An implementation and usability evaluation of automatic cash-payment system for hospital

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Most hospitals have the information system to deal with the register, billing and payment process in Taiwan. The payment mechanism is mainly by cash that is counted by the counter clerks. In order to lessen the workload of counter clerks and reduce the patient’s waiting time for speeding up the payment process, this study thus implemented a hospital automatic cash-payment (HACP) system. An experimental evaluation was also conducted to survey the perceptions of patient’s feeling about the system. The results displayed that relative advantage of system, complexity of system and perceived service quality of system have significantly effected on behavioral intention of HACP system use. Perceived service quality has most predictive power to the behavioral intention of system use. Behavioral intention of HACP system use has in turn positively effected on actual system use of HACP system.

Keywords: Complexity, Innovation diffusion theory, Perceived service quality, Relative advantage, Technology acceptance model

Introduction

With the implementation of the National Health Insurance (NHI) in Taiwan¹, most public like to go to large hospitals for medical treatment instead of local clinics. Public think large hospitals possess better medical equipments and have more doctors to choose than the local clinics. Thus, the larger hospitals are always full of patients. In order to provide better service quality and increase patient’s satisfaction, large scale hospitals have installed many information systems for automatic billing, scheduling, claims tracking, document management, charting, and electronic encounter documentation, such as registered system for patients, hospital’s clinical information system, electronic medical records system and so on²-³. Although the hospital has automatic billing system, the patients still are used to pay by cash, so they need to go to counter to pay the money. The payment process is not only causing the patients’ unsatisfactory to the hospital service quality, but also increasing the workload of counter clerks. Counter clerks facing different patients’ needs and having heavy workload of jobs are easily to have the stress or professional burnout⁴-⁷. Based on the previous researches’ definitions and practical applications, burnout is a syndrome of emotional exhaustion, depersonalization, and diminished personal accomplishment that occur among social workers, nurses, teacher, policeman, or clerks who are face-to-face providing services to customers⁸-¹².

Researches displayed that if the employee’s burnout condition has no effective coping strategies to solve it, employee burnout can lead to higher absenteeism, lower motivation to do required work, and higher turnover rate¹³-¹⁴. To lessen clerks’ workload and eliminate patients’ waiting times, a hospital automatic cash-payment (HACP) system was implemented to improve billing and payment process. Patients can go to HACP system directly and key in their identification number. System will show the amount of bill to pay. The patients insert the paper bill into the machine. HACP system will finish the payment process instead of going to counter waiting the clerk’s service. Payment mechanism of HACP system is different from vending machines such as drawer dispensing, locker cabinets, candy machine, soft drink, cigarette, ticket, hot food etc¹⁵-¹⁷, which only accepted coin. However, HACP system can accept paper bill and coins. A bill validator in HACP

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system can recognize bill patterns and various magnetic and optical markings printed on the bill.

Subsequently, Davis’s Technology Acceptance Model (TAM) and Roger’s Innovation Diffusion Theory (IDT) were applied to evaluate patient’s adoption behavior of HACP system to test system’s feasibility and usability. A questionnaire study accompanied cluster analysis is utilized to divide respondents into innovators, early adopters and the early majority categories to compare the differences among the factors affecting patient’s intention to use and actual use of HACP system. Subsequently, the differences in characteristics, such as compatibility, complexity of system, relative advantage, and perceived service quality, among all respondents are assessed to test the adoption of HACP system.

