adoption of new product development tools and techniques. They concluded that it might be due to size's interdependency with other variables in the model. Finally, a study of intranet adopters in Hong Kong also reported no significant differences in adoption and implementation of intranets between large and small organizations (Lai, 2001).

Organizational Readiness

Organizational readiness refers to the level of financial and technical resources of the firm (Kuan and Chau, 2001). Financial resources refer to the financial resources available to pay for new technological innovation costs, for implementation of any subsequent enhancements, and for ongoing expenses during usage. Technical resources refer to the level of sophistication of IT usage and IT management in an organization. For example, Iacovou *et al.* (1995) identified organizational readiness, which is represented by financial resources and technological resources, as an important determinant of EDI adoption. Chwelos *et al.* (2001) used organizational readiness to represent an intraorganizational construct, which in turn is represented by several dimensions: organization financial resources, IT sophistication, and trading partner readiness.

Mehrtens *et al.* (2001) also found that organizational readiness significantly influences Internet adoption. However, they found that the definition of organizational readiness is different. In their study, the level of IT knowledge among IT professionals, the level of IT knowledge among non-IT professionals, and level of IT use in the organization explain organizational readiness better than Iacovou's (1995) financial resources.

Table 6 Summary of Organizational Size and IT Adoption Studies

Source	Area Studied	Findings
Kimberly and Evanisko (1981)	12 innovations in hospital	The size of the organization is a significant predictor of administrative innovation and better predictor than either individual or contextual level variables.
Rai and Bajwa (1997)	Executive Information Systems	No significant differences in firm size were detected between adopters and non-adopters of EIS.
Zhao and Co (1997)	Manufacturing technology	Firm size had an effect on adoption and implementation of technology, especially advanced manufacturing technology.
Boeker and Huo (1998)	8-bit microprocessor	Firm size had no significant effect on the timing of adoption.
Premkumar (1999)	Information and communication Technologies	Size had a positive impact on the adoption decision of three out of four information technologies.
Thong (1999)	Computer Applications	Firm size affects both the adoption likelihood of IS and the extent of adoption.
Goode and Stevens (2000)	World Wide Web	Business size is associated with the adoption of computers by the respondent businesses, but it is not associated with the adoption of the World Wide Web.
Eder and Igbaria (2001)	Intranet	Organization size has a moderate direct effect on intranet diffusion.
Yao *et al.* (2002)	Asynchronous Transfer Mode (ATM)	University size is significantly related to ATM technology adoption in universities.
McDade *et al.* (2002)	Personal computer, VHS, Software, and etc.	The effect of firm size is far less important than that of organizational preferences when predicting the adoption of high-technology products.
Bajwa and Lewis (2003)	E-mail, Teleconferencing, Videoconferencing, Data conferencing	Larger organizations with larger IT functions adopt more ITs than their smaller counterparts.
Chang et al. (2003)	Data mining techniques	The organization size influences the adoption of data mining techniques in the financial service industry.

Organizational Structure

Organizational structures are often defined in terms of their centralization (Kwon and Zmud, 1987). More concentrated decision-making is associated with a centralized organizational structure. Although many studies have found centralization to be negatively associated with information technology innovation adoption and use (Damanpour, 1991), some positive associations have also been reported (Kimberly and Evanisko, 1981).

According to Ellis *et al.* (1994), organizational complexity plays a significant role in the adoption of LAN technology. Complexity refers to the number of levels in the organizational hierarchy, the number of geographic locations of an organization, and the number of departments or jobs in an organization. However, according to Lai and Guynes (1997), the organizational structure factors proved to be least effective in discriminating adoption. In their research, there was no significant relationship found between the ISDN adoption decision and the degree of centralization, formalization, or complexity. Lai and Guynes argued that other factors may overpower the structural factors during the time period chosen by this research. Eder and Igbaris (2001) also found that organization structure was not related to the diffusion or infusion of intranets.

Burns and Stalker (1961) suggested two different types of organizational structure: mechanistic and organic. A mechanistic structure is somewhat rigid in that it consists of very clearly delineated jobs, has a well-defined hierarchical structure, and relies heavily on the formal chain of command for control while an organic structure is more dynamic, decentralized, flexible, and informal. Daft (1986) states more organic organizations tend to adopt new technology more readily.

External Environment

Environmental factors are another force driving organizations to adopt IT. Environmental uncertainty, competitive pressure, industrial pressure, and government policy all serve as pressures on organizations. In many cases, organizations adopt technology due to the environmental pressure such as government policy (Teo *et al.*, 1998).

It is generally believed that competition increases the likelihood of innovation adoption (Link and Bozeman, 1991). Empirical studies show that more intense competition is associated with higher adoption rates (Levin *et al.*, 1987). Banker and Khosla (1995) observed that the adoption of many innovative practices in the US can be attributed to competitive pressures, especially from overseas. Carr and Hard (1996) state that one of the reasons that organizations initiate change is market forces. This includes global competition, new market opportunities, and changing customer needs and preferences. Premkumar and Margaret (1999) found that competitive pressure was a significant factor in adopting new information technologies for small businesses. However, Thong (1999) could not find any support between the adoption decision or the extent of adoption and competitive pressures in his work on small business adoption of IS.

According to Kuan and Chau (2001), external pressure to adopt a technology is an important factor in EDI adoption. They observed that a firm feels pressure to adopt the technology if its business partners request or recommend it to do so. They also found that government pressure had a positive impact on the adoption decision. In other words, the more companies felt government pressure, the more they adopted EDI.

According to Lowenthal (1994), government creates the most important external influence on organizations. However, Lowenthal observed that government pressures generally create less anxiety for companies than consumer pressures. According to his work, government factors are normally steady or at least predictable. This stability often results from the close relationship that industry builds with government. This history of relations between government and industry has made the government an important player in corporate decision making. He stated that consumers constitute the second external influence on organizations. For example, direct actions by groups of activists to change aspects of corporate policy provide a significant new force for change within organizations (Lowenthal, 1994).

Technology Push and Need Pull

The concept of technology-push/need-pull (TP/NP) is also used to explain organizational adoption (Chau and Tam, 2000). TP/NP has been studied in various areas including Engineering/R&D, Marketing, and Information Systems. The push/pull theory evolved from the engineering/R&D literature as a key paradigm to explain project success or failure (Mowery and Rosenberg, 1979; Utterback, 1974). The theory has played a key role in explaining the underlying motivation and driving forces behind the innovation of a new technology.

The technology-push model is based on the view that a new scientific discovery will trigger events ending with diffusion or application of the discovery (Munro and Noori, 1988). The technology-push school argues that the users' needs have a relatively minor role in determining the pace and direction of innovation. On the other hand, the market pull (or need) model is based on the view that users' needs are the key drivers of innovation, thereby suggesting that organizations should pay more attention to needs for innovation than maintaining technical competence (Mowery and Rosenberg, 1979).

In information systems, Zmud (1984) suggested using the technology-push (TP) and need-pull (NP) concepts to explain behavior in adoption of new technology. In his study, he developed a model of process innovation to explain practices in the adoption of software using responses in a questionnaire from 47 software development managers. Even though his investigation failed to validate the push-pull theory in the context of IT adoption, Zmud's framework has been empirically tested and supported by many other researchers.

After Zmud's research, Munro and Noori (1988) reexamined the theory and empirically supported the technology push adoption in manufacturing automation. They found that the integration of push-pull factors contributed to more innovativeness than solely a need-pull and, a technology-push motivation. They also found that the technology-push and integrative perspectives yielded more commitment to technology adoption than did the need-pull approach.

Rai and Patnayakuni (1996) also applied the TP/NP concept to organizational computer-aided software engineering (CASE) adoption. They proposed two need-pull and technology-push factors for CASE adoption. The two need-pull factors are information systems departments (ISD) environmental instability and ISD performance gap, and the two technology-push factors are the degree of learning about CASE from external information sources and the degree to which resources support internal experimentation of technology by the IS department. Rai and Patnayakuni concluded that there is a clear tension between the effect of need-pull and technology-push factors on the CASE adoption context.

Chau and Tam (2000) also proposed two TP/NP factors in the context of open systems adoption. The two TP-related factors are the benefits obtained from adopting the technology and the costs associated with its adoption, and the two need-pull factors are performance gap and market uncertainty. They found that a TP factor (migration cost) significantly influenced open systems adoption.

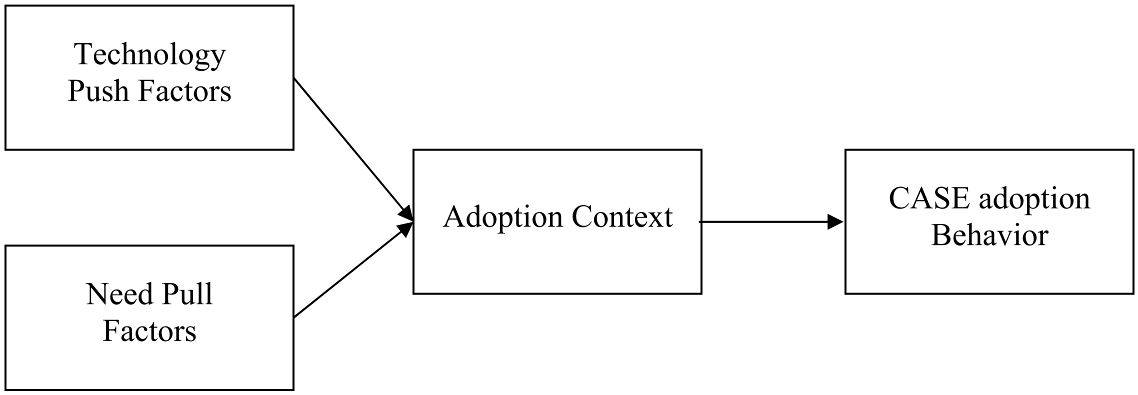


Figure 5 The influence of Technology Push and Need Pull on IT Adoption

Source: Rai, A., and Patnayakuni, R. (1996). A structural model for CASE adoption behavior. *Journal of Management Information Systems, 13*(2), 205-234.

Table 7 Organization IT Adoption and Technology Push and Demand Pull

Source	Theme	Research Methods	Human Subjects	Research Finding
Zmud (1984)	Software management	Survey	47 software development manager	Fail to validate the push-pull concept.
Munro and Noori (1988)	Manufacturing automation	Survey	900 Chief executive officers in Canadian manufacturing firms	The technology-push and integrative perspectives yielded more commitment to technology adoption than did the market-pull approach.
Rai and Patnayakuni (1996)	CASE tool adoption	Survey	2,700 IS executives in the U.S.	The need-pull factors do not directly promote CASE adoption behavior.
Drury and Farhoomand (1999)	Electronic Data Interchange (EDI) adoption	Survey	152 organizations using EDI	Both (TP and MP) are important.
Chau and Tam (2000)	Open systems adoption	Interview	11 directors / vice presidents of IS, 64 managers, and 14 executives	TP factor (Migration cost) significantly influence on open systems adoption.

Other significant factors in organizational level IT adoption

The characteristics of the CEO also are consistently identified as an important determinant of organizational level IT adoption (Thong, 1999). Some researchers suggest that the decision to adopt a technological innovation may simply be an outcome of the decision maker's style (Elam and Leidner, 1995). Particularly, in a small business, since the CEO is the main decision maker, the characteristics of the CEO are a crucial determinant. Thong (1999) found that innovative and IS-knowledgeable CEOs are very important predictors of organizational IT adoption. Thong and Yap (1995) also identified that the computer literacy of the small business owner and the lack of knowledge of the benefits derived from IT as important determinants for IT adoption. Ettlie (1990) has found that CEOs with more knowledge of the technological innovation are more likely to implement an aggressive technology adoption policy.

The existence of a technology support group including the IT department has been found to be a favorable influence on organizational adoption of new technology (Ball *et al.*, 1987; Goode and Stevens, 2000). Businesses with information technology support groups may be well equipped to assimilate new technology into their operations (Bergeron *et al.*, 1990). Also, the members of the information technology support group may positively influence technology adoption by acting as advocates for the new technology. Although fewer studies have explored the impact of IT function size on IT adoption, there is some empirical evidence suggesting that IT function size may have a positive influence on the adoption of IT innovations (Grover and Goslar, 1993). It has been convincingly argued that larger IT functions will have the resources that can facilitate the acquisition of technical competencies required to adopt IT innovations (Bajwa and Lewis, 2003).

Recently, supplier marketing activities are also identified as an important determinant of organizational IT adoption. Most adoption research has been biased towards adopter side variables in explaining the acceptance of innovations. In other words, past studies on information systems innovation have focused on explaining the innovation and adoption of information technology by the potential adopter population in the IT market. However, studies have shown that supplier marketing activities have a significant effect on the adoption decision (Frambach *et al.*, 1998). According to Mahajan *et al.* (1990), marketing activities and competitive strategies play an important part in the adoption innovations.

Non-adoption of Information Technology

Many of the earlier IS adoption studies focus on the factors that enhance adoption rather than the factors that inhibit it. Consequently, factors causing non-adoption or rejection of information systems (IS) have largely been overlooked or simply considered as a lack of adoption factors. However, Gatignon and Robertson (1989) found that "non-adoption is not the mirror image of the adoption decision" (p. 41).

The lack of non-adoption research is partially caused by the fact that the phenomenon is complex since the reasons for non-adoption may lie at earlier stages of the adoption process. Potential adopters may have actively decided to reject the innovation, they may have passively decided to reject the innovation, or they may have not progressed through certain stages of the adoption process yet (Frambach and Schillewaert, 2002; Naibh *et al.*, 1997). As most adoption studies do not follow a process approach, little is known about the factors that affect the process prior to actual adoption (Olshavsky and Spreng, 1996).

Some of the factors identified as barriers to the adoption of technology in prior studies are cost, technological complexity, and a need for internal system changes (Chau and Tam, 2000; Saunders and Clark, 1992). Higher cost for a technology innovation is negatively associated with its adoption (Premkumar and Potter, 1995). The cost of adoption is often associated with technical or organizational uncertainty (Chau and Tam, 2000). A lack of technological skills is another barrier to IT adoption. The organization may not have the IT savvy needed to see the possibilities the technological innovation holds. The firm's decision to adopt is based on their familiarity with IT and not necessarily on the benefits of the technological innovation. Another barrier to adoption is the lack of systems integration (Pfeiffer, 1992). Systems integration often requires new technical knowledge, additional hardware, new or extra software, different operating systems and extensive amounts of time for installation. A technological innovation that requires extensive system integration may not be adopted because it is too expensive, too time consuming, or does not relate to the priorities of the firm. Finally, many researchers raised the issue of security as an important inhibitor to IT adoption (Tan and Ouyang, 2003).

Healthcare Industry and Information Technology

Healthcare is one of the world's largest industries. In the United States, for example, it accounts for 14 percent of GDP (Janz *et al.*, 2005). Healthcare is also arguably the most complex and regulated industry, regularly facing change brought on by federal, state, and local regulation, changing competitive landscapes, mergers and acquisitions, and the pressures of cost control (Finch, 1999). The healthcare industry historically has lagged behind other industries in the adoption of technologies partially due to health care managers and executives struggling to cope with environmental challenges in the health care industry (Menon *et al.*, 2000). According to Rundle (2000), the healthcare industry is falling behind in issues of management, particularly with respect to adopting and managing automation and technology. Zukerman (2000) pointed out that it is the dynamic nature of the healthcare industry that leads organizations to struggle to survive in turbulent conditions. Janz *et al.* (2005) explained this struggling as the healthcare industry's increasingly limited resources and expanding expenses.

While the healthcare industry historically has lagged behind other industries in the adoption of technologies, this is changing at a faster rate (Finch, 1999). Healthcare industry leaders and decision makers have begun to realize the supporting role of technology in their effort to maintain a focus on quality care while meeting the pressures from regulatory bodies, competition, and achieving business and performance goals.

The introduction of IT in the healthcare environment led to an increased accessibility to healthcare providers, more efficient tasks and processes, and a higher quality of healthcare services (Kern and Jaron, 2003). These improvements became possible when an increasing number of healthcare providers began to use hand-held mobile devices networked by wireless LANs to reach patients and access medical information and electronic records. The healthcare market comprises only 10 % of the mobile computing market, but healthcare is projected to grow into a major segment for the total market for mobile computing (Finch, 1999).

The mobile workstation is an example of recently adopted mobile computing technology in hospitals, which can be used for medical records, diagnostics, charting, pharmacy, admissions, and billing. With mobile work stations, physicians can write prescriptions at the point of care, from their offices or from home computers (Coonan, 2002). While inputting orders, physicians can be prompted about drug interactions, potential alternatives, formulary restrictions and patient limitations. As a result, generally illegible handwriting is not an issue and the electronic support systems at the bedside can deter errors. Mobile applications are also used in tracking supplies (Chyna, 2005). With this application, users can scan supplies, medical devices and shipments with a scanner or PDA. The application then tracks supply location and can generate a report on use and the need for replenishment. In addition to those applications, mobile healthcare data centers and mobile telemedicine are expected to be widely used in the next few years (Varshney, 2005).

RFID and Healthcare

Ubiquitous, or pervasive, healthcare refers to healthcare to anyone, anytime, and anywhere by removing location, time and other restraints while increasing both the coverage and quality of healthcare (Varshney, 2005). RFID is an important element of ubiquitous healthcare and enables a fully automated solution for information delivery, thus reducing the potential for human error and increasing efficiency (ITU, 2005). The use of RFID technology in the health-care market is on rise. A recent study reports that the global market for RFID tags and systems in the healthcare industry will increase steadily from $90 million in 2006 to $2.1billion by 2016 (Harrop and Das, 2006). Item-level tagging of drugs is the major factor for the growth of RFID technology in the healthcare industry.

In the healthcare industry, RFID can be used in various areas. First, the most practical area, and the one gaining the quickest acceptance among healthcare organizations, is to attach active RFID tags to expensive or vital supplies (Greene, 2005; ITU, 2005). The items can then be retrieved quickly when needed or monitored. There are almost 100,000 fatalities every year in the US that are a result of errors in dispensing medicine (Gazette, 2005). Therefore, a well monitored medical supplies and medicine is critical for the healthcare industry. According to Frost and Sullivan, the investments by pharmaceutical companies in RFID will reach $ 2.3 billion by 2011 (Barnes, 2006).

RFID tags can also be attached to the patient to track their location (Smith and Konsynski, 2003) (See Figure 6). Tracking the location of patients is particularly important in cases of long-term care, mentally challenged patients, and newborns (ITU, 2005). The ability to determine the location of a patient within a hospital can facilitate and expedite the delivery of healthcare. From a patient convenience and enhanced experience perspective, if hospitals used patient identification RFID tags, a nurse or other caregiver would not have to wake the patient up to verify their identity. As tags become more sophisticated, they could be used to monitor and transmit patient data (e.g., temperature, respiration, pulse) through wireless sensors that will interoperate within a broad network of generic readers (Smith and Konsynski, 2003). Other possible applications of RFID in the healthcare industry include tracking physicians within the hospital and cleaning of hospital beds. Table 8 summarizes the RFID applications in the healthcare industry.

