THE IMPORTANCE OF SERVICE VALUE IN ACCELERATING THE ADOPTION OF RADIO FREQUENCY IDENTIFICATION TECHNOLOGY IN THE EMERGENCY ROOM OF HOSPITALS

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ABSTRACT

Hospitals are slow adopters of radio frequency identification technology (RFID), in comparison with retailers and military units. Customer satisfaction and organizational performance are important drivers for RFID adoption. It is central to understand how RFID can help improve customer service quality in hospitals, thereby improving customer satisfaction and organizational performance. The emergency room (ER) plays a vital role in a hospital because it receives patients in critical situations. Any mistakes made during the process of providing emergency medical services to a patient can seriously ruin the reputation of a hospital, and lower the morality and self-efficacy of caregivers. Many systematic problems manifest in the ER: overstretched staffs, insufficient resources, operational inefficiency via manual tracking of medical equipment, patient’s location and care progression of patients, slow response time and disturbing working environment. RFID can enhance the visibility of emergency medical supply chain, from admitting, sorting to treating patients with emergent medical services. This technology is an effective alternative to remedy these systematic problems, and improve service quality to internal (caregivers, MIS department and staff) and external customers (patients and their family members). This study deliberately incorporates the construct of service value, comprised of the factors of customer satisfaction, service quality and sacrifice, into the Unified Theory of Acceptance and Use of Technology (UTAUT). This integrative model can assist us in understanding the importance of service value in the RFID adoption process in the ER. Eighty five subjects, including caregivers, MIS department and staffs, participated in this study. Statistical analysis shows that customer satisfaction and service quality are two important elements of the service value when introducing RFID into the ER. The element of sacrifice is less salient in its influence on perceived service quality, which can affect the RFID decision of users. Our findings affirm that service value is as important as these four technology adoption constructs identified in the UTAUT model: performance expectancy, effort expectancy, social influence and facilitating conditions.

Keywords: UTAUT, RFID, Value Mode, TAM
INTRODUCTION

Many hospitals began recognizing the importance of sharing information across functional departments and with other caregivers. The enhanced visibility in the medical services supply chain can streamline business operations, improve productivity of medical rooms, reduce medical errors, and provide a higher level of accountability. WebMD, an online information portal, is dedicated to achieving the visibility by providing quality health information and services to all parties in the healthcare industry, including patients, physicians, healthcare professionals, employees, and health plan members. Like the information portal, information systems (e.g. Internet, bar coding, personal digital assistants, and telemedicine) are gaining in importance as an effective vehicle to facilitate the information exchange process.

Radio Frequency Identification (RFID) technology are unique in its monitoring, tracking and tracing capability. RFID can potentially deliver many benefits to the healthcare industry, some of which can be incorporated into the emergency room. For instance, RFID can automate the admitting, screening and treating process for patients, enhance communications between caregivers and support teams, and reduce medical errors. Although these benefits are promising, incorporating RFID into the ER is a rare practice up to date. Caregivers, line staff and MIS professionals possess little awareness with respect to potential benefits of RFID to the ER. The objective of this study is to derive an effective solution to accelerate the RFID adoption of these stakeholders by going beyond the awareness level.

Similar to consuming a product or service, we assert the decision to adopt RFID adoption is partly the effect of customer’s perceived service value. Perceived service value is a user’s tradeoff decision between the perceived benefits and costs (Dodds and Monroe, 1985). A user needs to make a give-and-take exchange decision when receiving products and service (Zeithaml, 1988). Hospitals tend to have a hierarchical and bureaucratic management structure. Convincing users about the perceived service value of using RFID in the ER is challenging, but very important. A user’s perceived service value can be improved via delivering high tangible/intangible benefits or lowering costs. RFID can potentially provide technical, functional, temporal and spatial services to users of RFID in the ER. However, not all these benefits are measurable in the context of RFID adoption in the ER. It is crucial to understand the resulting benefits and issues from employing RFID in the ER.