**HACP System Implementation**

**Multi-Drop Bus (MDB)**

MDB is a communication standard, which is a serial bus interface for electrically controlled vending machine and configured for Master-Slave operation. This interface communicates with a fixed data rate of 9600 bits/sec and a maximum of 32 slaves attached to the system under a master controller. In present system, two slaves (coin changer and bill validator) have been hooked. Each slave has a predefined address and command set. When operating, the master continuously polls each slave and the polled slave takes this chance to report its status in the real operation conditions by ACK (acknowledgement), NAK (non-acknowledgement) or specific data to the master such as the amount of money collected by a coin changer. The situation of communication collision has possibly been seen in other system, which would not happen in the MDB system. Because the protocol is strictly defined that only the master is allowed to poll slaves and a slave would passively respond to the bus polled by the master. Sometimes a slave could be disabled by the master for power saving during the system operation period. Some typical transmission processes (Fig. 1) include ADD stands for the address of a slave, which the master currently talks to. High transmission reliability is achieved through the usage of the CHK byte, which derived from checksum of the transmitted data. Any data, DAT, can be sent in response to a master’s command or back from a slave to the master. An asterisk indicates the ninth bit, mode bit, of a transmission byte to inform slaves that the ADD byte is sent from master, or to tell master that the last byte is currently transmitted from slave.

**Hardware Interface**

Hardware interconnection between the master and the slave is made with a photo-coupler (Fig. 2). Since each slave has its own photo-coupler wired to the master, electrical interference between different slaves can be avoided, and the possibility of single-point failure is also alleviated. Thus a reliable multi-drop communication system is set up.

**System Architecture and Experiment**

With the help of a communication controlling microcontroller (Fig. 3), which plays role of MDB master, coin changer and bill validator can receive commands from, and report status to HACP that is programmed in a personal computer. After seeing a doctor, a patient shall receive a billing slip. Then patient can use HACP and input his ID number. The patient shall put an adequate amount of money into the coin changer/bill validator according to the feeresh
YANG et al: AUTOMATIC CASH PAYMENT SYSTEM FOR HOSPITAL

487

amount displayed by the system. A report of the amount of money collected by the coin changer/bill validator is then sent, via MDB bus, to hospital management system with the cooperation of controlling microcontroller. As the balance check finishes, HACP will print out a receipt for the patient and, at the same time, a change is dispensed if required. Billing process totally completes after patient receives his receipt and gets change back.

System Evaluation

Two questions were examined in the system evaluation step: (1) The descriptive profiles for compatibility, perceived usefulness, perceived ease of use, perceived service quality (PSQ), behavioral intention of system use, and actual system use in the different types of innovative scale; and (2) Regression analyses were used to test the casual-effect among impact factors on intention to use the HACP system, which in turn affect on the actual system use.

Experiment Design

HACP system was installed in three local private hospitals and an experimental evaluation was conducted from May to November 2004. Study involved: i) A questionnaire was designed and left on the service desk for patients voluntarily to answer and to survey perceptions of patient’s feeling about system usage; and ii) Three-time interviews were conducted to ask the job loading of cashiers in counter within six months. Question is that did they feel workload reduction or not after HACP system was installed?

Theoretical Base and Testing Hypotheses

Fundamental problem that motivated this evaluation experiment is what factors determine patients’ acceptance and use of HACP system. Two well-matured theories of adoption and intention models, TAM and IDT are supported in this evaluation step. Basically, TAM was implemented to explain the determinants of user acceptance of end-user computing technologies. Two salient constructs, perceived ease of use (PEOU) and perceived usefulness (PU), are the primary antecedents to predict the intention of system use, which in turn determines actual system use (ASU). PEOU has significant impact on PU. Chen et al proposed that PEOU positively affected PU.

