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ORGANIZATIONAL-LEVEL RFID TECHNOLOGY ADOPTION IN THE HOSPITALITY INDUSTRY

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The purpose of this study was to explore the influence of technological, organizational, and environmental factors on the hospitality operators' adoption of radio frequency identification (RFID) technology. Based on a sample of 125 technology decision makers at major hospitality corporations in the US, the results of the study indicated that except stakeholder pressure, all of the technological, organizational, and environmental factors had significant impact on hospitality operators' intention to adopt RFID technology. By identifying the factors affecting hospitality operators' RFID technology adoption decisions, technology vendors could design appropriate marketing strategies to reach potential adopters and they could educate these adopters better on the benefits of RFID technologies in order to increase the usage of these technologies in the hospitality industry.

Key words: Radio frequency identification (RFID); Technology adoption; Hospitality

Introduction

Adopting and implementing appropriate technology has become a source of competitive advantage for organizations. One such recent technology is radio frequency identification (RFID). **"**RFID technology uses short-range wireless communication in radio frequency (RF) bands to transmit data to readers from inexpensive and disposable tags (microchips) and it automatically identifies objects or people with RFID tags several inches to several yards away" (Collins, 2010, p. 50). RFID system is composed of an RFID tag and an RFID reader that is linked to a back office data processing computer. The tag collects real-time data and then transmits that data via radio waves (Zhu, Mukhopadhyay, & Kurata, 2012). The reader receives radio waves to read the information stored in the tag, and the data processing equipment processes all the collected data (Wu, Nystrom, Lin, & Yu, 2006; Zhu et al., 2012).

RFID is used for a wide variety of applications. Examples of its applications include supply chain tracking, labeling of products for checkout at point of sale terminals, building access control proximity

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cards, cashless payment systems, toll collection, tracking library books, and theft prevention.

In 2003, the world's largest retailer, Wal-Mart, announced that it would require its top 100 suppliers to tag pallets and cases of goods with RFID tags. After Wal-Mart's announcement RFID quickly went from a relatively little-known technology to the next big thing (Malone, 2012). Wal-Mart's and other retailers' determinations and applications of RFID technology have attracted attention of service companies such as hospitality companies and resulted in increasing use of RFID technology in the hospitality industry.

Like the retail industry, the hospitality industry benefits from RFID technology such as more efficient supplier management processes and better inventory management, but improving the customer experience is the most important opportunity for RFID technology in the hospitality industry. Therefore, hospitality companies are looking to utilize the RFID technology to provide extra value for their customers instead of focusing solely on the supplier management process (Lee, Fiedler, & Smith, 2008).

RFID is also an exciting area for research due to its relative newness and continued expansion, and there has been a significant increase in the number of articles on adoption of RFID technologies in research journals. Researchers applied different information technology (IT) adoption theories and approaches to identify factors affecting RFID adoption at the organizational and individual levels (Brown & Russell, 2007; Kuan & Chau, 2001; Thong, 1999). However, despite the fact that several studies have examined adoption of RFID technologies in retail, logistic, and health care industries, to date little or no research has been conducted to determine the perception and the adoption of RFID technologies in the hospitality industry.

The purpose of the study was to identify factors determining operators' adoption of RFID technology in the hospitality industry. For this purpose, based on Tornatzky and Fleischer's (1990) Technology–Organization–Environment (TOE) model, the effects of technological, organizational, and environmental context on the hospitality operators' adoption of RFID technology were examined. Despite the fact that implementing RFID technologies helps increase productivity across the supply chain by reducing costs, this study considers RFID technology as a means for altering processes that deal directly with customers.

By using RFID technology, the hospitality companies can provide comfort and convenience to the guests without the service provider being present face to face and can store large amounts of data used for customized service (Khan & Khan, 2009). However, RFID technology and its applications are currently developing rapidly, which causes uncertainty about the benefits that RFID investments can provide. Therefore, hospitality managers are having hard time with RFID technology adoption decisions, trying to identify the configuration that is best for their operational needs (Ferrer, Dew, & Apte, 2010). For these reasons, there is a need for detailed understanding of the reasons for RFID technology adoption in the hospitality industry.

Literature Review

RFID Technology in the Hospitality Industry

RFID technology allows hospitality organizations to collect real-time data about their customers that helps them to customize their services. Some of the RFID applications in the hospitality industry include cashless payment systems, building intelligence systems, customer loyalty systems, luggage tracking, inventory tracking and asset management, RFID electronic locking systems, and RFID meeting technology. After extensive literature review, three different types of RFID technologies (*RFID Cashless Payment Systems*, *RFID Building Intelligence Systems*, and *RFID Meeting Technology*) were included in this research. The reason for choosing these RFID technologies was because they are either already being used or they have a great potential to be used by hospitality companies.