The Unified Theory of Acceptance and Use of Technology (UTAUT) asserts that (1) performance expectancy, (2) effort expectancy, (3) social influence and (4) facilitating conditions are four primary factors directly affecting IT adoption. Another factor, service value of users, can be just as important. From our literature review on the perceived service value theory and UTAUT, an integrative research model to assess the relationship between these five constructs and the intention to adopt RFID in the ER, and between RFID adoption intention and actual adoption behavior of caregivers and IS professionals is needed. Five hypotheses were derived to test their relationships. An execution of a survey and an interview produces interesting findings to validate our proposed hypotheses. Theoretical and practical implications based on these findings are important lessons for the management of a hospital, who have difficulty to or are planning to accelerate RFID adoption in the ER. Concluding remarks end this study.
Service Value

Patients come to hospitals for health care or medical treatment. A great degree of trust among patients, their family members, caregivers and staffs is indispensable because patient’s life is at stake. Before, during and after treatment, a high frequency of interpersonal contact is inevitable. This business nature shows the importance of service quality provided by caregivers, staffs and IS professionals to patients and their family members. Service quality is user’s perceptions about the degree of conformance of a product or service to customer expectations (Parasuraman, Zeithaml and Berry 1988). Heskett (1987) finds that employees are a major determinant for the quality of service received by customers because they deliver the service.

Service quality only tells part of the whole story for a success of IT adoption. According to the “Value Model,” service quality, along with sacrifice and satisfaction, are immediate determinant of service value (Gale 1994; Wakefield and Barnes 1996), which leads to the improvement of behavioral intention of users to use products or services, or adopt an IS. Other competing models (Anderson and Fornell, 1994; Mohr and Bitner, 1995; Gotlieb, Grewal and Brown, 1994; Parasuraman, Zeithaml and Berry, 1988) emphasize the relative importance of these three constructs (sacrifice versus service quality versus satisfaction) with respect to service value. Service quality, service value and customer satisfaction collectively have impact on behavior intentions (Cronin, Brady and Hult, 2000). The bivariate relationship between service value and its three prerequisites can shed lights on strategies to accelerate RFID adoption in the ER.

Effects of Service Quality on Service Value

Service quality in general includes five dimensions: tangible, reliability, responsiveness, assurance and empathy (Pitt, Watson and Kavan 1995). A customer appreciates service quality with pleasant experiences with tangible (physical facility, and intangible (consistency, caring, courtesy and timeliness) services. Service quality is a multi-dimensional construct. In the context of information systems adoption, the service quality construct can be decomposed into system quality, information quality and user satisfaction (DeLone and McLean, 1992).

It is imperative to take service quality into consideration when evaluating the success of information systems implementations (Pitt, Watson and Kavan, 1995). The success of RFID implementations in the ER also depends on its ability to help deliver high quality emergency medical service. The Food and Drug Administration (FDA) mandates that the healthcare industry improve its ability to identify drugs and patients. The success of this national initiative can enhance the visibility of medical service supply chain. Behind the high visibility requires the support of quality systems. RFID, as another enabler of this visibility, also needs to achieve certain level of system quality.

System quality is an important engineering-oriented or technical property to measure the success of IS, such as RFID. An ingenious RFID system can only deliver limited operational benefits, such as tracking assets and patients. To realize strategic benefits (e.g. minimize medical errors and streamline business operation), RFID needs to integrate with existing widespread wireless infrastructure, and other information systems (e.g. medical records, prescription systems, bar coding technology, ordering systems). Integrating with information systems across the supply chain can create the utmost benefits to RFID users in a hospital. Middleware is a key component to make the enterprise-wide integration a possibility. A well-designed RFID middleware needs to
include at least four basic elements: (1) reader and device management, (2) data management, (3) application integration, and (4) partner integration (Sweeney II, 2005).

The supply chain is the second most costly investment to a hospital, which costs as much as 40% of its operating costs (Haugh, 2006). The use of the widely accepted bar code technology in protecting patient’s safety represents less than 5% of hospitals nationwide (Rogoski, 2006). As late adopters of information systems hospitals are good candidates for improvements in supply chain operational efficiency. Through various forms of deployment, RFID can improve the quality of service in healthcare environments. In addition to easing the process of acquiring skills and knowledge to utilize RFID in the ER, hospital users need to appreciate information quality of RFID before they have motivation to use the system.

Information quality is the output of system quality. Proper measures of a system success also need to include information quality, an intangible or soft property. System quality and service quality are highly closely related to each other. Metrics to measure information quality range from accuracy, timeliness, currency, format, reliability and precision of information produced by an information system. Caregivers in the hospital have a higher level of preference to bar code technology (Schuerenberg, 2005). RFID has advantages over bar code technology in potentially delivering a higher level of information quality because of its scalability and interoperability with the existing hardware and software infrastructure. Considering only 5% of hospitals are using RFID technology, there are many opportunities to employ this technology to improve patient care, information quality and delivery.