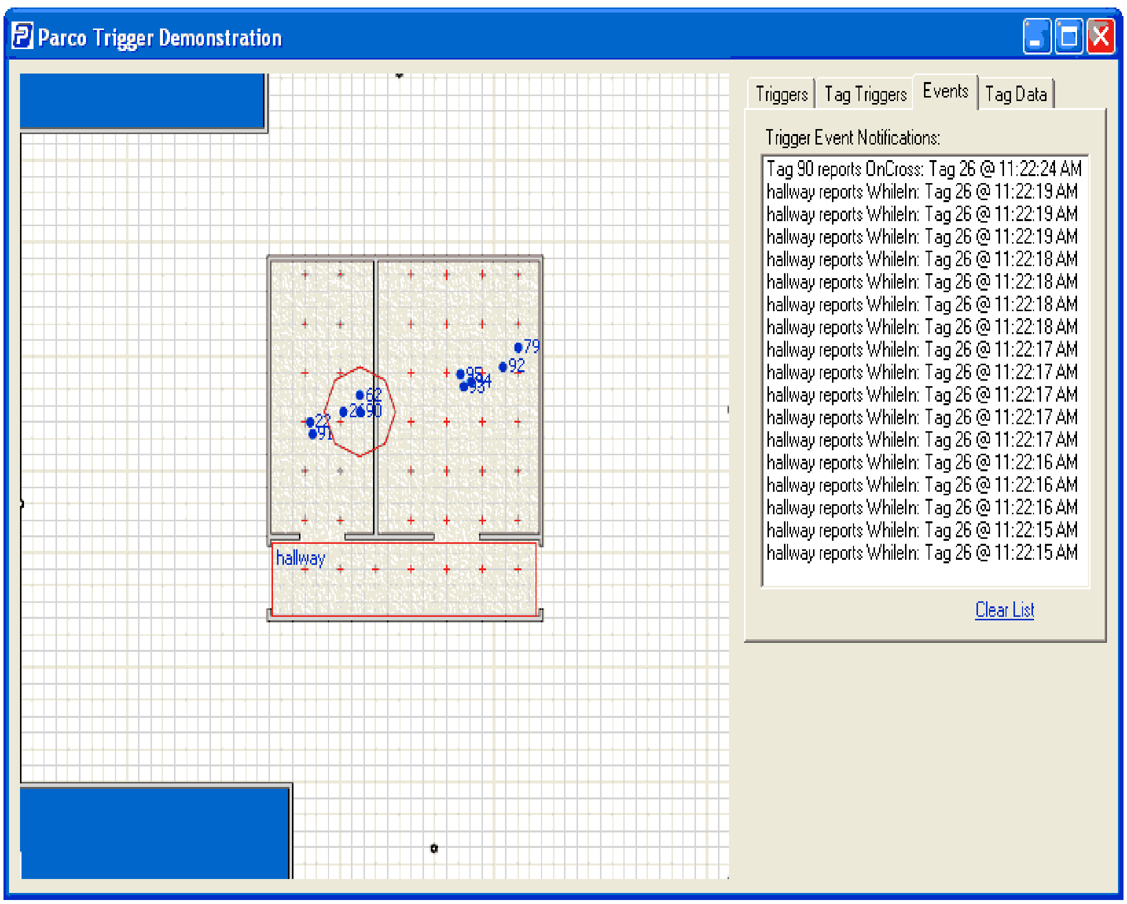


Figure 6 An Example of Patient Tracking System Screen

Source: http://www.rfidgazette.org/parco1.gif

Table 8 RFID Applications in the Healthcare Industry

RFID Applications in Healthcare	Examples
Tracking Medical Supplies or Medicine	• Holy Name Hospital in New Jersey is using an RFID asset tracking system which has enabled the staff to locate a piece of tagged equipment by using a PC. • Pfizer affixes RFID tags into all U.S. shipments of Viagra to counter fake pills • St. Vincent's Hospital in Alabama is monitoring the tagged surgical instruments for location and their maintenance schedule • Mississippi Blood Services is using RFID tags for inventory management.
Tracking Patient	• Bangkok hospital issues RFID wristband to patients which would carry information about their name, age, gender, drugs and the dosage to be administered. • Jacobi Medical Center in New York traces the medical history of their patients by reading information from the RFID radio wristbands
Locating Medical Staffs	• Staff and patients at the Beth Israel Hospital in New York can be located using the tagged bracelets that they wear.
Other Applications	• The Bielefeld municipal hospitals tested beds with integrated RFID chips in order to improve the deployment and cleaning of their hospital beds.

Source: Kanellos, M. (2005); Barnes (2006); Gazette (2005); Harrop (2006)

According a recent study, RFID and its related technologies in the hospital marketplace will reach $8.8 billion by 2010 (Sokol, 2005). The study reported that the market will be segmented into three general categories: RFID hardware and software integration ($1.3 billion), infrastructure support for RFID enablement ($2.7 billion) and hospital connectivity ($4.8 billion). Currently, less than 23 percent of RFID solutions implemented by hospitals are using passive RFID technology (Spyglass, 2006). Passive RFID systems require a reader to be waved near a transponder with an RFID chip and have been used in healthcare to identify patients or drugs in medication administration. The study, however, found that many hospitals hope to use active RFID systems in the future.

However, cost is a major barrier to adopt RFID in hospitals. A study reported that 57 percent of healthcare professionals indicated that a major hurdle is lack of available funding and 46 percent citing the cost of RFID tags and readers as a major barrier (BearingPoint, 2005). In addition, 60 percent of respondents said they have delayed some RFID activities while they wait for industry or government guidance on standards. Other study also found that many hospitals are concerned about the network infrastructure, scalability, integration capability and application availability of current RFID technology (Spyglass, 2006).

CHAPTER III

RESEARCH MODEL AND HYPOTHESES

Research Model

It is widely known that IT adoption is the process through which individual or other decision-maker units pass from first knowledge of an IT, to forming an attitude toward the IT, to a decision to adopt or reject, to implementation of the IT, and to confirmation of this decision (Rogers, 1983). Still, prior studies have not distinguished the factors influencing different phases of the adoption process. Consequently, it is difficult to find which phase is an antecedent of which. For example, perceived benefits and organization size have been cited as two most important factors determining adoption decisions within organizations but their role is different in the context of the adoption decision process. It is oblivious that organizational size does not determine how first knowledge of an IT assimilates or an attitude toward the IT forms within organizations.

To understand the nature of the organizational level IT adoption decision better, the present study distinguishes the driving factors behind the adoption of RFID from other factors which strengthen or weaken the effects of these factors. It will help to find the motivation of IT adoption within organizations and provide an answer to the research question: why do organizations adopt RFID? To accomplish the objective, this study uses the theory of technology push and need pull which has played a key role in explaining the underlying motivation and driving forces behind the innovation of a new technology.

This study also uses organizational readiness as moderating variables determining the speed and willingness to adopt RFID. Although it is important that organizations have motivation to adopt a new technology by perceiving the benefits of the technology or the pressure from internal or external forces, it is meaningless if the organization does not have appropriate resources or support to carry out the action. Organizational readiness in this study will provide insight into explaining different adoption behavior among different organizations. The research model is illustrated in Figure 7.

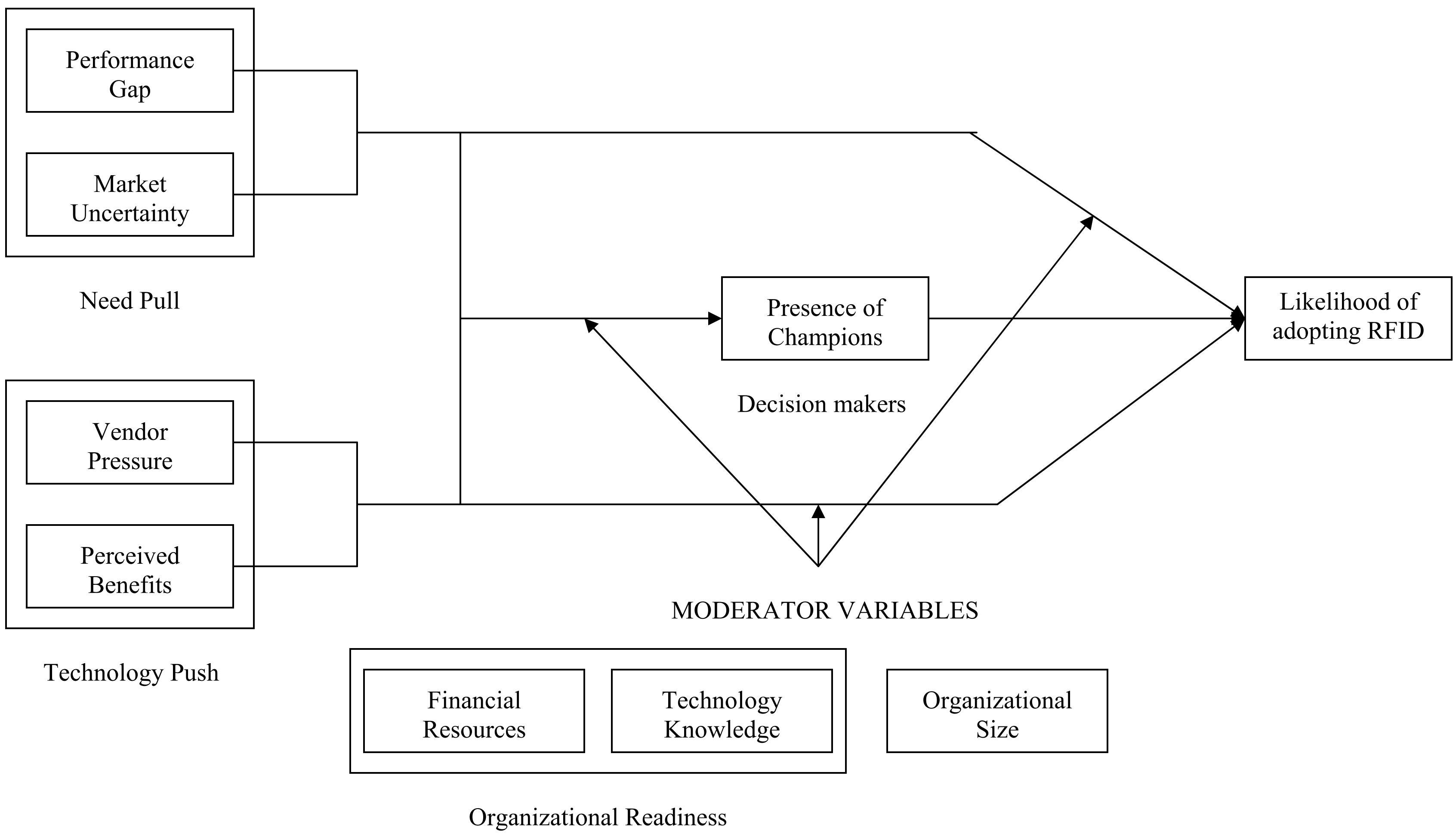


Figure 7 Research Model

Hypotheses Development

Likelihood of adopting RFID

The dependent variable in this study is the likelihood of adopting RFID. In prior studies, a simple dichotomous variable, "yes" or "no" to the adoption decision, has been widely used. This dichotomous dependent variable does not give any indication about future adoption or rejection of a IT and consequently classifies many future adopters as rejecters. Since RFID is relatively new and the purpose of this study is to predict the RFID adoption, this study deploys the likelihood of adopting RFID as the dependent variable instead of the dichotomous variable. This dependent variable helps us to distinguish future adopters who are currently considering or planning to consider from rejectors who decided to not to adopt RFID.

Characteristics of Decision Maker

The characteristic of the decision maker who ultimately makes the adoption decision is more important than any other factor in the adoption process. The present study includes one important dimension of the decision maker: presence of champions. A champion is defined as a management-level person who recognizes the usefulness of an idea to the organization and leads authority and resources for innovation throughout its development and implementation (Meyer, 2000). Prior studies consistently found that the presence of a champion facilitated the adoption of a new technology by providing the necessary drive and effort to initiate the adoption (Beath, 1991). According to Crum (1996), the existence of a champion has been found to be a significant factor in successful adoption and implementation of IS and telecommunications systems. Champions can also help overcome possible resistance in adopting new technologies (Rai and Patnayakuni, 1996).

Grover (1993) found that the existence of a champion was a significant discriminating factor between adopters and non-adopters. Teo and Ranganathan (2004) further found that among e-commerce adopters, 60.85% of the firms indicated the presence of such a champion. In contrast, among non-adopters, only 18.8% of the firms indicated the presence of a champion. This suggests the following hypothesis:

H_1: The presence of champions for RFID is significantly associated with the likelihood of adopting RFID.

Need Pull

Need-pull is one of the significant driving forces for innovation, and numerous studies have claimed that need-pull innovations have been found to be characterized by higher probabilities for success than have technology push innovations (Zmud, 1984). Meyers and Marquis (1969) found that three-quarters of the innovations were derived by need pull. Utterback (1974) also stated that 60-80% of the cases in his meta-analysis were derived by need pull. The present study includes two need pull factors to measure the role of need pull in organizational RFID adoption; performance gap and market uncertainty.

Performance Gap

Carr and Hard (1996) state that while the external world creates compelling needs for change, the internal one is the everyday reality for most organizations. Some of the internal considerations are shareholder dissatisfaction, falling profits, or market share. It has been suggested that the rate of innovation is likely to increase when changes in the environment make existing procedures unsatisfactory (March and Simon, 1958; Rai and Bajwa, 1997). According to Firth (1996), one of the characteristics that emerged to help explain the adoption of innovation is the performance gap or the perceived shortcoming of the organization or processes that may be remedied by a change. A performance gap from existing systems may result from a low satisfaction level with existing IT, an unacceptable price/performance ratio of the existing systems or an inability to serve the organization's new need (Chau and Tam, 2000). Bogan and English (1994) expressed that some elements of the core business system that appear overloaded, obsolete, or inadequate leads to identification and adoption improvement opportunities.

A national survey conducted by the American Society of Health-System Pharmacists revealed that 85% of patients are concerned about at least one medication-related issue when entering a hospital or health system (Fitzpatrick, 2002). Also, according to the Joint Commission on Accreditation of Healthcare Organizations, the most commonly reported surgical errors involved surgery on the wrong body part or site, the wrong patient or the wrong surgical procedure (Hendrickson, 2004). More surprisingly, Hendrickson reports that "mistakes" such as misidentification are responsible for 98,000 deaths per year in U.S. hospitals.

While there are numerous efforts to develop effectiveness measures of a system, user satisfaction has been the most commonly used measure of effectiveness within the IS field (DeLone and McLean, 1992; Kettinger and Lee, 1994). Since hospital managers frequently use staff or patient satisfaction surveys to improve existing systems, the performance gap found in the existing system necessitates a call to action to top hospital managers for adopting advanced technologies, and RFID may be seen as a possible solution for such performance gaps. This argument leads to the following hypotheses:

H_{2a}: The performance gap rising from existing inventory tracking and/or patient identification systems is significantly associated with the likelihood of adopting RFID.

H_{2b}: The performance gap rising from existing inventory tracking and/or patient identification systems is significantly associated with the presence of champions for RFID.

Market Uncertainty

The motivation to adopt new technology may come from pressure from the external market (Robertson and Gatignon, 1986). Even though market and external factors cannot be controlled by the management of the organization, they significantly affect the way the business is conducted. Carr and Hard (1996) argue that one of the reasons that organizations initiate change is market force, including global competition, new market opportunities, and changing customer needs and preferences. Sadler (1996) also reported that financial loss/drop in profits, increased competition/loss of market share, proactive opportunities and a new CEO, and technological development are the reasons that companies undertake change.

Mansfield *et al.* (1977) provided evidence that intense market competition appeared to stimulate the rapid diffusion of an innovation. Pfeffer and Leblebici (1977) also argued that it was when the organization faced a complex and rapidly changing environment that IT was both, necessary and justified. In a study of the adoption of telecommunications technologies in US organizations, Grover and Goslar (1993) also found significant relationships between environmental uncertainty and use of technology.

A recent number of studies consistently reported that hospitals face increasing healthcare costs, decreasing state funding, and reduced insurance and job benefits payments which push many hospitals to the brink of insolvency (Janz *et al.*, 2005; Varshney, 2005). This suggests the following hypotheses:

H_{3a}: The level of market uncertainty is significantly associated with the likelihood of adopting RFID.

H_{3b}: The level of market uncertainty is significantly associated with the presence of champions for RFID.

Technology Push

Technology push stems from recognition of a new technological mean for enhancing performance. Technology push proponents claim that change in technology is the primary driver of innovation. Phillips (1966) argued that the user needs had a relatively minor role in determining the pace and direction of innovation. Munro and Noori (1988) claimed that the technology-push and integrative perspectives yielded more commitment to technology adoption than did the market-pull approach. Chau and Tam (2000) also reported that technology push factors significantly influence open systems adoption. The present study includes two technology push factors: vendor promotion and perceived benefits.

Vendor Pressure

Prior studies on information systems adoption have extensively focused on explaining the innovation and adoption of information technology by the potential adopter population in the IT market. However, studies have shown that supplier marketing activities have a significant effect on the adoption decision (Frambach *et al.*, 1998). According to Rogers (1983) marketing activities and competitive strategies play an important part in the adoption of innovations. Especially, in mobile computing adoption, it has been found that vendors play a significant role determining adoption decision (Dash, 2001). This suggests the following hypotheses:

H_{4a}: Vendor pressure, or marketing activity, is significantly associated with the likelihood of adopting RFID.

H_{4b}: Vendor pressure, or marketing activity, is significantly associated with the presence of champions for RFID.

Perceived Benefits

Perceived benefits refers to the level of recognition of the relative advantage that a technology can provide to the organization (Rogers, 1995). Perceived benefits used in this study closely correspond to the term "relative advantage" that has been used in many innovation studies. The perceptions of an innovation by members of an organization's decision-making unit affect their evaluation of and propensity to adopt a new product (Rogers, 1995). The perceived benefits, including economic incentives, of adopting the technology should exceed that of alternatives, if organizations are to consider adopting (Anderson and Narus, 1999). Cragg and King (1993) found that perceived benefit was the only variable that was consistently found to be the most important factor for the adoption of EDI in a number of studies.

Perceived benefits are divided into two categories. The first is direct benefits, which are mostly operational savings related to the internal efficiency of the organization. The second one is indirect benefits, which are most tactical and competitive advantages that have an impact on business processes and relations. In the context of RFID, numerous direct and indirect benefits have been found including improved operational efficiency and flexibility (Jones *et al.*, 2005; Smith, 2005; Smith and Konsynski, 2003). Therefore, it is expected that perception of the benefits offered from RFID significantly influence the likelihood of adoption RFID and the presence of champions.