An RFID Cashless Payment System allows guests to set up an account linked to an RFID wristband that then can be used to spend money anywhere in the hotel. This method eliminates the need to carry cash and/or credit cards to make guest purchases within the property (Muta, 2006). Hersheypark, an amusement park in Hershey Pennsylvania, has implemented a RFID cashless point of sale system. With the new system, guests are able to make in-park purchases, check balances, and load additional funds onto their wristbands at

any of the park's 200 RFID-enabled POS stations (RFID Solutions Online, 2012).

RFID Building Intelligence System is another example of RFID technology in the hospitality industry. One example of such a system is RFID technology that enables guests to unlock their room door automatically as they approach it or as they wave the RFID-enabled device (such as a wrist band) over the door lock. When the guests enter the room, they could find the room set up to their individual preference for environment (such as lighting, window shades, room temperature, music, and TV channel) (Muta, 2006). Grand Hyatt San Francisco has installed RFID locks as a part of comprehensive renovation of its 659 guestrooms. The RFID locks allow contactless guestroom entry, and they give hotel staff a real-time view of guestroom access attempts for quick security response in the event of an intruder (VingCard Elsafe, 2012).

Another use of RFID technology in the hospitality industry is the RFID Meeting Technology. A nametag with an RFID chip in it can provide meeting planners real-time information about the meeting. With RFID technology, meeting planners could see what attendees are doing in meeting rooms in real-time and analyze all the information after the show is over. The data collected through RFID tags during the meeting can be used to help organizers with future conference planning such as optimizing sessions around interests and identifying the demands of the conference attendees (Korn, 2006).

At its Information on Demand Conference in Las Vegas, IBM used RFID technology on name tags worn by attendees that automatically tracks their session and meal attendance. The chips on the name tags included the name, title, and company of the person wearing it. As an attendee walked through the door leading into a conference session, an RFID receiver read the data on the chips. With this technology real-time data about the attendees were collected easily, which helped the meeting planner with day-to-day conference management (Thibodeau, 2007).

Even though RFID technology is now being increasingly used by hospitality companies with great benefits, it has some drawbacks, such as customer privacy. One privacy concern is that RFID tags can be scanned by anyone with an RFID scanner, which could conceivably access data encoded on RFID tag (Zhu et al., 2012). Another privacy concern is associated with data collection using RFID. For example, hospitality companies can collect data about their customers without their knowledge and may fail to provide them the record of the information gathered (Oztaysi, Baysan, & Akpinar, 2009). Furthermore, as previously stated, with RFID room key or name tag the guests or attendees can be tracked throughout the facility. Some guests or attendees might consider this as privacy violation.

Organizational Adoption

Daft (1978) defined organizational level technology adoption as "the adoption of an idea or behavior that is new to the organization adopting it" (p. 197). Researchers have proposed several technology adoption theories such as diffusion of innovation theory (DOI) (Rogers, 1995), technology acceptance model (TAM) (Davis, 1989), theory of planned behavior (Ajzen, 1991), and TOE framework (Tornatzky & Fleischer, 1990). Among these theories, Roger's (1995) DOI and Tornatzky and Fleischer's (1990) TOE framework has been widely accepted and has been found useful in understanding organizational-level technology adoption (Oliveira & Martins, 2011).

Tornatzky and Fleischer (1990) developed the TOE framework, which defines a "context for change" consisting of three elements: (1) technological context, (2) organizational context, and (3) environmental context. According to Tornatzky and Fleischer (1990), technological context includes both internal and external technologies that are relevant to the organization. Technological context factors include the perceived characteristics of the technology. On the other hand, organizational context factors include "firm size and scope, the centralization, formalization, and complexity of its managerial structure, the quality of its human resource (Tornatzky & Fleischer, 1990, p. 153). Finally environmental context is "the arena in which a firm conducts its business—its industry, competitors, access to resource supplied by others, and dealings with government" (Tornatzky & Fleischer, 1990, p. 153).

Many researchers have used the TOE framework to study organizational-level technology adoption

(Kuan & Chau, 2001; Thong, 1999; Zhu, Kraemer, & Xu, 2003). For example, based on the TOE framework, Zhu et al. (2003) developed a conceptual model for studying the adoption of electronic business at the firm level, incorporating six adoption facilitators and inhibitors. From a study of 3,100 businesses and 7,500 consumers in eight European countries, they found that technology competence, firm scope and size, consumer readiness, and competitive pressure were significant adoption drivers, while lack of trading partner readiness was a significant adoption inhibitor.

Using data collected from 575 Hong Kong firms, Kuan and Chau (2001) developed a perception-based TOE framework incorporating six factors (direct benefits, indirect benefits, cost, technical competence, industry pressure, and government pressure) as electronic data interchange (EDI) adoption predictors. Their study indicated that the perception-based model using a TOE framework is a useful approach for examining factors affecting the adoption decision. In the next section, the development of a theoretical framework, research model and the hypotheses of the study were discussed.