Improvements in service quality, comprised of system quality and information quality, are two preconditions to the enhancement of perceived service value. Caregivers and IS professionals need to first improve perceived service quality of RFID before its perceived value can be enhanced.

Hypothesis 1: Higher perceived service quality delivered by RFID system can positively influence the perceived value of caregivers and IS professionals about the use of RFID in the ER

Effects of Customer Satisfaction on Service Value

Satisfaction is a positive emotion or feeling derived from the consumption of a product or service (Hunt, 1977). A higher level of satisfaction reflects a higher level of positive sentiment towards the product or service encountered (Oliver, 1997; Rust and Oliver, 1994). When customer is satisfied with a product or service, he/she is more likely to make a purchase decision because the ratio of perceived benefits and cost is increased. This increase can be translated into the increased service value.

In the same token, caregivers who experience the usage of RFID in their job may have a positive or negative reaction to the system. Users with a higher positive response are more likely to have a higher perceived service value.

Hypothesis 2: Higher customer satisfaction with RFID system can positively influence the perceived value of caregivers and IS professionals about the use of RFID in the ER
Effects of Sacrifice on Service Value

Tasks and activities which occur before a person can enjoy the purchased goods/services are called “sacrifice”. “Sacrifice” is a cost associated with the enjoyment of a product or service. This construct is in monetary (item price) or non-monetary (time spent in searching and exchange information with other users, traveling) forms (Zeithaml, 1988). E-services or services provided on the Internet are more diversified in the dimension of “cognitive sacrifice”. A conceptual framework classifies “sacrifice” into technical, functional, temporal and spatial dimensions (Heinonen, 2006). For instance, accessibility, flexibility and navigation abilities are temporal and spatial dimension of “sacrifice”. Regardless of physical or digital product or service, sacrifice is the monetary and non-monetary amount spent in exchange for a product or service. A customer is more willingly to sacrifice more in order to obtain a product or service that he/she desires or values more.

A successful RFID implementation needs to minimize the sacrifice cost borne by caregivers and other stakeholders of a hospital. The sacrifice cost includes the economic costs which occur when switching from and existing technology. To properly assess the effect of sacrifice cost on user’s perceived service value, it is critical to understand the relative advantages of RFID over the existing bar code technology in the healthcare industry. Barriers to RFID adoption is synonymous with sacrifice cost borne with caregivers in a hospital.

Table 1 compares some facts and perceptions of these two technologies. The information in the table suggests RFID has higher utility than bar codes in its technical capabilities (e.g. read many times and different objects at the same time, with a higher tolerance of harsh conditions, and better security control).

The hurdles to deliver these promises are particularly higher in the healthcare industry than other industry sectors. Medical objects vary in shape, composition (liquid vs. powder vs. capsule vs. tablet) and size. The hierarchically organizational structure with multiple management levels and the conflict between administrators (looking to reduce cost) and physicians (best medical care) may inhibit the diffusion of novel technologies such as RFID.

RFID technology varies with its use of frequency, ranging from low frequency (LF), high frequency (HF), ultra high frequency (UHF) to microwave. Physics law states that the lower the frequency the closer the data transmission distance must be. RFID tags with a lower frequency work better with liquid and metals. This has brought forth the myth that UHF RFID technology is not appropriate in the healthcare and pharmaceutical industry. New developments, like UHF Gen2 tags, make UHF RFID technology usable in the healthcare field. The widely adopted RFID frequency is HF. First of all, most drugs are in various forms (liquid, powder, capsule and tablet) and mostly small in size. Tracking drugs at the item-level is the strength of LF and HF RFID technology. Using UHF RFID to track the item-level drugs is naturally challenging. Contrary to the myth, the emergency of UHF Gen2 tags has overcome the physical limitation. UHF Gen2 shows greater performance on and in containers with liquids and metals with more simultaneous reads, given the same price range as high-performance HF RFID systems, according to a joint industry report of RFID vendors (Symbol Technologies Inc., 2006). However, the slow adoption of UHF Gen2 forces the acceptance of dual RFID standards by most hospitals. This creates incompatible standards problems and makes the data integration across the supply chain a big
challenge. Most caregivers and RFID solution providers are still concerned about the inappropriate use of UHF RFID in the healthcare industry.