Another well-established theory for user adoption is IDT. IDT presents that innovation diffusion is achieved through user’s acceptance and use of new things or new system. Roger classified diffusion in his innovation adoption framework into five onwards stages (innovators, early adopters, early majority, late majority, and laggards) and five factors [relative advantage (RA), compatibility, complexity,
triaibility and observability]. Tornatzky & Klein\textsuperscript{26} found that RA, compatibility, and complexity were the important factors to affect the rate of innovation adoption. RAs refer to the degree to which an innovation provides benefits superseding its precursors and may incorporate with economic benefits, image enhancement, convenience and satisfaction\textsuperscript{19}. Basically, TAM and IDT have some explicit resemblances. RA construct in IDT is often treated as the same construct of PU in TAM. Therefore, in this study, RA is used as a surrogate of PU. RA is thus defined as “the degree to which HACP system provides economic benefits, image enhancement of hospital, convenience and satisfaction superseding counter clerks service”. Previous studies have found RA to be positively related to the adoption of new technology\textsuperscript{27,28}. Complexity refers to the degree to which an innovation is perceived to be difficult to understand, learn or operate\textsuperscript{19}. Although complexity is opposite to PEOU in ATM, the complexity construct in IDT is generally viewed as the same construct of PEOU in TAM. Therefore, complexity has been used as a surrogate of PEOU. Complexity is then defined as “the degree of HACP system is perceived to be difficult to operate”. Researches displayed complexity (corollary as perceived ease of use) is an important factor in technology adoption decisions\textsuperscript{29,30}. Roger\textsuperscript{19} proposed that complexity of technology creates a certain degree of uncertainty for successful implementation and therefore increases some risks in the adoption decision. Grover’s\textsuperscript{31} research displayed that there is negatively associated with adoption. Researches also suggested that TAM integrated with other concepts and diffusion theories would improve its predictive power of system use\textsuperscript{25,32}. Compatibility refers to which the innovation fits with the potential adopter’s existing values, previous experiences and current needs\textsuperscript{19}. Compatibility can be often treated as an external variable to positively affect PEOU and PU\textsuperscript{25,33,34}. Compatibility refers to which the innovation fits with the potential adopter’s existing values, previous experiences and current needs\textsuperscript{19}. Compatibility is reported positively related to adoption\textsuperscript{35}. Compatibility in this study is defined as “the degree to which adopting the HACP system is compatible with what patients do”.

PSQ is an important construct for information system discipline\textsuperscript{60}. With HACP being an information system, PSQ is a crucial factor to affect system’s adoption. Researches indicated that PSQ has positively affected on the intention of system use\textsuperscript{25}. PSQ is then defined as “the discrepancy between what patients expect and what patients get from this system” in this study.

From aforesaid studies, following hypotheses were tested in this evaluation step: H1-Compatibility of system has a positive influence on relative advantage of system; H2-Complexity of system has a negative influence on relative advantage of system; H3-Compatibility of system has a negative influence on complexity of system; H4-Relative advantage of system has a positive effect on intention to use the system; H5-Complexity of system has a negative influence on intention to use the system; H6-PSQ has a positive influence on intention to use the system; and H7-Intention to use the system has a positive influence on actual system use.

**Questionnaire Design and Pre-testing**

Questionnaire consists of two main parts: i) Demographic information such as gender, age, education, occupation, annual income, frequency of using HACP system within six months, and how do they feel about the system; and ii) The constructs of innovativeness (I), compatibility (C), complexity of system (CS), relative advantage (RA), perceived service quality (PSQ), behavioral intention to use HACP (BIU) system, and actual use of HACP (AU) system. Survey instruments of these constructs were adopted from earlier research\textsuperscript{29,30,34,37-39}.

The measurements of BIU and AU are the adaptation of Davis\textsuperscript{29} and Davis et al\textsuperscript{40}, and slightly modification the words of measures to fit the current research context. Two items of BIU construct were modified from Davis\textsuperscript{29,40} to measure the respondents’ intention to use the system. AU is measured by a binary variable asking whether the respondent has used HACP system. Additionally, two-item scales are also used to measure the intensity of system use, depending on the frequencies and times. One is a 7-point scale with the adjectives frequent and infrequent at the endpoints, and another is to check the box format with categories for current use within six months.

A six-item scale with a 7-point Likert scale from 1 (never agree) to 7 (completely agree) is adapted and modified from Moore & Benbasat’s\textsuperscript{30,39} and Ahn et al\textsuperscript{35} survey instrument for compatibility of HACP system. Respondents are asked to indicate the degree to which using a HACP system is compatible with their payment style and their lifestyles. To access CS and
RA of HACP system, 5 items each were adopted and modified from the work of Moore & Benbasat respectively, and generated totally 10 questions with a 7-point Likert scale from 1 (never agree) to 7 (completely agree). An 11-item instrument of PSQ with a 7-point Likert scale from 1 (never agree) to 7 (completely agree) is adapted and modified from Parasuraman et al. Instrument reflects five dimensions (tangibles, reliability, responsiveness, assurance, and empathy) to evaluate service quality of HACP system. The list of the measurement items is displayed in Appendix A.

