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Qing Cao
*Texas Tech University*

Jeff Baker
*American University of Sharjah*

James Wetherbe
*Texas Tech University*

Vicky Gu
*Texas Tech University*

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# ORGANIZATIONAL ADOPTION OF INNOVATION: IDENTIFYING FACTORS THAT INFLUENCE RFID ADOPTION IN THE HEALTHCARE INDUSTRY

Cao, Qing, Rawls College of Business Administration, Texas Tech University, Box 42101, Lubbock, TX, USA, 79409-2101, qing.cao@ttu.edu

Baker, Jeff, School of Business and Management, American University of Sharjah, PO Box 26666, Sharjah, United Arab Emirates, jbaker@aus.edu

Wetherbe, James C., Rawls College of Business Administration, Texas Tech University, Box 42101, Lubbock, TX, USA, 79409-2101, jim.wetherbe@ttu.edu

Gu, Ching (Vicky), Rawls College of Business Administration, Texas Tech University, Box 42101, Lubbock, TX, USA, 79409-2101, vickyching.gu@ttu.edu

## Abstract

*In this paper, we endeavor to make two specific contributions to research on the adoption of innovations. First, we propose a typology of innovations and suggest that theory-driven adoption research should strive to match innovation types with theories that have related explanatory emphases. We propose this overarching framework for innovation adoption research because different innovations have different characteristics, and thus, it seems unlikely that a single theoretical explanation can be developed to describe the adoption and diffusion of all types of innovations. Second, we develop a model that identifies the factors that influence the adoption of one particular type of innovation: RFID. Our research model is built upon the Technology – Organization – Environment (TOE) theoretical framework, and is tested using PLS on a dataset of US firms (N = 168). We also highlight an interesting empirical result that indicates that while researchers have generally argued that dissatisfaction with existing information systems drives adoption of new systems, in some cases it is satisfaction that drives the adoption of new systems.*

*Keywords: Adoption, Technology Diffusion, RFID, Technology-Organization-Environment Framework, Healthcare*

# 1 Introduction

One way in which organizations can cope with the competitive pressures of today's rapidly changing business environment is to adopt innovations that will enhance their competitiveness. Much has been written about the adoption of innovations by individuals (Venkatesh et al. 2003), but questions still remain about the process of organizational adoption. What factors influence the adoption of innovations by organizations? And at a broader level, what theory or theories explain the adoption of innovation in organizations? These two research questions are the focus of our ongoing research project.

The topic that we focus on in this paper is the adoption of a specific type of innovation, RFID, in a specific industry, healthcare. Healthcare is an important industry to examine because of its significant place in the world economy. The U.S. spends more per capita on healthcare than any other nation, with spending exceeding 16% of gross domestic product (GDP). Similar trends exist in European nations, such as Sweden and Germany, where over 10% of GDP is spent on healthcare (Smith et al. 2006; Steinwald 2007). With governments less able and less willing to pay the high cost of healthcare, efficiencies must be identified in this industry. RFID is an innovative technology that has the potential to help control expenditures. The benefits of RFID include improved efficiency, better decision-making, higher rates of asset utilization, and reduced potential for human error (Janz et al. 2005; Lee and Shim 2007), all of which are crucial given the economic and political concerns pertaining to increasing health care costs.

The structure of this paper is as follows. Section 2 includes a review and synthesis of foregoing research that reveals how the type of innovation being investigated determines the appropriate theoretical basis for a study. We then describe why the technology-organization-environment (TOE) framework is an appropriate basis for the investigation of RFID adoption. Our model and hypotheses are presented in section 3. Section 4 contains a description of our survey methodology, our data, and our partial least squares (PLS) analysis. Our results are discussed in section 5, the most interesting of which include the finding that dissatisfaction with existing information systems does not lead to the adoption of new systems. We explore possible reasons for this result.

