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Adoption of Hospital Information System (HIS) in Malaysian Public Hospitals

Nurul Izzatty Ismail^{a*}, Nor Hazana Abdullah^b, Alina Shamsuddin^c

^{a,b,c} *Department of Technology Management, Faculty of Technology Management and Business, Universiti Tun Hussein Onn Malaysia, Parit Raja, Batu Pahat, Johor, 86400, Malaysia*

Abstract

Hospital Information System (HIS) is important to be adopted by the hospitals to improve their operations and services. Despite their importance, only 15.2% of Malaysian Public Hospitals implemented the system through THIS, IHIS and BHIS categories which shows low adoption level of HIS in Malaysia. This study aims to identify factors affecting the HIS adoption across different categories of HIS's hospitals. The finding showed that there are significant differences between factors affecting HIS adoption in the THIS compared to IHIS's hospitals, and THIS and BHIS's hospitals. However there is no significant difference among factors between IHIS with BHIS's hospitals.

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1. Introduction

Healthcare sector is an important industry to serve high-quality services and healthcare treatment to citizens in every country in the world. It needs to be improved continuously, especially in the context of healthcare management. In Malaysia, the healthcare sector is divided into three categories namely Public Healthcare, Non-Governmental Organization (NGO) Healthcare and Private Healthcare, which includes hospitals and clinics (Country Health Plan, 2011). Among these categories, the public healthcare is the most critical category since it serves the largest number of

* Corresponding author. Tel.: +607-453-3842.

E-mail address: izzatty86@gmail.com

patients. Accordingly, public hospitals are usually bigger and more crowded. To accommodate escalating number of patients in public medical hospitals, several initiatives had been taken by Malaysian Government, which includes enhancing Information Technology (IT) applications in Malaysian Public Hospitals. A systematic hospital Information System (IS) helps to ensure faster, manageable and efficient hospital services. Furthermore, this system is envisioned to overcome several problems faced by the public hospitals in Malaysia, for example slow and inefficient services (Md. Zan, 2007), and escalating negligence cases due to improper medical documentation (Malaysian Health Report, 2009; Bernama, 2009). However, to date, only 21 out of 138 public hospitals implemented either Total Hospital Information System (THIS), Intermediate Hospital Information System (IHIS) and Basic Hospital Information System (BHIS). In addition, there is no present study which compared factors affecting different categories of HIS.

2. Hospital Information System (HIS)

HIS is defined as an integrated electronic systems that collect, store, retrieve and display overall patients' data and information such as history of patients' information, results of laboratory test, diagnoses, billing and others related hospital's procedures which are used in several departments within hospitals (Aniza et al., 2010; Nor Bizura, 2010; Nik Azliza et al., 2009). Consequently, HIS has several components, for example Clinical Information System (CIS), Financial Information System (FIS), Laboratory Information System (LIS), Nursing Information Systems (NIS), Pharmacy Information System (PIS), Picture Archiving Communication System (PACS) and Radiology Information System (RIS) (Biomedical Informatics Ltd., 2006). According to Biomedical Informatic Ltd. (2006), the HIS could have two or more HIS components whereby these components are linked to one another. Each component has different characteristics, based on its usage, department and users.

The implementation of Hospital Information System (HIS) in Malaysian Public Hospitals are divided into three categories, which known as Total Hospital Information System (THIS), Intermediate Hospital Information System (IHIS) and Basic Hospital Information System (BHIS), in which eleven public hospitals represented as THIS, two public hospitals represented as IHIS and eight hospitals represented as BHIS in Malaysia (Mohamad and Syed Mohd., 2008; Ismail et al., 2010; Malaysian Health Report, 2009; Malaysian Country Plan, 2011). It presents the total of 21 out of 138 or 15.2% of public hospitals adopted the system in Malaysia. This implementation is based on the hospital size and number of beds (Mohamad and Syed Mohd., 2008). Table 1 shows the description of public hospitals involved in HIS implementation.

2.1. Components of HIS in Malaysian Public Hospitals

In Malaysia, the forms of integrated information system that installed are different among the HIS's hospitals. On the other words, the Total Hospital Information System (THIS), Intermediate Hospital Information System (IHIS) and Basic Hospital Information System (BHIS) have different components of information systems installed in their hospitals (Suleiman, 2008).