Innovativeness construct, adopted and modified from Goldsmith & Hofacker scale, is to measure domain-specific innovativeness, which is a tendency to use and adopt ‘I’ within a specific domain. This construct is an intermediary between innate ‘I’ and innovative behavior. A 6-item with 7-point Likert scale of innovative attitudes towards HACP system was operationalized, as follows: i) “Compared to my friends, I like to try HACP system”; ii) “I am the last in the hospital to know the HACP system”; iii) “I am among the first in the hospital to use HACP system when it appears”; iv) “If I heard a new facility was available in the hospital, I would be interested enough to try it”; v) “I will use a new facility, even if I haven’t heard it yet”, and vi) “I use the HACP system before other people do”. Four of the six items in this scale describes social ‘I’.

Before the final version of questionnaire being distributed, a pilot test was conducted with 35 participants. Seven scales had reliabilities levels of 0.80 or better for all. Based on this pretest, a slightly refinements and minor adjustments of the wording and sequence of the questions were revised to prevent any vagueness and misunderstanding.

Sampling and Data Collection
The questionnaire survey was conducted to test the adoption of HACP system. In order to target the samples, prior to start the experiment, researchers privately solicited the clerks at service desks to have them support this project and help to collect the questionnaires. In order to reflect the actual system usage, if the patients use the system to pay bills, then the service clerk will politely ask whether the patients are willing to fill in the questionnaire. If the patients do not have intention to fill in the questionnaire, the service clerk will not force them to do it. The experiment lasted six months. One of researchers visited hospitals twice per month to see how the system works. Finally, out of 539 questionnaires collected, 458 valid questionnaires were found to be complete and usable in the analysis.

Results and Discussion
In order to offer a more insight into the respondents, a brief profile was summarized covering the demographic attributes of the participants (Table 1).

The samples included white- and blue-collar employees (138), businessman (188), service business employees (60) and students (72). The gender ratio was 52.2 for female (239) comparing to male 47.8 (219). Education of respondents was: university degree, 57.4; high school, 35.4; graduate school degree, 4.6; and under junior high school, 2.6%. Majority (48.5%) of the monthly income reported was in the medium-high socio-economic class. Respondents think the HACP system can save time (48.9%) and the HACP system is convenient (35.4%).

