

## Measuring the Success of Healthcare Information System in Malaysia: A Case Study

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**Abstract:** Information and communication technology has significantly improved the quality of healthcare information management and operation. In Malaysia, Healthcare Information System (HIS) has become popular and used by most of health institutions including government as well as private hospitals and clinics. Millions of ringgit was invested for those systems, in which requires better measurement for its return of investment or success. However, measuring the success of those systems are tricky due to lack of established measuring instrument. In addition, many factors also hinder the measurement such as the privacy of health data, administrative cooperation and participation of health sector staffs. It is important to measure the success of HIS especially from the user's perspectives as they are the main entity in using such systems. This study aims to measure the success of HIS called as Professional Medical Office (PMO) used by several clinics and health centres in Klang Valley. DeLone and McLean theory was used as the theoretical foundation to examine the key determinants comprise of system quality, information quality, service quality, intention to use, use, user satisfaction and net benefit which measure of success HIS implementation and application in healthcare industries. There are 45 respondents consist of doctors, nurses, therapist and staff admin of clinics that use PMO. Data was collected and analyzed using SPSS for descriptive and inferential analysis. Result shows that System Quality positively related to the Intention to Use and User Satisfaction while Use positively related to Net Benefits. Details findings are discussed in the later section.

**Keywords:** health information systems, success model, success measurement

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### I. Introduction

Rapid growing interest in healthcare information system and increased investment in its enabling technology have contributed significant improvement in development and management of Healthcare Information System (HIS). Swift developments in IT applications have led to IT being widely used in support of highly specific healthcare tasks and services [1]. Health institutions have considered various information technologies as possible solution to provide timely and accurate information to accomplish administrative works and enhancing operational effectiveness and efficiency within a reasonable budget [2].

There are many IT products developed and implemented in health centres or hospital to help physicians, nurses or practitioners to increase their productivity and automate their daily work tasks. Some of it was successfully meet the expectation by users in health organizations but some are still need improvement as in most of the cases of HIS users, they are from non-IT background. At the beginning of large-scale technology implementation by health care organizations around the globe, it is crucial to understand health workers' attitudes toward use of healthcare information technology and their intention to use the technology [3].

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 [4]. Subsequently, HIS consist of several components including Clinical Information System, Financial Information System, Laboratory Information System, Nursing Information Systems, Pharmacy Information System, Picture Archiving Communication System and Radiology Information System. Furthermore, 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.

According to [5] who is an officer with the Ministry of Health Malaysia, Malaysian government is always striving towards providing better health care for the people across the nation. The planning for use of ICT as enabler in healthcare services summarized as the following:

- i) Informed individual and population that will enable them to have more access and responsibility of their health.
- ii) Proactive illness and wellness management through highly skilled healthcare providers.
- iii) Delivery of service in a networked environment and effective sharing of information and resources.

Provision for services to be accessed from home through interaction with health care providers using multimedia networked.

## **II. Background Of Research**

Information technology (IT) has been proposed for use in healthcare for a variety of reasons; however the primary potential benefit must be for improved patient care and enhanced patient safety. If the only benefits gained are in administrative or organizational processes, then the full potential will not be realized. The types of software and hardware being implemented are extremely varied, but whatever the technology involved the vast majority require use by human beings, either staff members or patients or both [1]. If the systems are poorly designed and do not meet user needs, then the net benefits will not be achieved and money will be spent ineffectively and potentially putting patients at risk.

Many health institutions are already using certain types of HIS either in government or private hospitals and clinics. HIS is used to support a wide range of highly specified healthcare tasks and services to help the health workers implement their work in more effective and efficient way. There is a need to have established measurement in evaluation of those systems from user point of view. Physicians are key providers of healthcare services and are among the principal users of hospital information systems. It is important to ensure that these health professionals are satisfied in using such systems. HIS are supposed to help them execute their works more efficiently rather than expecting them to spend extra times learning to use the systems [6] (Chau and Hu, 2002). In addition, the success of HIS in hospitals is still low [3].

Information system success also refers to user satisfaction, system use, perceived usefulness and system quality [7]. HIS is a big scale IT project which necessitate several important resources including management support, financial and human power. Therefore, it is important to ensure HIS stakeholders are satisfied with its implementation. Health professionals, being the principal users of HIS must be fully understand in order to improve their satisfaction in using the systems. Failure to satisfy the target users may result in worse quality of health services. Poor HIS can increase the frequency of medical errors, decrease operational efficiency, and reduce the quality of healthcare services.