# 2 Literature Review

## 2.1 Adoption of Innovations

Organizational innovation is defined simply as "the adoption of an idea or behavior that is new to the organization adopting it" (Daft 1978, p. 197). IS innovations can be classified as administrative, business process, and/or technical innovations. *Administrative innovations* in IS facilitate the planning, control, and coordination of the organization, or serve the same purposes within some subunit of the organization (Daft 1978; Zmud 1982). Examples of administrative innovations in IS include the creation of the CIO position and database administrator (DBA) function within organizations, the departmentalization of the software maintenance function, and the choice to outsource the IS function of a firm (Ang and Cummings 1997; Gillenson 1985; Swanson 1994; Swanson and Beath 1990). *Business process innovations* are changes to the methods and procedures that a firm uses to produce a specific output such as a product or service (Davenport 1993). Examples of business process innovations include the adoption of application prototyping methods (Swanson 1994), the use of information systems for accounting, payroll, and HR functions (Swanson 1994), and the use of MRP and ERP systems to computerize business processes (Cooper and Zmud 1990; Swanson 1994). *Technical innovations* are changes to the computer hardware, software systems, and data communications technology that the organization uses. The adoption of e-business is one example of a technical innovation. The development of the Internet and its related standards and technologies, the ubiquity of the web browser, widely-available broadband connectivity, and wireless

Internet access have paved the way for business transactions to be conducted online (Zhu et al. 2003; Zhu and Kraemer 2005; Zhu et al. 2006a; Zhu et al. 2006b; Zhu et al. 2004). Other similar examples include the use of inter-organizational systems such as electronic data interchange (EDI) (Premkumar et al. 1994), and the adoption of open systems (Chau and Tam 1997).

With different types of innovations to study, many researchers have noted that it is unlikely that a single theoretical explanation for the organizational adoption and diffusion of innovations can be developed (Kimberly and Evanisko 1981; Lai and Guynes 1997; Lee and Shim 2007; Thong 1999; Zhu et al. 2006b). We observe that the organizational adoption of administrative innovations has been investigated using theories that explain organizational forms and practices, which are often drawn from the fields of management and organizational psychology. Examples of such research include the use of institutional theory to study the outsourcing of the IS function (Ang and Cummings 1997), and the use of Galbraith's theory of organizational design to study the departmentalization of software development and maintenance (Swanson 1994). When researching the adoption of business process innovations, theories that account for the type of tasks that are being performed in the business processes have been considered. Task-technology fit and the work upon which it is built are examples (Cooper and Zmud 1990; Goodhue and Thompson 1995). Finally, the study of technical innovations has been undertaken using theories that explicitly take into account the characteristics of the particular technology (Chau and Tam 1997; Chwelos et al. 2001). Studies of the adoption of open systems use the technology-organization-environment (TOE) framework (Chau and Tam 1997), as does an extensive research program to study the adoption of e-business (Zhu et al. 2003; Zhu and Kraemer 2005; Zhu et al. 2006b; Zhu et al. 2004). Also, the adoption of electronic data interchange (EDI) has been investigated using the diffusion of innovations theory (Premkumar et al. 1994).

RFID, the focus of this study, can be classified as a technical innovation, one that represents a change to the hardware, systems, and infrastructure of the organization. RFID tags represent new hardware items, devices that are being engineered and refined to be used by a firm to track assets and other business objects. RFID is widely seen as a replacement for bar-coding because it has a number of technological advantages, including eliminating the need for line of sight to detect a tag, allowing simultaneous identification of multiple tags, and increased data storage and data manipulation (Hardgrave et al. 2008). RFID adoption also entails the development of new information systems that include not only RFID tags, but also wireless sensors and software systems to manage the data collected from the tags. Furthermore, the new wireless networks that are being built represent changes to the IT infrastructure of the firm.

We argue that the TOE framework is an appropriate theory for the study of RFID adoption for two reasons. First, as we have mentioned, RFID is primarily a technical innovation, and the TOE framework is a theory that explicitly takes into account the technologies that are available to the firm in an adoption decision. Second, the precedent in prior literature is to examine interorganizational systems, a type of technical innovation, using the TOE framework (e.g. (Chwelos et al. 2001; Grover 1993; Iacovou et al. 1995; Kuan and Chau 2001; Thong 1999)). Because RFID enables the transfer of information to partners along the supply chain, it is a type of interorganizational system (Sharma et al. 2007). Thus, we believe that the TOE framework is an appropriate choice for this research.