H_{5a}: Perceived benefits are significantly associated with the likelihood of adopting RFID.

H_{5b}: Perceived benefits are significantly associated with the presence of champions for RFID.

Organizational Readiness

Organizational readiness reflects a firm's financial and technological capabilities, or the level of use of knowledge and skills (Dosi, 1991). While it is important that organizations have motivation to adopt a technology by perceiving the benefits of the technology or the pressure from internal or external forces, it is meaningless if the organization does not have appropriate resources to carry out the action. Kwon and Zmud (1987) expressed that successful IS implementation occurs when sufficient organizational resources are directed first toward motivation, then toward sustaining the implementation effort. Therefore, organizations without such resources may be less able to adopt innovation and thus demonstrate lower readiness. In prior studies, two dimensions in organizational readiness received the most attention: financial and technical readiness.

Financial readiness refers to the financial resources available to pay for new technological innovation costs, for implementation of any subsequent enhancements, and for ongoing expenses during usage (Iacovou *et al.*, 1995). Financial resources are consistently found to be a significant determinant of organization IT adoption. Technical readiness refers to the level of sophistication of IT usage and IT management in an organization (Chwelos *et al.*, 2001; Iacovou *et al.*, 1995). Indicators such as the quick ratio, the working capital/sales ratio and the general and administrative expenses/sales ratio, which were developed by Pare and Rayment (1991), have been used to measure IT sophistication.

Many recent studies found that organizational IT knowledge is a more important dimension of organizational readiness than any other dimension. For example, Mehrtens *et al.* (2001) found that knowledge among non-IT professional was a significant determinant of organizational readiness as well as IT adoption. Attewell (1992) conceptualized the diffusion of complex technological innovations in terms of decreasing knowledge barriers. Attewell claimed that because of obstacles with developing the necessary skills and technical knowledge, many businesses are tempted to postpone adoption of the innovation until the barriers to adoption are lowered or circumvented. Ettlie (1990) also found that business owners with more knowledge of the technological innovation are more likely to implement an aggressive technology adoption policy. Finally, Lai and Guynes (1994) argued that technology awareness by management determines the relative timing of an organization's decision to adopt an innovation, compared to the other organizations. They added that management with high technology awareness normally has a high tolerance for uncertainty and is eager to try out new ideas. Therefore, technology awareness is a significant dimension of the adoption process and contributes positively to the adoption decision (Lai and Guynes, 1994).

Thus, even though organizational readiness is not a driving force for IT adoption in organizations, it plays a significant role in organizational IT adoption by determining the speed and willingness of IT adoption by strengthening or weakening the motivation of IT adoption. This argument leads to the following hypotheses:

H_6: The relationship between the driving forces of adopting RFID and the likelihood of adopting RFID will be further strengthened in the presence of a higher organizational financial resource.

H_7: The relationship between the driving forces of adopting RFID and the likelihood of adopting RFID will be further strengthened in the presence of higher organizational information technology knowledge.

Organizational Size

One of the reasons prior studies on the effects of organization size on IT adoption have generated little consensus on the size-adoption relationship is that size correlates with many structural characteristics, such as formalization or decentralization, that tend to have contradictory effects on innovation adoption (Boeker and Huo, 1998). Many have argued that larger size implies a larger pool of resources and a better ability to compete, and large organizations are more capable of sustaining failures or absorbing the risk in trying new things (Bajwa and Lewis, 2003; Chang *et al.*, 2003). Also, it is argued that scale economies will typically be greater in larger organizations, which may in turn enhance the feasibility of adoption (Kimberly and Evanisko, 1981; McDade *et al.*, 2002).

However, an important minority view is that larger size may create bureaucratic barriers, making it more difficult to legitimize a new technology within the organization, in turn hindering innovation adoption (Dougherty and Hardy, 1996). For example, Hage (1980) examined several empirical studies on organization size and innovation and concluded that the relationship between the two variables was generally negative. Also, it is argued that the coordination between different sub-units of the organization required to adopt the innovation may be more easily achieved in small organizations rather than large organizations (Nord and Tucker, 1987). Finally, it may be important for smaller organizations to differentiate themselves in a highly competitive market by quickly offering the latest technology to customers (Tornatzky and Klein, 1982), implying that such small firms would be more likely to be among the first to adopt innovations.

In response to these divergent views, some researchers have suggested that this issue is too complex to allow for a single sweeping statement concerning the relationship between innovation adoption and firm size (Ettlie and Rubenstein, 1987). Thus,

H_8: The relationship between the driving forces of adopting RFID and the likelihood of adopting RFID will be significantly moderated by organizational size.

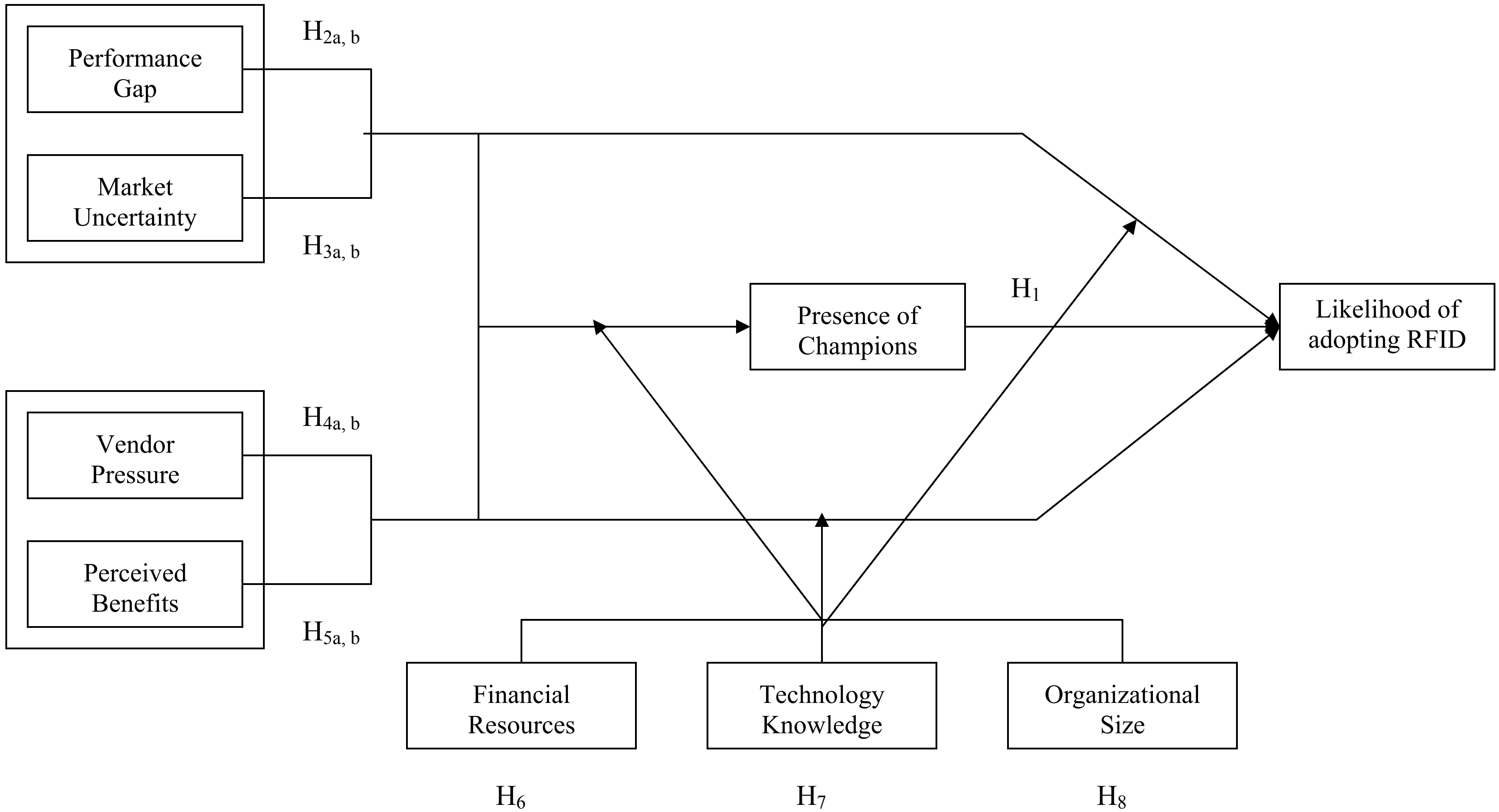


Figure 8 Research Model with Hypotheses

CHAPTER IV

METHODOLOGY

Over the past several years, the methodology deployed to study IS has received almost as much attention as the subject of the research (Galliers and Land, 2002). Each method has its strengths and weaknesses to solve different facets of research problem, so the question of which research method is most appropriate for a certain study is not easily answered. According to Palvia *et al.* (2003), survey methodology is most frequently used in IS research, followed by framework and conceptual models, laboratory experiments, and case studies.

Survey research was the predominant methodology in this study. In conducting a survey, the investigator elicits opinions, attitudes, and beliefs of a sample group regarding some issues of interest. The survey method allows researchers to study and describe large populations fairly quickly at a relatively low cost (Babbie, 2004). It has been used successfully to test hypotheses, describe populations, develop measurement scales, and build theoretical models in research across a wide variety of domains.

A web-based survey was used to collect data for this study. There are well-documented practical problems with the paper based form of data collection including poor response rates, slow response, and manual transcription of data from a hard copy questionnaire to an appropriate statistical analysis tool (Ilieva *et al.*, 2002; Thompson *et* *al.*, 2003). Consequently, research into electronic data collection methods increased significantly during the late 1990s with (1) a growing number of Internet and email users and (2) various computer-assisted data collection techniques.

Web-based surveys have advantages over paper-based surveys in terms of response speed, follow-up, real-time data accuracy check, and special display effects (Boyer *et al.*, 2002). Once startup costs are absorbed, online surveys can save money by reducing the paper, ink, mailing, and environmental costs associated with their paper based counterparts (Thompson *et al.*, 2003). In addition, automatic data entry increases accuracy because coding errors are less likely. Furthermore, the survey is delivered faster, responses are received more quickly, and the data analysis/feedback steps are accelerated.

However, there are also some challenges when implementing a web-based survey (Thompson *et al.*, 2003). First, there is the apprehension that some or all of the population may not have access to the equipment needed to fill out the survey. In anticipation of this concern, it is important to ensure that respondents have necessary computer access. Second, some electronic surveys do not ensure “one person, one survey,” thereby raising questions about ballot stuffing, which occurs when a survey is completed multiple times by the same person. However, Spera (2000) argued that the probability of people taking the time to submit multiple responses to an electronic survey is quite low, and Church (2001) found that none of his participants submitted the same survey responses multiple times.

Several validations are conducted in Web-based surveys (Peytchev and Crawford, 2005). Respondent authentication may be the most basic form of validation conducted in Web-based surveys. Most commonly, authentication is conducted using a username and/or password. However, even though assigning unique access control numbers can prevent ballot stuffing while barring unauthorized persons for the survey, it has been speculated that the use of the mechanism may negatively affect respondents' perceptions of anonymity (Stanton, 1998). When a password protection mechanism is not possible, other mechanisms to help control access to a survey include the use of web browser cookies, and the collection of Internet Protocol (IP) and Media Access (MAC) addresses (Peytchev and Crawford, 2005). For example, a cookie may be stored on a respondent's computer that identifies that computer as one that has already been used to complete the survey.

Web-based validations may also be used as a mechanism to reduce slips where a respondent may accidentally miss a response input, such as a radio button or check box, and submit a page with missing data. Idleman (2003) reported web respondents had less missing data than paper based survey respondents. Dillman *et al.* (1998) also found that the electronic survey group had more completed questions than the paper group. In addition, respondents tended to write more words in open-ended questions on the electronic survey than on the paper based survey. In the same vein, Buchanan and Smith (1999) observed that the reliability of the scale from the Web survey sample was higher than that from the paper based sample.

Operationalization of Measurement Variables

Venkatraman and Grant (1986) proposed the following filtering rules for identifying well-developed MIS survey instruments:

1. The scale uses multiple, high-level items rather than single, nominal items
2. The scale is internally consistent.
3. The scale is valid.

All latent constructs in this study employed multiple item scales. The majority of the items were written in the form of statements with which the respondent is to agree or disagree on a 7-point Likert scale. Other items that could not be measured with Likert scales are written in the form of open-ended questions. Most items were adopted from existing instruments and modified to fit the context of RFID when necessary. New items were developed through a literature review on the topics. In order to ensure the appropriateness of the research instrument in this research, the instrument was tested for reliability, content validity, and construct validity. The questionnaire is presented in Appendix A.

Likelihood of RFID adoption was measured by three items adapted from Chewelos *et al.* (2001). Respondents were asked to give their answers to following questions:

1. At what stage of RFID technology development is your organization currently engaged?
2. If you organization is not currently using RFID, does your organization intend to adopt RFID?
3. If your organization intends to adopt RFID, how soon do you anticipate that it will have an operational RFID system?

Performance Gap was measured by three items adapted from Chau & Tam (2000) and Rai & Patnayakuni (1996). Respondents were asked to indicate the extent to which they agree with statements relating to the performance gap:

1. Our employees are satisfied with the existing inventory tracking system.
2. Our employees are satisfied with the existing patient identification system.
3. Our patients are satisfied with the existing patient identification system.

Market Uncertainty was measured by three items adapted from Chau & Tam (2000). Respondents were asked to respond to the following questions in a seven-point Likert-type scale with anchors from 'rare' to 'very often,' and from 'strongly disagree' to 'strongly disagree.'

1. The frequency of cost-increases in the healthcare industry
2. The competition among hospitals is very intense.

Perceived benefits was measured by four items adapted from various IT journals and magazines. Since perceived benefits are divided into two categories, direct benefits and indirect benefits, two items were chosen from each direct and indirect benefits. Respondents were asked to give their level of agreement or disagreement with the following four potential benefits of adopting RFID.

1. Overhead cost reduction
2. Reduced error rates
3. Improved customer service
4. Improved hospital image

Vendor pressure was developed for this study through a literature review on the topic. Respondents were asked to respond to the following questions in a seven-point Likert-type scale with anchors from 'no pressure at all' to 'extreme pressure' and from 'no influence' to 'strong influence,' respectively.

1. Please rate the pressure that vendors place on your hospital to adopt RFID.
2. Please rate the amount of influence vendors, which are currently providing your IT applications, have in your organization's decision whether or not to adopt RFID.
3. Please rate the amount of influence vendors, which are not currently providing your
IT applications, have in your organization's decision whether or not to adopt RFID.

The presence of champions was measured by three items adapted from Rai & Patnayakuni (1996). Respondents were asked to give their level of agreement or disagreement on the flowing questions.

1. RFID has no strong advocates in our hospital.
2. There are one or more people in our hospital who are enthusiastically pushing for RFID.
3. Nobody in our hospital has taken the lead in pushing for the adoption of RFID.

Technology knowledge was measured by using a scale developed by Looi (2005). Respondents were asked to indicate the extent to which they agree with statements relating to knowledge about RFID:

1. We have very little knowledge how RFID can help to improve our hospital
2. We will use RFID sooner if we know more about what it can do for our hospital.
3. We do not have the technical knowledge and skills to start using RFID.

Financial resources was measured using a scale developed by Chewelos *et al.* (2001). Respondent were asked to respond to the following questions in a seven-point Likert-type scale with anchors from 'not at all significant' to 'extremely significant' and from 'strongly agree' to 'strongly disagree,' respectively.

1. Our organization has the financial resources to adopt RFID.
2. In the context of your organization's overall information systems budget, how significant would be the cost of developing and implementing RFID technology?

Organization (Hospital) size was measured by the number of beds in the hospital. While organization size has been most commonly measured by the number of employees, in hospitals the most common measure used has been the number of beds (Kimberly and Evanisko, 1981). The number of beds and the number of employees in the hospital were highly correlated, providing additional justification for the use of the number of beds as the measure of hospital size (Kimberly and Evanisko, 1981).

Human Subjects

Since organizations but not individuals adopt RFID, the unit of analysis for the study is therefore at the organizational level. Subjects for this study are required to be decision makers within the organization. The sample in this research consists of decision makers including Chief Executive Officers (CEOs), Presidents, Chairman, Chief Medical Officers (CMOs), and IT executives in 865 US hospitals. IT executives in hospitals include Chief Information Officers (CIOs), Chief Technology officers (CTOs), VPs in Technology, and Directors of IT. Names and email addresses of these executives will be drawn from the *Directory of Top Computer Executives* and the *Corporate Technology Directory*. The survey instrument was placed on a web site where participants accessed and completed the survey. An email stating the purpose of the study and the strict confidence of the data was sent along with URLs of the survey website to promote participating in the survey.

Although the applicability of findings in one sector to those in another is clearly problematic, concentration of the research focus can help to identify and isolate factors that clarify the nature of the phenomenon in that section and, at the very least, can be helpful in suggesting hypotheses that may be generalizable beyond that sector and tested in others (Kimberly and Evanisko, 1981). The use of a single industry (hospitals) also increases an ability to control for key organizational and environmental confounds (Menon *et al.*, 2000). Thus, this paper concentrates on the healthcare sector and attempts to identify the relative contribution of a number of factors to an explanation of observed variability in adoption of mobile applications by hospitals. Although hospitals certainly are not the only potential adopters of innovations in the health sector, they are major consumers of innovations in the healthcare arena (Kimberly and Evanisko, 1981).

Pilot Study

Two pilot studies were conducted before the final questionnaires are administered to the subjects. The first pilot study was conducted using the expert panel of 10 faculty and doctoral students to ensure the clarity of the instructions and procedures of the survey. Modification of the survey procedure instructions and survey questions was made based on the comments and recommendations. The second pilot study was conducted using ten CIOs and CEOs in U. S. hospitals. In the second pilot test, validity and reliability of measurements was tested and confirmed.

CHAPTER V

DATA ANALYSIS

Data was collected using the web site of Surveymonkey.com between May 2006 and August 2006 (Appendix B). The survey site was designed to be user-friendly and utilized navigation aids to lead respondents through the survey. In order to reduce respondents' effort in scrolling up and down the screen and make them understand the content better, the questionnaire was divided to 5 pages, and each page displayed the screen number and the number of questions in the screen.

An email message was distributed to 865 senior mangers in U. S. hospitals. There were total of 143 responses after two follow-up emails encouraging participation. Among 143 responses, 126 responses were found to be complete and usable. The final response rate was 14% (126/865). Among respondents, 44% (56/126) of them were Chief Information Officer (CIO), 29% were Director of Information Technology, 10% were Chief Executive Officer (CEO), 7% were Vice President of Information Technology, 1% were Chief Technology Officer (CTO), and 9% were other which includes chief nursing officer (CNO) and operation officer. A half of the respondents said they have been in this professional career for between16 and 25 years, and 85% of the respondent indicated that they are in current position for between 1 and 10 years.