HIS quality design can reduce learning effort for HIS users and reduce their frustration which can lead to unnecessary stress. This is more important considering most health workers are from non IT background. Lack of budget and times also make it worse by providing little training on using the systems, leaving them to learn all by themselves. Thus, quality of the systems is also an important indicator for measuring the systems success.

[8] in their review has listed several benefits of HIS including patient's data are more accessible, remote access to the data, save time and space, data accuracy and decrease of medication errors. On the other hand, they further added several issues of HIS which are expensiveness of HIS implementation, time consuming, technical issues, lack of IT skills and systems security. [9] stated that successful implementation of HIS needs four main facilitators namely people, process, technology and environment. They further added that barriers in HIS implementation should be overcome throughout the stages of implementation.

This study use PMO as the HIS for the measurement purposes. Professional Medical Office (PMO) is a Healthcare Information System that used among physician and staff in hospitals, medical centers and clinics. It was developed by CompuGroup Medical Sdn. Bhd in Sweden and already used by customers in Singapore, South Africa, Europe and also Malaysia. Successful implementation of HIS generally require satisfaction on the part of staff [10], and PMO already have this reputation among the users. It is a fast growing software here in Malaysia and received good feedback from customers. Lack of local study prompt this research to investigate PMO success among Malaysian PMO users.

## **III. Research Methodology**

The following section discuss about the research framework, hypotheses, data collection and data analysis.

### **3.1 Research Model**

This research was conducted using DeLone and McLean updated IS success model [11] as shown in Figure 1.

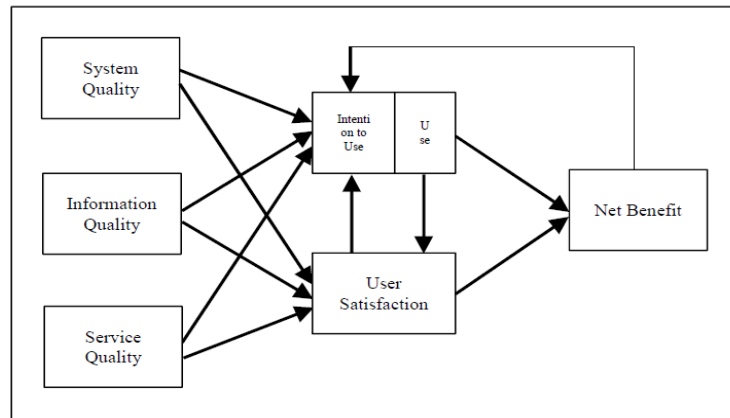


Figure 1: Research Framework (DeLone and McLean 2003)

DeLone and McLean updated IS success model have 7 dimensions with relationships between the constructs as shown in Figure 1. This model has 6 success dimensions as follows [11]:

- i. System quality – for online environment, its measures the desired characteristics of an online systems including usability, availability, reliability, adaptability and response time.
- ii. Information quality - captures the content issue including personalized, complete, relevant, easy to understand and security.
- iii. Service quality - refers to the overall support delivered by service providers such as IS department or outsource parties.
- iv. Usage - measures nature of use, navigation patterns, use frequency, task completed using the systems.
- v. User satisfaction - measure users opinions on the systems such as repeat use of the systems, regularity use of systems and task completion satisfaction.
- vi. Net benefits - considered as the most important success measures as it measure both positive and negative impacts of the system use.

### 3.2 Research Hypotheses

Hypotheses are listed based on proposed model.

- H1 System Quality will positively affect Intention to Use
- H2 System Quality will positively affect User Satisfaction
- H3 Information Quality will positively affect Intention to Use
- H4 Information Quality will positively affect User Satisfaction
- H5 Service Quality will positively affect Intention to Use
- H6 Service Quality will positively affect User Satisfaction
- H7 Use will positively affect User Satisfaction
- H8 User Satisfaction will positively affect Intention to Use
- H9 Use will positively affect Net Benefit
- H10 User Satisfaction will positively affect Net Benefit
- H11 Net Benefit will positively affect Intention to Use
- H12 System Quality will positively affect Use
- H13 Information Quality will positively affect Use
- H14 Service Quality will positively affect Use

This research was conducted using quantitative research methodology. The instrument used was a set of questionnaire consist of 7 sections (system quality, information quality, service quality, intention to use, use, user satisfaction, and net benefit) with 28 items altogether. Items were adapted from previous studies as well as self-developed by the researcher. The questionnaire used five scales of Likert's Scale measurement with 1 = Strongly agree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Disagree.

