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Identification of parameters affecting the success of the hospital information system & presentation of a model for user satisfaction improvement

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Abstract

The identification of effectivedeterminants and measures on the success of hospital information systemscould significantly lead to the improvement of theirperformance. In this paper, the effectivedeterminants and measures on the success of hospital information systems have been identified and then the data has been collected with the help of two researcher-made (customized) questionnaires and finally analyzed with inferential statistics by the SPSS software. According to the questionnaires, the results of the collected data weredivided into two groups: results of experts and those of system users'. Inthe experts group, after identifying the measures and determinants from the literature, there were presented to expertsand with the use of one sample T test, the influencing measures and determinantson the success of hospital information systems have been identified. These measures were provided to users and then the confirmatory factor analysis was performed to assess the validity of questionnaires and structure of the identifieddeterminants from the users' opinions. Finally, several linear regression analyseswere conducted to examine the hypotheses and proposed model to improve user satisfaction in hospitals.

Keywords: Hospital information system, assessment determinants, Delone and Mclean model

1- Introduction

Information management system is a system which collects the environmental data, records transactions and organizational operations and then filters, organizes , chooses and presents them to managers as information which makes it a useful tool for managers to create their required information (Murdick& Munson, 1986). Hospital Information System (HIS), as a kind of management information system, has a significant importance. HIS aims to integrate the information by using computers and is designed to save, process, retrieve and analyze hospital information in managerial, clinical and administrative fields.

This system should be able to save the information, retrieve them precisely and timely,amalgamate the data,efficiently present and exchange data to other users in the hospital environment.

To enhance the performance and effectiveness of this system in healthcarefield, a special attention has been given to information systems and healthcareinstitutes, especially hospitals and a heavy investigationis made on creation and development of these systems (Seddon, 1994). So it is vital to evaluate the success of information systems, especially HIS, to realize their value and performance and justify the great volume of investment on the creation and development of these systems.
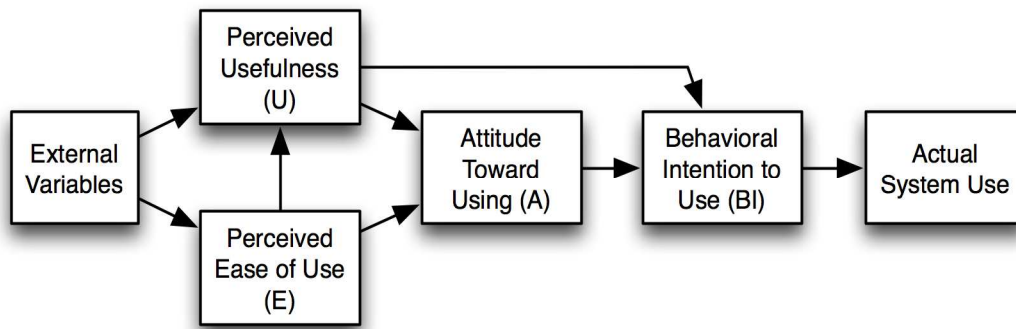
2- Review of Literature

By emerging the health information systems in early 1960s, HIS has been spreading across the globe. The first HIS in Iran was created in early 1370s by the private sector which covered the reception, release and mechanization processes in the following hospitals: Taleghani in Urumie, KhatamolAnbia in Zahedan, Auzar in Ahvaz, and Mehr, Sajjad, Toos, Jam, ShahidRajaie and Tehran Heart center in Tehran. The government sector entered this field; Social Security Organization in its laboratories, ISIran company in Farabi and ShahidChamran Hospitals. The use of HIS streamlines the treatment process and patient care,improves the quality, enhances the satisfaction and lessens the costs.

Researches show the dissatisfactionover HIS in Iran, so it's important to investigate the success of HIS and identify the effective measures on the success of systems. A number of researches have investigating the success of these systems. Some of them were trying to identify the effective measures on its success and some others were aimed to show how to evaluate systems. Evaluation means assessing the relative value of phenomena using special determinants (Shahmoradi, Ahmadi&Rezaie, 1386). The creation and development of information systems consists of 4 levels; definition of goals, design, execution and evaluation. Continuous evaluation is one of the main components of HIS and its main purpose is to give attention to the effective measures in the health system. At first, researches were evaluating the HIS for economic reasons and the performance determinantwas being used for assessing the information systems (Borovits and Neumann, 1979). Then, the system evaluation determinant was changed from performance to effectiveness, and instead of focusing on personal goals, variables shifted the emphasis on organizational goals (McLean, 1973).Some researchers, with accepting the success determinant for assessing the information systems, refer to the highly varied nature of this approach. They also believe that there is little agreement on the variables used to measure the success of information systems.