Demographically, of the 126 respondents, 81% were male, and 19% were female. More than a half of the respondent (57%) were between 40 and 49 years of age, 37% were between 50 and 60 years of age, 13% were 60 years of age or older, and 11.9% were between 30 and 39 years of age. In terms of education, 52.4% of the respondents were college graduates, 33.4% were master/MBA graduates, 11.9% were 2-year college graduates, and 2.4% were others including some college work and programming school. Characteristics of the respondents are summarized in Table 9

Of the 126 hospitals represented by the respondents, 23 hospitals had evaluated RFID, 21 hospitals were evaluating RFID, and 62 hospitals planned to evaluate RFID. Among 23 hospitals which had evaluated RFID, a majority of them (22/23) planned to adopt RFID. Only 4 hospitals were using RFID and 16 hospitals were not considering RFID. In terms of hospital size, 32% of the hospitals were between 201 and 300 beds, 21% were 101 and 200 beds, and 11% were between 301 and 400 beds. Characteristics of the organizations which the respondents represented are summarized in Table 10.

Table 9 Characteristics of Respondents

Current Position	Frequency	Percent (%)	Cumulative (%)
Chief Information Officer	56	44.0	44.0
Director of Information Technology	36	29.0	73.0
Chief Executive Officer	13	10.0	83.0
VP of Information Technology	9	7.0	90.0
Chief Technology Officer	1	1.0	91.0
Others including • Network Administrator • Operations Officer • VP Operation • Chief Nursing Officer	11	9.0	100.0

Years in Professional Career	Frequency	Percent (%)	Cumulative (%)
1 – less than 5 years	5	4.0	4.0
5 – less than 10 years	8	6.0	10.0
10 – less than 15 years	4	3.0	13.0
15 – less than 20 years	30	24.0	37.0
20 – less than 25 years	32	26.0	63.0
25 – less than 30 years	17	13.0	76.0
Over 30 years	30	24.0	100.0

Years in Present Position	Frequency	Percent (%)	Cumulative (%)
1 – less than 5 years	50	40.0	40.0
5 – less than 10 years	57	45.0	85.0
10 – less than 15 years	10	8.0	93.0
15 – less than 20 years	4	3.0	96.0
20 – less than 25 years	5	4.0	100.0

Gender	Frequency	Percent (%)	Cumulative (%)
Female	24	19.0	19.0
Male	102	81.0	100.00

Age	Frequency	Percent (%)	Cumulative (%)
30 – 39	15	11.9	11.9
40 – 49	57	45.2	57.1
50 – 59	37	29.4	86.5
Over 60	17	13.5	100.0

Education	Frequency	Percent (%)	Cumulative (%)
2 year college	15	11.9	11.9
4 year college	66	52.4	64.3
Master/MBA	42	33.4	97.7
Other	3	2.3	100.0

Table 10 Characteristics of Organizations

Stage of RFID Technology Development	Frequency	Percent (%)	Cumulative (%)
Currently using RFID Technology	4	3.1	3.1
Have evaluated, and plan to adopt	22	17.4	20.5
Have evaluated, but do not plan to adopt	1	0.7	21.2
Currently evaluating	21	16.6	37.8
Plan to evaluate	62	49.2	87.0
Not considering	17	13.0	100.0

Hospital Size	Frequency	Percent (%)	Cumulative (%)
1 – 25	1	1.0	1.0
26 – 100	12	10.0	11.0
101 – 200	26	21.0	32.0
201 – 300	41	32.0	64.0
301 – 400	14	11.0	75.0
401 – 500	4	3.0	78.0
501 – 600	28	22.0	100.0

Non-Response Bias

Grover *et al.* (1994) advocate the practice of comparing later respondents with earlier respondents, as later respondents may possess similar characteristics to those sample members who did not respond at all. However, the arguments of Filion (1975) suggest that the method of using respondent data to examine non-respondents is flawed. First, it assumes that a non-response bias actually does exist, and second, it can neither prove nor disprove the existence of such a bias on all research variables at once. While the usefulness and accuracy of such a method is open to question, such an analysis was conducted nevertheless.

In an attempt to test for any non-response error, the earlier respondents were compared with late respondents based on their responses on RFID development stage, financial resource, technology knowledge, and organizational size. For the purpose of analysis of non-response error, the respondents who responded after the first email were classified as early respondents and the respondents who responded after final follow-up email were classified as late respondents.

In ANOVA, the p-value indicates the probability that the means of the two groups are equal. A small p-value leads to the conclusion that the means are different. Likewise, a large p-value leads to the conclusion that the means of the two groups are not different. The result of ANOVA on the response of RFID development stage (F-ration = 0.118 and p-value < .733) indicated that the difference in the mean scores of the two groups is not statistically significant. Therefore, it can be concluded that the means of the two groups are not different. The ANOVA results of Financial resources (p-value < .252), technology knowledge (p-value < .153), and organizational size (p-value < .237) also indicated that the means of the two groups are not different even though the p-values for those constructs are much lower than the one of RFID development stage. Therefore, it was found that there was no significant difference between the two groups. The results of ANOVA are presented in Table 11.

Table 11 Non-response Bias Test Result

		Sum of Squares	df	Mean Square	F	Sig.
RFID development stage	Between Groups	.225	1	.225	.118	.733
	Within Groups	72.550	38	1.909		
	Total	72.775	39			
Financial Resources	Between Groups	2.756	1	2.756	1.352	.252
	Within Groups	77.488	38	2.039		
	Total	80.244	39			
Technology Knowledge	Between Groups	4.444	1	4.444	2.124	.153
	Within Groups	79.511	38	2.092		
	Total	83.956	39			
Organizational Size	Between Groups	3.600	1	3.600	1.443	.237
	Within Groups	94.800	38	2.495		
	Total	98.400	39			

In addition, since the position of the respondents in this survey vary from Chief Executive Officers (CEO) to Chief Nursing Officers (CNO), it is very important to find out the possible response bias caused by the different positions of the respondent. In an attempt to test for any response bias from different positions, each position except for CTO, which has fewer than two cases, was compared based on the response of performance gap and perceived benefits, both constructs are believed to represent the attitude of the respondents toward organizations and RFID. Duncan's new multiple range test (MRT), or Duncan test, was used to compare the mean. MRT is a multiple comparison procedure to use the studentized range statistic to compare sets of means (Duncan, 1955). The result of MRT showed that there were actually two groups based on the response of performance gap. The first group is comprised of VP of IT and CIO, and the second group is comprised of Director of IT, CEO, and others (i.e. CNO). This suggests that the perception of performance gap among IT managers except for Director of IT is slightly lower than the one of other senior managers. However, the difference was not noticeable. The following MRT test based on the response of perceived benefits showed that there was no significant difference among five different groups. The results of Duncan test are presented in Table 12.

Collectively these results suggest that all the groups are very similar, and the impact of non-response error and response bias based on the positions on the results of this study is minimal.

Table 12 Results of Duncan Test

Performance Gap

Position	N	Subset for alpha = .05	
		1	2
VP of IT	9	3.3704	
CIO	56	4.0060	4.0060
Dir of IT	36		4.1296
Other	11		4.2121
CEO	13		4.2564
Sig.		.079	.533

Perceived Benefits

Position	N	Subset for alpha = .05
		1
CEO	13	5.6923
VP of IT	9	6.0556
Other	11	6.2273
CIO	56	6.2946
Dir of IT	36	6.3333
Sig.		.052

Data Analysis and Result

Data analysis was carried out in accordance with a two-stage methodology where the measurement model is first developed and evaluated separately from the full structural equation model (Hair *et al.*, 1998). Accordingly, the first step in the data analysis was to establish the convergent and discriminant validity of the constructs, and the second step was to test the structural model on the cleansed measurement model. Following the two-stage analytical procedures, first the measurement model is analyzed, and then the structural model is followed.

The Measurement Model

In the initial test of internal consistency reliability, one perceived benefit item (PB1) was dropped due to its low loading in factor analysis (Table 13). Therefore, the measurement model for organizational RFID adoption includes 21 items to measure 7 constructs. Confirmatory Factor Analysis (CFA) was performed to examine the validity of the items and underlying constructs in the measurement model.

Table 13 Factor loading for constructs

Construct	Measurement Instrument	Loading
Performance Gap (PG)	• Our employees are well satisfied with the existing inventory tracking system. • Our employees are well satisfied with the existing patient identification system. • Our patients are well satisfied with the existing patient identification system.	.777 .919 .863
Market Uncertainty (MU)	• The competition among hospitals is very intense. • The frequency of cost-increase in the healthcare industry	.833 .896
Vendor Pressure (VP)	• Please rate the pressure that vendors place on your hospital to adopt RFID. • Please rate the amount of influence vendors, which are currently providing your IT applications, have in your organization's decision whether or not to adopt RFID. • Please rate the amount of influence vendors, which are not currently providing IT applications, have in your organization's decision whether or not to adopt RFID.	.936 .949 .860
Perceived Benefits (PB)	• Overhead cost reduction • Reduced error rates • Improved customer service • Improved hospital image	.664 .810 .862 .789
Presence of Champions (PC)	• RFID has no strong advocates in our hospital. • There are one or more people in our hospital who are enthusiastically pushing for RFID. • Nobody in our hospital has taken the lead in pushing for the adoption of RFID.	.816 .833 .834
Financial Resources (FR)	• Our organization has the financial resources to adopt RFID. • In the context of your organization's overall information systems budget, how significant would be the cost of developing and implementing RFID technology?	.807 .820
Technology Knowledge (TK)	• We have very little knowledge about how RFID would be used in our hospital. • We might use RFID sooner if we knew more about what it could do for our hospital. • We do not have the technical knowledge and skills to start using RFID.	.874 .810 .858

The measurement model was estimated using the maximum likelihood method, and the goodness of fit indices is displayed in Table 14. It has been recommended that the model chi-square test be used as a goodness of fit index, with a smaller chi-square value (usually non-significant chi-square test) indicating a better model fit (Joreskog and Sorbom, 1993). The chi-square value for the initial measurement model was statistically significant (p = 0.000). However, the chi-square test usually is not considered as the absolute standard by which the goodness of fit of the model is judged because it is sensitive to sample size (Hayduk, 1987; Joreskog and Sorbom, 1993). Other tests, such as goodness of fit index (GFI), comparative fit index (CFI), normed fit index (NFI), and non-normed fit index (NNFI), should also be used to judge the goodness of fit of the model.

Table 14 Measurement Model Fit Indices

	RMSEA	NFI	NNFI	GFI	CFI
Observed Value	0.076	0.92	0.95	0.83	0.96
Recommended Value	≤0.08	≥ 0.90	≥ 0.90	≥ 0.90	≥ 0.90

RMSEA = Root mean square error or approximation;
NFI = Normed Fit Index;
GFI=Goodness-of-fit index;
CFI = Comparative fit index.

The fit indices of the measurement model are within accepted thresholds, except for GFI, which is slightly lower than the commonly cited threshold. RMSEA was well within the range of acceptability recommended. It was suggested that a RMSEA that is less than 0.8 indicates good fit and reasonable errors of approximation in the population

(MacCallum *et al.*, 1996). CFI, which is robust to sampling characteristics (Hoyle and Panter, 1995), also showed a high value 0.96, while the index in the 0.90 range is viewed as adequate fit. Only the GFI at 0.84 was somewhat below the 0.90 benchmark. While GFI can be brought up to 0.90 by dropping items, it was not conducted to pursue that route in the interest of content validity. Overall, the measurement model is not perfect but acceptable, so this measurement model was tentatively accepted as the study's measurement model.

In addition to the global measures of fit, several other assessment criteria were considered to examine the internal structure of the scale. The internal consistency of the measurement model was assessed by computing the composite reliability. These reliability coefficients are displayed for all the study variables in Table 15. All constructs had composite reliability higher than the benchmark of 0.60 (Bagozzi and Yi, 1988). This suggested that a high internal reliability of the data existed. Along with the coefficients of composite reliability, the coefficients of average variance extracted (AVE) are also displayed in Table 12. The AVE indicates what percentage of the variance of the construct is explained by individual items. All constructs had AVE higher than the benchmark of 0.5 (Bagozzi and Yi, 1988). Therefore, it suggests that the items can adequately explain the variance in the constructs.

Table 15 Assessing the Measurement Model

Latent Variables	Composite Reliability	Average Variance Extracted
Performance Gap (PG)	0.85	0.67
Market Uncertainty (MU)	0.89	0.70
Vendor Pressure (VP)	0.93	0.76
Perceived Benefits (PB)	0.89	0.69
Financial Resources (FR)	0.91	0.81
Technology Knowledge (TK)	0.90	0.78
Presence of Champion (PC)	0.89	0.82
Adoption (AD)	0.76	0.60

The structural model

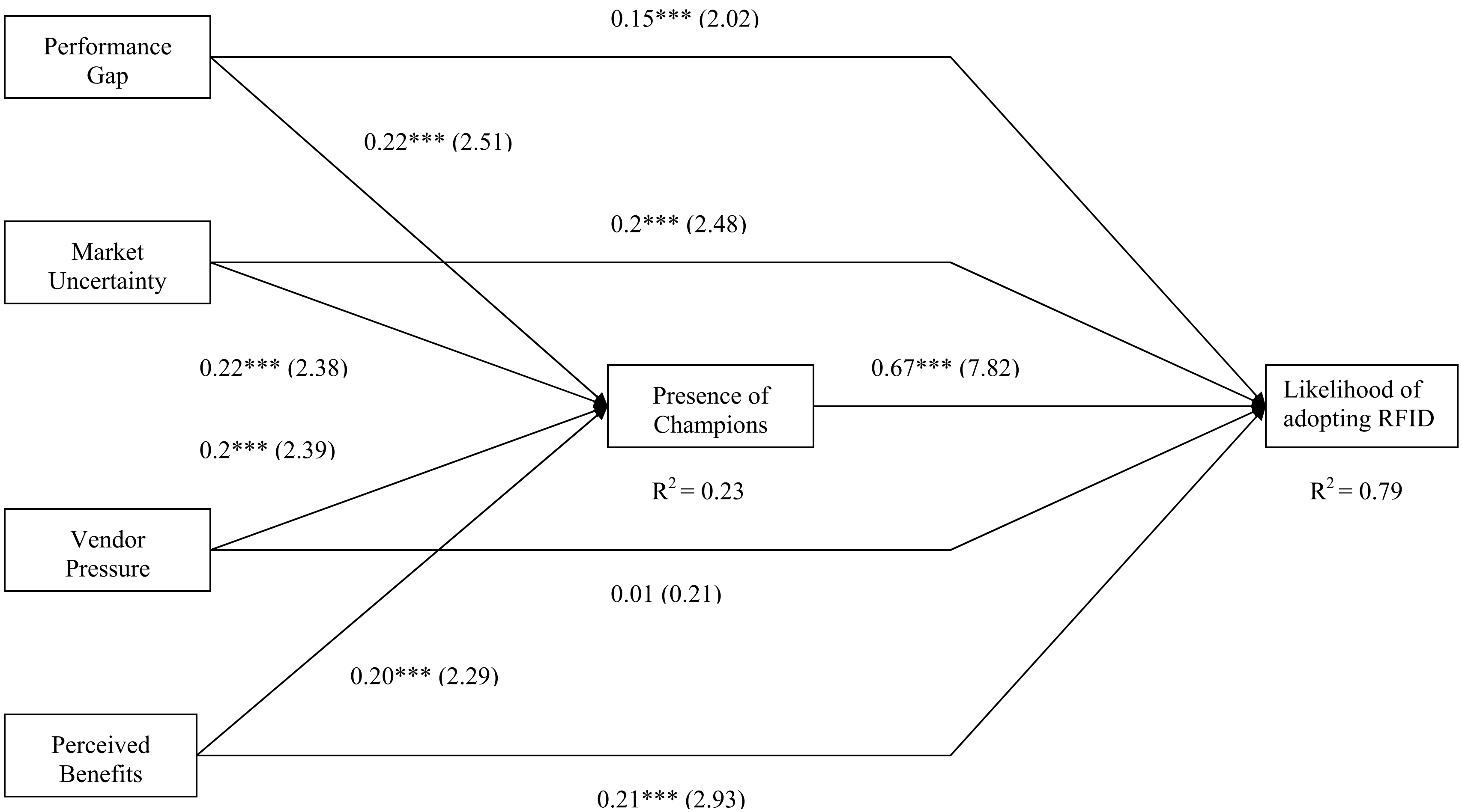
The validity of the structural model of the research model was tested using LISEL 8.72. The fit statistics indicate that the research model provides a good fit to the data (Table 16). The χ^2 is significant and all other statistics are within the range that suggests a good model fit (Hair, *et al.* 1998). The one exception was GFI, which was 0.88, which is below 0.90 but close to 0.90.

Table 16 Structural Model Fit Indices

Fit Index	Recommend value	Observed value
χ^2 /degrees of freedom	≤3.00	1.59
GFI	≥ 0.90	0.88
AGFI	≥ 0.80	0.81
NFI	≥ 0.90	0.91
NNFI	≥0.90	0.94
CFI	≥ 0.90	0.96
RMSEA	≤0.08	0.06

Figure 9 shows the standardized LISREL path coefficients with their respective significant levels and t-statistics. All the proposed hypotheses were supported except for H4a, the path between vendor pressure and likelihood of adopting RFID. The findings indicated that need pull, technology push, and the presence of champions strongly impact on the likelihood of adopting RFID in hospitals. The model explained substantial variance in likelihood of adopting RFID and modest variance in presence of champions.

Hypothesis 1 is strongly supported ($\beta = 0.67$ $t = 7.82$) as consistent with prior studies. It is the strongest factor in the proposed model. This indicates that the presence of champions is a critical factor driving RFID adoption in hospitals.



*** p <.001

Figure 9 Result of the Proposed Research Model on Need Pull and Technology Push

Hypothesis 2a and 2b are also supported as predicted. It suggests that the performance gap caused by the existing systems influences organizations' decision to adopt RFID directly or indirectly by the presence of champions. Hypothesis 3a and 3b are also supported and indicate that under market uncertainty, organizations may consider adopting RFID to overcome the threat.

Hypothesis 4a is also supported by data, but hypothesis 4b is not supported. This indicates that vendor pressure may cause the presence of champions but not strong enough to lead organizational RFID adoption. Hypothesis 5a and 5b are also supported as predicted. This simply means that perceived benefits of RFID is an important driving factor in determining organizational RFID adoption.

Multi-group Analysis

A multi-group analysis was performed to test the moderating effects of financial resources, technology knowledge, and organizational size in the proposed model. First, the moderating effects of financial resources on all the relationships were tested. The analysis procedure involved the preliminary step of calculating a mean value for financial resources (3.87) and then grouping the respondents into two groups based on their responses to financial resources instrument items. Results indicated that 57 respondents scored a summated average of less than 3.87, whereas 69 respondents scored a summated average of greater than 3.87. The next step was to test the structural model using those responses of (a) the below mean group and (b) of the above mean group. An examination of overall goodness of fit statistics between the two structural model tests indicated a comparable level of overall fit (see Table 17). This indicates no differences between the groups.