## 2.2 The Technology – Organization – Environment Framework

The technology-organization-environment (TOE) framework (Tornatzky and Fleischer 1990) explains that three different contexts influence adoption decisions. First, the *technological context* includes the internal and external technologies that are relevant to the firm. Second, the *organizational context* refers to the characteristics and resources of the firm, including the firm's size, degree of centralization, degree of formalization, managerial structure, human resources, amount of slack resources, and linkages among employees. Third and finally, the *environmental context* includes the size and structure of the industry, the firm's competitors, the regulatory environment, the macroeconomic context, and the regulatory environment. These three elements present "both constraints and opportunities for technological innovation" (Tornatzky and Fleischer 1990, p. 154). The TOE framework aligns with innovation diffusion theory (Rogers 1995), which explains that technological characteristics of the innovation, as well as internal and external characteristics of the organization, are all related to the adoption of innovations (Zhu and Kraemer 2005). Extant research has demonstrated that the TOE model has broad applicability and possesses explanatory power across a number of technological, industrial, and national/cultural contexts (Baker 2011).

# 3 Hypothesis Development

Perceptions about the attributes and benefits of innovations primarily determine whether or not the innovation will be adopted (Rogers 1995). Perceived benefits have been investigated in empirical adoption research, and have been broadly supported (Chau and Tam 1997; Kuan and Chau 2001; Lee and Shim 2007). Perceived benefits are also similar to the term "relative advantage" that has been included and supported in other adoption studies (Grover 1993; Lee and Shim 2007; Thong 1999).

The stated benefits of RFID technology include direct benefits such as improved tracking of assets, which can lead to higher utilization rates of equipment, and more detailed data on supply chain transactions. Both can enable firms to identify inefficiencies, increase computerization of object tracking, and reduce the amount of human oversight and associated labor cost (Borriello 2005; Want 2004). Indirect benefits can result from more accurate patient charts, better tracking of patients within hospitals, cost savings, and more timely treatments for patients. This has the potential to improve patient care and health, reduce mortality, and improve patient satisfaction (Janz et al. 2005; Wang et al. 2006). We therefore present the following hypothesis:

> *HYPOTHESIS 1A: Higher levels of perceived benefits of RFID are positively associated with adoption of RFID in healthcare organizations.*

RFID adoption is not without challenges. There are technical difficulties such as detecting a tag when it is affixed to metallic or liquid-filled objects (Niederman et al. 2007; Want 2004). Related issues arise due to reflection, refraction, and dissipation of RFID signals as they pass through walls, doors, and other equipment. This problem has been observed to be particularly acute in healthcare organizations (Janz et al. 2005), where buildings have more interior walls than warehouses, the most common setting for RFID use. Additionally, there are problems associated with detecting tags that are in storage and not currently assigned to objects (Janz et al. 2005). Perhaps the two greatest barriers to the adoption of RFID is the cost of the tags (Curtin et al. 2007), and the difficulty of protecting personal information stored on tags (Janz et al. 2005). In a healthcare setting, where patient privacy is tremendously important, solutions are needed to ensure security.

These barriers are not insignificant. In each of these situations, the cost-benefit calculations must be performed by the hospital. Where barriers cannot be removed, where problems cannot be solved, or where costs are seen as too high, adoption will be less likely. Therefore, we hypothesize:

> *HYPOTHESIS 1B: Higher levels of perceived barriers to RFID are negatively associated with adoption of RFID in healthcare organizations.*

In addition to the benefits of and barriers to RFID, the IT competence of an organization is also part of the technological context that promotes (or inhibits) adoption (Zhu and Kraemer 2005). IT competence includes infrastructure and technical skills, both of which are important for new innovations to be adopted (Kwon and Zmud 1987; Mata et al. 1995; Thong 1999). IT competence even extends to non-IT professionals within the organization, a group that has been shown to be more likely to support and accept new technologies when they have a relatively high level of IT knowledge about technological innovations (Ettlie 1990; Mehrtens et al. 2001). Firms with a high degree of IT competence are better-prepared and perhaps more confident to implement and use RFID in their organization. They possess a larger installed base of technology that RFID can be built upon and integrated with; they also have the skills to implement RFID and the knowledge to leverage the data that it generates. For these reasons, we hypothesize, *HYPOTHESIS 1C: Higher levels of IT competence are positively associated with adoption of RFID in healthcare organizations.*