Theoretical Framework and Research Model

In this study, based on Tornatzky and Fleischer's (1990) TOE model, nine determinants of RFID adoption were identified within three contexts to determine whether each context influences organizational RFID adoption in the hospitality industry. Although specific factors identified within the three contexts may vary across different studies, the TOE provides a useful analytical framework that can be used for studying different types of technology adoption at the organizational level. Furthermore, TOE framework has a solid theoretical basis and has been widely applied in research and empirically accepted to be appropriate for investigating organizational adoption of an innovation (Kuan & Chau, 2001; Oliveira & Martin, 2010; Zhu et al., 2003).

As previously stated, Roger's (1995) DOI and Tornatzky and Fleischer's (1990) TOE framework were the only theories that were widely accepted and used in organizational-level technology adoption studies. TOE framework is consistent with DOI theory, since Rogers (1995) identified similar factors as determinants of organizational technology adoption. For example, Roger's (1995) innovation characteristics and internal and external characteristics of the organization are similar to technology and organization context of TOE. However, TOE framework also includes an additional context, environmental context, which was ignored in DOI. For the RFID technology adoption in the hospitality industry, some of the environmental factors such as stakeholder pressure and information intensity may be more critical compared to other types of technologies. This makes TOE framework better to explain factors affecting organizational RFID technology adoption in the hospitality industry (Oliveira & Martins, 2011). For these reasons, we believe that the TOE framework is appropriate for studying organizational RFID adoption, and we adopted this theoretical framework and extended it to the RFID domain in the hospitality industry. The three organizational RFID adoption contexts and their determinants are listed in Table 1.

Technological Context

Relative Advantage

Rogers (1995) defines relative advantage as "the degree to which an innovation is perceived as being better than the idea it supersede" (p. 229). Relative advantage has been found to be an important factor in determining adoption of new technologies. For example, Lertwongsatien and Wongpinunwatana (2003) examined the factors influencing e-commerce adoption decisions in small and medium-size enterprises in Thailand. The authors found that the higher the level of management understanding of the relative advantage of the e-commerce, the greater the likelihood of the allocation of the managerial, financial, and technological resources needed to adopt and implement e-commerce applications.

Table 1
Factors Affecting Organizational-Level RFID Adoption

1.Technological context	Relative advantage, compatibility, complexity, cost
2.Organizational context	Top management support, organizational readiness, knowledge about RFID technology
3. Environmental context	Stakeholder pressure, information intensity

As with other technologies, RFID technology has both direct and indirect benefits to organizations. The benefit of the RFID technology is that it provides a positive perception and thereby creates an incentive for the organizations to use the technology. It is expected that relative advantage of RFID technology positively influences the perception and consequently its adoption. Hence:

H1: Relative advantage of RFID technology will have a significantly positive relationship with hospitality operators' intention to adopt RFID technology.

Compatibility

Tornatzky and Klein (1982) defined compatibility as being in line with values or norms of potential adopters or being in congruence with existing practices of the adopter. Most studies confirmed that compatibility had a positive association with innovation adoption (Grover, 1993; Seyal & Rahman, 2003). For successful RFID adoption and implementation, RFID technology should be compatible with the existing technology infrastructure of the adopting organization. In addition, RFID technology should be consistent with the needs and the strategic goals of the adopting firm. Hence:

H2: Compatibility of RFID technology will have a significantly positive relationship with hospitality operators' intention to adopt RFID technology.

Complexity

Complexity of an innovation has a negative relationship with its adoption. Rogers (1995) defined complexity as "the degree to which an innovation is perceived as relatively difficult to understand and use" (p. 257). A number of studies investigated the relationship between complexity and innovation adoption and they mostly found that complexity had a negative effect on adoption (Cooper & Zmud, 1990; Thong, 1999). An RFID system is more complex than a barcode system. Therefore, for hospitality organizations, integrating RFID technologies into current property management systems may be an important issue to consider. Hence:

H3: Complexity of RFID technology will have a significantly negative relationship with hospitality operators' intention to adopt RFID technology.

Cost

One of the most important factors that affect the decision to adopt a new technology is the full costs involved for adoption within the organization. Rogers (1995) stated that the less expensive the innovation, the more likely it was to be adopted. Organizations try to gain benefits from the adoption of a new technology that would be commensurate with the costs associated with it (Premkumar & Roberts, 1999). Tornatzky and Klein (1982) stated that if the perceived cost associated with a new technology is low, it is more likely to be adopted.

In the context of RFID, the costs are likely to play an important role in the adoption decision. Especially, if the adopting organization is not working with a bar code system already, the costs of RFID could be relatively high. Hence:

H4: Cost of RFID technology will have a significantly negative relationship with hospitality operators' intention to adopt RFID technology.

Organizational Context

Top Management Support

Top management support indicates the willingness of senior management to allocate resources for adoption of an innovation. Previous studies indicated that top management support played an important role in the adoption and the diffusion of innovation within organizations (Orlikowski, 1993; Premkumar & King, 1994; Wesh & White, 1981). Premkumar and Roberts (1999) stated that top management support is critical for proving a supportive atmosphere and providing sufficient resources for adoption of new technologies. Hence:

H5: Top management support will have a significantly positive relationship with hospitality operators' intention to adopt RFID technology.