Table 17 Comparison of Structural Models with High/Low Financial Resources

Response Group	χ^2	d.f.	RMSEA	NFI	NNFI	GFI	CFI
Below Mean	150.437	104	0.089	0.773	0.843	0.76	0.88
Above Mean	178.729	104	0.103	0.821	0.864	0.76	0.89

An examination of the paths also showed the same result (Table 19). The t-values for all need-pull and technology push factors to presence of champions were found non-significant except for vendor pressure in high financial resources and perceived benefits in low financial resources. Interestingly, the path from perceived benefits to presence of champion changed from significant to non-significant as the financial resources responses changed from low to high. It suggests that financial resource is not a moderator in the likelihood of adopting RFID model.

The process was repeated for technology knowledge resulting in a mean value of 5.18, to which 40 respondents scored below and 86 respondents scored above. As depicted in Table 18, the structural model was again tested using those responses of (a) the below mean group and (b) of the above mean group. An examination of overall goodness of fit statistics between the two structural model tests indicated a different level of overall fit. The indices of the above mean group showed better overall fit than the below mean group.

Table 18 Comparison of Structural Models with High/Low Technology Knowledge

Response Group	χ^2	d.f.	RMSEA	NFI	NNFI	GFI	CFI
Below Mean	154.02	104	0.111	0.625	0.671	0.683	0.748
Above Mean	182.14	104	0.094	0.843	0.888	0.799	0.914

An examination of the paths showed that the main difference between two groups was caused by the different effect of presence of champions on likelihood of adopting RFID (Table 20).

Table 19 Tests of Financial Resources as Moderating Variables

	Low Financial Resources			High Financial Resources		
	Estimate	t-value	p-value	Estimate	t-value	p-value
Performance Gap → Presence of Champion	0.21	1.87	n.s.	0.24	1.96	n.s.
Market Uncertainty → Presence of Champion	0.08	0.72	n.s.	0.26	1.87	n.s.
Vendor Pressure → Presence of Champion	0.07	0.65	n.s.	0.26	2.11	<0.01
Perceived Benefits → Presence of Champion	0.50	3.78	<0.01	0.06	0.45	n.s.
Performance Gap → Likelihood of Adopting RFID	0.27	1.99	<0.01	0.05	0.60	n.s.
Market Uncertainty → Likelihood of Adopting RFID	0.38	2.34	<0.01	0.06	0.75	n.s.
Vendor Pressure → Likelihood of Adopting RFID	0.09	-0.68	n.s.	0.04	0.49	n.s.
Perceived Benefits → Likelihood of Adopting RFID	0.28	1.70	n.s.	0.36	4.15	<0.01
Presence of Champions → Likelihood of Adopting RFID	0.38	2.18	<0.01	0.67	7.87	<0.01

* n.s. denotes Not significant

Table 20 Tests of Technology Knowledge as Moderating Variables

	Low Technology Knowledge			High Technology Knowledge		
	Estimate	t-value	p-value	Estimate	t-value	p-value
Performance Gap → Presence of Champion	0.30	1.90	n.s.	0.06	0.50	n.s.
Market Uncertainty → Presence of Champion	-0.16	-0.95	n.s.	0.22	1.57	n.s.
Vendor Pressure → Presence of Champion	0.43	2.44	<0.01	0.22	2.06	<0.001
Perceived Benefits → Presence of Champion	0.09	0.64	n.s.	0.28	2.30	<0.001
Performance Gap → Likelihood of Adopting RFID	0.03	0.80	n.s.	0.10	1.21	n.s.
Market Uncertainty → Likelihood of Adopting RFID	0.14	3.29	<0.01	0.08	1.16	n.s.
Vendor Pressure → Likelihood of Adopting RFID	-0.00	-0.10	n.s.	0.07	0.87	n.s.
Perceived Benefits → Likelihood of Adopting RFID	0.03	0.77	n.s.	0.14	1.58	n.s.
Presence of Champions → Likelihood of Adopting RFID	0.01	0.24	n.s.	0.85	8.87	<0.001

* n.s. denotes Not significant

Similar to financial resources, the t-values for all need-pull and technology push factors to presence of champions and likelihood of adopting RFID showed little difference, but the path from presence of champions to likelihood of adopting RFID changed from significant to non-significant as the technology knowledge responses changed from high to low.

The process was repeated again for organizational size. The result showed a mean value of 4.42, to which 80 respondents scored below and 46 respondents scored above. As depicted in Table 21, the structural model was tested using those responses of (a) the below mean group and (b) of the above mean group. An examination of overall goodness of fit statistics between the two structural model tests indicated a different level of overall fit. The indices of the below mean group, as opposed to prior studies, showed actually better overall fit than the above mean group.

Table 21 Comparison of Structural Models with Small/Large Organization

Response Group	χ^2	d.f.	RMSEA	NFI	NNFI	GFI	CFI
Below Mean	167.69	104	0.088	0.855	0.905	0.800	0.927
Above Mean	184.99	104	0.132	0.665	0.692	0.674	0.764

An examination of the paths showed that the main difference between two groups was caused by the different effects of need pull and technology push on likelihood of adopting RFID (Table 22). The result showed that all the paths from need-pull and technology push factors to likelihood of adopting RFID changed from significant to nonsignificant as the organizational size responses changed from small to large.

Summarized results for the hypothesis tests are presented in Table 23.

Table 22 Tests of Organizational Size as Moderating Variable

	Smaller Organization			Larger Organization		
	Estimate	t-value	p-value	Estimate	t-value	p-value
Performance Gap → Presence of Champion	0.15	1.44	n.s.	0.27	2.02	<0.001
Market Uncertainty → Presence of Champion	-0.10	-0.75	n.s.	0.09	1.06	n.s.
Vendor Pressure → Presence of Champion	0.22	1.95	n.s.	0.12	1.02	n.s.
Perceived Benefits → Presence of Champion	0.42	3.43	<0.001	0.35	2.46	<0.001
Performance Gap → Likelihood of Adopting RFID	0.21	2.38	<0.001	0.16	1.11	n.s.
Market Uncertainty → Likelihood of Adopting RFID	0.26	2.33	<0.001	0.26	1.61	n.s.
Vendor Pressure → Likelihood of Adopting RFID	-0.26	-2.65	<0.001	0.19	1.48	n.s.
Perceived Benefits → Likelihood of Adopting RFID	0.33	2.94	<0.001	0.30	1.93	n.s.
Presence of Champions → Likelihood of Adopting RFID	0.67	6.33	<0.001	0.37	2.67	<0.001

* n.s. denotes Not significant

Table 23 Summary of Hypothesis Tests

Hypothesis Number	Description	Result
H_1	Presence of Champions → Likelihood of Adopting RFID	Supported
H_{2a}	Performance Gap → Likelihood of Adopting RFID	Supported
H_{2b}	Performance Gap → Presence of Champions	Supported
H_{3a}	Market Uncertainty → Likelihood of Adopting RFID	Supported
H_{3b}	Market Uncertainty → Presence of Champions	Supported
H_{4a}	Vendor Pressure → Likelihood of Adopting RFID	Not Supported
H_{4b}	Vendor Pressure → Presence of Champions	Supported
H_{5a}	Perceived Benefits → Likelihood of Adopting RFID	Supported
H_{5b}	Perceived Benefits → Presence of Champions	Supported
H_6	Moderating effect of Financial Resources on Likelihood of Adopting RFID and Presence of Champions	Not Supported
H_7	Moderating effect of Technology Knowledge on Likelihood of Adopting RFID and Presence of Champions	Supported
H_8	Moderating effect of Organizational Size on Likelihood of Adopting RFID and Presence of Champions	Supported

CHAPTER VI

IMPLICATIONS AND CONCLUSIONS

Conclusions and Discussion

Discussion of Results

Motivated by a need to understand the underlying motivation and driving forces behind the RFID adoption in the healthcare industry, this study proposed and tested a model predicting the likelihood of adopting RFID within organizations. Specifically, this research proposed technology push, need pull, and the presence of champions as the key factors determining RFID adoption in the healthcare industry. Two technology push factors (perceived benefits and vendor pressure), two need pull factors (performance gap and market uncertainty), and presence of champions (decision makers) were proposed and used in this study. This study also predicted that moderator variables (financial resources, technology knowledge, and organizational size) moderate the relationship between those factors and the likelihood of adopting RFID in hospitals.

The measurement model was confirmed with adequate reliability and validity with respect to the measure of all the constructs in the research model. The structural model also provided a good fit to the data, and all path coefficients in the research model were found statistically significant (except the path from vendor pressure to the likelihood of adopting RFID). The result revealed that need pull, technology push, and the presence of champions successfully explain the motivation of RFID adoption in hospitals. The proposed research model explained substantial variance in the likelihood of adopting RFID (79%) and modest variance in the presence of champions (23%).

In this research model, the presence of champions emerged as the most important factor influencing RFID adoption in the healthcare industry. This simply means that the presence of champions is an essential element for organizations to adopt RFID. This is consistent with the literature recognizing the importance of champions in the IT adoption process (Rai and Patnayakuni, 1996).

As predicted, both need pull factors contributed to the likelihood of adopting RFID and the presence of champions for RFID in hospitals. This result implies that an organization may not consider adopting a new technology unless a need, such as performance gap and market uncertainty, was recognized. In other words, in the context of RFID adoption, the satisfaction level with existing computing systems and the uncertainty of future market perceived by organizations are closely related to the need for improvement and the adoption decision.

As expected, perceived benefits of RFID were found to be an important motivator of RFID adoption. The coefficient implies that perceived benefits contributed to the presence of champion for RFID as well as the likelihood of adopting RFID. This seems reasonable since increased awareness about the potential benefits of RFID technology would stimulate individuals to promote the technology and speed up the RFID adoption decision. It simply implies that many hospitals would adopt RFID when they perceive

RFID as an exciting new opportunity with potential and benefits including reducing error rates and improving customer service. Surprisingly, though, overhead cost reduction, which has been an important factor in prior information technology adoption decision (Chau and Tam, 2000), was not considered as a possible benefit of RFID. Many top hospital mangers did not expect to have overhead cost reduction by adopting RFID. The survey results showed that the respondents selected reduced error rates and improved customer service as the major benefits of RFID technologies.

Contrary to the hypothesis, vendor pressure, another technology push factor, did not have any significant direct effect on the likelihood of adopting RFID. This result suggests that hospital IT adoption decision is not significantly influenced by vendor's marketing activities. Although vendor pressure has no direct effect on the likelihood of adopting RFID, the data analysis revealed that vendor pressure has indirect effect on the likelihood of adopting RFID by stimulating the presence of champions for RFID. This suggests that vendor's marketing activities are still important factors promoting the adoption of RFID.

In this study, it is proposed that organizational readiness, defined by a firm's financial and technological capabilities, plays a significant role in the RFID adoption by determining the speed and willingness of the adoption decision. Surprisingly, this study did not find the significant role of financial resources in RFID adoption and concludes that the level of organizational financial resources does not strengthen or weaken the motivation of RFID adoption caused by technology push and need pull. This may be interpreted as organizations which have sufficient financial resources still hesitate to adopt RFID. This simply means that the level of financial resources is not a determinant of adopting RFID. Future studies are needed to explain this phenomenon.

Not surprisingly, technology knowledge was found to be a significant moderator in organizational RFID adoption and an important discriminator of adopters and non-adopters. It is very important to note that the major difference of the high and low technology knowledge groups is caused by the path from the presence of champions to the likelihood of adopting RFID. This simply reconfirms the importance of understanding and knowledgeable about the potentials of IT, especially among senior managers. Although many hospitals recognize that RFID will be important for them in the future, top mangers of those hospitals may not understand what RFID is about and its current importance to their business. This lack of understanding may lead them to discount the impact of RFID and lead them to believe that they have plenty of time to adopt RFID. With greater knowledge, the degree of uncertainty involved in IT adoption will diminish, resulting in a less risky adoption of IT.

Therefore, it appears that technology knowledge plays a significant role in RFID adoption and overcoming the lack of technology knowledge will lead to greater probability of RFID adoption.

The result of the study revealed that organizational size significantly moderates the relationship between the motivation and adoption of RFID. However, the direction for the relationship was opposed to that hypothesized. The research of model of the smaller hospitals which have less than 300 beds actually showed better fit indices than the hospitals which have over 300 beds. The result is consistent with some prior studies which found that larger size may create bureaucratic barriers, making it more difficult to legitimize a new technology within the organization, in turn hindering innovation adoption (Dougherty and Hardy, 1996; Hage, 1980). This result also may be explained by the fact that smaller organizations try to differentiate themselves in a highly competitive market by quickly offering the latest technology to customers (Tornatzky and Klein, 1982).

Conclusion and Implication

The findings from the present study show that in addition to technology factors, other factors, such as the presence of champions, performance gap, and market uncertainty, are important to help understand the adoption of RFID adoption. The result revealed that technology push and need pull are almost equal contributors to the likelihood of adopting RFID and the presence of champions for RFID. This suggests that in deciding whether or not to adopt RFID, organizations seem to pay attention to the potential benefits as well as to the potential and existing problems.

The findings for this study also showed that hospitals which are more knowledgeable about IT are more likely to adopt RFID. It is especially important that the top mangers must be aware of the ability of RFID and how to use it properly. The lack of knowledge of the IT adoption process and insufficient awareness of the potential benefits may be inhibiting organizations from adopting IT. In short, a successful RFID adoption should include technology push, need pull, and the presence of champions for RFID. However, it is also important to notice that the motivation of adopting RFID created by the potential benefits from RFID and the existing problem may be meaningless if the organization does not have appropriate knowledge about RFID.

This research has unique contributions for researchers and practitioners. First, this study makes several contributions to the existing information technology adoption literature. This study contributes to understanding the nature of the organizational IT adoption process by identifying the motivation behind RFID adoption and the role of the constructs in predicting RFID adoption. Especially, the concept of technology push and need pull used in this study will provide additional insights to related areas such as Engineering, R&D, and Marketing. Characteristics of IT, which have been a major focus of IT adoption study (Rogers, 1995), may only explain one aspect of RFID adoption phenomenon. This study embraces technology push and need pull into a single research model and successfully tests the effects of the variables. The proposed research model explained substantial variance in the likelihood of adopting RFID (79%).

Second, unlike prior studies which heavily focused on explaining the innovation and adoption of IT by the potential adopter population, this study adds supplier activities which are gaining more attention and have a significant effect on the adoption decision. Although vendor pressure has no direct effect on the likelihood of adopting RFID, it is very important to notice that vendor pressure has an indirect effect on the likelihood of adopting RFID by stimulating the presence of champions for RFID.

Third, this study is one of few attempts using organizational factors as moderating variables. Prior studies heavily used organizational variables as direct determinants of adopting IT (Chwelos *et al.*, 2001; Elizabeth and Pearson, 2004). The current study, using organizational factors as moderating variables, explains the organizational adoption process more clearly and provides new insight into IS adoption research.

Finally, revalidating and redefining the existing constructs such as organizational readiness is expected to contribute to future IS organizational adoption research. For example, it is worth noting that organizational technology knowledge is a better predictor of organizational readiness than financial resources, and that technology knowledge successfully discriminates future IT adopters from non-adopters.

In addition to the theoretical contribution, this research has important practical implications for organizations, both RFID adopters and RFID vendors. The empirical finding of this research showed that RFID is still in an early adoption stage in the healthcare industry. Of the 126 organizations surveyed, only 4 organizations are currently using RFID and almost a half of the organizations (64) are still planning to evaluate. The survey results also showed that the RFID adoption rate is expected to increase significantly since a majority of organizations (22 out of 23) which have evaluated RFID would plan to adopt it. To increase their chance of successful RFID adoption, vendors and IT consultants are advised to target their marketing at business with innovative top managers. They should look out for indicators of innovative behaviors such as adoption of new production technology or processes and participation in trade exhibitions. For those organizations with top mangers who are less innovative, researchers and vendors should take steps to create IT awareness among these top mangers so as to education them. Adaptive top mangers prefer not to adopt IT unless they are sure that adoption of IT is one way of doing things better and not doing things differently. With a better understanding of IT and its potential benefits, these top mangers may develop more positive attitudes towards adoption of IT. Government agencies and IS researchers promoting IT adoption may focus their effort on raising IT literacy while informing organizations about the associated challenges and benefits of RFID to increase the chance of success RFID adoption. This can be achieved through subsidized IT seminars and training programs specially designed for top mangers.

Limitations and Direction for Future Research

It is important to evaluate the study's results and contributions in light of its limitations. This study has several limitations. First, since RFID is a nascent technology, some IT executives in the healthcare industry might have slightly different interpretations of RFID. This may influence the reliability of this study. Second, a single respondent used in this research to collect data from each organization can be another limitation. A majority of prior IS organization studies have been based solely on the responses from a single IS or top executive of the surveyed organizations. However, it has been questioned how adequately the single response represents the entire organization (Lai and Guynes, 1997). Although these top executives are critical in influencing the adoption decision processes, their perspectives may not adequately describe the organizational adoption behavior. Third, the sample size of this study (126) is much less than 200, a suggested minimum number for an appropriate SEM test (Hair *et al.*, 1998). However, some studies suggest the ratio of sample size to estimated parameters be between 5:1 and 10:1, similar to regression analyses, for an appropriate SEM test (Kelloway 1998). Therefore, the ratio of sample size to estimated parameters from our study, 8.4:1 (main model) and 6.3:1 (moderating model), are acceptable. Fourth, significant percentages of the presence of champions remain unexplained. This study only explains 23% of the variance in the presence of champion. More research on this area is needed to find potential determinants of the presence of champion. Finally, the analysis of this study presents only a snapshot of RFID adoption. Therefore, this study may not be able to discuss how these patterns of adoption are changing over time. Future studies using a longitudinal approach may help shed light on these trends.

The concern of privacy and security has become a major issue in adopting RFID. Millions of RFID receivers are expected to be placed everywhere including airports, highways, retail stores, and even consumers' homes, all of which will be constantly reading, processing, and evaluating consumer's behaviors and purchases. Opponents of RFID have proposed measures to prevent RFID's relentless information-gathering, ranging from disabling the tags to boycotting the products of companies which use or plan to implement RFID technology. Security of RFID has also become a major issue to organizations since information on RFID tags can be easily stolen or breached. Therefore, future studies on privacy and security of RFID are needed. Especially, the study focusing on the impact of the privacy issue on the organizational RFID adoption will help future RFID development and adoption areas.

Future studies using qualitative research are also needed to help to understand organizational level RFID adoption better. Especially, since RFID is still in an early development stage, qualitative studies will help to generate ideas and concepts related to the context of RFID adoption within organizations. The case study focusing on a single entity or phenomenon bounded by time and activity may help to understand these phenomena.

