Journal of Applied Science, Engineering, Technology, and Education *ISSN: 2685-0591 (online)*
Vol. 4 No. 2 (2022)
https://doi.org/10.35877/454RI.asci1287

Application of DeLone and McLean Methods to Determine Supporting Factors for the Successful Implementation of Electronic Medical Records at Bali Mandara Eye Hospital

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Abstract

Information technology in the health sector is currently an important factor in providing health services, especially hospitals. Bali Mandara Eye Hospital has implemented information technology in the registration process and bill issuance from 2015. Electronic Medical Record is a new application that will be implemented in 2021 at Bali Mandara Eye Hospital. Electronic Medical Record is a computerized system for recording patient health history. The implementation of electronic medical records at the Bali Mandara Eye Hospital for 1 year has many problems both in terms of regulations, systems and users. Therefore, the DeLone and McLean methods are used to determine the success rate of the implementation of electronic medical records. In this method, research is conducted on 6 variables, namely System Quality, Information Quality, Service Quality, Intention of Use, User Satisfaction and Net Benefits. From each variable, the researcher combines indicators from other researchers that are more appropriate for measuring electronic medical records. The results obtained that all statements submitted are valid. The success rate of electronic medical records at the Bali Mandara Eye Hospital was obtained at 3.22 or 80.50%. To be able to increase this value, it is recommended to improve the Information Quality, System Quality and User Satisfaction.

Keywords: DeLone and McLean Method; Electronic Medical Record; IS Success Model;

Received: 15 July 2022 Revised: 29 October 2022 Accepted: 3 November 2022

1. Introduction

Information technology has an important role in today's health services where the quality of information processing is an important factor for the success of health care institutions. A good information system can support clinical workflows in various ways that will contribute to better patient care. Hospitals are no exception, which is a busy health industry in intensifying strategic service quality improvements through the contribution of the Hospital Information System (Alam et al., 2016). Hospital Information System is an arrangement that deals with data collection, data management, information presentation, analysis and inference of information and storage of information needed for hospital activities (Sabarguna, 2017).

Electronic Medical Record (EMR) is a computerized health information system that contains demographic data, medical data, and can be equipped with a decision support system. Health care facilities implement EMR as an effort to improve service quality, increase patient satisfaction, improve documentation accuracy, reduce clinical errors, and speed up access to patient data (Bilimoria et al., 2017). Electronic Medical Records have actually been widely used in Indonesian health services, but many health workers and managers of health care facilities are still hesitant to use them because there are no laws and regulations specifically regulating their use. As the Hospital develops and the implementation of

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the EMR system, after implementing the system it is important to measure and evaluate whether the investment in the implementation and maintenance of information technology is beneficial (Petter & Fruhling, 2011) and whether the system meets the organization's objectives (W. DeLone & McLean, 2003).

In order for an information system to be successful and have a positive impact on the organization, the information system must first have an impact on the individual. In order to have an impact on individuals, user satisfaction must be achieved. In addition, the information system must begin to be used routinely for operations. In order for these two things to be achieved, the quality of the system and the quality of information must be good first (Nugroho & Rahayu, 2018). With the schematic linkages and interdisciplinary understanding, the implementation of RME will be able to provide effective and efficient management of patients, doctors and clinics as well as improve good outcomes for hospitals (Kamalul Ariffin et al., 2018).

This study aims to measure the success rate of implementing electronic medical records, so that hospitals can prioritize variables that need to be improved.

2. Research Method

2.1. Research Design

This study uses quantitative research methods, where researchers make previously formulated questions related to the assessment, attitudes, perceptions of Electronic Medical Record (EMR) users. The method used in this study is a survey with data collection techniques using questionnaires.

2.2. Population

The object of research is the employees of the Bali Mandara Eye Hospital, both civil servants or contract employees who have used Electronic Medical Records. The population referred to in this study are direct users, namely doctors, nurses, medical recorders, nutritionists, and indirect users, namely IT staff.

2.3. Research Variable

In this study, the variables used consisted of 6 variables, namely: System Quality, Information Quality, Service Quality, Use, User Satisfaction and Net Benefits.

2.3.1. Information Quality

Information Quality in question is measuring the system output information. The variables in this study were measured using several indicators adapted from various sources, it shown on table 1.

Table 1. Indicator of information quality variable

No	Indicator	References
1	Accuracy	(Iivari, 2005)
2	Completeness	(Iivari, 2005)
3	Consistency	(Iivari, 2005)
4	Format	(Iivari, 2005)
5	Relevance	(DeLone & McLean, 2003)

2.3.2. System Quality

System quality means the quality of the combination of hardware and software in an information system. The focus is the performance of the system, which refers to how well the capabilities of the hardware, software, policies, procedures of the information system can provide the information needs of users (W. H. DeLone & McLean, 1992). The variables in this study were measured using several indicators adapted from various sources, it shown on table 2.