<table>
<thead>
<tr>
<th>Technical parameters</th>
<th>RFID</th>
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<tr>
<td>Read one item at a time</td>
<td>Read multiple items at a time</td>
</tr>
<tr>
<td>Object to object communication</td>
<td>Objects to objects communication</td>
</tr>
<tr>
<td>Need a clear line of sight</td>
<td>Do not need clear line of sight</td>
</tr>
<tr>
<td>Require controlled conditions</td>
<td>Withstand harsh conditions</td>
</tr>
<tr>
<td>Carry limited content</td>
<td>Carry rich content with memory</td>
</tr>
<tr>
<td>Limited effective reading range</td>
<td>Extended reading range (passive vs. active tags)</td>
</tr>
<tr>
<td>Slower processing speed</td>
<td>Faster processing speed</td>
</tr>
<tr>
<td>Can only read information</td>
<td>Can read and write information</td>
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</table>

<table>
<thead>
<tr>
<th>Scope of applications</th>
<th>RFID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited or restricted primarily to inventory control</td>
<td>Wider range of applications with greater benefit to management analysis</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Interorganizational capability</th>
<th>RFID</th>
</tr>
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<tbody>
<tr>
<td>A universally accepted standard</td>
<td>Lacks a universally accepted standard</td>
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<tr>
<th>Economic value (cost/benefit)</th>
<th>RFID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low item cost (less than $.01 per tag)</td>
<td>High item cost (greater than $.25 per tag)</td>
</tr>
<tr>
<td>Low initial investment (already sunk)</td>
<td>High initial investment (to be made)</td>
</tr>
<tr>
<td>Low economies of scale</td>
<td>Moderate economies of scale</td>
</tr>
<tr>
<td>Above breakeven at present</td>
<td>Below breakeven at present</td>
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<table>
<thead>
<tr>
<th>Security/Privacy</th>
<th>RFID</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low and local security control (cannot disable)</td>
<td>High and remote security control (can disable)</td>
</tr>
<tr>
<td>Well along the adoption life cycle (established)</td>
<td>Early in the adoption life cycle (pending)</td>
</tr>
<tr>
<td>Of minimal concern to individual consumers</td>
<td>Of significant concern to individual consumers</td>
</tr>
<tr>
<td>Easily tampered with</td>
<td>More difficult to tamper with</td>
</tr>
</tbody>
</table>

Many caregivers translate these technical and behavioral problems into the economic cost of the decision to deploy RFID. Exacerbated with systematic problems existing in ERs, lowering caregiver’s perceptions about the value to sacrifice when switching to or replacing with RFID technology from bar code technology is a crucial determinate of service values. **Hypothesis 3**: The less caregivers and IS professionals in the ER need to sacrifice with using RFID, the higher their perceived services values of RFID can be enhanced.

**Service Values ➔ Behavioral Intention**

A study that surveyed 313 users in a hospital shows that 53% of them deem RFID as a “very important” wireless technology (Briggs, 2005). Potential benefits, such as automation of assets tracking and streamlining patient admission process to the ER, delivered by RFID have attracted a growing number of caregivers. There are a wide range of RFID applications in the healthcare industry. The primary uses of RFID in the ER include the real-time tracking and tracing of assets, patients and visitors. These usages can enhance the efficiency of providing emergency medical services. A study shows that RFID can improve the measurement and control of workflow processes at a Level-1 trauma unit of a hospital (Janz, Pitts and Otondo, 2005). Other RFID applications are used to reduce and minimize medical errors. A study finds that RFID can help detect counterfeit drugs, eliminate data-entry errors, monitor the progression of a patient,
and ensure treatments given to right patients. A unique application of RFID is replacing the existing practice of using Sharpie markers to outline the body areas to be operated on, with a “smart” label containing patient’s medical records and affixed to the surgical areas (Gordon, 2005). Some hospitals use RFID as a fail-safe mechanism to secure the blood transfusion process and to automate the sharing process of information related to the blood transfusion (Messmer, 2006). Cost is not a major consideration when evaluating RFID technology. Patient safety and quality of care are two top major concerns to a hospital when considering deploying RFID technology (Briggs, 2005). The perceived benefit of caregivers can be improved along with an increasing number of innovative use of RFID to improve patient safety and quality of care in the hospital.