IT infrastructure is complex when a wide variety of computer hardware, operating systems, data standards, security procedures, and unintegrated systems are in place in an organization (Chau and Tam 1997). We argue that a complex infrastructure creates difficulties in adopting a new technology such as RFID. In contrast, a less-complex infrastructure presents a simplified technical environment, one where the challenges of a new system implementation are reduced. Fewer potential points of failure exist in linking the new RFID system to existing systems. If a small-scale test or phased implementation of RFID is to be performed, a simple infrastructure creates an ideal environment, one where issues are simpler to address as there are fewer systems with which to interact. For each of these reasons, we argue that it is disadvantageous for an organization to have a complex IT infrastructure. Therefore, we hypothesize:

*HYPOTHESIS 2A: Higher levels of IT infrastructure complexity are negatively associated with adoption of RFID in healthcare organizations.*

Researchers have traditionally argued that dissatisfaction with existing technology is a factor that increases the likelihood of adoption of an innovation (Chau and Tam 1997). When organizations find that the performance of existing systems does not met their needs and expectations, they search for new technology solutions. Thus, it has been argued that a low level of satisfaction with existing systems provides an impetus to adopt new systems. Empirical support for this assertion has been found as well (Chau and Tam 1997).

*HYPOTHESIS 2B: Higher levels of satisfaction with existing systems are negatively associated with adoption of RFID in healthcare organizations.*

Financial resources have been highlighted as an important factor in the implementation of new technologies (Iacovou et al. 1995; Ramamurthy et al. 1999). Successful IS implementation takes place when resources are directed towards first, motivating, and then to sustaining, the implementation project (Kwon and Zmud 1987). Furthermore, an RFID adoption project will require an investment in hardware, software, and training. Simply put, firms possessing the financial resources to undertake such an implementation project, and the funds to apply to follow-on projects to leverage the data, are more likely to do so than firms without those resources. For this reason, we hypothesize:

*HYPOTHESIS 2C: Higher levels of financial resources are positively associated with adoption of RFID in healthcare organizations.*

Market uncertainty has been explored in several TOE-based studies, with virtually all finding support for the importance of this factor (Chau and Tam 1997; Grover 1993; Thong 1999; Zhu et al. 2003; Zhu and Kraemer 2005; Zhu et al. 2006b; Zhu et al. 2004). We echo this earlier work and suggest that IT innovations are often adopted in situations of market uncertainty because IT is seen as one way that organizations can become more agile and better-positioned to respond to emerging competitive threats (Sambamurthy 2000; Sambamurthy et al. 2003). Similarly, it has been explained that innovations allow firms to achieve an edge in competitive environments (Chau and Tam 1997).

Clearly market uncertainty is a characteristic of the healthcare industry. Hospitals face increasing costs, decreases in government funding, reduced insurance and job benefits payments (Janz et al. 2005). There is additional uncertainty in healthcare because of changing government regulation, patient privacy initiatives, transition to electronic health records, consolidation in the industry, and contentious relationships between physicians, hospitals, and insurers (Amar 2008; Baker et al. 2008; Janz et al. 2005). RFID presents a way for healthcare organizations to improve efficiency, improve patient care, and be seen as a market leader, thus helping the healthcare firm to position itself well in an uncertain environment. For these reasons, we hypothesize:

*HYPOTHESIS 3: Higher levels of market uncertainty are positively associated with the adoption of RFID in healthcare organizations.*