Table 2. Indicator of system quality variable

No	Indicator	References
1	Easy to Learn	(Gable et al., 2008)
2	Easy to User	(Gable et al., 2008)
3	Reliability	(DeLone & McLean, 2003)
4	Response Time	(DeLone & McLean, 2003)
5	Security	

2.3.3. Service Quality

Service quality is defined in this study as the perceived assessment of the results of comparing user expectations to the services they receive. The variables in this study were measured using several indicators adapted from various sources, it shown on table 3.

Table 3. Indicator of service quality variable

No	Indicator	References
1	Assurance	(DeLone & McLean, 2003)
2	Empathy	(DeLone & McLean, 2003)
3	Responsiveness	(DeLone & McLean, 2003)

2.3.4. Intention of Use

The variables in this study were measured using several indicators adapted from various sources, it shown on table 4.

Table 4. Indicator of intention of use variable

No	Indicator	References
1	Number of Visits	(DeLone & McLean, 2003)
2	Willingness	(Mardiana et al., 2015)

2.3.5. User Satisfaction

It is the response and feedback that the user generates after using the information system. The user's attitude towards the information system is a subjective criterion of how much the user likes the system used. The variables in this study were measured using several indicators adapted from various sources, it shown on table 5.

Table 5. Indicator of user satisfaction variable

No	Indicator	References
1	Adequacy	(Almutairi & Subramanian, 2005)
2	Effectiveness	(Almutairi & Subramanian, 2005)
3	Efficiency	(Almutairi & Subramanian, 2005)
4	Overall satisfaction	(Almutairi & Subramanian, 2005)

2.3.6. Net Benefits

It is the effect caused by the use of information systems on individuals, groups, organizations, industries, communities, etc., this includes individual impacts, benefits from customers and society and organizations. in terms of the organization can be measured from organizational performance, perceived usefulness, and influence work practices (Petter et al., 2008).

The variables in this study were measured using several indicators adapted from various sources, it shown on table 6.

Table 6. Indicator of net benefits variable

No	Indicator	References
1	Job Performance	(Iivari, 2005)
2	Time Saving	(DeLone & McLean, 2003)
3	Usefulness	(Iivari, 2005)

2.4. Conceptual framework

The concept of the DeLone and McLean Model (2003) is divided into 3 aspects, namely the technological aspect including Information Quality, System Quality and Service Quality, the human aspect including Intention to Use and User Satisfaction and organizational aspects represented by Net Benefits. There are 5 variables to be studied by dividing 3 independent variables (Information Quality, System Quality and Service Quality) and 3 dependent variables (*Intention of Use, User Satisfaction* and *Net Benefits*).

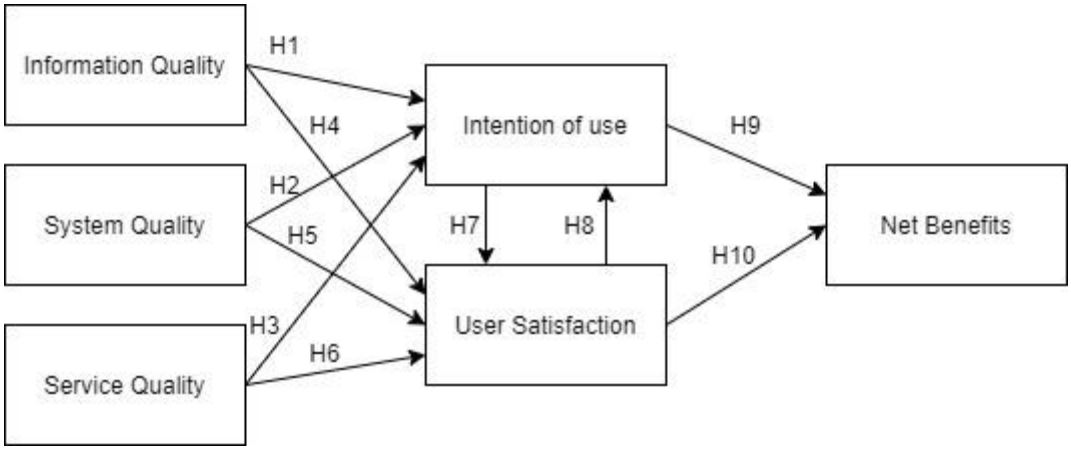

Fig 1. Research Conceptual Framework

Based on Figure 1, 10 hypotheses can be obtained which can be described as follows:

1. Hypothesis 1 (H1): information quality of EMR has a significant positive effect on Intention of Use
2. Hypothesis 2 (H2): system quality of EMR has a significant positive effect on Intention of Use
3. Hypothesis 3 (H3): service quality of EMR has a significant positive effect on Intention of Use
4. Hypothesis 4 (H4): information quality of EMR has a significant positive effect on user satisfaction
5. Hypothesis 5 (H5): system quality of EMR has a significant positive effect on user satisfaction
6. Hypothesis 6 (H6): service quality of EMR has a significant positive effect on user satisfaction
7. Hypothesis 7 (H7) Intention of Use EMR has a significant positive effect on user satisfaction
8. Hypothesis 8 (H8) user satisfaction has a significant positive effect on Intention of Use
9. Hypothesis 9 (H9) Intention of Use EMR has a significant positive effect on the organization's Net Benefits
10. Hypothesis 10 (H10): user satisfaction has a significant positive effect on the organization's Net Benefits

2.5. Research Flow

The flow of research is the steps of carrying out research starting with an interest in knowing certain phenomena and then developing into ideas, theories, conceptualizations, selecting appropriate research methods, and so on. The flow of this research is used as a guide for the author in carrying out this research so that the results achieved do not deviate from the predetermined goals.

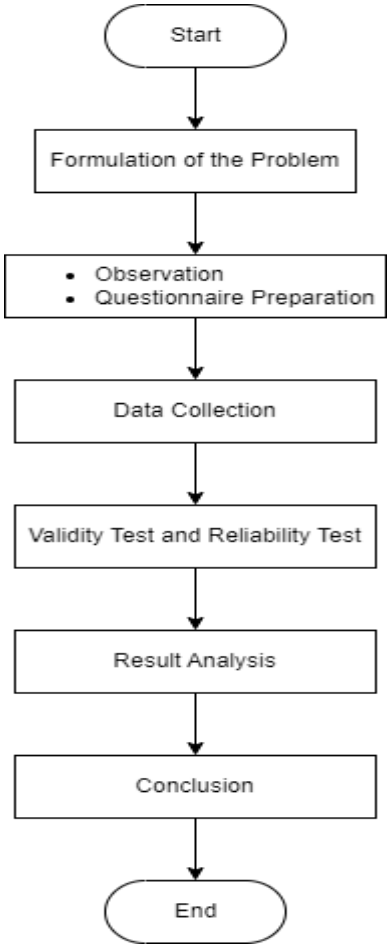

Fig 2. Research Flow

3. Result and Discussion

3.1. Validity Test

Validity testing in this study was carried out using the help of software from a computer called SPSS Ver.26.0. Testing the validity is by comparing the value of $r_{result} > r_{table.}$ Definition of r_{table} is a table with a numerical model to test the validity of the research instrument.

To get the value of $r_{table,}$ use the formula:

$$df = n - 2 \quad (1)$$

Information:

df = *degree of freedom*, the value that will be obtained after performing calculations using the table formula R.
n = number of respondents.

So that the value of *df* or N is 92 with a significance level of 0.05, then the number 0.202 is obtained as the value of r_{table}.

Table 7. Validity Test Results

No.	Questionnaire Code	r_{result}	r_{table}	Status
		System Quality		
1	IQ1	0.749	0.202	Valid
	IQ2	0.685	0.202	Valid
	IQ3	0.722	0.202	Valid
	IQ4	0.676	0.202	Valid
	IQ5	0.672	0.202	Valid
		Information Quality		
2	SQ1	0.618	0.202	Valid
	SQ2	0.668	0.202	Valid
	SQ3	0.587	0.202	Valid
	SQ4	0.599	0.202	Valid
	SQ5	0.505	0.202	Valid
	SQ6	0.489	0.202	Valid
	SQ7	0.365	0.202	Valid
	SQ8	0.483	0.202	Valid
	SQ9	0.499	0.202	Valid
	SQ10	0.490	0.202	Valid
		Service Quality		
3	SEQ1	0.719	0.202	Valid
	SEQ2	0.608	0.202	Valid
	SEQ3	0.745	0.202	Valid
	SEQ4	0.673	0.202	Valid
	SEQ5	0.649	0.202	Valid
		Intention of Use		
4	IU1	0.733	0.202	Valid
	IU2	0.758	0.202	Valid
	IU3	0.651	0.202	Valid
	IU4	0.754	0.202	Valid
	IU5	0.632	0.202	Valid
		User Satisfaction		
5	US1	0.798	0.202	Valid
	US2	0.684	0.202	Valid
	US3	0.692	0.202	Valid
	US4	0.669	0.202	Valid
	US5	0.614	0.202	Valid
		Net Benefits.		
6	NB1	0.575	0.202	Valid
	NB2	0.343	0.202	Valid
	NB3	0.453	0.202	Valid
	NB4	0.481	0.202	Valid
	NB5	0.449	0.202	Valid

Based on the test results in Table 7, each statement produces an rcount value that is greater than r_{table}. Thus, the instrument used in this study stated that all statement items on the questionnaire were valid.