The different classification of HIS is determined by different components of Information System (IS) being implemented in the hospitals. THIS's hospitals are also be known as paperless hospitals because they have complete HIS components. While IHIS and BHIS using hybrid system, which maintain both electronic and manual systems. This is because, both of IHIS and BHIS's hospitals adopted only with several forms of IS. Therefore, a previous study by Ismail et al. (2013) found the factors that affecting the HIS adoption in Malaysian Public Hospitals are Technological, Organizational, Environmental and Human. However, the critical factors are low satisfaction level in THIS's hospitals, and low acceptance level in IHIS' and BHIS's hospitals. Thus, this finding indicates that THIS's hospitals are different from IHIS and BHIS's hospitals, while IHIS and BHIS's hospitals are quite similar. Previous studies by various researchers had identified several benefits and issues of HIS adoption.

2.2. HIS Benefits and Issues

HIS adoption has various benefits, as well as issues or problems. Previous studies found several benefits of HIS as follows: Patient data of HIS is accessible (Mohammad and Syed Mohamad, 2005; Nguyen, 2011), remote access of data within the hospital (Aftergut, 2011; Park, 2012), save time and space (Khartik, 2011; Park, 2012), legibility and

accuracy of data (Khartik, 2010; Peterson, 2006) and decrease of medication errors (Delbert and Meyer, 2010; Fiumara et al., 2008). However, previous studies also found several issues of HIS adoption as follows: High cost or expensive of HIS adoption (Boonstra and Broekhuis, 2010; Orill, 2011), time consuming in dealing with the system (Moseberry, 2011; Orill, 2011), technological and technical issues of the system (Boonstra and Broekhuis, 2010; Moseberry, 2011), lack of IT skills (Boonstra and Broekhuis, 2010; Moseberry, 2011) and confidentiality and security of the system (Littlejohns, 2003; Tachninaridi and Muura, 1994).

2.3. *Technology Acceptance/Adoption Theories*

In research, theory is important because it provides a framework for analysis, facilitates the efficient development of the field, and is needed to solve the real world problems. In this study, Theory of Reasoned Action (Fishbein & Ajzen, 1975), Theory of Planned Behavior (Ajzen, 1985), Technology Acceptance Model (TAM) (Davis, 1986), Technological, Organizational and Environmental (TOE Framework) (Tornatzky & Fleischer, 1990), DeLone and McLean Model (DeLone and McLean, 1992), Diffusion of Innovation Theory and Unified Theory of Acceptance and Use of Technology (UTAUT) were reviewed in terms of their applicability of use at organizational level. Three theories are deemed suitable to be applied at the organisational level, namely TOE Framework, DeLone and McLean IS Success Model, and IDT. However, the TOE was the best theory to be employed in this study because the three factors of the TOE framework (Technological, Organisational and Environmental) were consistent with factors uncovered during the first phase of qualitative study (Ismail et al., 2013).

The technological context is important to ensure successful adoption of IT. Kwon and Zmud (1987) mentioned that successful of IT is depends on importance of internal technology resource-infrastructure, technical skills, developers and user time. Besides that, Tornatzky and Fleischer (1990) had stated an availability and characteristics inside the Technology context. Besides that, organizational context is also important to ensure an efficiency of organizational structure in hospitals. According to Burns and Stalker (1994), the organizational context refers to firm size; centralization, formalization, and complexity of its managerial structure; the quality of its human resources; and the amount of slack resources available internally. Whereas, environmental is becomes the important context to ensure an effectiveness of the IT towards the hospitals. The environmental context refers to surrounding area of the firm, consisting of multiple stakeholders such as industry members, competitors, suppliers, customers, the government, the community, etc. (Angeles, R., 2013). A previous qualitative study by Ismail et al. (2013) showed Human contexts are also significant in HIS adoption in Malaysian Public Hospitals. Thus, this context is added to the existing TOE framework. Human refers to skill, experience and self-awareness of hospital staff members to deal with HIS, Prior to this, several hypotheses had been formulated in this study as follows:

H1a: THIS's hospitals are significantly different with IHIS and BHIS's hospitals in terms of Technological, Organizational, Environmental and Human Contexts.

H1b: IHIS and BHIS's hospitals are significantly different with THIS's hospital in terms of Technological, Organizational, Environmental and Human Contexts.

3. **Research Methodology**

This study employed quantitative approach via the used of cross-sectional survey. The survey had been conducted at six public hospitals in Malaysia. These hospitals were chosen based on the HIS categories of hospitals, which includes THIS, IHIS and BHIS's hospitals. There were 229 respondents among THIS, IHIS and BHIS's hospitals were participated in this survey. The respondents were chosen among the HIS users among these hospitals. Hospital A and Hospital B represented as THIS's hospital, while Hospital C and Hospital D represented as IHIS's hospitals, whereas Hospital E and Hospital F represented as BHIS's hospitals, as shown in Table 1. The total of sample size shows 73 respondents were from THIS's hospital, 83 respondents were from IHIS's hospitals and 73 samples of respondents were from BHIS's hospitals.