Organizational Readiness

Organizational readiness refers to the level of (1) financial and (2) technological resources of the

organization (Iacovou, Benbasat, & Dexter, 1995). Financial resources refer to the financial resources available to pay for a new technological innovation cost, the costs for implementation of any subsequent enhancement, and the costs incurred on an ongoing basis during usage. Technical resources refer to the level of sophistication of the information systems usage and the information systems' management in an organization (Iacovou et al., 1995). Many studies indicated that organizational readiness is an important variable for innovation adoption (Chwelos, Benbasat, & Dexter, 2001; Mehrtens, Crag, & Mills, 2001). Hence:

H6: Organizational readiness will have a significantly positive relationship with hospitality operators' intention to adopt RFID technology.

Knowledge About RFID Technology

According to the theory of barriers to innovation, which was developed by Attewell (1992), overcoming the lack of knowledge of the innovation will lead to greater likelihood of adopting the innovation. Studies indicated that having technical knowledge about an innovation in an organization will increase the motivation toward innovation adoption (Attewell, 1992; Thong, 1999).

An RFID system is much more complex than a barcode system. Therefore, knowledge about RFID technologies in an organization will have a positive impact on the adoption decision. For instance, if an organization is familiar with RFID technologies through past experience, the likelihood of adopting such technologies would be high. Hence:

H7: Knowledge about RFID technology will have a significantly positive relationship with hospitality operators' intention to adopt RFID technology.

Environmental Context

Stakeholder Pressure

In this study stakeholder pressure was defined as the level of intensity placed on the organization by the competitors, trading partners, customers, and government. Institutional theory focuses on the importance of institutional environments on shaping organizational structure and actions. Some studies combined the institutional theory with TOE framework (Oliveira & Martins, 2011). The institutional theory adds pressure from competitors and from trading partners to the environmental context of the TOE framework. Competitor pressure refers to the intensity level of the competitive environment within the industry where the firms operate. It is generally believed that competition in the industry increases the likelihood of innovation adoption (Link & Bozeman, 1991; Premkumar & Roberts, 1999).

However, customers also may affect the innovation adoption decision. Zhu et al. (2003) stated that customer readiness in an important factor affecting technology adoption decision since it indicates the potential market volume and customer willingness to use the technology (Zhu et al., 2003). Another factor for organizations to adopt an innovation comes from regularity bodies such as local, state, or federal governments. In some cases, an organization may adopt an innovation due to influences exerted by its trading partner. A firm may feel pressure to adopt the technology if its business partners request it to do so (Kuan & Chau, 2001). Hence:

H8: Stakeholder pressure will have a significantly positive relationship with hospitality operators' intention to adopt RFID technology.

Information Intensity

Information intensity refers to the degree of information that is present in the product or service of an organization (Thong, 1999). Since information intensive products tend to be more complex than others are, they require more information to specify their attributes. Porter and Miller (1985) stated that information-intensive products and services can be tactically improved through information technology. Thong (1999) stated that organizations in different sectors had different information needs and those in high information-intensive sectors are more likely to adopt information technologies than those in less information-intensive sectors. Hence:

H9: Information intensity will have a significantly positive relationship with hospitality operators' intention to adopt RFID technology.

The proposed model was developed based on the extant literature and provides a theoretical

framework of the critical factors that determine the hospitality operators' adoption of RFID technology (Fig. 1).

Methodology

Instrument

After extensive literature review, three different types of RFID technologies (RFID Cashless Payment Systems, RFID Building Intelligence Systems, and RFID Meeting Technology) were included in this research. Participants were asked to assess these RFID technologies separately by considering the questions asked for each of them.

The organizational adoption questionnaire consisted of four parts with a total of 32 items, including technology decision makers' familiarity with RFID technology, RFID technology adoption, the organization profile, and technology decision maker's profile.

The organizational RFID adoption section comprises of ten constructs (relative advantage, compatibility, complexity, cost, top management support, organizational readiness, knowledge about RFID, stakeholder pressure, information intensity, and the intention to adopt RFID technology). Each of the organizational adoption factors was measured by two items. Relative advantage, cost, top management support, organizational readiness, knowledge about RFID and stakeholder pressure scales were adapted from Sharma (2007). Sharma (2007) developed these scales specifically for RFID technology adoption using questions from prior literature and from semistructured interviews conducted in the exploratory phase of their study.