However, there are some potential risks such as (1) local optimization of isolated RFID system, and (2) the incapability of a hospital to deal with the improved medical supply chain because of the existing over-stretched staff problems (Rappold, 2003). Local optimization arises from not being able to integrate with a hospital’s existing wireless network infrastructure in order to support clinical and administrative applications, such as order entry, as well as medical and patient tracking. The risks of deploying a new technology are amplified in a patient care delivery environment where the health of a person is at stake. In addition, the lack of industry best practices and problems (Shutzberg, 2004) within the healthcare information systems infrastructure and clinical operations is well documented. There are costs incurred by the facility through the overhead incurred by the supply chain standardization requirements and the purchase and maintenance of RFID. Costs of these kinds can discount a user’s perceived service value with a product or a service. For instance, Wal-Mart underestimated the cost its suppliers needed to bear to support RFID technology offsetting any saving created (Warren, 2004).

Service value is a function of perceived benefit and perceived cost with a product or a service. Wal-Mart’s case provides an important lesson that RFID adopters need to try not only improving the perceived benefits, but also lowering the costs. By doing so, user’s perceived service value can be improved. Users with a higher perceived service values are more likely to have a higher intention to adopt RFID. Hypothesis 4: Higher service values delivered by RFID can positively influence the behavioral intention of caregivers and IS professionals in the ER

Behavioral Intention ➔ Actual Behavior

The showcases of Wal-Mart and Best Buy are examples of actual RFID implementation. Wal-Mart’s top 100 suppliers deploy RFID in order to comply with the mandated requirements. In contrast, Best Buy aims to streamline its operational process by tagging all product cases and pallets. Different reasons trigger RFID initiatives of companies. Whatever the reason to justify the RFID initiative, a positive intention is essential. Higher intention of adopting RFID system can encourage caregivers to use RFID. Hypothesis 5: Higher intention of adopting RFID system can improve the actual usage of caregivers and IS professionals in the ER.
Service Quality

Customer Satisfaction

Sacrifice

H1

H2

H3

H4

H5

Behavioral Intention

Actual Use

Figure 1: Service Value Model and Hypotheses

MEASUREMENT MODEL

Parasuraman, Zeithaml and Berry’s developed SERVQUAL scale to measure the success of traditional and closed information systems. RFID is a vehicle for collaboration and open interconnectivity. SERVQUAL is not adequate to address RFID adoption. Online etail quality (eTailQ) is a measure, specifically designed to assess important attributes that contribute to online service quality (Wolfinbarger and Gilly, 2003). This instrument is comprised of four dimensions and fourteen items. Four dimensions are reliability, system design, privacy/security and customer service. These attributes can better capture the quality attributes of an integrative RFID system. We therefore adopt eTailQ to measure the construct of service quality. Cronin et al. (2000) develops an instrument to measure the other constructs of the research model posed in this study: customer satisfaction, sacrifice, service value, and behavioral intention. We adopted this instrument to measure the bivariate relationship between these constructs. The authors also developed some self-reporting questions to assess the actual behaviors.

RESEARCH METHODOLOGY

We tested the proposed hypotheses by surveying caregivers (physicians, nurses and staffs) who work in the ER and have experiences using RFID in their work. These hospitals are located in northern, middle and southern parts of Taiwan. A cursory examination of secondary data showed that nine hospitals would implement RFID systems. An interview with the management of these hospitals allowed us to screen out four hospitals that did not deploy RFID systems as the secondary data claimed. The remaining five hospitals were actually implementing RFID systems, primarily in their ERs. Four of these five hospitals agreed to participate in this research project. We added another hospital that was planning to adopt RFID systems, but not included in the secondary data. A pilot test was conducted with subjects to evaluate the appropriateness of semantics, wording and sentence of questionnaire in the context of RFID adoption.

A full-scale survey was conducted after the questionnaire was modified based on the feedback of pilot test. Eighty-five caregivers working in these five hospitals were randomly chosen and surveyed online or offline. Four samples were invalid and not included for further statistical analysis. Figure 2 depicts the business flow of emergency medical services in ERs of hospitals used in this study. The primary RFID applications of ERs in the studied hospitals were: (1) streamline the admission process for patients, (2) mitigate potential errors in prescription...
process, (3) match blood types and patient’s personal medical records, and (4) locate patients and medical supplies.

**Statistical Analysis and Discussion**

*Descriptive Statistics*

Multivariate analysis method was adopted to assess the relationship between independent and dependent variables. The statistical software used to assist the analysis is SPSS. Twenty nine subjects are males and fifty two subjects are females. The sampled number of subjects are 3, 24, 15, 29 and 10 from Hospital A, B, C, D and E, respectively. Fifty five subjects are caregivers in the ER, and twenty six subjects are from the information system department. The age distribution is as follows: 73 subjects are below the age of 40 while 8 subjects are above the age of 40.