Table 1. Research Sites and Research Samplings of Quantitative Study

THIS	Sample Size	IHIS	Sample Size	BHIS	Sample Size
Hospital A	40	Hospital C	41	Hospital E	43
Hospital B	33	Hospital D	42	Hospital F	30
Total	73	Total	83	Total	73

3.1. Descriptions of Measurements

The questionnaires were obtained from validated questionnaires from Mohammad Chuttur (2009), McGill, Klobas and Hobbs (2004) and Thiri Naing (2006), as shown in Table 2.

Table 2. Descriptions of Measurements

Contexts	Validated Questionnaires	Theory/Source	Adapted Factors
Technological	Mohammad Chuttur (2009)	Technology Acceptance Model (Davis, 1986)	Perceived Usefulness Perceived Ease of Use
	McGill et al. (2004)	McLean and DeLone IS Success Model (McLean and DeLone, 1992)	System Quality
	Ismail et al. (2013)	From previous qualitative findings	User Acceptance
Environmental	Thiri Naing (2006)	Technology, Organization, Environment Model (Tornatzky and Fleischer, 1990)	Environmental
	Ismail et al. (2013)	From previous qualitative findings	Training
Organizational	Thiri Naing (2006)	Technology, Organization, Environment Model (Tornatzky and Fleischer, 1990)	Managerial Control
	Ismail et al. (2013)	From previous qualitative findings	Vendor
Human	McGill et al., (2004)	McLean and DeLone IS Success Model (McLean and DeLone, 1992)	Information Quality User Satisfaction
	Ismail et al. (2013)	From previous qualitative findings	Skill and Experience

3.2. Measurement

Overall, this questionnaire has 70 questions. These questions were divided into five sections, as follows: 1) Section A: Demographic Information, 2) Section B: Technological Context, 3) Section C: Organizational Context, 4) Section D: Environmental Context. 5) Section E: Human Context. Section A had eight questions of demographic information. Section B had twenty-six questions, Section C had eleven questions, Section D had eleven questions, and Section E had fourteen questions. Section B, Section C and Section D had items for Technological, Human and Organizational Factors. All items use seven point of Likert Scale to evaluate the questions, as follows: 1 = Extremely Disagree, 2 = Disagree, 3 = Somewhat Agree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Extremely Agree. According to Vagias, (2006), the seven point of Likert Scale is the convenient Likert Scale to evaluate the details of each question.

3.3. Sampling

Overall, this questionnaire has 70 questions. In this study, the researcher had chosen a non-probability sampling because of the following justifications 1) The population was hidden and hard to reach. This situation made the development of sampling frame became impossible, 2) Time consuming to find respondents by probability sampling. This is because, random selection does not worked through this study in hospital environments, 3) Costly when the researcher had to go to the hospitals for several times to meet several respondents in sampling frames by purposive sampling method. Thereafter, the type of non-probability used in this study was a purposive sampling. This is because, the target respondents had been identified as HIS users.

4. Data Analysis

A Statistical Package for the Social Sciences (SPSS) was employed in this study, since it is a common tool in most quantitative research. ANOVA was used to examine the differences of factors among different categories of HIS. Prior to the analysis, assumptions of ANOVA test were tested.

5. Findings

Data were obtained from 229 respondents of six hospitals among THIS, IHIS and BHIS's hospitals. Table 3 showed that majority of respondents were female (67.2%). In addition, majority of respondents were between 31 to 40 years old (40.6%). Moreover, the total respondents were Malay (84.5%). Therefore, most of the respondents which participated in this survey were nurses (38%). The percentage shows 49.3% of the respondents had one to ten year work experience in the hospitals, whereas 56.3% of the respondents had been involved in between one to three times of training annually.

Table 3. Respondent's Demographic

Demography	Category	Frequency	%
Gender	Male	75	67.2
	Female	154	32.8
Age	21-30 Years Old	78	34.1
	31-40 Years Old	93	40.6
	41-50 Years Old	41	17.9
	>50 Years Old	17	7.4
Race	Malay	82	84.5
	Chinese	6	6.2
	Indian	2	2.1
	Bumiputera	7	7.2
Working Position	Doctor	13	5.7
	Pharmacist	11	4.8
	IT officer	9	3.9
	Nurse	87	38
	Medical Assistant	21	9.2
	Medical Record Officer	8	3.5
	Others	80	34.9
Work Experience	<1 Year	12	5.2
	1-10 Years	113	49.3
	11-20 years	70	30.5
	>20 Years	34	14.8
Computer Training Annually	Never	74	32.3
	1-3Times	129	56.3
	4-6 Times	10	4.4
	>6 Times	16	7

According to Table 4, all contexts which includes Technological, Organizational, Environmental and Human are significantly different across HIS categories.