World Health Organization (WHO) argues that, design and evaluation of hospital information systems based on standard and known models is essential to have high quality systems, data and user satisfaction. So far, various models have been proposed for the evaluation of hospital information systems such as ISO 10: 9241, Davis' Technology Acceptance Model, Zmud model, Delone& Mclean model and etc.

One of the most common hospital information systems evaluation models that have been used in the studies is ISO 9241 -10. The main purpose of this model is to ensure the applicability of software systems. Isometric is a reliable tool for evaluating usability of hospital information systems with the goal of assessing the user satisfaction (Hamborg et al, 2004). Rogers' diffusion of innovation model is one of the models for understanding the relationship between people and technology which has also been used in studies of hospital information system. Using this model can help in determining the willingness of users to use the hospital information system.This model discusses the implementation of new technologies and innovations in an organization.
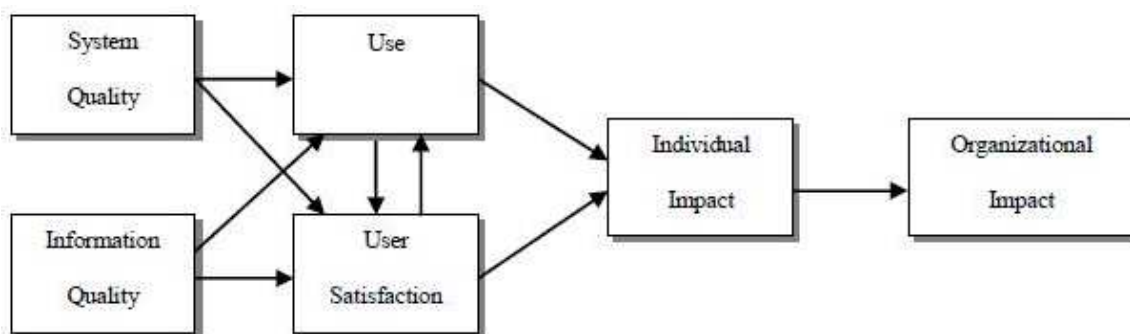
Davis Technology Acceptance Model was presented in 1989 to model the user acceptance of information technology. The purpose of the Technology Acceptance Model provides a general description of the parameters of information technology which are able to describe the user behavior of a wide range of computing technologies and the users are of different types. Technology acceptance model can be seen in Fiure 1.

Fig.1. Davis Technology Acceptance Model (Davis, 1989)

A key objective of the Technology Acceptance Model is to provide a basis for tracking the impact of external factors on internal beliefs, attitudes and tendencies. Davis and colleagues (1989) argue that the perceived ease of use influences the users' attitudes towards the use and the perceived usefulness directly or indirectly. Perceived ease of use depends on people's view that using a particular system does not require physical and mental effort. In 1979, Zmud presented a model based on the previous modelsin which the individual variants influence on the success of management information system were divided into independent and dependent factors such as user's attitude, cognitive behavior, system design and user involvement.

Although many models have been designed on the Hospital Information System assessment, the Delone and Mclean model is more comprehensive and popular and this is why it has been used in plenty of researches. Delone and Mclean tried to create a comprehensive model by combining and organizing previous works on information system assessment. After surveying the determinants of about 180 researches on the success of information systems, they introduced their model in 1992 based on the following determinants: information quality, system quality, use, user satisfaction, individual and organizational impact. They considered the success of information systems as a dependent variable which was evaluated by the model. The relationship among these 6 determinants are as follows: system quality and information quality influence the use and user satisfaction individually or together; system use can affect the user satisfaction either positively or negatively and vice versa; the use and user satisfaction directly influence the individual impact and finally the individual impact causes and organizational impact. However Delone and Mclean haven't defined a specific relation between system quality and information quality (1992). Delone and Mclean model is illustrated in Figure 2.