3.2. Reliability Test

Reliability test can also be said as a tool used to measure a questionnaire which is an indicator of a variable. Reliability testing can be done using the SPSS program by selecting the analyze menu, then selecting the scale sub menu, then selecting reliability analysis. The results of the analysis will be obtained through the statistical results of Cronbach Alpha *(α)*. A variable is said to be reliable if it gives a value of Cronbach Alpha > 0.60 (Sugiyono, 2014). The results of the questionnaire reliability testing in this study can be seen the table 8.

Table 8. Reliability Test Result

No	Variable	Cronbach Alpha	Status
1	Information Quality	0.777	Valid
2	System Quality	0.727	Valid
3	Service Quality	0.769	Valid
4	Intention of Use	0.782	Valid
5	User Satisfaction	0.774	Valid
6	Net Benefits	0.616	Valid

3.3. Normality Test

This normality test is used to see if this regression model research has a normal distribution value. As for normality testing in this study using SPSS ver26.0 software with One Sample Kolmogorov Smirnov Test, with a significant level of 0.05 or 5%. It is said to be normal if the significance value is > 0.05 and vice versa. The following are the details of the normality test results:

To test the normality test, the data used are residual data derived from the regression results of IQ, SQ, SEQ, IU, US, and NB.

Table 9. Normality Test Result

One-Sample Kolmogorov-Smirnov Test		
		Unstandardized Residual
N		94
Normal Parameters[a,b]	Mean	0.0000000
	Std. Deviation	1.11510384
Most Extreme Differences	Absolute	0.062
	Positive	0.062
	Negative	-0.060
Test Statistic		0.069
Asymp. Sig. (2-tailed)		0.200[c,d]

a. Distribution test is Normal.
b. Calculated from data.
c. Lilliefors Significance Correction.

Based on Table 9, it can be seen that the magnitude of the asymp.Sig (2-tailed) number is 0.200 which is greater than the predetermined alpha level of 0.05 (5%). Thus, the data in this study is declared to be normally distributed.

3.4. Multiple Linear Regression Analysis

Regression analysis is an analysis that measures the effect of the independent variable on the dependent variable. At this stage, a test will be carried out to see the regression function of the relationship between variables, the coefficient of determination, the correlation between variables and also the standard error.

This test was carried out with the help of software called SPSS ver26.0. Below are the results of multiple linear regression testing:

Table 10. Regression test result

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	5.126	1.835		2.794	0.006
	IQ	0.102	0.048	0.193	2.119	0.037
	SQ	0.151	0.052	0.257	2.882	0.005
	SEQ	0.246	0.091	0.253	2.699	0.008
	IU	0.066	0.037	0.159	1.770	0.080
	US	0.093	0.048	0.171	1.924	0.058

a. Dependent Variable: Net Benefits

Based on the results in table 10, it can be formulated the multiple linear regression equation according to Gujarati (Gujarati et al., 2012) as follows:

$$Y = \alpha + \beta 1\ \chi 1 + \beta 2\ \chi 2 + \beta 3\ \chi 3 + \beta 4\ \chi 4 + \beta 5\ \chi 5 + e \quad (2)$$

Net Benefits = 5.126 + 0.151 + 0.102 + 0.246 + 0.066 + 0.093 + e

From the Eq. 2, we can explain that:

(1) The constant (α) in this study of 5.126 indicates that if the variables of System Quality (SQ), Information Quality (IQ), Service Quality (SEQ), Usage (IU), and User Satisfaction (US) are assumed to be constant or equal to zero then the dependent variable Net Benefit is 5.126 units.

(2) The regression coefficient value of the System Quality (SQ) variable is 0.102 with a significance level of 0.037. This means that the System Quality variable increases by one unit, the Net Benefit value will also increase by 0.037. It means that the System Quality variable has a positive and significant relationship with the Bali Mandara Eye Hospital.

(3) The regression coefficient value of the Information Quality (IQ) variable is 0.151 with a significance level of 0.005. This means that the Information Quality variable increases by one unit, the Net Benefit value will also increase by 0.151. It means that the Information Quality variable has a positive and significant relationship with the Bali Mandara Eye Hospital.