# 4 Methodology

## 4.1 Sample

The unit of analysis in this study is the organization, and as such, the subjects for this study are the IT decision makers within the organization such as the CIO, CTO, or the Director of IT. Contact information was drawn from a list of attendees of the 2007 Healthcare CIO Summit in the United States. Surveys were administered where adoption was measured as a binary dependent variable. A total of 800 questionnaires were mailed out and 168 usable responses were received (21% response rate). To examine the possibility of nonresponse bias, the distributions of the number of employees and the number of hospital beds were compared. No statistically significant differences were detected at the $p < 0.1$ level (Flynn et al. 1994). Descriptive statistics for our sample appear in Table 1. The specific RFID applications that hospitals plan to adopt or have already adopted are listed in Table 2.

| | Number of Respondents | Percentage of Respondents |
|---|---|---|
| Hospital Tax Status | | |
| For-profit | 62 | 37% |
| Non-profit | 106 | 63% |
| Geographic Location | | |
| Rural | 55 | 33% |
| Urban | 113 | 67% |
| Size (# of Beds) | | |
| Less than 300 | 88 | 52% |
| 300-500 | 58 | 35% |
| More than 500 | 22 | 13% |
| Respondent's Position | | |
| CIO | 102 | 61% |
| CTO | 66 | 39% |
| IT Director | | |
| Avg. yrs. in position | 5.1 years | |

*Table 1. Descriptive Statistics (N = 168)*

| RFID Applications | |
|---|---|
| Tracking and tracing of patients and medical staff | 132 (79% of sample) |
| Patient identification | 93 (55%) |
| Tracking and tracing of medical equipment | 64 (38%) |
| Tracking and tracing of medical products | 57 (34%) |
| Inventory management | 38 (23%) |
| Procurement management | 29 (17%) |

*Table 2. RFID Applications Planned or in Use*

## 4.2 Validity and Reliability

In this study, overall instrument validity is assessed by evaluating the results of content validity, criterion-related validity, convergent validity, construct validity, and reliability tests (Boudreau et al. 2001; Straub 1989). The survey questionnaire used in this study was based on innovation and organizational adoption literature, as well as RFID research. A total of 27 items (12 formative, 15 reflective) measure the constructs in our model. Items for each dimension were adapted from prior research (Chau and Tam 1997; Hong and Cao 2009; Lee and Shim 2007). PLS was used to assess the psychometric properties of all scales used in the study and the structural model. PLS was chosen because some of our constructs are formative, and LISREL is not well-suited to modelling such constructs. Control variables in our study include firm size, tax status (for-profit or nonprofit), and geographic location (urban or rural). A pilot study was conducted by distributing a preliminary questionnaire to IT executives of several hospitals in a city in the Midwestern US. IT executives were asked to examine the degree to which the preliminary questionnaire captured the constructs and how easy or difficult the preliminary questionnaire was to complete. Based upon results from the preliminary questionnaire, a revised questionnaire was constructed and used to gather responses from IT executives of hospitals. Content validity was thus established by carefully defining the topic of concern, describing items to be scaled, developing the scales to be used, and using a panel of experts to judge the quality of the instrument (Cooper and Schindler 1998).

Criterion-related validity is the degree to which the survey instrument correlates with one or more criteria. The expected cross validity index (ECVI) is one measure for criterion-related validity (Kline 1998). The ECVI values of all constructs are well below the value of 1 that has been described as "adequate". The unidimensionality test provides evidence of a single latent construct (Flynn et al. 1990). A confirmatory factor analysis (CFA) was conducted in PLS to assess item loadings, discriminant validity, and internal consistency of all scales. This study employs CFA in PLS to test the unidimensionality of the constructs because CFA is deemed to be a better technique for assessing unidimensionality than EFA (Bagozzi 1980; O'Leary-Kelly and Vokurka 1998). Standardized loadings for scale items ranged from 0.72 to 0.90 (Table 3), which are in the moderate-to-high range. The t-values for scale items ranged from 7.85 to 14.25, exceeding the 2.0 rule of thumb. All loadings were significant ($p < 0.01$).