Fig.2. Delone and Mclean information system success assessment model

In 2003, Delon and MacLean developed their model by making some adjustments such as adding the "service quality" determinant to the model. Service quality refers to the services which are provided bythe hospital information system supplier like instruction and support. The improved model has been

used innumerous researches which aimed to assess the success of hospital information systems. Although Delon and McLean model is one of the fundamental models in this field, many other studies have been done on the basis of relationship among determinants of the model. However due to comprehensiveness of the model, Delone and Mclean model has been used as the basis of this research. The conceptual model and related variables are described in the following section.

3- Conceptual model and the variables

The study has used questionnaires to extract the information from the hospitals. The population of this study consisted of all hospital users in Tehran hospitals. The formula for the finite population sampling and random sampling method has been used to estimate the sample size. According to the formula of the sampling, the sample size was 60 hospitals and the researcher randomly referred to 5 users per hospital and gave them a questionnaire. One-sample t-test has been used to identify effective measures and determinants in providing a model for assessing the success of hospital information system. One-sample t-test is used when there's one sample of a population and we want to compare the mean value with a common condition, standard or even an expected number. In this research, twocustomized questionnaires were used for data collection.

A) The first questionnaire consisted of 155 determinants that have been given to the experts (34 experts) to identify factors that affect the assessment of system's success. It is worth noting that the determinants are derived from the literature review and the findings of the researcher from observations.

B) The second questionnaire was designed after extractingthe experts' comments about the factors influencing the success of the evaluation system from the user perspective. The questionnaire is consisted of two sections; the first sectionwas designed to obtain demographic information and the second section containedLikert-scale (very low, low, medium, high and very high) questionsbased on 42 determinants.

For data analysis, a one-sample t-test was performed initially to select determinants and then KMO test was used to assess the adequacy of the sample size. The validity was evaluated through confirmatory factor analysis and in the next step; the multiple linear regression method was performed to examine the conceptual model. The conceptual model of research is shown in Figure 3. As can be seen, the research model has three independent, mediating and dependent variables. The independent variable is a variable that can impact on the dependent variable either negatively or positively. The dependent variable is one which a researcher tries to explain or predict the nature variability. The dependent variable in this studyis "general interest (organization / individual)". Because the variables "use / intent of use "and" user satisfaction " are under the influence of independent variables and are influencing the dependent variable,they are considered as mediating variables in this study.
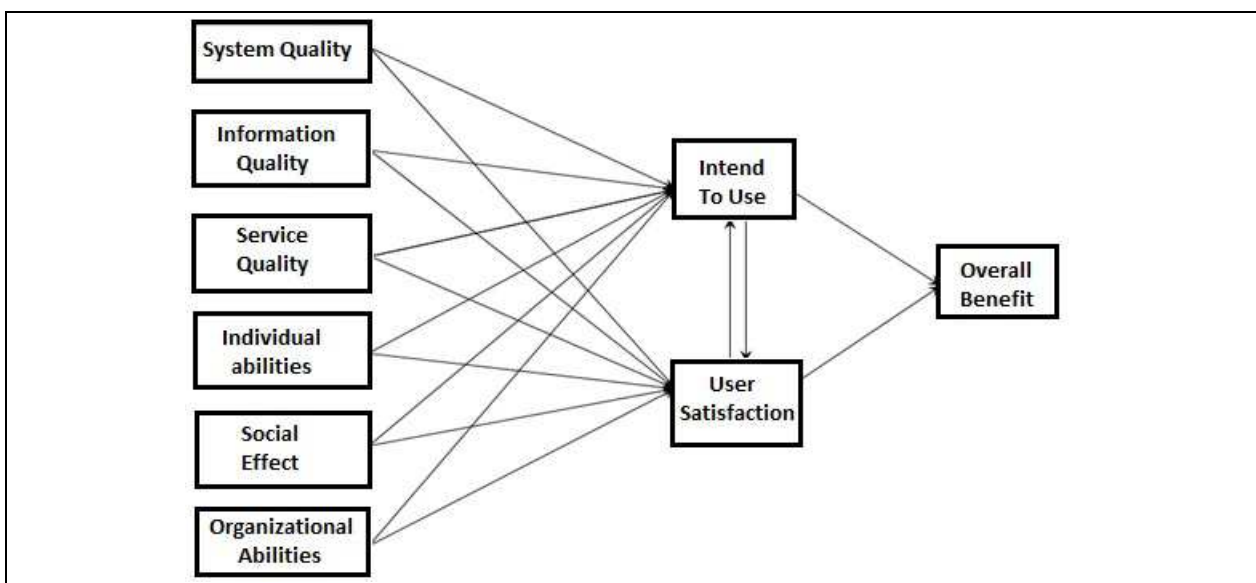