Complexity scale was adapted from Premkumar and Roberts (1999), which determined if learning to operate RFID technology and integrating it to current practices would be difficult. One of the items for information intensity scale was adapted from Thong and Yap (1995) and the other item was developed by the researchers. The information intensity scale assessed if it is important for organizations to have access to reliable, relevant, and accurate information (Thong & Yap, 1995) and if the information requirements for effective operation in the future will demand the use of RFID technology. Compatibility scale, which was developed by the researchers, determined if the RFID technology is compatible with the overall operational

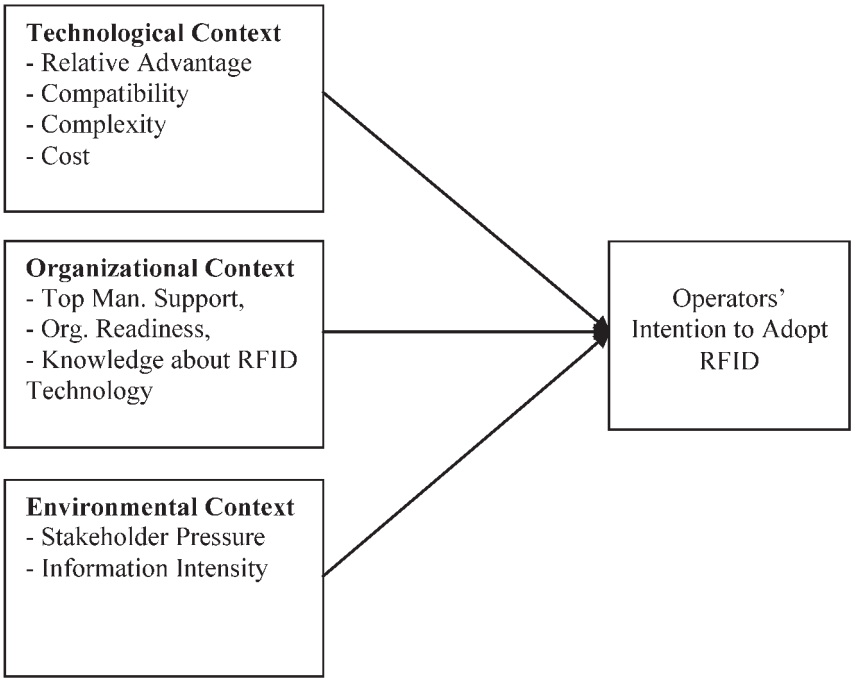

Figure 1. Research model for hospitality operators' adoption of RFID technology.

needs of the company and if it is in perfect fit with the company's strategic goals. Intention to adopt scale was adapted from Davis, Bagozzi, and Warshaw (1992). All of the items were measured using 5-point Likert scales ranging from "strongly disagree" (1) to "strongly agree" (5).

The organization's profile section consists of four items: the number of approximate full-time employees, the amount of approximate annual sale, the type of ownership, and the type of operation. The technology decision maker's profile section included questions about technology decision maker's age, education level, and organizational position.

A pilot test was conducted to ensure clarity, content validity, and reliability of the questionnaire. Forty questionnaires were distributed to 30 students and 10 faculty members. Some modifications were made as a result of the pilot test.

Sampling and Data Collection

The data for organizational RFID adoption were collected using the subscription list of Hospitality Financial and Technology Professionals (HFTP). The subscription list was purchased from HFTP. The subscribers to HFTP are typically technology decision makers at major hospitality corporations in the US who were the target population for organizational RFID adoption part of the study.

Questions were asked to determine if the respondents were familiar with RFID technology. The entire population of subscribers (3,080) was invited to participate in the survey. The survey was conducted between July and August, 2010. After 2 weeks, an email reminder was sent out to HFTP subscribers.

A question about respondents' position within the organization was added to the questionnaire to confirm that only the respondents who were authorized to make information technology decisions within the organization would answer the questions.

An e-mail invitation was sent out first to the potential respondents, and they were directed to the web survey. Around 3,000 e-mails were delivered and 154 completed questionnaires were returned, producing a response rate of 5%. After the initial screening of the questionnaires for accuracy, completeness, and validity of the responses, 125 questionnaires were retained and used in the study for further analysis.

Data Analysis

In the first step of the analysis, mean scores were calculated from the items for each of the RFID technology systems: RFID Cashless Payment System, RFID Building Intelligence System, and RFID Meeting Technology. The overall RFID score for each item was determined for the composite of the mean scores for each technology system.

Three exploratory factor analyses were performed for each technological, organizational, and environmental context to reduce the number of adoption attributes to a few dimensions. The principal components and orthogonal (VARIMAX) rotation methodology was used. Only variables with a factor loading of 0.5 or greater were considered for determining the items within each dimension.

Three multiple regression analyses were conducted for each technological, organizational, and environmental context to explore the impact of each dimension on operators' intention to adopt RFID technology. The "intention to adopt" items were averaged to provide the dependent variable in regression analyses.

Results

Respondents' Demographic and Professional Characteristic

Demographic data were collected regarding respondents' age, education, and organizational position. The majority of the respondents were between the ages of 41 and 50 (34%) and 51 and 60 (30%). As for education level, 47% of the participants stated that they had a bachelor's degree. The majority (54%) of the participants' incumbent position was Chief Technology Officer/IT Manager. Thirty-nine percent of the participants have been working in their current position for 6–10 years.