| Construct (Reliability) | Indicator | Loadings | Convergent Validity (t-statistic) |
|---|---|---|---|
| Benefits of RFID (0.82) | Ben1 | 0.74** | 8.21 |
| | Ben2 | 0.78** | 8.83 |
| | Ben3 | 0.81** | 9.94 |
| | Ben4 | 0.75** | 9.38 |
| Barriers of RFID (0.84) | Bar1 | 0.77** | 8.89 |
| | Bar2 | 0.80** | 9.52 |
| | Bar3 | 0.72** | 7.85 |
| | Bar4 | 0.90** | 14.25 |
| | Bar5 | 0.76** | 9.46 |
| IT Competence (0.82) | ITC1 | 0.75** | 10.02 |
| | ITC2 | 0.72** | 8.75 |
| | ITC3 | 0.78** | 8.90 |
| | ITC4 | 0.86** | 12.87 |
| IT Infrastructure Complexity (0.84) | Com1 | 0.80** | 10.66 |
| | Com2 | 0.82** | 10.82 |
| | Com3 | 0.78** | 8.82 |
| Satisfaction with Existing System (0.82) | Sat1 | 0.81** | 9.16 |
| | Sat2 | 0.78** | 8.37 |
| Financial Resources (0.84) | Res1 | 0.80** | 10.19 |
| | Res2 | 0.81** | 11.25 |
| Market Uncertainty (0.88) | Env1 | 0.84** | 11.76 |
| | Env2 | 0.85** | 12.08 |
| | Env3 | 0.79** | 9.89 |
| | Env4 | 0.82** | 10.34 |
| | Env5 | 0.85** | 12.31 |
| | Env6 | 0.83** | 11.45 |
| Adopt (n/a) | Ado1 | n/a | n/a |

**p<0.01

*Table 3. Reliability, Factor Loadings, and Convergent Validity*

To assess discriminant validity (Chin 1998), (1) indicators should load more strongly on their corresponding construct than on other constructs in the model, and (2) the square root of the average variance extracted (AVE) should be larger than the inter-construct correlations (Chin 1998). Results of the CFA show that, without exception, all indicators load more highly on their own construct than on other constructs. Furthermore, as shown in Table 4, all constructs share more variance with their indicators than with other constructs. Thus, these results point to the discriminant validity of our scales.

| | Construct (Reliability) | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| 1. Benefits of RFID | .82 | .72 | | | | | | |
| 2. Barriers to RFID | .84 | -0.28 | .73 | | | | | |
| 3. IT Competence | .82 | 0.28 | -0.25 | .78 | | | | |
| 4. IT Infrastructure Complexity | .84 | -0.39 | 0.31 | -0.18 | .74 | | | |
| 5. Satisfaction with Existing System | .82 | 0.19 | -0.23 | 0.15 | -0.35 | .75 | | |
| 6. Financial Resources | .84 | 0.14 | -0.15 | 0.42 | -0.2 | 0.21 | .73 | |
| 7. Market Uncertainty | .88 | 0.22 | -0.18 | 0.25 | -0.19 | 0.37 | 0.17 | .77 |

*Table 4. Correlation Matrices*

## 4.3 The Structural Model

In this study, partial least squares (PLS) was used in data analyses for three reasons. First, our research model is deemed to be a formative model as it contains three formative constructs (Benefits of RFID, Barriers to RFID and IT Infrastructure Complexity) (Marakas G.M. et al. 2007). Covariance-based SEM approaches such as LISREL are not suitable for formative models in that they allows exogenous constructs to freely correlate with one another (Petter et al. 2007). PLS is a viable alternative approach to analyze formative models as it aims to maximize the explained variance of endogenous variables (Gefen et al. 2000). Second, PLS is a component-based approach and as such it is relatively robust to deviations from a multivariate distribution and does not require a large sample size (Chin 1998). Third and finally, PLS makes for stronger predictions as compared with LISREL (i.e., a covariance-based SEM) and this research is prediction-oriented in nature. In our study, we used PLS-Graph 3.0 to examine the structural model and our hypotheses.