Fig.3.the conceptual model of research

To calculate the reliability of study, with a total of 34 questionnairesgathered from experts and a pre-test (pilot), 30 second-type questionnaireshave been distributed among the sample population and Cronbach's alpha was calculated using SPSS software. Cronbach's alpha is a method for calculating the reliability of the measurement tool. Reliability is the degree to which an assessment tool produces stable and consistent results. The reliability of each parameter is detailed in Table 1 below.

Table.1.Reliability of research's questionnaires

Determinants	Cronbach alpha The first questionnaire	Cronbach alpha The second questionnaire
System Quality	0.795	0.739
information Quality	0.727	0.731
Service Quality	0.714	0.770
Individual capabilities	0.744	0.848
Social Impact	0.733	0.792
Organizational capabilities	0.719	0.798
Use / intent of use	0.753	0.911
User satisfaction	0.727	0.873
Organization/individual profit (benefit)	0.745	0.839

According to the data, reliability coefficient in all the determinants in both questionnaires was above 0.7.One-sample t-test was used to identify the effective measures and determinants for assessing the success of the hospital information system model. As the Likertscale (very low, low, relatively low, moderate, moderately high, high and very high) is used in the experts' questionnaire the score from 1 to 7 was considered for each of these questions. According to the results of the One-sample t-tests, the parameters in Table 2 were obtained for each of the determinants.

Table.2. Summary of the results of identifying determinants from experts' perspective
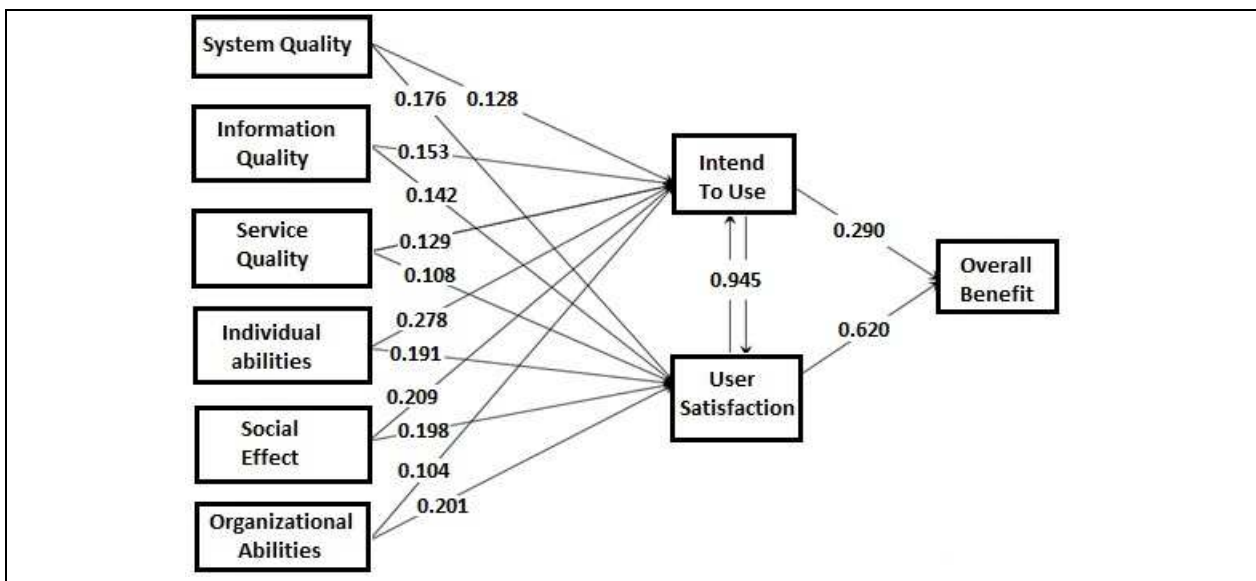
Parameters	row	Determinants
System Quality	1	Simplicity of the software
	2	Response time
	3	Conformity with user expectations
	4	The perfectness of the software based on the referring to the support center of software company's
	5	Reliability / Validity
	6	The suitability of the software based on the users' needs to perform job duties
	7	The adaptability with the manual system
	8	Fault tolerance; capabilities of the system that prevent the occurrence of serious consequences resulting from small errors
	9	Extensibility
	10	The level of system's security and the possibility to provide access level based on layered information to protect valuable data
	11	The time required to perform a standard function
	12	Availability
	13	Suitable for learning
	14	Suitable for personalizing
information Quality	15	Accuracy of Information
	16	Ease of understanding
	17	Adequacy
	18	usability
Service Quality	19	Providing adequate training
	20	Speed of service
	21	Competence of support staff
	22	Services in accordance with agreed service levels
Individual capabilities	23	Computer literacy
	24	Positive attitude towards the system
	25	Understanding the financial costs
Social Impact	26	Vendor's reputation in the community / brand
	27	Environmental and demographic conditions
	28	system vendor introducers' credibility
Organizational capabilities	29	Manager support for the implementation of system
	30	Quality of internal support services
	31	Adequate funding and credits required for the implementation of the system
Intent of use	32	Voluntary use
	33	The use of the system for reporting and personal affairs such as vacation requests, certificate requests and ...
	34	intention of use
User satisfaction	35	Being useful
	36	Satisfaction of different user groups of the system
	37	Receiving an appropriate response to user expectations
General interest (corporate and individual)	38	Increase of speed
	39	Improve decision-making and organizational communication
	40	Ease of doing things
	41	Increase of Productivity
	42	Improvement of patient care