Data collection was done by distributing questionnaire form to 100 health practitioners (doctors, nurses, therapist and admin staffs) at several clinics in Klang Valley who used PMO as the HIS at their clinics. Due to privacy issue and lack of time among the staffs to answer questionnaire, only 46 questionnaires were returned back. From 46 questionnaires, 4 were omitted due to invalid responses or unfinished answers. The 42 questionnaire were further used for the analysis of this study.

#### IV. Result and discussion

##### 4.1 Respondent’s Demography

Table 1 shows the demographic data of the 42 respondents. Most of the respondents were from 20-30 years old group (64%). Only 3 males were participated while the rest are females. This is due to higher number of female nurses and admin staffs in those clinics who participated the most in this study. In general, most of the respondents are familiar with using the computer with about 65% of them have experiences of more than 9 years. About 85% of respondents have experience of using PMO for approximately 1 to 3 years.

##### 4.2 Reliability Test

Next analysis was assessing the reliability of the instrument. Cronbach's Alpha (CA) was computed. According to Baars et al., (2005) the amount of high reliability for CA is the value of 0.7 and above. **Table 2** shows Cronbach’s Alpha for each variable; in overall all components used in this study have a Alpha value of more than 0.7, meaning all components are reliable for the test.

**Table 1:** Demographic Profile of the Respondents

Measure	Item	Frequency	Percent
Age	<20	1	2.4
	20-30	27	64.3
	31-40	7	16.7
	41-50	3	7.1
	>50	3	7.1
	Missing	1	2.4
Gender	Male	3	7.1
	Female	39	92.9
Job	Doctor	4	9.5
	Therapist	5	11.9
	Nurse	15	35.7
	Admin	18	42.9
	Staff		
Years of using computer	1-3	6	14.3
	3-6	3	7.1
	6-9	6	14.3
	>9	27	64.3
Years of using PMO	<1	17	40.5
	1-3	19	45.2
	3-5	3	7.1
	5-7	2	4.8
	Missing	1	2.4

**Table 2:** Reliability Test Result

Variable Name	Code	Cronbach's Alpha	N of Items
System Quality	Q	.907	4
Information Quality	IQ	.858	4
Service Quality	SV	.923	4
Intention to Use	IU	.951	4
Use	U	.836	4
User Satisfaction	US	.969	4
Net Benefit	NB	.941	4
Overall		.977	28

##### Correlation Test

Correlation analysis was used to indicate the direction and strength of the linear relationship between variables. Pearson correlation coefficient (r) can varies from -1 to +1. Positive sign indicates a positive correlation between two variables (if one variable increase, so will the other). Meanwhile, negative sign indicates negative correlation between two variables (if one variable increase, the other will decrease) and value

between 0 and 1 represent the strength of the relation (Pallant, 2004). **Table 3** shows correlation between each variable.

**Table 3** Correlation Coefficient

		Q	IQ	SV	IU	U	US	NB
Q (System Quality)	Correlation	1	.688**	.746**	.717**	.661**	.775**	.626**
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000
IQ (Information Quality)	Correlation	.688**	1	.618**	.654**	.659**	.761**	.692**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000
SV (Service Quality)	Correlation	.746**	.618**	1	.663**	.583**	.670**	.626**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000
IU (Intention to Use)	Correlation	.717**	.654**	.663**	1	.818**	.874**	.821**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000
U (Use)	Correlation	.661**	.659**	.583**	.818**	1	.818**	.892**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000
US (User Satisfaction)	Correlation	.775**	.761**	.670**	.874**	.818**	1	.827**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000
NB (Net Benefit)	Correlation	.626**	.692**	.626**	.821**	.892**	.827**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	

\*\* Correlation is significant at the 0.01 level (2-tailed).

The correlation value between .10 and .29 interprets as small correlation, r value between .30 and .49 interpret as medium, and the r value between .50 and 1.0 interprets as large correlation (Cohen, 1988). Referring back to correlation Table 3, all factors in this study have large or strong correlation. With this positive result, significance of relationship between variable factors will be investigated. Result shown that Use and Net Benefit have the highest correlation value (.892) followed by User Satisfaction and Intention to Use (.874).

