Measuring the Success of Hospital Information System across Multispecialty Hospitals in Bahrain

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Abstract: Purpose: The aim of this paper is to measure the success of HISs (hospital information systems) in Bahrain from their end user's perspectives. Methodology: a quantitative design using a questionnaire based on the DeLone and McLean Information System Success Model (2003) was employed to examine the key determinants comprise of SQ (system quality), IQ (information quality), SerQ (service quality) as the independent variables and their effect on the US (user satisfaction), U (system use) and the perceived NB (net benefits) as the success measures. There are 324 respondents consisting of doctors, nurses, technicians, pharmacists and admin staff of hospitals. Data were analyzed using SPSS. Findings: SQ, IQ and SerQ are significantly positively related to US and U, and the two later are in turns significantly positively related to the perceived NB out of the system to both users and organizations. Research implications: the research reflects the experience of using innovative healthcare technologies in the Middle East and its results show the importance of improving the systems technical quality to ensure more satisfied users, more utilized technologies and to reach the optimal purpose of implementing these systems and reap out their prospected benefits. Moreover, sufficient training and full dependency on the systems are required to get more confident users and reduce the daily work load.

Key words: Healthcare innovative technologies, hospital information systems, Delone and McLean IS success model.

1. Introduction and Background

Information technology has tremendously advanced in the past few decades and has its marks in all the fields including medical practice. Hospitals are one field that provides most complicated setup, dealing with vast amount of patients in a wide range of needs, offering many kinds of services in different medical departments. Management needs to control and monitor this complicated structure and the advancements in the diagnosis, treatment and information processing helped the health organizations profoundly improve its functioning. HISs (hospital information systems) are a huge technological advancement that has interacted with the medical professionals in different domains and it can be defined as "a comprehensive, integrated and specialized information system designed to manage

the administrative, financial and clinical aspects of hospitals and healthcare facilities" [1].

Generally, the main aim of Healthcare Information Systems including the HISs is to manage the information that is needed by the healthcare providers to improve their day to day activities and increase their tasks efficiencies [2] and the optimum purpose of any information systems can be accomplished by customizing its services to provide accurate information matching the end users' requirements [3], moreover, the success of the personnel in performing a job relies tremendously on the quality of IS (information systems) that is installed in the organizations [4].

The quality is considered as one of the most important criteria for the success of HISs [5] and it is reflected by the desired characteristics of these systems materialized by: IQ (information quality) (ease of use, security, accuracy, completeness, relevance, timeliness), SQ (system quality) (speed, features, flexibility and documentation) and SerQ

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(service quality) (backing delivered by the IT department and the maintenance company) [6].

An extensive effort has been done by the healthcare sector in Bahrain to improve the healthcare services and to introduce the high cost state-of-the art health technologies in different hospitals and health centers across, such as Al-Care system in BDF (1994) hospital, I-Seha in Salmaneya hospital (2012), and H.OP.E system in King Hamad University Hospital (2015). However, no studies have been conducted to investigate the success of these HISs implementations. According to Ref. [7], measuring the success of the HISs from the user's satisfaction measure is highly significant, because the users of the system are its actual customers, and in this purpose, identifying the factors affecting users' satisfaction and studying them will help enhancing the system quality and possibly will be positively reflected on the quality of patient care.

The aim of this paper is to measure the success of the existing HISs in Bahrain from the end users' perspectives and the effect of the SQ, IQ and SerQ on it. The researchers used the U (system use), US (user satisfaction) and the perceived NB (net benefits) as the success measures employing Delone and Mclean updated information system success model.

2. Research Methodology

2.1 Research Model

This study was conducted using DeLone and McLean updated IS success model as shown in Fig. 1. DeLone and McLean model was found to be the most broadly acknowledged model for the measurement of IS success [8, 9]

Each variable's indicators in Table 1 were determined referring to literature studies that have been reviewed. The indicators used in this study are as follow:

• SQ—"the Measures of Information System Output" [10] and it's "the technical quality of the information system itself" [11].

• IQ—the desirable features of the input and output of the data within the system and the information delivered by the system [12].

• SerQ—"the overall support delivered by the service provider, applies regardless of whether this support is delivered by the IS department, a new organizational unit, or outsourced to an ISP (Internet service provider)" [11].

• US—"the level of satisfaction of the users when utilizing an IS" [13].

• U was defined by [14] as "the degree and manner in which staff and customers utilize the capabilities of an information system." And it measures the frequency and the extent of the user actual interaction with the system [12].

• The NB captures all the negative and positive user, organizational, and customer impacts of the system [11].

2.2 Research Hypotheses

Eight hypotheses will be tested based on the D & M model (Fig. 1).

H1. System quality has a positive affect on user satisfaction.

H2. System quality has a positive effect on system use.