Table 1—Demographic profile of participants

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Frequency</th>
<th>%</th>
<th>Cumulative %</th>
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<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>239</td>
<td>52.2</td>
<td>52.2</td>
</tr>
<tr>
<td>Male</td>
<td>219</td>
<td>47.8</td>
<td>100</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Under 20</td>
<td>98</td>
<td>21.4</td>
<td>21.4</td>
</tr>
<tr>
<td>21-30</td>
<td>150</td>
<td>32.8</td>
<td>54.2</td>
</tr>
<tr>
<td>31-40</td>
<td>108</td>
<td>23.6</td>
<td>77.8</td>
</tr>
<tr>
<td>Over 40</td>
<td>102</td>
<td>22.3</td>
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<tr>
<td><strong>Highest education</strong></td>
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<td></td>
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<tr>
<td>Under junior high school</td>
<td>12</td>
<td>2.6</td>
<td>2.6</td>
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<tr>
<td>High school</td>
<td>162</td>
<td>35.4</td>
<td>38</td>
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<td>University</td>
<td>263</td>
<td>57.4</td>
<td>95.4</td>
</tr>
<tr>
<td>Graduate School</td>
<td>21</td>
<td>4.6</td>
<td>100</td>
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<tr>
<td><strong>Per month income</strong></td>
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<tr>
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<td>65</td>
<td>14.2</td>
<td>14.2</td>
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<tr>
<td>Under $10000 NT</td>
<td>27</td>
<td>5.9</td>
<td>20.1</td>
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<td>$10001-20000NT</td>
<td>30</td>
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<td>26.7</td>
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<td>$20001-35000NT</td>
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<td>19.7</td>
<td>46.4</td>
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<td>$35001-50000NT</td>
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<td>48.5</td>
<td>94.9</td>
</tr>
<tr>
<td>Over 50000NT</td>
<td>24</td>
<td>5.1</td>
<td>100</td>
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<td><strong>Occupation</strong></td>
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<tr>
<td>Blue-white collar employees</td>
<td>135</td>
<td>30.2</td>
<td>30.2</td>
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<tr>
<td>Businessman</td>
<td>188</td>
<td>41.0</td>
<td>71.2</td>
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<tr>
<td>Service business</td>
<td>60</td>
<td>13.1</td>
<td>84.3</td>
</tr>
<tr>
<td>Students</td>
<td>72</td>
<td>15.7</td>
<td>100</td>
</tr>
<tr>
<td><strong>How do patients feel about the system</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Save time</td>
<td>224</td>
<td>48.9</td>
<td>48.9</td>
</tr>
<tr>
<td>Convenient</td>
<td>162</td>
<td>35.4</td>
<td>84.3</td>
</tr>
<tr>
<td>Reduced error rate</td>
<td>72</td>
<td>15.7</td>
<td>100</td>
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Cronbach $\alpha$ was conducted to measure the internal consistency. To examine discriminant validity, an exploratory factor analysis was conducted using orthogonal rotation to ensure the loadings on hypothesized factors. Following the initial screening of the respondents for reliability and discriminant validity, the hypotheses were tested. Two-step approach was applied to analyze the data. At the beginning, a cluster analysis with k-means method was conducted to group the respondents into three groups- innovators, early adopter, and early majority- to identify the different characteristics of respondents based on the constructs of CS, RA, C, PSQ, BIU, and AU. K-means method is one of the better techniques available for clustering large data sets where the goal is to group respondents into meaningful groups to describe behavior\textsuperscript{42,43}. Secondly, in order to observe high inter-item correlations and the causal-effect, regression analyses were applied to test hypotheses.

**Reliability and Validity of Measurement**

Reliability analysis of all factors in the present experiment step was above 0.80 (Table 2). This result indicates a high internal reliability of the data exists, because these reliability values are above the value of 0.7 suggested by Nunnally\textsuperscript{44} for basic research. Exploratory factor analysis (EFA)\textsuperscript{45}, assessed to examine discriminant validity, initially used principal component analysis to process factor, then used varimax as orthogonal rotation and Eigen value equaling to 1 to get factor loading which should be greater than 0.5\textsuperscript{46}. If an item with factor loading values is not greater than 0.5, then the item should be deleted and abandoned from further analysis. The loadings of each independent construct of PSQ, CS, RA, and C are all greater than 0.5 and no items were deleted to fit the literature supported (each item factor loading >0.5).

**Analysis and Discussion**

According to Roger\textsuperscript{19} DOI theory and Prendergast\textsuperscript{47} suggestion, as the adoption rate has reached 38.6 percent, HACP system’s diffusion reached the early majority. Thus, on the basis of ‘I’ scale, only three clusters- innovators, early adopters, and the early majority- are formed to analyze the respondent’s adoption of HACP system. The descriptive profiles (Table 3) for C, RA, CS, PSQ, BIU, and AU show that there is a significant difference among the clusters based on Roger’s\textsuperscript{19} DOI theory. Majority (40.6 %) of the respondents belong to early adopter. Overall, the means scores of each construct is: innovators, 10.85-61.68; early adopters, 10.37-56.88; and, early majority, 9.34-50.28. Thus innovators have a high mean score comparing with early adopters and the early adopters have a high mean score comparing with early majority for each factor, regardless of RA, PSQ, C, BIU and AU. However, in the construct of complexity of system, early majority has the highest mean score. Early adopters come next and innovators have the lowest mean score. Thus innovators have a more positive impression on the HACP system than early adopters, and then in turn early majority. This implies that respondents (patients) may feel the...
system is useful for them and easy to operate. In sum, the HACP system is acceptable for most of respondents.