**Regression Analysis**

Regression analysis is a statistical process for estimating the relationships among variables. The variable that will be predicted is called the dependent variable (in this study is IU, US, U and NB). The variables that are using to predict the other variable's value is called the independent variable (in this study is Q, IQ, SV, U, US, NB). Beta and Significant values used to analyse the result of statistical technique from multiple regression. Table 4 shows system quality (Q), information quality and service quality (SV) are not significant correlated to intention to use (IU). Two variables are significant toward IU which is user satisfaction (US) and net benefit (NB).

**Table 4** Regression Result for Intention to Use (IU)

Dependent Variable: Intention to Use (IU)							
R <sup>2</sup> =.807, adjusted R <sup>2</sup> =.780, F=30.034, *p<.05; **p<.01; ***p<.001							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-.402	1.698		-.237	.814		
Q	.123	.180	.093	.685	.498	.291	3.441
IQ	-.180	.183	-.117	-.983	.332	.380	2.633
SV	.108	.150	.084	.720	.476	.399	2.509
US	.602	.176	.571	3.412	.002	.192	5.211
NB	.348	.148	.319	2.354	.024	.292	3.425

\*\* US; \*NB

**Table 5** shows that information quality (IQ) is significantly correlated to use (U) while system quality and service quality are not significant.

**Table 5:** Regression between Use and Q, IQ and SV

Dependent Variable: Use (U)							
R <sup>2</sup> =.522, adjusted R <sup>2</sup> =.484, F=13.815, *p<.05; **p<.01; ***p<.001							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	2.513	1.794		1.400	.170		
Q	.320	.184	.324	1.732	.091	.360	2.775
IQ	.417	.181	.365	2.304	.027	.502	1.991
SV	.112	.166	.116	.671	.506	.423	2.365

**Table 6** shows 3 factors are significant correlated to user satisfaction (US). The factors are system quality (Q), information quality (IQ), and use (U) while service quality (SV) is not significantly correlated to user satisfaction. Table 7 shows use (U) and user satisfaction (US) are significantly related to net benefit (NB).

**Table 6** Regression Analysis for User Satisfaction (US)

Dependent Variable: User Satisfaction (US)							
R <sup>2</sup> =.798, adjusted R <sup>2</sup> =.776, F=36.471, *p<.05; **p<.01; ***p<.001							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-5.484	1.546		-3.548	.001		
Q	.335	.161	.266	2.080	.045	.334	2.994
IQ	.363	.162	.249	2.234	.032	.441	2.269
SV	.073	.141	.060	.523	.604	.418	2.393
U	.565	.136	.443	4.144	.000	.478	2.091

\*\*\* U; \* Q,IQ

**Table 7** Regression Analysis for Net Benefit (NB)

Dependent Variable: Net Benefit (NB)							
R <sup>2</sup> =.824, adjusted R <sup>2</sup> =.815, F=91.157, *p<.05; **p<.01; ***p<.001							
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
	B	Std. Error	Beta			Tolerance	VIF
(Constant)	-1.167	1.168		-.999	.324		
U	.801	.144	.650	5.567	.000	.331	3.017
US	.286	.113	.295	2.530	.016	.331	3.017

\*\*\* U; \* US

**Summary of Hypotheses**

From 14 hypotheses proposed at beginning, 8 were accepted and 6 were unsupported as listed in Table 8.

**Table 8:** Summary of Hypotheses

H1	System Quality will positively affect Intention to Use in PMO	Unsupported
H2	System Quality will positively affect User Satisfaction in PMO	Supported
H3	Information Quality will positively affect Intention to Use in PMO	Unsupported
H4	Information Quality will positively affect User Satisfaction in PMO	Supported
H5	Service Quality will positively affect Intention to Use in PMO	Unsupported
H6	Service Quality will positively affect User Satisfaction in PMO	Unsupported
H7	Use will positively affect User Satisfaction in PMO	Supported
H8	User Satisfaction will positively affect Intention to Use in PMO	Supported
H9	Use will positively affect Net Benefit in PMO	Supported
H10	User Satisfaction will positively affect Net Benefit in PMO	Supported
H11	Net Benefit will positively affect Intention to Use in PMO	Supported
H12	System Quality will positively affect Use in PMO	Unsupported
H13	Information Quality will positively affect Use in PMO	Supported
H14	Service Quality will positively affect Use in PMO	Unsupported

Figure 2 shows proposed framework which have positive relationship between each of factors. Fourteen hypotheses tested collectively using regression test using SPSS 20 and it was found that 8 hypotheses have positive relationship as shown in Figure 2.