BIBLIOGRAPHY

Agarwal, R. (2000). Individual Acceptance of Information Technologies. In R. W. Zmud (Ed.), *Framing the Domains of IT Management: Projecting the Future through the Past* (85-104). Cincinnati, OH: Pinnaflex Educational Resources, Inc.

AIM. (2001). Shrouds of Time: History of RFID. Retrieved January 20, 2006, from http://www.aimglobal.org/technologies/rfid/resources/shrouds_of_time.pdf

Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behavior and Human Decision Processes, 50*, 179-211.

Anderson, J. C., & Narus, J. A. (1999). *Business Market Management: Understanding, Creating, and Delivering Value*. New Jersey: Prentice Hall.

Angeles, R. (2005). RFID technologies: Supply-Chain Applications and Implementation Issues. *Information Systems Management, 22*(1), 51-65.

Asif, Z., & Mandviwalla, M. (2005). Integrating the Supply Chain with RFID: A Technical and Business Analysis. *Communications of the Association for Information Systems, 15*, 393-427.

Attewell, P. (1992). Technology Diffusion and Organizational Learning: the Case of Business Computing. *Organization Science, 3*(1), 1-19.

Babbie, E. (2004). *The Practice of Social Research* Belmont, CA: Thomson Wadsorth.

Bagozzi, R. P., & Yi, Y. (1988). On the evaluation of structural equation models. *Journal of the Academy of Marketing Science, 16*(1), 74-94.

Bajwa, D. S., & Lewis, L. F. (2003). Does Size Matter? An Investigation of Collaborative Information Technology Adoption by U.S. Firms. *Journal of Information Technology Theory and Application (JITTA), 5*(1), 29-46.

Ball, L. D., Dambolena, I. G., & Hennessey, H. D. (1987). Identifying Early Adopters of Large Software Systems *Database, 19*(1), 21-27.

Banker, R. D., & Khosla, I. S. (1995). Economics of Operations Management: A Research Perspective. *Journal of Operations Management, 12*(3,4), 423-435.

Barnes, K. (2006). RFID exploding into pharma industry. Retrieved September 3, 2006, from http://www.in-pharmatechnologist.com/news/ng.asp?n=64786-gartner-frost-and-sullivan-rfid

BearingPoint. (2005). Large Healthcare Organizations Are Embracing RFID. Retrieved September 4, 2006, from http://www.nahit.org/cms/index.php?option=com_content&task=view&id=157&Itemid=148

Beath, C. M. (1991). Supporting the Information Technology Champion. *MIS Quarterly, 15*(3), 355-371.

Bergeron, F., Rivard, S., & De Senne, L. (1990). Investigating the Support Role of the Information Center. *MIS Quarterly, 14*(3), 247-260.

Boeker, W., & Huo, Y. P. (1998). Innovation Adoption by Established Firms: Unresolved Issues. *Journal of High Technology Management Research, 9*(1), 115-130.

Bogan, C., & English, M. (1994). *Benchmarking for Best Practices: Winning Through Innovative Adaptation* New York McGraw-Hill.

Boyer, K. K., Olson, J. R., Calatone, R. J., & Jackson, E. C. (2002). Print versus Electronic Surveys: A comparison of Two Data Collection Methodologies. *Journal of Operations Management, 20*(4), 357-373.

Buchanan, T., & Smith, J. L. (1999). Using the Internet for Psychological Research: Personality Testing on the World Wide Web. *British Journal of Psychology, 90*(1), 125-144.

Burns, T., & Stalker, G. M. (1961). *The Management of Innovation*. London: Tavistock Publications.

Carr, D. K., & Hard, K. J. (1996). *Managing the Change Process*. New York: McGraw-Hill.

Chang, S.-C., Chang, H.-C., Lin, C.-H., & Kao, S.-C. (2003). The Effect of Organizational Attributes on the Adoption of Data Mining Techniques in the Financial Service Industry: An Empirical Study in Taiwan. *International Journal of Management, 20*(4), 497-503.

Chau, P. Y. K., & Tam, K. Y. (2000). Organizational Adoption of Open Systems: A 'technology-push, need-pull' perspective. *Information & Management, 37*(5), 229-239.

Church, A. H. (2001). Is There a Method to Our Madness? The Impact of Data Collection Methodology on Organizational Survey Results. *Personnel Psychology, 54*(4), 937-970.

Chwelos, P., Izak Benbasat, & Dexter, A. S. (2001). Research Report: Empirical Test of an EDI Adoption Model. *Information Systems Research, 12*(3), 304-321.

Chyna, J. T. (2005). Going Wireless. *Healthcare Executive, 20*(5), 48-49.

Coonan, G. M. (2002). Making the Most of Mobility. *Health Management Technology, 23*(10), 32-36.

Cragg, P. B., & King, M. (1993). Small-Firm Computing: Motivators and Inhibitors *MIS Quarterly, 17*(1), 47-60.

Crum, M., Premkumar, G., & Ramamurthy, K. (1996). An assessment of motor carrier adoption, use and satisfaction with EDI. *Transportation Journal, Summer*, 44-57.

Daft, R. L. (1986). *Organizational Theory and Design* (2nd ed.). St. Paul, MN: West Publishing.

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

Damanpour, F. (1992). Organizational Size and Innovation. *Organization Studies, 13*(3), 375-402.

Dash, J. (2001). IBM, Intel Push Wireless Health Care. *Computerworld, 35*(21), 10.

DeLone, W. H., & McLean, E. R. (1992). Information Systems Success: The Quest for the Dependent Variable. *Information Systems Research, 3*(1), 60 - 95.

Dewar, R. D., & Dutton, J. E. (1986). The Adoption of Radical and Incremental Innovations: An Empirical Analysis. *Management Science, 32*(11), 1422-1433.

Dillman, D. A., Tortora, R. D., Contadt, J., & Bowker, D. (1998). *Influence of Plain vs. Fancy Design on Response Rates for Web Surveys.* Paper presented at the The Joint Statistical Meetings of the American Statistical Association, Dallas, TX.

Dosi, G. (1991). The Research on Innovation Diffusion: An Assessment. In N. N. a. A. Grubler (Ed.), *Diffusion of Technologies and Social Behavior* (pp. 179-208). New York: Springer Verlag.

Dougherty, D., & Hardy, C. (1996). Sustained Product Innovation in Large, Mature Organizations: Overcoming Innovation-to-Organization Problems. *Academy of Management Journal, 39*(5), 1120-1153.

Drury, D. H., & Farhoomand, A. (1999). Information Technology Push/Pull Reactions. *The Journal of Systems and Software, 47*(1), 3-10.

Duncan, D. B. (1955). Multiple range and multiple F tests. *Biometrics* 11, 1-42.

Eder, L. B., & Igbaris, M. (2001). Determinants of Intranet Diffusion and Infusion. *Omega, 29*(3), 233-242.

Ein-Dor, P., & Segev, E. (1978). Organizational Context and the Success of Management Information Systems. *Management Science, 24*(10), 1064-1077.

Elam, J. J., & Leidner, D. G. (1995). EIS adoption, Use, and Impact: The Executive Perspective. *Decision Support Systems, 14*(2), 89-103.

Elizabeth, E. G., & Pearson, J. M. (2004). Electronic Commerce Adoption: An Empirical Study of Small and Medium US businesses. *Information & Management, 42*(1), 197-216.

Ellis, R. W., Jones, M. C., & Arnett, K. P. (1994). Local Area Network Adoption: An Empirical Assessment. *Information Resources Management Journal, 7*(4), 20-29.

Ettlie, J. E. (1990). What Makes a Manufacturing Firm Innovative? *Academy of Management Journal, 4*(4), 7-20.

Ettlie, J. E., & Rubenstein, A. H. (1987). Firm Size and Product Innovation *Journal of Product Innovation Management, 4*(2), 89-108.

Fanberg, H. (2004). The RFID Revolution. *Marketing Health Services, 24*(3), 43-44.

Fano, A., & Gershman, A. (2002). The Future of Business Services in the Age of Ubiquitous Computing. *Communications of the ACM, 45*(12).

Filion, F. L. (1975). Estimating bias due to non-response in mail surveys. *Public Opinion Quarterly, 39*(4), 482-492.

Finch, C. (1999). Mobile Computing in Healthcare. *Health Management Technology, 20*(3), 64-65.

Firth, M. (1996). The diffusion of managerial accounting procedures in the People's Republic of China and the influence of foreign partnered joint ventures. *Accounting, Organizations and Society, 21*(7), 629-654.

Fishbein, M., & Ajzen, I. (1975). *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research*. Reading, MA: Addison-Wesley Publishing Company.

Fitzpatrick, M. (2002). Add New Technology to Your Wish List. *Nursing Management, 33*(12), 6.

Frambach, R. T., Barkema, H. G., Nooteboom, B., & Wedel, M. (1998). Adoption of A Service Innovation in the Business Market: An Empirical Test of Supply-Side Variables. *Journal of Business Research, 41*(2), 161-174.

Frambach, R. T., & Schillewaert, N. (2002). Organizational Innovation Adoption: A Multi-Level Framework of Determinants and Opportunities for Future Research. *Journal of Business Research, 55*(2), 163-176.

Galliers, R. D., & Land, F. F. (2002). Choosing Appropriate Information Systems Research Methodologies. In M. D. Myers & D. E. Avison (Eds.), *Qualitative Research in Information Systems*. London: Sage Publications.

Gatignon, H., & Robertson, T. S. (1989). Technology Diffusion: An Empirical Test of Competitive Effects. *Journal of Marketing, 53*(1), 35-49.

Gazette. (2005). RFID in the Pharma supply chain. Retrieved September 2, 2006, from http://www.rfidgazette.org/2005/11/rfid_in_the_pha.html

Gefen, D., Straub, D. W., & Boudreau, M.-C. (2000). Structural Equation Modeling and Regression: Guidelines for Research Practice. *Communications of AIS, 4*(7), 1-77.

Goode, S., & Stevens, K. (2000). An Analysis of the Business Characteristics of Adopters and Non-adopters of World Wide Web technology. *Information Technology and Management, 1*(1-2), 129-154.

Grandon, E., E. , & Pearson, J. M. (2004). Electronic Commerce Adoption: An Empirical Study of Small and Medium US businesses. *Information & Management, 42*(1), 197-215.

Greene, J. (2005). Is Your Hospital Ready for Radio Frequency Identification? *Trustee, 58*(8), 30-31.

Grover, V. (1993). An Empirically Derived Model for the Adoption of Customer-Based Interorganizational Systems. *Decision Sciences, 24*(3), 603-641.

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

Grover, V., Lee, C., & Durand, D. (1994). Analyzing Methodological Rigor of MIS Survey Research from 1980-1989. *Information & Management, 24*(6), 305-317.

Hage, J. (1980). *Theories of Organization*. New York: John Wiley.

Hair, J. F., Anderson, R. E., Tatham, R. E., & Black, W. C. (1998). *Multivariate Data Analysis with Readings*. Englewood Cliffs, NJ: Prentice-Hall.

Harrop, P., & Das, R. (2006). *RFID in Healthcare 2006-2016*. Cambridge, UK: IDTechEx.

Hayduk, I. A. (1987). *Structural equation modeling with LISREL*. Baltimore, MD: John Hopkins University Press.

Hendrickson, D. (2004). Study: RFID in Hospitals Shows ROI Promise. *Mass High Tech, 22*(47), 4.

Hoyle, R. H., & Panter, A. T. (1995). Writing about structural equation models. In R. H. Hoyle (Ed.), *Structural Equation Modeling: Concepts, Issues, and Applications* (pp. 158-176). Newbury Park, CA: Sage Publications.

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

Idleman, L. (2003). *Comparing Responses to Mail and Web-Based Surveys.* Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, IL.

Ilieva, J., Baron, S., & Healey, N. M. (2002). Online Surveys in Marketing Research: Pros and Cons. *International Journal of Market Research, 44*(3), 361-382.

ITU. (2005). Ubiquitous Network Societies: The Case of Radio Frequency Identification. Retrieved January 20, 2006, from http://www.itu.int/osg/spu/ni/ubiquitous/Papers/RFID%20background%20paper.pdf

Janz, B. D., Pitts, M. G., & Otondo, R. F. (2005). Information Systems and Health Care II: Back to the Future with RFID: Lessons Learned - Some Old, Some New. *Communications of the Association for Information Systems, 15*.

Jones, P., Clarke-Hill, C., Hillier, D., & Comfort, D. (2005). The Benefits, Challenges and Impacts of Radio Frequency Identification Technology (RFID) for Retailers in the UK. *Marketing Intelligence & Planning, 23*(4/5), 395-402.

Joreskog, K. G., & Sorbom, D. (1993). *Lisrel 8: A guide to the problem and applications*. Chicago: Scientific Software International.

Kanellos, M. (2005). RFID tags used to track Hurricane Katrina dead. Retrieved September
2, 2006, from http://networks.silicon.com/lans/0,39024663,39152382,00.htm

Kennedy, A. M. (1983). The Adoption and Diffusion of New Industrial Products: A Literature Review. *European Journal of Marketing, 17*(3), 31-88.

Kern, S. E., & Jaron, D. (2003). Healthcare Technology, Economies and Policy: An Evolving Balance. *IEEE Engineering in Medicine and Biology, 22*(1), 16-19.

Kettinger, W. J., & Lee, C. C. (1994). Perceived service quality and user satisfaction with the inf. *Decision Sciences, 25*(5,6), 737-766.

Kimberly, J. R., & Evanisko, M. J. (1981). Organizational Innovation: The Influence of Individual, Organizational, and Contextual Factors on Hospital Adoption of Technological and Administrative Innovations. *Academy of Management Journal, 24*(4), 689-703.

Kuan, K. K. Y., & Chau, P. Y. K. (2001). A Perception-Based Model for EDI Adoption in Small Businesses Using a Technology-Organization-Environment Framework. *Information & Management, 38*(8), 507-521.

Kwon, T., H, & Zmud, R. W. (1987). Underlying the Fragmented Models of Information Systems Implementation. In R. J. Boland & R. A. Hirscheim (Eds.), *Critical issues in Information Systems Research*. New York: John Wiley and Sons.

Lai, F., Hutchinson, J., & Zhang, G. (2005). Radio Frequency Identification (RFID) in China: Opportunities and Challenges. *International Journal of Retail & Distribution Management, 33*(11/12), 905-916.

Lai, V. S. (2001). Intraorganization Communication with Intranets. *Communications of the ACM, 44*(7), 95-100.

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

Lai, V. S., & Guynes, J. L. (1997). An Assessment of the Influence of Organizational Characteristics on Information Technology Adoption Decision: A Discriminative Approach. *IEEE Transactions on Engineering Management, 44*(2), 146-157.

Lee, M., K. O. , & Cheung, C., M. K. . (2004). Internet Retailing Adoption by Small-to-Medium Sized Enterprises (SMEs): A Multiple-Case Study. *Information Systems Frontiers, 6*(4), 385-397.

Levin, S. G., Levin, S. L., & Meisel, J. B. (1987). A Dynamic Analysis of the Adoption of a New Technology: The Case of Optical Scanners. *The Review of Economics and Statistics, 69*(1), 12-17.

Link, A. N., & Bozeman, B. (1991). Innovative Behavior in A Small-Sized Firms. *Small Business Economics, 3*(3), 179-184.

Looi, H. C. (2005). E-Commerce Adoption in Brunei Darussalam: A Quantitative Analysis of Factors Influencing Its Adoption. *Communications of the Association for Information Systems, 15*, 61-81.

Lowenthal, J. N. (1994). *Reengineering the Organization*. Milwaukee: ASQC Quality Press.

Lyytinen, K., & Yoo, Y. (2002). Issues and Challenges in Ubiquitous Computing. *Communications of the ACM, 45*(12), 63-65.

MacCallum, R. C., Browne, M. W., & Sugawara, H. W. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods, 1*, 130-149.

Mahajan, V., Muller, E., & Bass, F. M. (1990). New Product Diffusion Models In Marketing: A Review And Dir. *Journal of Marketing, 54*(1), 1-26.

Mansfield, E., Rapoport, J., Romeo, A., Villani, E., Wagner, S., & Husic, F. (1977). *The Production and Application of New Industrial Technology*. New York: Norton.

March, J. G., & Simon, H. A. (1958). *Organizations*. New York: Wiley.

McDade, S., R. , Olivia, T., A. , & Pirsch, J., A. . (2002). The Organizational Adoption of High-Technology Products "For Use": Effects of Size, Preferences, and Radicalness of Impact. *Industrial Marketing Management, 31*(5), 441-456.

McGinity, M. (2004). RFID: Is This Game of Tag Fair Play? *Communications of the ACM, 47*(1), 15-18.

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

Menon, N. M., Lee, B., & Eldenburg, L. (2000). Productivity of Information Systems in the Healthcare Industry. *Information Systems Research, 11*(1), 83-92.

Meyer, M. (2000). Innovation Roles: From Souls of Fire to Devil's Advocates. *The Journal of Business Communication, 37*(4), 328-347.

Meyers, S., & Marquis, D. G. (1969). *Successful Industrial Innovation*. Washington, D.C: National Science Foundation.

Moch, M. K., & Morse, E. V. (1977). Size, Centralization, and Organizational Adoption of Innovations. *American Sociological Review, 42*(5), 716-725.

Moore, G. C., & Benbasat, I. (1991). Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation. *Information Systems Research, 2*(3), 192-222.

Mowery, D., & Rosenberg, N. (1979). The Influence of Market Demand upon Innovation: A Critical Review of Some Recent Empirical Studies. *Research Policy, 8*, 102-153.

Munro, H., & Noori, H. (1988). Measuring Commitment to New Manufacturing Technology: Integrating Technological Push and Marketing Pull Concepts. *IEEE Transactions on Engineering Management 35*(2), 63-70.

Naibh, M. I., Bloem, J. G., & Poiesz, T. (1997). Conceptual Issues in the Study of Innovation Adoption Behavior. *Advances in Consumer Research, 24*, 1-7.

Nijssen, E. J., & Frambach, R. T. (2001). Determinants of the Adoption of New Product Development Tools by Industrial Firms *Journal of Product Innovation Management, 29*(2), 121-131.

Nord, W. R., & Tucker, S. (1987). *Implementing Routine and Radical Innovation*. Lexington, MA: Lexington Books.

Olshavsky, R. W., & Spreng, R. A. (1996). An Exploratory Study of the Innovation Evaluation Process. *The Journal of Product Innovation Management, 13*(6), 512-529.

Palvia, P., Mao, E., Salam, A. F., & Soliman, K. S. (2003). Management Information Systems Research: What's There in A Methodology? *Communications of the Association for Information Systems, 11*(16), 289-309.

Pare, G., & Raymond, L. (1991). *Measurement of Information Technology Sophistication in SMEs.* Paper presented at the Administrative Sciences Association of Canada Nineteenth Annual Conference, Nigeria Falls, Ontario, Canada.

Peytchev, A., & Crawford, S. (2005). A Typology of Real-Time Validations in Web-Based Surveys. *Social Science Computer Review, 23*(2), 235-249.