Four regression analyses were performed to understand causal-effect of each hypothesis. First, the regression analysis (Table 4) was conducted for C, CS and RA (H1 & H2). Overall ANOVA model is significant (P<0.001). \( R^2 \) for this analysis was 0.483 at F=69.329 (P<0.001) in RA of system are accounted for by CS and C. The C (p=0.000) and CS (p=0.003) turned out to have a significant effect on RA. C has a positive effect on RA and complexity has a negative effect on relative advantage. C (\( \beta=0.398, \text{Sig.}=0.000 \)) has a more significant predictive power than CS (\( \beta=0.142, \text{Sig.}=0.003 \)) for RA of system. The result is consistent with researches, which predicted CS and C have a significant impact on RA\(^{22,25,29,33,34,40}\).

Second, C was regressed against CS. The overall ANOVA model is significant (P<0.001). \( R^2 \) for this analysis was 0.487 at F=142.081 (P<0.001) in CS use is accounted for by C. As expected, C (p=0.000) has a negative significant effect on CS (Table 5). This result is consistent with earlier researches\(^{25,33,34}\).

Thirdly, in order to understand the impact of CS, RA and PSQ on HACP system use, the relationship was tested of CS, RA and PSQ on BIU. The overall ANOVA model is significant (P<0.001). \( R^2 \) for this analysis was 0.339 at F=19.595 (P<0.001) in intention to use the system is accounted for by CS, RA and PSQ. As expected, PSQ (p=0.001), CS (p=0.003) and RA (p=0.007) turned out to have a significant effect on BIU (Table 5). However, CS has a negative effect on BIU. These results are consistent with earlier studies\(^{22,25,29,40}\). PSQ is the most significant predictive variable for the BIU, followed by CS, and then RA is least predictive power in this study. This indicated that patients are more careful about the service qualities. The possible argument is that patients think HACP to speed up their counter service. Thus PSQ has the most predictive power to BIU.

Finally, BIU was regressed against actual HACP system use. The overall ANOVA model is significant (P<0.001). \( R^2 \) for this analysis was 0.203 at F=19.515 (P<0.001) in actual system use. As expected, behavior intention of HACP system use (p=0.000) has a significant effect on actual HACP system use (Table 5). This result is consistent with earlier researches\(^{29,40}\).

**Limitations**

Four limitations should be addressed in this study. Firstly, the evaluation of this study represents only a preliminary study to investigate the innovation attributes and adoption constructs on HACP system in patients’ system use. These factors may not enough to evaluate the impact of system usage. Hence, the evaluation results may not generalize to all patients. Further experiments are required to assess more external variables or individual personality, which might influence system usage to gain a better understanding of information technology or system acceptance. Secondly, the evaluation of this study is a kind of snapshot research. CS, RA, and PSQ would change over time while the respondents are using more times of the system. Therefore, further study should focus on a longitudinal study over time to understand the change of system usage and reduce the

<table>
<thead>
<tr>
<th>Table 4—Regression results of H1 &amp; H2</th>
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<tr>
<td>Construct</td>
</tr>
<tr>
<td>--------------------------------------</td>
</tr>
<tr>
<td>Complexity of system</td>
</tr>
<tr>
<td>Compatibility</td>
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Dependent variable: Relative advantage; F=69.329, Sig. =0.000

**p<0.000; **p<0.01, *p<0.05

<table>
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<tr>
<th>Table 5—Regression results of H3 to H7</th>
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<tr>
<td>Dependent variable</td>
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<tr>
<td>---------------------------------------</td>
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<tr>
<td>Complexity of system (H3)</td>
</tr>
<tr>
<td>F=142.081, Sig.=0.000</td>
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<tr>
<td>Intention of system use (H4-H6)</td>
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<tr>
<td>F=19.595, Sig.=0.000</td>
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<td>F=19.515, Sig.=0.000</td>
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**p<0.000, **p<0.01, *p<0.05
bias of the research. Thirdly, the system is probably only workable at Asia area where people are used to pay cash as their daily transaction tools, even the system is still in preliminary stage and is not commercialized yet. The results can’t generalize to all well-developed countries’ hospitals such as American area or European areas, where people are used to use check or credit card as their transaction tools. Fourthly, HACP system is not commercialized yet, so only three local hospitals were installed as testing samples. The results may not be generalized to all samples.