Factor Analyses

Factor analysis of the technological items yielded a four-factor model and explained 94.3% of the variance. Given the scree plot and theoretical relevance, it was determined that four factors were retained. The overall significance of the correlation matrix was less than $\alpha = 0.001$ with a Bartlett test of sphericity value of 904.9. This showed that the data matrix had sufficient correlation to the factor

analysis. The Kaiser-Meyer-Olkin overall measure of sampling adequacy (MSA) was significant with a value of 0.673. Factor 1 (relative advantage) explained 51.3% of the variance; factor 2 (complexity) explained 17.8% of the variance; factor 3 (compatibility) explained 14% of the variance; factor 4 (cost) explained 11.1% of the variance. The results of the factor analysis were presented in Table 2.

Factor analysis for organizational attributes resulted in three factors and explained 91.6% of the variance. Scree plot indicted that a three-factor solution would be appropriate. The overall significance of the correlation matrix was less than $\alpha = 0.001$. Bartlett test of sphericity value was 527.544. The Kaiser-Meyer-Olkin overall MSA was significant with a value of 0.732. Factor 1 (organizational readiness) explained 62% of the variance; factor 2 (knowledge about RFID) explained 17.4% of the variance; factor 3 (top management support) explained 12.1% of the variance (Table 3).

Four environmental attributes from the factor analysis resulted in two factors and explained 91.1% of the variance. The overall significance of the correlation matrix was less than $\alpha = 0.001$. Bartlett test of sphericity value was 319.054. The Kaiser-Meyer-Olkin overall MSA was significant with a value of 0.510. Factor 1 (information intensity) explained 51.7% of the variance; factor 2 (stakeholder pressure) explained 39.3% of the variance (Table 4).

Reliability and Validity of Measurement Scales

Cronbach's alpha was utilized to assess the reliability of measurement scales. Values of Cronbach's alpha greater than 0.70 are deemed to be reliable (Nunally, 1959). Table 5 shows the values of Cronbach's alpha. The reliability coefficients for 10 scales ranged from 0.82 to 0.97. Considering the minimal acceptable level of alpha coefficient (i.e., 0.70), these values suggested that scales could be considered reliable and used for further analysis. Face validity was assessed by asking the faculty members and graduate students in School of Hotel and Restaurant Administration at Oklahoma State University about whether the content of the scales appeared to be adequate. They all agreed that the scales seemed to measure what they supposed to measure.

Regression Analyses

Three multiple regression analyses were conducted for each technological, organizational, and environmental contexts to explore the impact of each dimension derived from factor analyses on operators' intention to adopt RFID technology. The results of regression of the four technology dimensions against the dependent variable of "intention to adopt" are listed in Table 6. In general, the model fit the data quite well. The regression equation characteristics of "intention to adopt" indicated an acceptable adjusted R^2 of 0.598. This indicated that

Table 2
Results of Factor Analysis for Technological Context

Factors	Factor Loadings	Eigenvalue	Variance Explained
Factor 1 (Relative advantage)		4.105	51.3
1. Adopting RFID will allow us to reduce cost.	0.932		
2. Adopting RFID will allow us to offer better quality product/ service.	0.916		
Factor 2 (Complexity)		1.425	17.8
1. Learning to operate RFID would not be very difficult.	0.926		
2. Integrating RFID in current work practices will not be very difficult.	0.925		
Factor 3 (Compatibility)		1.123	14.0
1. Compatible with the overall operational needs of the company.	0.940		
2. In perfect fit company's strategic goals.	0.914		
Factor 4 (Cost)		0.893	11.1
1. Cost for equipment, software, and networking will not be prohibitively expensive.	0.922		
2. Cost of integrating RFID technologies with existing information management system will not be prohibitively expensive.	0.899		

Table 3
Results of Factor Analysis for Organizational Context

Factors	Factor Loadings	Eigenvalue	Variance Explained
Factor 1 (Organizational readiness)		3.722	62.0
1. Availability of financial resources to meet the cost of adoption and implementation of RFID technology is high.	0.903		
2. The overall of readiness of our organization for adopting, implementing, and using of RFID technology is high.	0.893		
Factor 2 (Knowledge about RFID)		1.048	17.4
1. My employees are aware of how RFID technology improve their job function.	0.923		
2. My organization is aware of the strengths and the limitation of RFID technology.	0.883		
Factor 3 (Top management support)		0.730	12.1
1. Top management's support for the use of RFID technology is high in our company.	0.887		
2. Top management's desire to actually change our business model using RFID technology is high.	0.883		

about 60% of the variation in intention to adopt RFID technology was explained by the model. The F-ratio of 47.086 was significant ($p < 0.001$), indicating that the results of the regression could hardly have occurred by chance.

Multiple regression analysis indicated that relative advantage, complexity, compatibility, and cost had beta coefficients which were statistically significant ($p < 0.001$). In addition, standardized estimates (beta coefficients) of each variable reflected the relative importance of variables in the model. Regression analysis indicated that relative advantage had the strongest impact on operators' intention to adopt RFID technology (standardized $\beta = 0.498$) followed by complexity (standardized $\beta = 0.369$), cost (standardized $\beta = 0.353$), and compatibility (standardized $\beta = 0.318$) (Table 6). The results indicated that hypotheses 1, 2, 3, and 4 were supported.