One of the scientific methods to study the internal structure of a set of criteria and a measure of validity is Confirmatory factor analysis, which estimates loadings and explores the relationships between a set of criteria.

Load factor, Correlation factor criterion is related with the famous and like any other relationship is interpreted.

Accordingly, whatever criterion is a bigger factor,Interpretation of the criteria should be given more weight.In this paper, using confirmatory factor analysis method, factor loading of each criterion was calculated based on its criteria.Using multiple linear regression models, the hypothesis was put into test in order to provide the final model.

Therefore, based on the results of research assumptions, the final model of the research is illustrated in Figure (4).

Fig.4.Final Model

To calculate the success of the hospital information system assessment, questionnaires were handed to experts in hospital information systems in Shariati and ShahidHasheminejadhospitals. This questionnaire included questions related to the system quality, information quality, service quality, and individual abilities, social and organizational capabilitiesand was designed to check the effects of the current system. For each question, the following values were attributed: 0 as "None", 1as "somewhat/fairly", and 2 for the "Yes".

After completing the questionnaire at each of the hospitals, their responses were entered in the Microsoft Excelsoftware and according to the calculator designed to evaluate the success, success of each hospital information system was evaluated and the output was given to the hospitals. The output of the model for the information system of Tehran'sShariati hospital showed 33.21% of success and for ShahidHasheminejad hospital 63.66 percent of success, which matched with the assessments made by the hospitals themselves(attached you can find approval of both hospitals).

4-Results and conclusions

With regard to the key role of users as users of information system in hospital health care centers,their perspective on the importance of the system is particular. If the system does not meet users' expectations, they will be ignored and even will be seen as saboteur and annoying. In this paper, a model is proposed to assess the success of the hospital information system to improve the satisfaction of users of the system. Based on the survey results, user satisfaction has an impact on the overall benefit (individual/organizational) and the extent of this impact as well as other impact indicators on the final research model is well marked.

In this paper, several effective determinants were added to the Delon and Maclean model in order to improve the hospital's information system. Due to the positive and significant effect of individual and organizational capabilities and social impacts (determinants added to the Delon and Maclean model in this study), on the intent of use and user satisfaction, it is recommended that the hospitals in designing or purchasing the information systems, in addition to considering the system quality, information quality and service quality indicators, also consider those three new determinants in order to increase the overall benefit of the individuals and the organizations. In present model, due to the addition of the ability of the individual indicators, as well as organizational capabilities, social effects to Delon and Mclean models, the extent of the impact on the overall benefits of the user satisfaction has increased and reached to 0.639 level

5- Suggestions for research

Given the importance of hospital information system in giving service to the patients, it is recommended that the factors influencing patient satisfaction would be identified to provide a more comprehensive model to assess the success of the hospital information system and if approved by the experts, it can be included in the model and statistical analysis. Another noteworthy proposal is that after identifying the requiredfeatures of the systems, a modelwould be proposed to design a hospital information system and presenting it to the companies that create these systems.

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