Table 4. Technological, Organizational, Environmental and Human Contexts Across HIS Categories

Contexts		Sum of Squares	df	Mean Square	F	Sig.
Technological	Between Groups	21.775	2	10.888	15.891	.000
	Within Groups	154.840	226	.685		
	Total	176.615	228			
Organizational	Between Groups	32.480	2	16.240	21.744	.000
	Within Groups	168.794	226	.747		
	Total	201.274	228			
Environmental	Between Groups	25.209	2	12.605	19.051	.000
	Within Groups	149.527	226	.662		
	Total	174.736	228			
Human	Between Groups	34.995	2	17.497	25.434	.000
	Within Groups	155.478	226	.688		
	Total	190.472	228			

Note: * $p < 0.05$, ** $p < 0.01$

A Post-Hoc test were performed to determine which categories differed as shown in Table 5. It is found that THIS is significantly differed from IHIS and BHIS's hospitals, while there is no significantly different between IHIS and BHIS's hospitals in all four contexts of Technological, Organizational, Environmental and Human contexts. This finding has proven the previous qualitative finding by Ismail et al. (2013) in which the THIS's hospital has significantly difference of IHIS and BHIS's hospitals, whereas the IHIS and BHIS's hospital has no significant difference of THIS's hospital.

Table 5. Differences of THIS, IHIS and BHIS's Hospitals By Technological, Organizational, Environmental and Human Contexts

Dependent Variable	(I) TYPE	(J) TYPE	Mean Difference (I-J)	Std. Error	Sig.
Technological	BHIS	IHIS	.03420	.13282	.964
		THIS	.67923*	.13701	.000
	IHIS	BHIS	-.03420	.13282	.964
		THIS	.64503*	.13282	.000
	THIS	BHIS	-.67923*	.13701	.000
		IHIS	-.64503*	.13282	.000
Organizational	BHIS	IHIS	.13166	.13867	.610
		THIS	.86979*	.14305	.000
	IHIS	BHIS	-.13166	.13867	.610
		THIS	.73814*	.13867	.000
	THIS	BHIS	-.86979*	.14305	.000
		IHIS	-.73814*	.13867	.000
Environmental	BHIS	IHIS	.07058	.13052	.851
		THIS	.74680*	.13464	.000
	IHIS	BHIS	-.07058	.13052	.851
		THIS	.67623*	.13052	.000

	THIS	BHIS	-.74680*	.13464	.000
		IHIS	-.67623*	.13052	.000
Human	BHIS	IHIS	-.10510	.13309	.710
		THIS	.77779*	.13729	.000
	IHIS	BHIS	.10510	.13309	.710
		THIS	.88289*	.13309	.000
	THIS	BHIS	-.77779*	.13729	.000
		IHIS	-.88289*	.13309	.000

Note: *p < 0.05, **p < 0.01

Thereafter, this is important to examine the number of differences in estimate effect size when using an ANOVA test (Levine and Hullett, 2002). In addition, Eta-Squared (η^2) was used to estimate the effect size in this study as shown in Table 6.

Table 6: Size Effect of Technological, Organizational, Environmental and Human in THIS, IHIS and BHIS’s Hospitals

Contexts	Eta Squared
Technological	.123
Organizational	.161
Environmental	.144
Human	.184

According to the findings, Human context becomes the most highest of size effect to THIS, IHIS and BHIS’s hospitals. It shows that the Human Context brought to important factor in influencing the HIS adoption in Malaysian Public Hospitals.

6. Conclusion and Discussions

This study examined the factors affecting the Hospital Information System (HIS) adoption in Malaysian Public Hospitals were different among HIS categories. The finding shows there are significant differences between the THIS with IHIS and BHIS’s hospitals. However, there is no significant difference between IHIS with BHIS’s hospitals, based on Technological, Organizational, Environmental and Human contexts. Moreover, the Eta-Squared test shows that Human context had the highest size effect of HIS adoption in Malaysian Public Hospitals. This might imply the importance of human skills, experience, expert, satisfaction and information quality to successful HIS adoption. This context has supports the reviews of literature from previous studies in which Fundamental problems such as lack of computer skills, complex tasks, complex function have influenced the successful HIS adoption. This study has positive implications, especially to Malaysian Ministry of Health to improve HIS adoption among Malaysian Public Hospitals.

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