The results of regression of the three organizational dimensions against the dependent variable of "intention to adopt" are listed in Table 7. The results of regression analysis indicated that 71% of the variation in intention to adopt RFID technology was explained by the model (adjusted $R^2 = 0.716$). The F-ratio of 105.078 was significant ($p < 0.001$). Multiple regression analysis indicated that top management support, organizational readiness, and knowledge about RFID had beta coefficients that were statistically significant ($p < 0.001$). The results of regression analysis indicated that top management support had the strongest impact on operators' intention to adopt RFID technology (standardized $\beta = 0.565$) followed by organizational readiness (standardized $\beta = 0.496$) and knowledge about RFID (standardized $\beta = 0.397$) (Table 7). Results indicated that hypotheses 5, 6, and 7 were also supported.

Table 4
Results of Factor Analysis for Environmental Context

Factors	Factor Loadings	Eigenvalue	Variance Explained
Factor 1 (Information Intensity)		2.070	51.7
1. The information requirements for effective operations in the future will demand the use of RFID technology in our company.	0.980		
2. It is very important for our company to have access to reliable, relevant, and accurate information.	0.978		
Factor 2 (Stakeholder pressure)		1.576	39.3
1. The amount of pressure placed on our organization to adopt and use RFID technology by legal and ethical regulations is high.	0.928		
2. The amount of pressure placed on our organization to adopt and use RFID technology by critical partners, competitors and customers is high.	0.924		

Table 5
Summary of Cronbach's Alpha for Measurement Scales

Measurement Scales	Cronbach's Alpha
Intention	0.8209
Relative advantage	0.9775
Compatibility	0.9132
Complexity	0.9480
Cost	0.9070
Top management support	0.9196
Organizational readiness	0.9011
Knowledge about RFID	0.8940
Stakeholder pressure	0.8333
Information intensity	0.9600

The results of regression of the two environmental dimensions against the dependent variable of "intention to adopt" are listed in Table 8. The results indicated that 14% of the variation in intention to adopt was explained by the model (adjusted $R^2 = 0.141$). The F-ratio of 10.938 was significant ($p < 0.001$). Only information intensity had beta coefficient that was statistically significant ($p < 0.001$). The results of regression analysis indicated that stakeholder pressure did not have a significant impact on operator's intention to adopt RFID technology ($p > 0.05$) (Table 8). Results indicated that while hypothesis 8 was supported, hypothesis 9 was not supported.

Conclusion and Implications

Overall, the results of the study indicated that except stakeholder pressure, all of the technological, organizational, and environmental factors had significant impact on hospitality operators' intention to adopt RFID technology.

Table 6
Regression Analysis for Technological Factors

Variable	B	Standardized Beta	t
(Constant)	4.013		97.207*
Relative advantage	0.363	0.498	8.75*
Complexity	0.269	0.369	6.48*
Cost	0.257	0.353	6.20*
Compatibility	0.232	0.318	5.59*

Adjusted $R^2 = 0.598$; $F = 47.086$; significance $F = 0.000$.
*$p \leq 0.01$.

Table 7
Regression Analysis for Organizational Factors

Variable	B	Standardized Beta	t
(Constant)	4.013		115.621*
Top management support	0.411	0.565	11.80*
Organizational readiness	0.361	0.496	10.30*
Knowledge about RFID	0.289	0.397	8.28*

Adjusted $R^2 = 0.716$; $F = 105.078$; significance $F = 0.000$.
*$p \leq 0.01$.

The results indicated that one of the technological factors, relative advantage, had the strongest impact on operators' intention to adopt RFID technology in the hospitality industry. These findings were consistent with the prior literature (Kuan & Chau, 2001; Premkumar & Roberts, 1999; Thong, 1999), indicating that hospitality operators believed that adopting RFID technologies provides benefits to their organization, such as reducing costs and providing better quality products or services to their customers. When hospitality operators are not aware of the benefits of RFID technology or when they believe that they could not gain benefits from RFID adoption, they would maintain the current operational systems. Therefore, the findings of this study suggested that technology companies should increase user awareness of the potential advantages and benefits of RFID technologies through better education and training seminars.

Consistent with the previous studies (Cooper & Zmud, 1990; Thong, 1999), the findings of the study indicated that complexity and compatibility were important factors that affect hospitality operators' RFID technology adoption decision. The results confirmed that when learning to operate RFID technologies and integrating them in the current work practices were difficult, the organizations

Table 8
Regression Analysis for Environmental Factors

Variable	B	Standardized Beta	t
(Constant)	4.023		66.530*
Information intensity	0.275	0.382	4.52*
Stakeholder pressure	0.071	0.098	1.16

Adjusted $R^2 = 0.141$; $F = 10.938$; significance $F = 0.000$.
*$p \leq 0.01$.

would be less likely to adopt them. Integrating RFID technologies into current property management systems may be a challenge. Therefore, technology companies should teach and train potential RFID adopters about how to operate and use RFID technologies. In addition, technology companies should provide free-of-charge system evaluation to verify that the current system is compatible with the new RFID technology.