Pfeffer, J., & Leblebici, H. (1977). Information Technology and Organizational Structure. *Pacific Sociological Review, 20*(2), 63-70.

Pfeiffer, H. K. C. (1992). *The Diffusion of Electronics Data Interchange*. New York: Springer-Verlag.

Phillips, L. (1966). Patents, Potential Competition and Technical Progress. *American Economic Review, 56*(1/2), 301-310.

Premkumar, G., & Margaret, R. (1999). Adoption of New Information Technologies in Rural Small Businesses. *Omega, 27*(4), 467-484.

Premkumar, G., & Potter, M. (1995). Adoption of Computer Aided Software Engineering (CASE) Technology: An Innovation Adoption Perspective. *ACM SIGMIS Database 26*(2), 105-124.

Rai, A., & Bajwa, D., S. (1997). An Empirical Investigation into Factors Relating to the Adoption of Executive Information Systems: An Analysis of EIS for Collaboration and Decision Support. *Decision Sciences, 28*(4), 939-974.

Rai, A., & Patnayakuni, R. (1996). A Structural Model for CASE Adoption Behavior. *Journal of Management Information Systems, 13*(2), 205-234.

Rappold, J. (2003). The Risks of RFID. *Industrial Engineer, 35*(11), 37-38.

RFID. (2006). The Cost of RFID Equipment. Retrieved April 21, 2006, from http://www.rfidjournal.com/faq/20

Roberts, J. (2004). Memphis, Tenn., Hospital Tests RFID Tag Technology to Track Patients. *Knight Ridder Tribune Business News*, 1.

Robertson, T. S., & Gatignon, H. (1986). Competitive Effects on Technology Diffusion. *Journal of Marketing, 50*(3), 1-12.

Rogers, E. M. (1983). *Diffusion of Innovations* (3 ed.). New York: The Free Press.

Rogers, E. M. (1995). *Diffusion of Innovations* (4 ed.). New York: The Free Press.

Römer, K., Schoch, T., Mattern, F., & Dübendorfer, T. (2004). Smart Identification Frameworks for Ubiquitous Computing Applications. *Wireless Networks, 10*(6), 689-700.

Rundle, R. L. (2000, October 23). Administrative Technology Begins to Take Hold in Healthcare Systems. *The Wall Street Journal,* pp. B1, B6.

Sadler, P. (1996). *Managing Change*. London: Kogan Page.

Saunders, C., & Clark, S. (1992). EDI Adoption and Implementation: A Focus on Interorganizational Linkage. *Information Resource Management Journal, 5*(1), 9-19.

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

Smith, H., & Konsynski, B. (2003). Developments in Practice X: Radio Frequency Identification (RFID) - An Internet for Physical Objects. *Communications of the Association for Information Systems, 12*, 301-311.

Sokol, B. (2005). RFID and Emerging Technologies Market Guide to Healthcare. Retrieved September 1, 2006, from http://www.rfidjournal.com/article/articleview/1534/1/1/

Spera, S. D. (2000). *Transitioning to Web Survey Methods: Lessons from A Cautious Adopter*. Paper presented at the 15th Annual Conference of the Society for Industrial and Organizational Psychology, New Orleans, LA.

Spyglass. (2006). Providers Not Passive about RFID. Retrieved September 5, 2006, from http://healthdatamanagement.com/HDMSearchResultsDetails.cfm?articleId=12499

Stanton, J. M. (1998). An Empirical Assessment of Data Collection Using the Internet. *Personnel Psychology, 51*(3), 709-725.

Straub, D. W., & Beauclair, R. A. (1988). Current and Future Uses of Group Decision Support Systems Technology: Report on a Recent Empirical Study. *Journal of Management Information Systems, 5*(1), 101-116.

Tan, Z., & Ouyang, W. (2003). Globalization and E-commerce: Factors Affecting E-Commerce Diffusion in China. *Communications of the Association for Information Systems, 10*(2), 4-32.

Teo, T., Tan, M., & Wong, K. (1998). A Contingency Model of Internet Adoption in Singapore. *International Journal of Electronic Commerce 2*(2), 95-118.

Teo, T. S. H., & Ranganathan, C. (2004). Adopters and Non-adopters of Business-to-Business Electronic Commerce in Singapore. *Information & Management, 42*(1), 89-102.

Thompson, L. F., Surface, E. A., Martin, D. L., & Sanders, M. G. (2003). From Paper to Pixels: Moving Personnel Surveys to the Web. *Personnel Psychology, 56*(1), 197-227.

Thong, J., & Yap, C. S. (1995). CEO Characteristics, Organizational Characteristics and Information Technology Adoption in Small Businesses. *Omega, 23*(4), 429-442.

Thong, J. Y. L. (1999). An Integrated Model of Information Systems Adoption in Small Businesses. *Journal of Management Information Systems, 15*(4), 187-214.

Tornatzky, L. G., & Fleischer, M. (1990). *The Processes of Technological Innovation*. Lexington, MA: Lexington Books.

Tornatzky, L. G., & Klein, K. J. (1982). Innovation Characteristics and Innovation Adoption-Implementation: A Meta-Analysis of Findings. *IEEE Transactions on Engineering Management, 29*(1), 28-45.

Twist, D. C. (2005). The Impact of Radio Frequency Identification on Supply Chain Facilities. *Journal of Facilities Management, 3*(3), 226-239.

Utterback, J. (1974). Innovation in Industry and the Diffusion of Technology. *Science, 183*(4125), 620-626.

Varshney, U. (2005). Pervasive Healthcare: Applications, Challenges and Wireless Solutions. *Communications of the Association for Information Systems, 16*, 52-72.

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User Acceptance of Information Technology: Toward a Unified View. *MIS Quarterly, 27*(3), 425-478.

Venkatraman, N., & Grant, J. H. (1986). Construct Measurement in Organizational Strategy Research: A Critique and Proposal. *Academy of Management Review, 11*(1), 71-87.

Wang, J.-C., & Tsai, K.-H. (2002). Factors in Taiwanese Firms' Decisions to Adopt Electronic Commerce: An Empirical study. *The World Economy, 25*(8), 1145-1167.

Webster, F. E. c. (1969). New Product Adoption in Industrial Markets: A Framework for Analysis. *Journal of Marketing 33*(3), 35-39.

Weiser, M. (1993). Some Computer Science Issue in Ubiquitous Computing. *Communications of the ACM, 36*(7), 74-84.

Wilson, A. L., Ramamurthy, K., & Nystrom, P. C. (1999). A Multi-Attribute Measure for Innovation Adoption: The Context of Imaging Technology. *IEEE Transactions on Engineering Management, 46*(3), 311-321.

Wolfe, R. A. (1994). Organizational Innovation: Review, Critique and Suggested Research Directions. *The Journal of Management Studies, 31*(3), 405-431.

Yao, J., E. , Xu, X., Liu, C., & Lu, J. (2002). Organizational Size: A Significant Predictor of IT Innovation Adoption. *The Journal of Computer Information Systems, 43*(2), 76-82.

Zaltman, G., Duncan, R., & Holbeck, J. (1973). *Innovations and Organizations*. New York: Wiley & Sons.

Zhao, H., & Co, H. C. (1997). Adoption and Implementation of Advanced Manufacturing Technology in Singapore. *International Journal of Production Economics, 48*(1), 7-19.

Zmud, R. W. (1984). An Examination of 'Push-Pull' Theory Applied to Process Innovation in Knowledge Work. *Management Science, 30*(6), 727-738.

Zuckerman, A. M. (2000). Creating A Version for the Twenty-First Century Healthcare Organization. *Journal of Healthcare Management, 45*(5), 294-305.

APPENDIX A

SURVEY QUESTIONNAIRE

May 4, 2006

Dear Respondents:

The Department of Management and Information Systems at Mississippi State University is conducting a short survey regarding adoption of Radio Frequency Identification (RFID) technology. As part of a major effort to understand RFID adoption, we need your cooperation by responding to this survey, which should take a maximum of 10 minutes. Your responses are extremely important and will be strictly confidential.

Participation in this study is completely voluntary, and you may discontinue your participation at any time without penalty. The data will be held in strict confidence. No reference will be made to the information of individual respondents in any report. Only aggregated and summarized information will be reported. If you would like a copy of the final report of this study, please let us know. We will be happy to send you a copy of the final report.

If you have any questions about this project, please feel free to contact Dr. J.P. Shim at Mississippi State University (662-325-1994) or Cheon-Pyo Lee (662-325-8475). For additional information regarding human participation in research, please feel free to contact the Mississippi State University Regulatory Compliance Office at 662-325-0994.

Your cooperation will be greatly appreciated.

Sincerely yours,

Dr. J.P. Shim
Professor
Management and Information Systems
Mississippi State University
Mississippi State, MS 39762
Tel: (662) 325-1994
Email: jshim@cobilan.msstate.edu

Cheon-Pyo Lee
Ph.D. Candidate
Management and Information Systems
Mississippi State University
Mississippi State, MS 39762
Tel (662) 615-1242
Email: CL183@msstate.edu

Please continue on to the survey.

Part I. Please answer the following questions.

1. At what stage of RFID technology development is your organization currently engaged?

1 Not considering
2 Plan to evaluate
3 Currently evaluating
4 Have evaluated, but do not plan to evaluate
5 Have evaluated, and plan to adopt
6 Currently using RFID Technology

2. If your organization is not currently using RFID, does your organization intend to adopt RFID?

Do not intend to adopt RFID				Definitely Intend to adopt RFID		
1	2	3	4	5	6	7

3. How soon do you anticipate that your hospital will have a RFID system?
1. 1 year or less
2. Within 2 years but over 1 year
3. Within 5 years but over 2 year
4. Over 5 years

Part 2: Please rate the extent to which you agree or disagree with these statements.

		Strongly Disagree *Strongly Agree*
1	Our employees are well satisfied with the existing inventory tracking system.	1 2 3 4 5 6 7
2	Our employees are well satisfied with the existing patient identification system.	1 2 3 4 5 6 7
3	Our patients are well satisfied with the existing patient identification system.	1 2 3 4 5 6 7
4	RFID has no strong advocates in our hospital.	1 2 3 4 5 6 7
5	There are one or more people in our hospital who are enthusiastically pushing for RFID.	1 2 3 4 5 6 7
6	Nobody in our hospital has taken the lead in pushing for the adoption of RFID.	1 2 3 4 5 6 7
7	Our organization has the financial resources to adopt RFID.	1 2 3 4 5 6 7
8	We have very little knowledge about how RFID would be used in our hospital.	1 2 3 4 5 6 7

9	We might use RFID sooner if we knew more about what it could do for our hospital.	1 2 3 4 5 6 7
10	We do not have the technical knowledge and skills to start using RFID.	1 2 3 4 5 6 7
11	The competition among hospitals is very intense.	1 2 3 4 5 6 7

Part 3: Please indicate your opinion each of the following statements.

		Rare *Very Often*
1	The frequency of cost-increase in the healthcare industry	1 2 3 4 5 6 7
		Not at all Significant *Extremely Significant*
2	In the context of your organization's overall information systems budget, how significant would be the cost of developing and implementing RFID technology?	1 2 3 4 5 6 7
		No pressure At all *Extreme Pressure*
3	Please rate the pressure that vendors place on your hospital to adopt RFID.	1 2 3 4 5 6 7
		No Influence *Strong Influence*
4	Please rate the amount of influence vendors, which are currently providing your IT applications, have in your organization's decision whether or not to adopt RFID.	1 2 3 4 5 6 7
		No Influence *Strong Influence*
5	Please rate the amount of influence vendors, which are not currently providing IT applications, have in your organization's decision whether or not to adopt RFID.	1 2 3 4 5 6 7

Part 4: Please rate the importance of achieving each of the following benefits of RFID in terms of your organization's decision as to whether or not to adopt RFID.

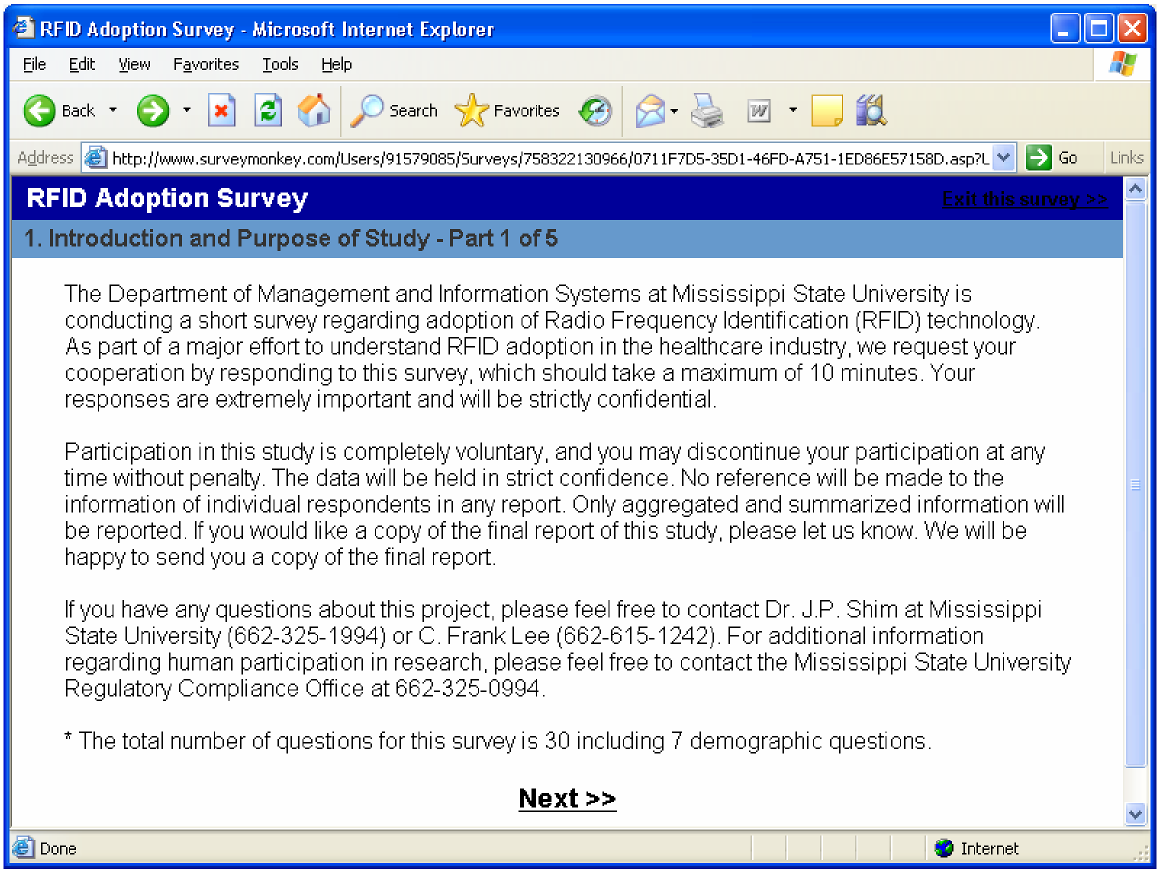
		Not at all Important *Extremely Important*
1	Overhead cost reduction	1 2 3 4 5 6 7
2	Reduced error rates	1 2 3 4 5 6 7
3	Improved customer service	1 2 3 4 5 6 7
4	Improved hospital image	1 2 3 4 5 6 7

Demographics: Please circle the appropriate category:

Gender	M / F
Age	20 – 29 30 – 39 40 – 49 50 – 59 60 +
Hospital size (Number of beds)	1 – 25 26 – 100 101 – 200 201 – 300 301- 400 401 – 500 More than 500
Position	Chief Executive Officer (CEO) Chief Medical Officer (CMO) Chief Information Officer (CIO) Chief Technology Officer (CTO) VP of Information Technology Director of Information Technology Other ( )
Years in professional career	1 – 5 6 – 10 11 – 15 16 – 20 21 – 25 26 – 30 30 +
Years in present position	1 – 5 6 – 10 11 – 15 16 – 20 21 – 25 26 – 30 30 +
Education	High school 2-year college 4 year college Master/MBA Doctorate/MD Other ( )

APPENDIX B

SURVEY WEBSITE



RFID Adoption Survey - Microsoft Internet Explorer

http://www.surveymonkey.com/Users/91579085/Surveys/758322130966/0711F7D5-35D1-46FD-A751-1ED86E57158D.asp?L

RFID Adoption Survey

Exit this survey >>

1. Introduction and Purpose of Study - Part 1 of 5

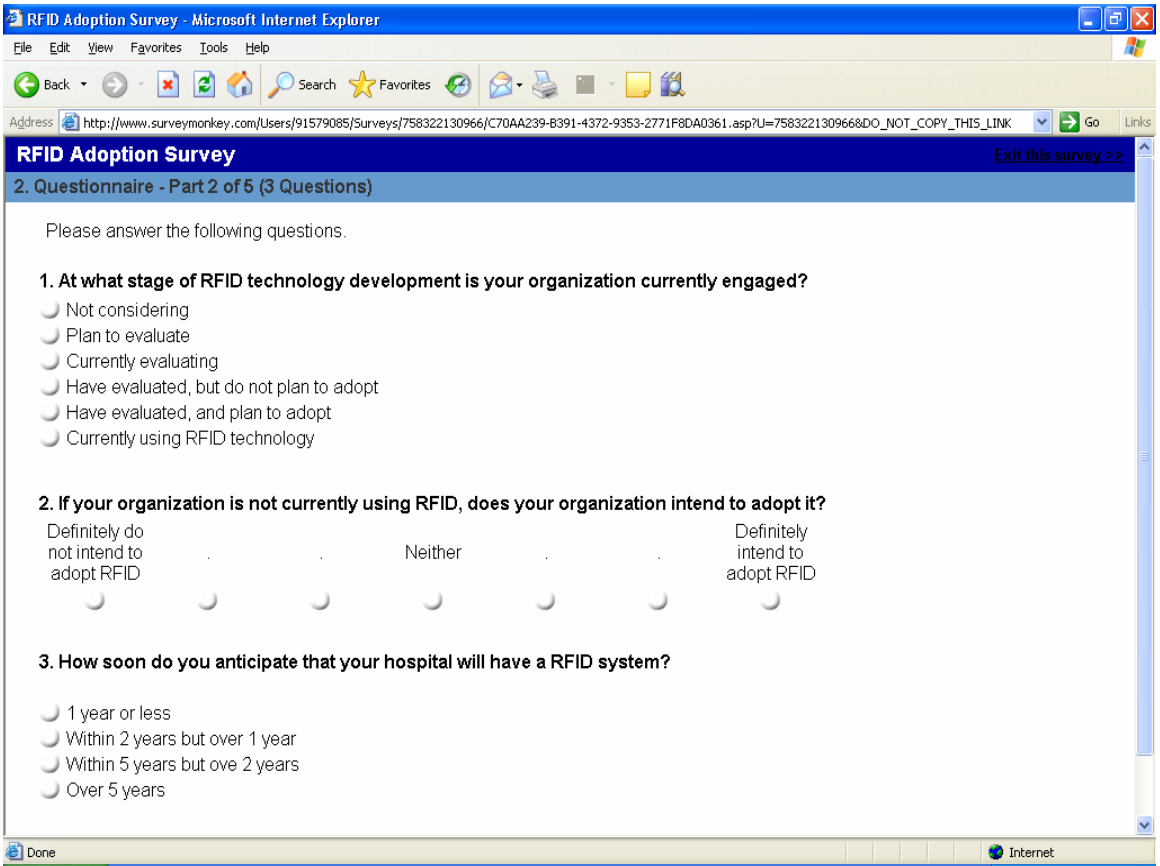
The Department of Management and Information Systems at Mississippi State University is conducting a short survey regarding adoption of Radio Frequency Identification (RFID) technology. As part of a major effort to understand RFID adoption in the healthcare industry, we request your cooperation by responding to this survey, which should take a maximum of 10 minutes. Your responses are extremely important and will be strictly confidential.