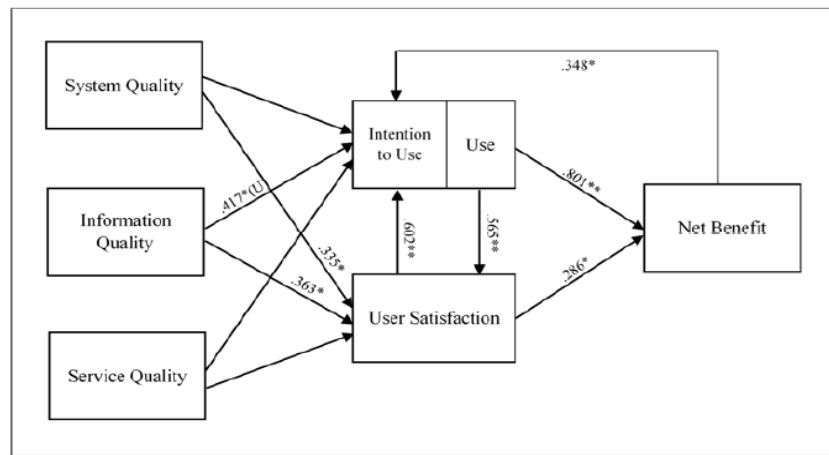


Figure 2: Final Research Model

### V. Conclusion

This study measures the success factors of HIS in several clinics at Klang Valley, Malaysia whom use PMO as their system. Despite the importance of HIS implementation in health institutions in order for them to be more efficient and effective in managing various data and resources, its success is hardly been measured. This is due to newness of such application being use in Malaysia. This study use DeLone and McLean (2003) success model as the basis of instrument development. Seven components were measured which are system quality, information quality, service quality, intention to use, use, user satisfaction and net benefits. Result shows that there are several significant relationships between the variables. Use was found significantly related to net benefits as well as user satisfaction towards intention to use and net benefits. Net benefit was found related to intention to use and use was related to user satisfaction. At the same time, information quality was related intention to use and user satisfaction while system quality related to user satisfaction. Thus it is important to ensure that any HIS must properly meet the system quality and information quality to ensure user satisfaction. Due to limitation of data and small number of respondents used in this study, more studies will be needed to measure the success of Malaysia HIS services.

### References

- [1] Haux, R. Health information systems – past, present, future, *International Journal of Medical Informatics* 75 (3–4) (2005).
- [2] Meijden M.J, H.J. Tange, J. Troost, A. Hasman, Determinants of success of inpatient clinical information systems: a literature review, *Journal of American Medical Information Association*. 10 (3) (2003).
- [3] Garcia S.D, Effken A. J. Development and Initial Evaluation of Clinical Information Systems Success Model (CISSM). *International Journal of Medical Informatics* 82 (2013) 539-552.
- [4] Nik Ariffin, et al. (2008). Improving Electronic Medical Records (EMRs) Practices through a Clinical Microsystem in the Malaysian Government Hospitals. *Communications of the IBIMA*, 5, pp. 50-64.
- [5] Selvaraju S. Health Information Management: Malaysian Experience. Health Informatics Center, Ministry of Health, Malaysia, 2006. <http://www.apami.org/apami2006/papers/Health%20Information%20Management%20Malaysian%20Experience.pdf> [Accessed 21 March 2016].
- [6] Chau P.Y.K., Hu P.J.H., Investigating healthcare professionals' decisions to accept telemedicine technology: an empirical test of competing theories, *Information Management*. 39 (4) (2002).
- [7] Sabherwal, R., Jeyaraj, A., Chowa, C., 2006. Information system success: individual and organizational determinants. *Management Science* 52 (12), 1849–1864.
- [8] Nurul I.I, Nor Hazana A, Alina S. Adoption of Hospital Information System (HIS) in Malaysian Public Hospitals. *Procedia - Social and Behavioral Sciences* 172 ( 2015 ) 336 – 343.
- [9] Sulaiman, H. Wickramasinghe, N. (2014) "Assimilating Healthcare Information Systems in a Malaysian Hospital," *Communications of the Association for Information Systems: Vol. 34, Article 77*.
- [10] Vikkelsø, S., Subtle redistribution of work, attention and risks: electronic patient records and organizational consequences, *Scandinavian Journal of Information Systems*. 17 (1) (2005).
- [11] DeLone, W.H., McLean, E.R., The DeLone, McLean model of information systems success: a ten-year update, *Journal of Management Information System*. 19 (4) (2003).