The results of the study indicated that cost had a significant negative impact on hospitality operators' intention to adopt RFID technology. The findings revealed that unless the US hospitality operators perceive commensurate benefits relative to the costs, they are unwilling to adopt RFID technologies. Therefore, the technology companies should work with the senior management of the adopting firm and make the required financial analyses to evaluate the RFID technologies in terms of whether the benefits outweigh the costs of adopting them.

The results indicated that as an organizational factor, top management support had the strongest impact on hospitality operators' intention to adopt. Prior studies on IT adoption suggested that top management support plays a crucial role in adoption of innovation in organizations (Orlikowski, 1993; Wesh & White, 1981). To get adequate resources to adopt and implement a new technology, top management's vision and commitment are essential (Premkumar & Roberts, 1999). Technology companies must communicate with the top managers of the adopting firm and educate them about the benefits and the challenges of RFID technologies to gain their support for the adoption process.

Study findings, along with previous research findings in IT adoption (Kwon & Zmud, 1987; Mehrtens et al., 2001), indicated that organizational readiness had a significant positive impact on hospitality operators' intention to adopt RFID technology. The study findings suggested that due to lack of RFID technology expertise, the hospitality operators should hire experienced consultants or increase the level of technological knowledge of the employees by sending them to training sessions on the use of RFID technology. In addition, hospitality operators should allocate sufficient funds for RFID technology investments by evaluating and adjusting their information technology budget. This could be accomplished by providing appropriate financial and technical support from RFID technology providers and other related parties. If inadequate budgets prevail, hospitality operators should not choose low-cost solutions, since they will not fulfill the expectations of the benefits derived from RFID adoption.

As hypothesized, knowledge about RFID technology was found to have significant positive impact on hospitality operators' intention to adopt RFID technology. Greater knowledge about RFID technology will be useful in analyzing the current issues related to RFID and will therefore help in identifying which RFID technologies will be most appropriate for the organization. The findings of the study suggested that to develop and improve the RFID knowledge of hospitality operators, technology vendors need to educate hospitality operators to ensure that they know the advantages and benefits of RFID technologies. Providing live presentations and hosting technology fairs specifically designed for hospitality operators will help technology vendors to identify potential RFID adopters, and will give them a chance to make hospitality operators understand all the advantages and disadvantages of RFID technologies.

The findings of the study revealed that as an environmental factor only information intensity had a significant positive impact on hospitality operators' intention to adopt RFID technology. Studies indicated that information-intensive products require more information to specify their attributes, and organizations with more information-intensive products need to have an appropriate information technology to acquire and disseminate accurate and adequate information about their products (Grover, 1993; Thong, 1999). Consistent with these studies, the findings of the study indicated that hospitality operators believed that information requirements for effective operations require RFID technology. For instance, information management is crucial in the development and implementation of loyalty programs in hospitality organizations. Loyalty programs based on intense customer information such as demographic profiles and spending patterns may require appropriate information technology to increase the efficiency of the program. At this point, RFID technologies can be used in the process of collection of the

necessary information that is required to implement the loyalty program successfully.

Based on the literature regarding the TOE framework and RFID, this study successfully adopted TOE framework and extended it to the RFID domain in the hospitality industry, which provided a unique theoretical contribution to the RFID literature. In addition, the study provides useful information to technology companies and hospitality consultants as they attempt to identify the potential adopters of RFID technologies in the hospitality industry. The findings of the study can be used to design appropriate marketing strategies to reach these potential adopters. It is important to identify the factors that influence an organization's decision to adopt of RFID technologies due to its potential to provide resources for competitive advantage. By identifying the factors affecting hospitality operators' decisions to adopt RFID technologies, technology vendors could educate prospective adopters better on the potential benefits of RFID technologies in order to increase the usage of these technologies.

Limitations and Future Study

This study was a perception-based study and actual RFID technology use was not assessed in this study. Information about RFID technology in general and about hospitality RFID technologies (some images also provided for hospitality RFID technologies in the questionnaires) were provided in the first page of the questionnaires and assumed to be informative enough for respondents to create perception about RFID technology. Future research that will measure the actual use of RFID technology may provide more accurate and valid results for hospitality operators' perceptions about RFID technologies.

There may be other factors that influence a decision whether or not to adopt RFID technologies in the hospitality industry. Future research could explore whether other factors (e.g., demographic and cultural differences, organizational size) are associated with RFID adoption. In addition, to obtain detailed information about RFID technologies in the hospitality industry, future research might explore different kinds of hospitality RFID technologies.

Finally, the current study was limited to US hospitality operators. More research involving other countries would provide useful information for comparing cultural differences in RFID adoption in the hospitality industry.

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