Conclusions

HACP system is a cash-payment system, which can reduce counter workload and then in turn reduce their work stress. It can speed up patients’ payment process. Patients don’t need to stand in a queue for paying bills. This could increase patients’ satisfaction for hospital service. The evaluation step is only a preliminary study to test the system usage with C, PSQ, CS and RA, in TAM theory and IDT theory, at HACP system. Based on TAM and IDT, this research proposed an experiment to predict and explain the patient’s acceptance of HACP system. Empirically tested among 458 valid patients, the experiment was found to be reliable. TAM and IDT provide a robust theory background to investigate the adoption behavior of individual. The findings from this evaluation step displayed that CS and C can be viewed as related to usage experience prior to adoption of a new technology and thus have significantly effected on RA. Participants adopt HACP system because it is convenient, easy to use and high service quality. Compatible experiences of HACP system lead participants to RA. BIU has positively effected on AU of HACP system. The results show that CS, RA and PSQ are three important constructs to understand the usability of system usage. This is consistent with earlier studies. This result recommends that any system implementation need to test the feasibility of system usage to increase the system acceptance for the users.

In Asia area, especially Taiwan and China, people are still used to pay cash as their transaction tools. This system may not be useable at well-developed areas hospitals. After the system being well matured and commercialized, system usability can be tested again. Except to use in the hospital, the cash-payment system can also be applied in restaurant or self-service gas station and so on.

Since HACP system is not commercialized yet, a further study is required to assess the system’s adoptions for more respondents at different hospitals. A large-scale study needs to test the feasibility and usability of the HACP system in actual operating settings. This research represents only an early attempt to develop the HACP system for hospital cash payment. Further studies are required to modify the system more stable and friendly user-interface attracting patients’ use.

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YANG et al: AUTOMATIC CASH PAYMENT SYSTEM FOR HOSPITAL

Appendix A—List of measurement items

Perceived service quality (PSQ)

PSQ1 HACP system has a up-to-date hardware and software

PSQ2 HACP system’s physical facilities are visually appealing

PSQ3 The appearance of the physical facilities of HACP system is keeping with the services provided

PSQ4 HACP system is dependable

PSQ5 HACP system provides its services at the times it promises to do so

PSQ6 HACP system is an error-free payment system for patients

PSQ7 HACP system confirms patients exactly when services will be performed

PSQ8 Patients will feel safe in their transactions with HACP system
PSQ9  HACP system gives patients individual attention
PSQ10 HACP system has enough operating hours convenient to all patients
PSQ11 HACP system has the patient’s best interests at heart

Complexity of system (CS)
CS1 Learning to operate HACP system is easy for me
CS2 I find it easy to use HACP system to do the payment in hospital
CS3 My interaction with HACP system is clear and understandable
CS4 I find HACP system easy to use
CS5 I find it is easy for me to be skillful at using HACP system

Behavioral intention (BI)
BI1 I intend to use HACP system
BI2 I would like to use HACP system rather than the cashier

Actual use (AU)
AU1 Have you ever used the HACP system?
AU2 How often do you use HACP system? (A 7-point scale with the adjectives frequent and infrequent at the endpoints.)
AU3 How many times do you use HACP system in the last six months? (A check the box format with categories for current use of: not at all; less than once; about once; 2 or 3 times; 4 to 5 times; about once a month; more than 6 times)

Relative advantage (RA)
RA1 Using HACP system enables me to accomplish the payment more quickly in hospital
RA2 Using HACP system makes it easier for me to pay bills in hospital
RA3 Using HACP system enhances my payment more efficient in hospital
RA4 Using HACP system reduce my waiting time in hospital
RA5 Using HACP system improves the quality of payment in the hospital

Compatibility (C)
C1 Using HACP system fits my payment style
C2 Using HACP system fits well with the way I pay bills
C3 I find HACP system very useful to pay bills in hospital
C4 Using HACP system would enhance the performance in payment process
C5 Using HACP system would help me to finish the payment in the shortest time
C6 Using HACP system is compatible with the most aspects of my payment