*Reliability and Validity Analysis*

Experts in the healthcare industry were invited to participate in the pilot test to assess the content quality of questionnaire. The content validity of questionnaire was further enhanced with Cronbach \( \alpha \) test to assess the internal consistency of the model used to measure constructs in the proposed framework. Table 2 shows Cronbach \( \alpha \) values for six theoretical constructs used in this study. All Cronbach \( \alpha \) values exceeded the threshold value 0.7 (Fornell and Larcker, 1981; Compeau and Higgins, 1995b). This indicates that the adopted questionnaire has a high internal reliability. Inter-item correlation matrices were used to confirm that the measurement model incorporates the constructs to have high intra-construct item correlations, and low inter-construct item correlations. This test further supports the suitability of this measurement model.

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Service Quality</th>
<th>Customer Satisfaction</th>
<th>Sacrifice</th>
<th>Service Value</th>
<th>Behavioral Intention</th>
<th>Actual Use Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cronbach ( \alpha )</td>
<td>0.958</td>
<td>0.955</td>
<td>0.854</td>
<td>0.911</td>
<td>0.964</td>
<td>0.865</td>
</tr>
</tbody>
</table>

Table 2: Cronbach \( \alpha \) values of Theoretical Constructs

Pearson’s chi-square test (\( \chi^2 \)) allows the testing of a null hypothesis that there is no difference between each observed and theoretical frequency distribution. PLS models examine the reliability, convergent validity, discriminant validity, means and standard deviations of the measurement model. Data were pooled from the studied subjects (N=81). Table 3 shows Pearson’s testing results to confirm the existence of a positive relationship between independent variables of performance expectancy, effort expectancy and social influence, and the dependent variable of behavioral intention. Another Pearson test of the relationship between facilitating conditions and actual use behavior also confirm the existence of a significantly positive relationship (\( p=0.799 <0.01 \)). All identified relationships in the research model are significant to each other. Positive Pearson testing results eliminate the possibility of a high correlation between and among independent variables. This provides a strong basis for the next round of regression analysis to assess the predictive power of independent variables for dependent variables.
Regression Analysis

The linear regression analysis was adopted to determine the predictive power of independent variables for respective dependent variables. Three formulas were constructed for regression analysis. The first formula is used to validate H1, H2 and H3. The second and third formulas are to validate H4 and H5, respectively.

- Service Values of Using RFID in ERs = Service Quality + Customer Satisfaction and Sacrifice + constant
- Behavioral Intention of Using RFID in ERs = Service Values + constant
- Actual Use of RFID in ERs = Behavioral Intention of Using RFID in ERs + constant

Table 4 displays the direct effect of service quality, customer satisfaction, and sacrifice on service values perceived by caregivers and IS professionals when implementing RFID in the ER. These three independent variables together can explain 65.3% (R square value) of the service values of using RFID in ERs perceived by caregivers. These independent variables have relatively power to predict the degree of behavioral intentions, in the order of service quality (beta=0.676), customer satisfaction (beta=0.234) and sacrifice (beta=0.142). This indicates that service quality has a higher influence than customer satisfaction at improving the perceived service values of using RFID in the ER by caregivers and IS professionals, followed by the construct of sacrifice. The first two independent variables of service value (p=0.000 < 0.01) and customer satisfaction (p=0.001<0.01) have significantly predictive power on the perceived service values of using RFID in the ER. The construct of sacrifice does not have significant effects on the service value (p=0.605).

Table 4: Regression Analysis (DV = Service Values)

<table>
<thead>
<tr>
<th>Beta</th>
<th>p-value</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sacrifice</td>
<td>0.142</td>
<td>0.605</td>
</tr>
<tr>
<td>Service Quality</td>
<td>0.676</td>
<td>0.000</td>
</tr>
<tr>
<td>Customer Satisfaction</td>
<td>0.234</td>
<td>0.001</td>
</tr>
</tbody>
</table>

Table 5 displays the direct effect of service values on the behavioral intention of adopting RFID in the ER by caregivers and MIS department. The service values factor can explain 62.2% (adjusted R square value) of the behavioral intention of adopting RFID in ERs.
Table 5: Regression Analysis of the Relationship between Service Values and Behavioral Intention of Using RFID Technology by Medical Teams

Table 6 confirms the existence of this positive relationship (p=0.00<0.01). The behavioral intention factor can explain 55.8% (Adjusted R square value) of the actual use of RFID in ERs. The difference in the actual use of RFID in ERs is sensitive to the changes of the behavioral intention (beta=0.751).