H3. Information quality has a positive effect on user satisfaction.

H4. Information quality has a positive effect on system use.

H5. Service quality has a positive effect on user satisfaction.

H6. Service quality has a positive effect on system use.

H7. Use has a positive effect on perceived net benefit.

H8. User satisfaction has a positive effect on perceived net benefit.

2.3 Research Design

The research design was quantitative cross sectional using a fully structured questionnaire including 31
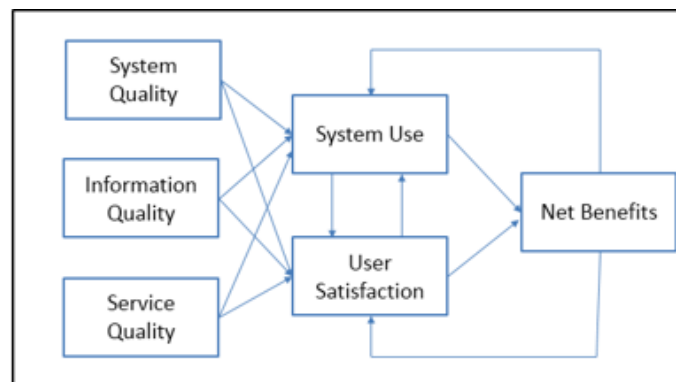
Fig. 1   Delone & Mclean updated information success model, 2003.

Table 1   D & M Variables and the indicators employed for this study.

Variables	Indicators
System quality	Ease of use, user interface, and system speed.
Information quality	Accuracy, conciseness, completeness, relevance, reliability, accessibility.
Service quality	Reliability, responsiveness, training, Availability of user guides and help functions, down time, Remote access.
Use	Extent of system usage.
User satisfaction	Usefulness and overall satisfaction.
Net benefits	Reduction of medical errors, enhanced medical services, incremental productivity and profitability, enhanced reputation and recommendation of system to other hospitals (Performance of individuals and hospitals).

items. The research involves seven hospitals in Bahrain from both private and public sectors with different specialties and bed capacities, and using different HISs. Population consists of Doctors, Nurses, Pharmacists, Technicians, Administrative staff and other users from which the sample was selected using non probability convenience sampling technique. The questionnaire was distributed to the respondents through the HR department of the hospitals. Moreover, Survey Monkey® was also used to distribute the questionnaire electronically to collect as many responds as possible.

The questions employed "a five-point Likert scale" to give the participants' responses that are alternating between "strongly disagree = 1" and "strongly agree = 5" to measure the variables using the indicators mentioned in previous section. Data analysis and manipulation were done using SPSS V. 23 software.

Out of the 615 questionnaires distributed form which 359 questionnaires were returned back yielding a response rate of 58.3%. From 359 questionnaires, 308 questionnaires were further used for the analysis of this research. Furthermore, only 16 valid

questionnaires were collected from the web link. The total number of questionnaire statistically analyzed was 324.

3. Result and Discussion

3.1 Respondent's Demography

Table 2 shows the demographic data of the sample participants. A majority of respondents were females with the percentage of 70.7%, middle aged (30-39 years old) (45.7%). The participation of non-Bahrainis (66.7%) was stronger than Bahrainis. Highest participation of the study sample 54.8% was obtained among nurses, followed by physicians 19.8%. Moreover, more than half of the sample respondents (56.5%) have experience in current hospital of 1-5 years.

3.2 Reliability Test

Cronbach's Alpha coefficient was determined to test the reliability of the measuring scale. If the value of this coefficient was equal to or greater than 0.7, then the measurement tool is considered reliable and accurate [15]. As shown in Table 3, the 31 items

Table 2   Demographic profile of the respondents.

		Frequency	Percent
Gender	Male	95	29.3
	Female	229	70.7
	Total	**324**	**100.0**
Age	20-29	114	35.2
	30-39	148	45.7
	40-49	51	15.7
	50-59	8	2.5
	60 and above	3	.9
	Total	**324**	**100.0**
Nationality	Bahraini	108	33.3
	Non Bahraini	216	66.7
	Total	**324**	**100.0**
Job Position	Physician	64	19.8
	Pharmacist	13	4.0
	Nurse	176	54.3
	Lab technician	22	6.8
	Administrative Staff	10	3.1
	IT Staff	11	3.4
	Head of IT department	1	.3
	Others	27	8.3
	Total	**324**	**100.0**

Table 3   Reliability test result.

Variable name	Abbreviation	Cronbach's alpha	N. of items
System quality	SQ	0.848	4
Information quality	IQ	0.891	6
Service quality	SerQ	0.773	4
System use	U	0.964	4
User satisfaction	US	0.914	4
Net benefits	NB	0.962	9
	Overall	0.964	31

related to the HIS quality and success model have an overall Cronbach's Alpha value of 0.964 reflecting a highly reliable tool as the value is very close to 1.0.