Participation in this study is completely voluntary, and you may discontinue your participation at any time without penalty. The data will be held in strict confidence. No reference will be made to the information of individual respondents in any report. Only aggregated and summarized information will be reported. If you would like a copy of the final report of this study, please let us know. We will be happy to send you a copy of the final report.

If you have any questions about this project, please feel free to contact Dr. J.P. Shim at Mississippi State University (662-325-1994) or C. Frank Lee (662-615-1242). For additional information regarding human participation in research, please feel free to contact the Mississippi State University Regulatory Compliance Office at 662-325-0994.

* The total number of questions for this survey is 30 including 7 demographic questions.

Next >>



RFID Adoption Survey - Microsoft Internet Explorer

http://www.surveymonkey.com/Users/91579085/Surveys/758322130966/C70AA239-B391-4372-9353-2771F8DA0361.asp?U=758322130966&DO_NOT_COPY_THIS_LINK

RFID Adoption Survey

Exit this survey >>

2. Questionnaire - Part 2 of 5 (3 Questions)

Please answer the following questions.

1. At what stage of RFID technology development is your organization currently engaged?

- Not considering
- Plan to evaluate
- Currently evaluating
- Have evaluated, but do not plan to adopt
- Have evaluated, and plan to adopt
- Currently using RFID technology

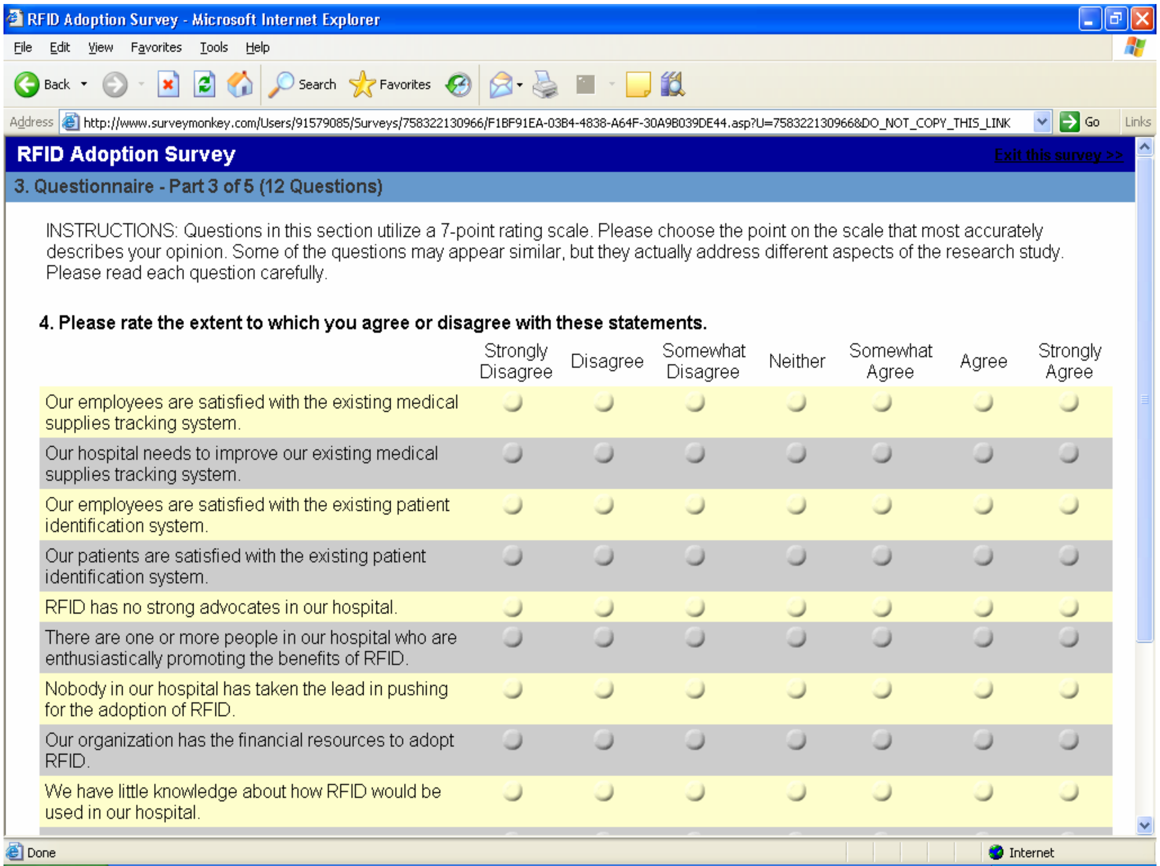
2. If your organization is not currently using RFID, does your organization intend to adopt it?

Definitely do not intend to adopt RFID	.	.	Neither	.	.	Definitely intend to adopt RFID
○	○	○	○	○	○	○

3. How soon do you anticipate that your hospital will have a RFID system?

- 1 year or less
- Within 2 years but over 1 year
- Within 5 years but ove 2 years
- Over 5 years

Done — Internet



RFID Adoption Survey - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address http://www.surveymonkey.com/Users/91579085/Surveys/758322130966/F1BF91EA-03B4-4838-A64F-30A9B039DE44.asp?U=758322130966&DO_NOT_COPY_THIS_LINK

RFID Adoption Survey Exit this survey >>

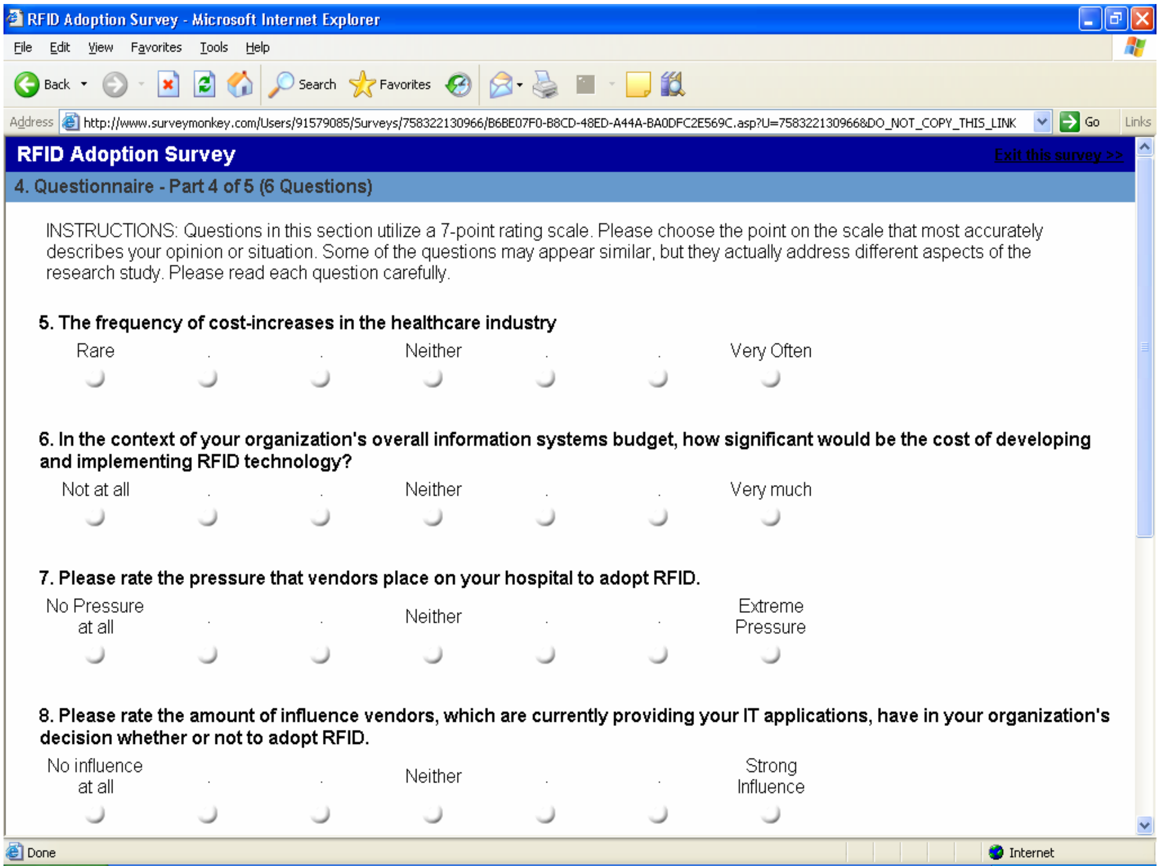
3. Questionnaire - Part 3 of 5 (12 Questions)

INSTRUCTIONS: Questions in this section utilize a 7-point rating scale. Please choose the point on the scale that most accurately describes your opinion. Some of the questions may appear similar, but they actually address different aspects of the research study. Please read each question carefully.

4. Please rate the extent to which you agree or disagree with these statements.

	Strongly Disagree	Disagree	Somewhat Disagree	Neither	Somewhat Agree	Agree	Strongly Agree
Our employees are satisfied with the existing medical supplies tracking system.	○	○	○	○	○	○	○
Our hospital needs to improve our existing medical supplies tracking system.	○	○	○	○	○	○	○
Our employees are satisfied with the existing patient identification system.	○	○	○	○	○	○	○
Our patients are satisfied with the existing patient identification system.	○	○	○	○	○	○	○
RFID has no strong advocates in our hospital.	○	○	○	○	○	○	○
There are one or more people in our hospital who are enthusiastically promoting the benefits of RFID.	○	○	○	○	○	○	○
Nobody in our hospital has taken the lead in pushing for the adoption of RFID.	○	○	○	○	○	○	○
Our organization has the financial resources to adopt RFID.	○	○	○	○	○	○	○
We have little knowledge about how RFID would be used in our hospital.	○	○	○	○	○	○	○

Done Internet



RFID Adoption Survey - Microsoft Internet Explorer

RFID Adoption Survey Exit this survey >>

4. Questionnaire - Part 4 of 5 (6 Questions)

INSTRUCTIONS: Questions in this section utilize a 7-point rating scale. Please choose the point on the scale that most accurately describes your opinion or situation. Some of the questions may appear similar, but they actually address different aspects of the research study. Please read each question carefully.

5. The frequency of cost-increases in the healthcare industry

Rare	.	.	Neither	.	.	Very Often

6. In the context of your organization's overall information systems budget, how significant would be the cost of developing and implementing RFID technology?

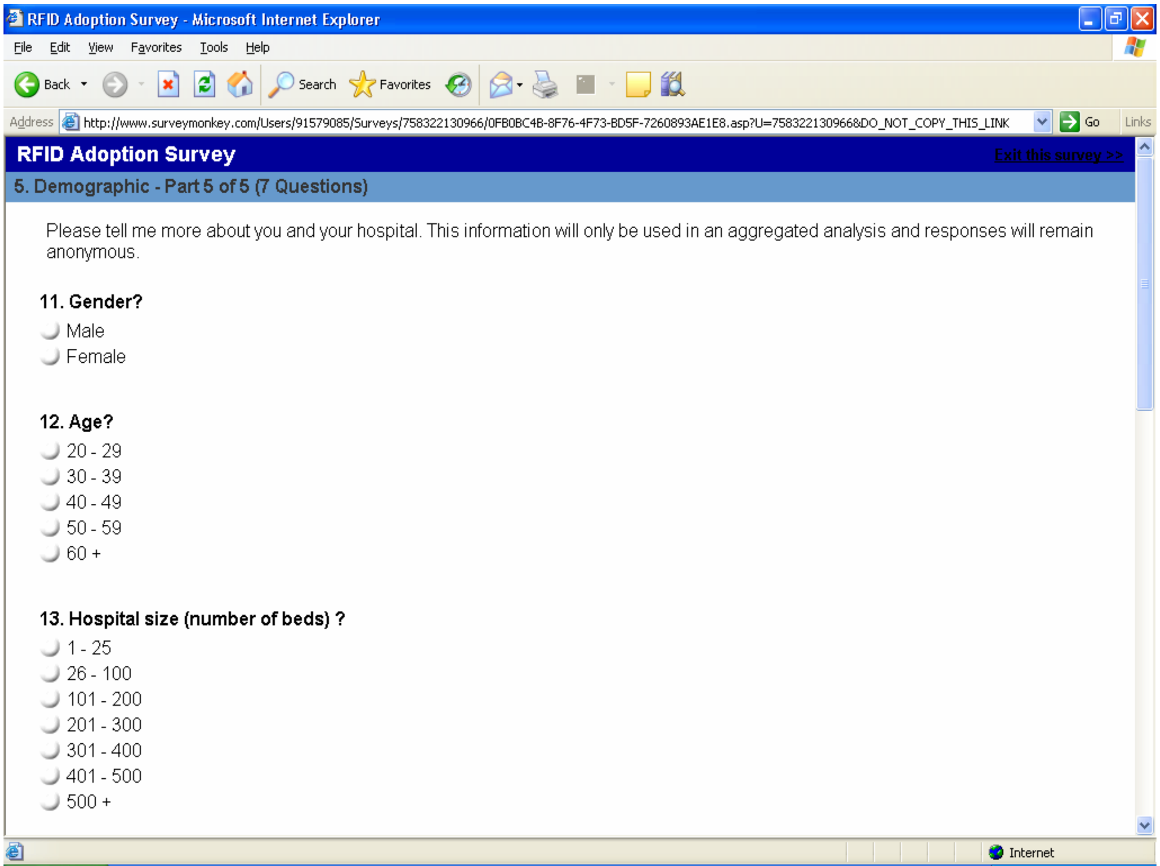
Not at all	.	.	Neither	.	.	Very much

7. Please rate the pressure that vendors place on your hospital to adopt RFID.

No Pressure at all	.	.	Neither	.	.	Extreme Pressure

8. Please rate the amount of influence vendors, which are currently providing your IT applications, have in your organization's decision whether or not to adopt RFID.

No influence at all	.	.	Neither	.	.	Strong Influence



RFID Adoption Survey - Microsoft Internet Explorer

RFID Adoption Survey

Exit this survey >>

5. Demographic - Part 5 of 5 (7 Questions)

Please tell me more about you and your hospital. This information will only be used in an aggregated analysis and responses will remain anonymous.

11. Gender?

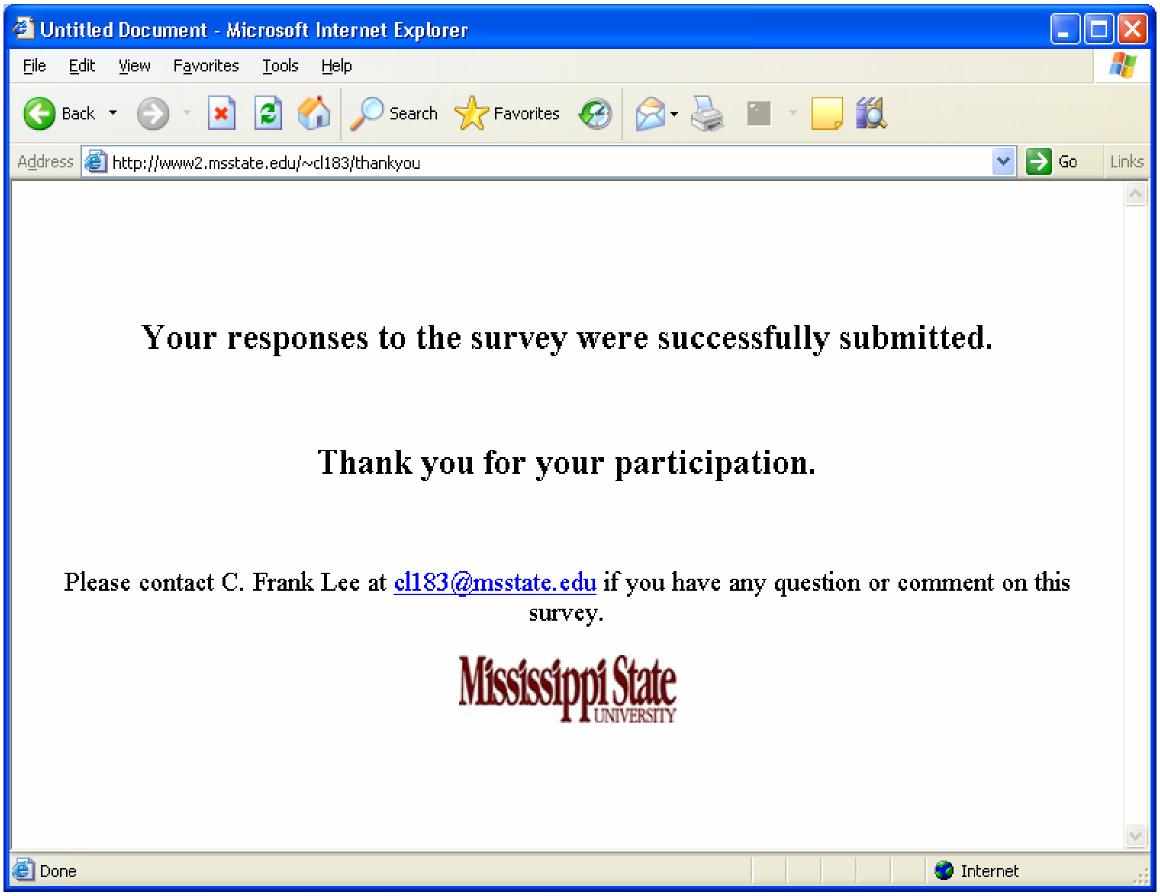
- Male
- Female

12. Age?

- 20 - 29
- 30 - 39
- 40 - 49
- 50 - 59
- 60 +

13. Hospital size (number of beds) ?

- 1 - 25
- 26 - 100
- 101 - 200
- 201 - 300
- 301 - 400
- 401 - 500
- 500 +


Untitled Document - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Search Favorites
Address http://www2.msstate.edu/~cl183/thankyou
Go Links
Your responses to the survey were successfully submitted.
Thank you for your participation.
Please contact C. Frank Lee at cl183@msstate.edu if you have any question or comment on this survey.
Mississippi State
UNIVERSITY
Done
Internet