The performance of the model was assessed by looking at the $R^2$ as PLS does not provide an overall goodness of fit index. Table 5 shows the results of our research. The technological context, organizational context, and environmental context (H1a, H1b, H1c, H2a, H2b, H2c, as well as H3) clearly impact hospitals' decision to adopt RFID. Thus, our results support the TOE model. None of our control variables are statistically significant.

| | |
|---|---|
| Technological Context | |
| Benefits of RFID | 0.31** |
| Barriers to RFID | -0.20* |
| IT Competence | 0.29** |
| Organizational Context | |
| IT Infrastructure Complexity | -0.18* |
| Satisfaction with Existing System | 0.25** |
| Financial Resources | 0.19* |
| Environmental Context | |
| Market Uncertainty | 0.26** |
| Control Variables | |
| Firm Size | 0.06 |
| Tax Status | 0.05 |
| Geographic Location | 0.06 |
| $R^2$ | 0.27** |
| F Statistic | 24.41** |

*$p < 0.05$, **$p<0.01$

*Table 5. PLS Results (N = 168, Dependent Variable: RFID Adoption)*

# 5 Discussion

It has been repeatedly observed that it is unlikely that a single theoretical explanation for the organizational adoption of innovations can be developed (Kimberly and Evanisko 1981; Lai and Guynes 1997; Lee and Shim 2007; Thong 1999; Zhu et al. 2006b). In light of this difficulty finding a comprehensive explanation for adoption of innovations, we suggest an overarching framework as a guide for theory-driven research in this area. We argue that a match that should be pursued between innovation type and theoretical explanation. Innovations in IS are characterized in this study as either administrative, business process, or technical innovations. Researchers who are investigating administrative innovations will find the most useful theoretical explanations for adoption within the fields of management and organizational psychology. Researchers that focus on the adoption of business process innovation should make use of theories that focus specifically on the tasks that are performed as the business process is executed. And researchers that study technical innovations should utilize theories that account for the characteristics of a particular technology (Chau and Tam 1997; Chwelos et al. 2001). We argue that mismatch between innovation type and theory will prevent key factors influencing adoption from being elucidated. Our framework provides a reminder that theory must be related to the innovation type and to its characteristics in order to develop a model with adequate explanatory power, and in order for researchers to add to the IS field's body of knowledge. This framework and its associated recommendations for matching theories with innovation types is the first contribution of this research.

The second contribution of this study is our integrated model of adoption for one particular type of innovation, RFID, in a healthcare context. We explain that RFID is a technical innovation, the adoption of which can be explained with the TOE framework that has been applied in the study of other technical innovations. All but one of our hypotheses were supported, indicating strong support for our model and our list of characteristics that influence RFID adoption.

As we have noted in the abstract and introduction, one unexpected finding from our study is that satisfaction with existing systems is positively associated with adoption of RFID. This was unexpected, runs counter to established literature, and at first appeared counter-intuitive. A closer inspection reveals why this result is both interesting and informative. In the healthcare context, RFID can be understood as the "next generation" of tracking technologies. That is, it can be understood as providing an incremental technological change within the organization (Hardgrave et al. 2008). When organizations that use earlier-generation technologies such as bar-coding are satisfied with their system, they are likely to invest in incremental upgrades. In fact, it is precisely this opinion that was expressed in an interview that followed our quantitative data collection. One of our subjects, the CIO of a hospital system headquartered in the midwestern United States stated, "We feel that the knowledge we gained from using the previous bar-coding system is very useful for implementing the current RFID system and we also believe that the RFID system can provide us with improved efficiency, reduced human intervention, and improved customer experience."

From a theoretical perspective, we note that innovations have been described as one of three types, creating incremental, synthetic, or discontinuous changes (Tornatzky and Fleischer 1990; Tushman and Nadler 1986). When an incremental change will result from an innovation, and when an incremental change is all that is desired by an organization, we argue that it is satisfaction with the existing technology, not dissatisfaction, that will drive adoption. In our context, users who are dissatisfied with their existing tracking systems will not recognize value in tracking assets or other business objects, and will be less likely to adopt new tracking systems such as RFID. Thus, we contend that if an organization is satisfied with existing systems, it is because they have recognized benefits from those systems. And when a "next-generation" or follow-on technology creates incremental change, satisfaction with existing systems will drive adoption.

We acknowledge that our assertion that satisfaction drives the adoption of innovations that produce incremental change while dissatisfaction drives the adoption of innovations that create synthetic or discontinuous change, should be treated cautiously at this point, and bears further investigation.

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