3.3 Regression Analysis

To test the research hypotheses, and to examine the association between the study variables, multiple regression analysis was applied, where regression analysis is a statistical method used to examine the impact and the relationships between a dependent and one or more independent variables. The dependent variables in this research are US, U and NB, while the independent variables are SQ, IQ, and SerQ. Adjusted R^2, Beta coefficients, and F statistics using

P—significance values are used to interpret and analyze the results of regression tests.

Table 4 that SQ, IQ, and SerQ are all significantly positively related to US, where the value of Beta coefficient shows that the SQ have the strongest effect on US (B = 0.314) where the weakest effect on US among Healthcare professionals in Bahrain is SerQ effect (B = 0.272).

Table 5 shows that SQ, IQ, and SerQ are all significantly positively related to U, where the value of Beta coefficient shows that the SerQ has the strongest effect on U (B = 0.374) where the weakest effect on U among Healthcare professionals in Bahrain is SQ effect (B = 0.152).

Table 4   Regression result for user satisfaction (US).

Dependent Variable: User Satisfaction (US)					
F= 141.339 (p= 0.000 <0.01), R^2= 0.570, adjusted R^2= 0.566.					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	-.203	.185		-1.100	.272
SQ	.367	.062	.314	5.898	.000
IQ	.393	.076	.292	5.194	.000
SerQ	.303	.051	.272	5.931	.000

Table 5   Regression analysis for system use.

Dependent Variable: System Use (U)					
R^2= 0.474, adjusted R^2= 0.470, F= 96.295 (p= 0.000 <0.01)					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.036	.201		.177	.860
SQ	.175	.068	.152	2.586	.010
IQ	.361	.082	.273	4.392	.000
SerQ	.409	.055	.374	7.363	.000

Table 6   Regression analysis for perceived net benefits.

Dependent Variable: Net Benefits (NB)					
R^2= 0.763, adjusted R^2= 0.764, F= 520.934 (p= 0.000 <0.01)					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.579	.092		6.321	.000
US	.544	.039	.593	14.080	.000
U	.311	.039	.333	7.919	.000

Table 7   Supported study hypotheses.

H1	System quality has a positive effect on user satisfaction.	Supported
H2	System quality has a positive effect on system use.	Supported
H3	Information quality has a positive effect on user satisfaction.	Supported
H4	Information quality has a positive effect on system use.	Supported
H5	Service quality has a positive effect on user satisfaction.	Supported
H6	Service quality has a positive effect on system use.	Supported
H7	Use has a positive effect on perceived NB.	Supported
H8	User satisfaction has a positive effect on perceived NB.	Supported

Table 6 shows that US and U are significantly positively related to system NB, where the value of Beta coefficient shows that the US has the strongest effect on NB (B = 0.593).

From the regression tables above the following study hypotheses were accepted and supported for the users of HISs in Bahrain, see Table 7.

4. Conclusion

The aim of this paper is to measure the success of the existing HISs in Bahrain from the users' perspectives using the system quality characteristics as the key factors affecting the success of the systems and users' satisfaction, system use and net benefits as the success indicators employing Delone and Mclean Updated Information System Success model. A quantitative approach was used to meet the purpose of this study using a questionnaire survey that was adapted from the previous studies. It was concluded from the study hypotheses that the effect of the quality dimensions of the HISs was all supported and accepted in this study, showing that in Bahrain there are significantly positive relationships among the quality dimensions, user satisfaction and system use, and the effect on the individuals' and hospitals' performance related to that (perceived net benefits) of the HISs. Use and user satisfaction was found to be significantly related to the net benefits, however, the user satisfaction showed a higher effect on the net benefits than the system use. Thus it is important to ensure that any HIS must properly meet the system quality, service quality and information quality to ensure user satisfaction which will be reflected positively on the individual and hospital performances.

Although the implementation of HISs in the hospitals in Bahrain carries many benefits from many aspects, continuous and ongoing assessment of the system is crucial to guarantee its success and reaching the optimal objectives of the implementation.

Recommendations

Form the hypotheses tested, it's highly recommended that the policy and decision makers in the healthcare sector to have an ongoing process of evaluating, and controlling the technical quality of the healthcare IT investments in Bahrain and to continuously benchmark them with the worldwide standards in order to enhance their quality which will positively help reap out the most of such systems net benefits and reach the optimal objective of their implementations.

Limitations

The researchers employed the convenience sampling technique which can limit the generalization of the study results. Secondly, time and resources limitations were faced due to the privacy restrictions. Moreover, the study covered a single period that might not disclose long term effect factors, therefore, a multiple period approach is suggested.

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