(4) The regression coefficient value of the Service Quality (SEQ) variable is 0.053 with a significance level of 0.246 with a significance level of 0.008. This means that if the Service Quality variable increases by one unit, the Net Benefit value will also increase by 0.246. It means that the Service Quality variable has a positive and significant relationship with the Bali Mandara Eye Hospital.

(5) The regression coefficient value of the Usage variable (IU) is 0.066 with a significance level of 0.080. This means that when the Usage variable increases by one unit, the Net Benefit value will also increase by 0.066. It means that the usage variable has a positive and significant relationship with the Bali Mandara Eye Hospital.

(6) The value of the regression coefficient of the User Satisfaction (US) variable is 0.058. This means that the User Satisfaction variable increases by one unit, the Net Benefit value will also increase by 0.098. It means that the User Satisfaction variable has a positive and significant relationship with the Bali Mandara Eye Hospital.

3.5. Partial Test

This test aims to analyze the hypotheses that have been formulated individually (partial) to see how significant or insignificant the influence of a variable is. In decision making t test which states the hypothesis is accepted or rejected,

we first determine t_{table} with a significant degree 5%. The independent variable is said to be influential if its significance is less than 0.05.

The t_{table} value in this study are 1.662. Partial test can have an effect if $t_{result} > 1.662$ with significant value (Sig) < 0.05.

Table 11. Partial test result

No	Information	t_{result}	Sig
1	Information Quality on Intention of Use	7.087	0.000
2	System Quality on Intention of Use	2.861	0.005
3	Service Quality on Intention of Use	3.175	0.002
4	Information Quality on User Satisfaction	2.921	0.004
5	System Quality on User Satisfaction	2.276	0.025
6	Service Quality on User Satisfaction	2.222	0.029
7	Intention of Use on User Satisfaction	2.757	0.027
8	User Satisfaction on Intention of Use	3.490	0.001
9	Intention of Use on Net Benefits	2.307	0.023
10	User Satisfaction on Net Benefits	3.788	0.000

In accordance with Table 11, the results of the study can be described as follows:

1. Hypothesis 1 (H1): information quality of EMR has a significant positive effect on Intention of Use be accepted
2. Hypothesis 2 (H2): system quality of EMR has a significant positive effect on Intention of Use be accepted
3. Hypothesis 3 (H3): service quality of EMR has a significant positive effect on Intention of Use be accepted
4. Hypothesis 4 (H4): information quality of EMR has a significant positive effect on user satisfaction be accepted
5. Hypothesis 5 (H5): system quality of EMR has a significant positive effect on user satisfaction be accepted
6. Hypothesis 6 (H6): service quality of EMR has a significant positive effect on user satisfaction be accepted
7. Hypothesis 7 (H7) Intention of Use EMR has a significant positive effect on user satisfaction be accepted
8. Hypothesis 8 (H8) user satisfaction has a significant positive effect on Intention of Use be accepted
9. Hypothesis 9 (H9) Intention of Use EMR has a significant positive effect on the organization's Net Benefits be accepted
10. Hypothesis 10 (H10): user satisfaction has a significant positive effect on the organization's Net Benefits be accepted

3.6. Discussion

Based on the results of research conducted in July 2022, the average value for each variable is seen in Table 12.

Table 12. Variable Average Value

Code	Variable	Average
IQ	Information Quality	3.05
SQ	System Quality	3.13
SEQ	Service Quality	3.32
IU	Intention of Use	3.16
US	User Satisfaction	3.06
NB	Net Benefits	3.60
Grand Mean		**3.22**

This study uses a score for each question with a value of 1 as the lowest score and 4 as the highest score. So the total value of the highest average is 4 or 100% which means very good. If seen from Table 12, the successful implementation of Electronic Medical Records at the Bali Mandara Eye Hospital got a score of 3.22 or 80.50% which means good.

The variable that has the highest average value is Net Benefits (NB). While the variables with values below the average are the Information Quality (IQ), System Quality (SQ) and User Satisfaction (US).

4. Conclusion

Based on the research conducted, the results obtained that the variables carried out by the research, namely information quality, service quality, system quality, actual use, use satisfaction, net benefit (individual impact) have a positive relationship between variables. The success rate of Electronic Medical Record implementation is 3.22 or 80.50%. With 3 variables that have values below the average, namely the quality of information, system quality and user satisfaction. So it is necessary to prioritize the improvement of the system on these 3 variables to increase the success of the Electronic Medical Record implementation.

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