Table 6: Regression Analysis of the Relationship between Behavioral Intentions and Actual Use

Table 7 summarizes testing results of our proposed hypotheses. All five hypotheses were supported with statistical evidences. Academic and practical implications on these findings will be discussed in the following section.

Table 7: Summary of Hypotheses Testing Results
DISCUSSION

This research project integrates the Service Value and Unified Theory of Acceptance and Use of Technology (UTAUT) models. The objective is to investigate the effect of major service value-added factors on the behavioral intentions and the actual use of RFID technology in ERs. Eighty-one caregivers and MIS department participated in this research project via online and offline surveys. Empirical data collected in this study confirms the existence of relationship hypothesized in the research model in the context of RFID adoption in the ER by caregivers and MIS department. Service quality has the highest predictive power (67.6%) for the perceived service values of adopting RFID technology in the ER. This indicates that caregivers are interested in adopting RFID if this system has a high reliability, user-friendly system design, sound security control and great customer service. The presence of all quality attributes can directly contribute to caregiver’s perceived service values. Customer satisfaction is the second most important attribute to improve the perceived service values. Caregivers and IS professionals who are satisfied with RFID system shows a higher perceived benefits and a lower perceived costs. Consequently, service values can be improved. The sacrifice factor does not play an important role of improving caregiver’s perceived service values. Major concerns of caregivers and IS professionals are to provide quality medical care and services when adopting a new technology. Although caregivers are concerned about tangible costs, intangible patient care costs and overhead are more important. Non-quantitative costs manifest itself through patient care liability and the supply chain risks of changing interface technologies with the suppliers.

Perceived service value directly determines the behavioral intention of adopting RFID in the ER by caregivers and IS professionals. To accelerate RFID adoption in ERs, it is just as important to utilize the influence of service values to improve the behavioral intention of adopting RFID in the ER by caregivers and IS professionals. The chain of logic between the behavioral intention and the actual use behavior is confirmed in the context of RFID adoption in ERs. Improving the intention of caregivers and IS professionals in adopting RFID in the ER can increase the number of actual users.

LIMITATIONS

Little control of experience and volunteerism of use are two major limitations of this study. Past literature shows that both factors can influence the intention of using an information technology and the actual behavior of using it (Venkatast et al., 2003). In this study, caregivers and IS professionals complied with the mandatory requirements of their hospitals to deploy RFID technology in the ER. The compulsory participation of the experiment results in the inability to control for the potential effects of user intention with RFID. While most of the participants did not have any experience with RFID, some of the participants may have had some experience with using bar codes. Subjects participating in this study were of one homogeneous culture. Taiwan is a country endowed with masculinity and high uncertainty avoidance culture. From the anthropological and technological perspective, social norms, particularly in the society where femininity and high uncertainty avoidance cultures are prevalent, are stronger determinant of behavioral intention of using new information technology than gender, age and experience (Srite and Karahanna, 2006).
FUTURE RESEARCH

Future research may want to conduct a longitudinal study of a limited number of sample hospitals, since it is less obtainable to increase sample size in this industry sector than other sectors. An in-depth investigation of case studies is appropriate vehicle to achieve this purpose. To stay with the survey method, researchers can investigate the use of RFID across industries to generalize their findings. With a more controllable environment, researcher can manipulate those two moderating factors (volunteerism of use and culture) ignored in this study to improve the validity of their findings. The adopted value model originates from the marketing theory. Many information systems studies theorize the relationship between constructs of performance expectancy, effort expectancy, social influence, and facilitating conditions, and behavioral intention. These studies confirm relationships between those constructs and the improvement of behavioral intention and the actual use behavior of a product or service. Future research can further explore these constructs in the context of RFID.

CONCLUSION

Emergency Room caregivers believe that RFID technology can provide benefits and that the results warrant the effort required to use the technology. However, there is not a lot of social pressure to drive increased use. The pressure to increase the use of RFID technology must come from rational, and not emotional, decision making. While slower, it may be a more effective foundation on which to build.

REFERENCES

Available upon request