Technology Acceptance Model in health care centers of Iran

Reza Safdari[1], Marjan Ghazi Saeedi[1], Ali Valinejadi[2], Hamid Bouraghi[1, 3*], Hossein Shahnavazi[4]

[1]Department of Health Information Management, School of Allied Medical Sciences, Tehran University of Medical Sciences, Tehran, Iran.
[2]Department of Health Information Technology, School of Allied Medical Sciences, Semnan University of Medical Sciences, Semnan, Iran.
[3]Department of Health Information Management, Hamedan University of Medical Sciences, Hamedan, Iran.
[4]Medical Records Department, Iranian Forensic Medicine Organization, Tehran, Iran
* Corresponding author: Hamid Bouraghi, Department of Health Information Management, School of Allied Medical Sciences, Tehran University of Medical Sciences, Tehran, Iran.

Abstract:

Background: In recent decades, in line with advances in technology and its application in various fields, different patterns and models have emerged in the field of technology adoption. Previous studies showed that the models in the study of various technologies and their acceptance have different functions. The aim of this study was to provide a Technology Acceptance Model for health care centers in Iran.

Methods: This was a qualitative study and the required data were collected by interview. The participants of the study included physicians, nurses and managers who work at cardiac specialty hospitals in Tehran.

Results: According to the "qualitative content analysis" methodology, 4 components including human factors, structural and technical factors, monitoring and management factors and organization strategies were selected as the final major categories. The findings suggest that more attention by senior hospital managers should be paid to the space, structure, and technology deployment in hospitals. In addition, the appropriate structure should be provided and determination and regulation of these four effective factors should be considered as a priority for technology adoption. These factors should be taken into account in organizational decisions and supportive policies are necessary.

Keywords:

adoption of technology, technology acceptance model, healthcare organization, new technology

1. Introduction:

Man of the third millennium is trying to accelerate the process of development and technology usage in different parts of the social system to move away from the traditional pattern and create a new pattern in accordance with the requirements of the information age (1). Technology infrastructure in hospitals, impact heavily on hospital procedures and, modeling, forecasting and measure capacity of health technologies, is effective in improving quality of service and in addition to the possibility of resolving the existing problems, the possibility of creating a clear vision of the future without risk will be provided by modeling and simulation. Given that background of any modeling and simulation is identifying the nature of its indices, the importance of identifying the performance indicators of the health system is doubled (2).

One of the main issues that public organizations are facing is acceptance and successful implementation of technology innovations, in order to keep pace with new technologies (3, 4).

For example, information technology in recent years due to the growth and rapid spread, and the use of computer facilities and the transfer of data and creating worldwide networks such as the Internet, drastically changed the environment of information exchange. Also, in the health sector, the use of efficient information systems, for achieving efficiency, effectiveness and quality of services and satisfaction of clients is an undeniable necessity. IT effects on economic, social and cultural aspects of society and its role in life will improve over time. The nature and function of information technology include an extremely wide range so that survival in today's changing world requires serious attention to the IT functions (5).

Public organizations in recent decades have witnessed significant developments in rapid technological change. Innovation is a key factor in creating competition and such an engine of development lets organizations be more efficient in the global economy (6), so government agencies to benefit from innovation and to gain a competitive advantage (7), are willing to accept technological innovations.

In this situation, the most important issue for healthcare centers is their ability to provide innovation, organizational technology, designs, equipment and system processes and markets. Impact of technology on medical knowledge and practice, eliminated the domestic restrictions and work flow to create innovative services (8).

To achieve optimum and better performance in hospital, technology infrastructure deployment in hospital, is

considered a necessity. Therefore, the main issue of this study is designing a model of technology acceptance in healthcare centers.

Literature review:

Developments of the last century were so massive that caused sequential appearance of different ages. Nuclear age, the space age, microelectronics age, information age and the age of biotechnology, each is a sign of profound changes in cognitive phenomena and science. The pace of change has caused the development and technological progress in the last two decades, as throughout history. In the scientific and experimental approaches, the reason for this great transformation considered a phenomenon called technology(9). In addition to the wellbeing and security valuation based on the technology and its level, the framework of political cooperation, economic and security is determined on the same basis (10).

Claxton says about technology definition: Technology is the application of different branches of science to solve scientific problems that because of the variety of environmental conditions may vary from area to area. In other words, technology is set of methods, experiences and practical science that humans use to dominate the environment and solving problems related to their relationship with the environment (11).

Studies show that customer acceptance is a key factor in the use of technology to provide services (12, 13). To investigate factors influencing the technology acceptance, a variety of models and methods is used in the world and two of the most prestigious of them are the Technology Acceptance Model (TAM) (14) and Information Technology Infrastructure Library (ITIL).

Technology Acceptance Model deals with the factors at the individual level (15). This model has been used in many researches in different countries and its applicability is investigated. Technology Acceptance Model introduced by Davis in 1986 according to theory of reasoned action to model the adoption of information technology by end users. This model, provide an explanation for the factors affecting the acceptance of computer by users and the model is at the level of individual factors (16).

Also framework of information technology infrastructure library model, includes a set of best practices to reduce costs coincide with improving the quality of IT services that is presented to the user (17).

Lee et al (2003) in a meta-analysis, by analyzing 101 studies conducted from 1986 to 2003 concluded that this model is applicable in different environments and on the different systems, tasks and topics (18).

The meta-analysis key TAM-based projects, conducted by Legris and colleagues (2003), shows that this model, on average, only 40% of the variance in predicting the decision to use and this indicates that some variables such as IT experience has been largely ignored.

They noted that there are three major limitations in these studies: a. Study Samples were mainly university students, while these studies were done on students to be extended to employees of commercial organizations. This is despite the fact that the educational organizations with business organizations are different in structure. b. Software that used in these studies, were office software or system development software. They suggest that these studies must be performed with software that is related to organizational processes, Such as decision support software.

3. In this model, the actual use of users measured through self-report questionnaire. Since that measure the user's actual use is associated with many problems, this method is convenient but it should be noted that the questionnaire is relative tool in such cases (19).

In another study, King and He (2005) reviewed 86 published studies according to the Information Technology Acceptance Model concluded that this model is one of the most prestigious and powerful model that have been raised in this area (20).

2. Materials and Methods:

Qualitative research approach, formed to help researchers to understand human beings and the social and cultural contexts in which humans live in (21). Grounded theory is a systematic and qualitative procedure that explains a process, action or interaction about real wisdom in the overall conceptual level (22). To gather the necessary information, open interview approach has been used. Method of data analysis in this study is the theoretical coding retrieved from grounded theory approach. The theoretical coding is operation in which the data are analyzed, conceptualized and are placed together in a new form, and is the main process in which the theory is developed based on data (23).

Coding steps used in this study include:

1. Open coding based on the extracted components from the pilot study of theoretical foundations of research
2. Axial coding
3. Selective coding

Each above three steps was applied on the research samples, for example, the content of the first research interview (S1) implemented and summarized in open coding of the first interview content and placed under classified concepts:

"This model makes works fast and easy in all parts of the hospital (12S2). Access levels for each section should be clearly defined and prevents work interference of the personnel (13S2)"

In the axial coding, research components were linked together and in the pattern of the research paradigm organizational factors, placed under actions and interactions section that finally, were combined in the selective coding phase and for its systematic approach, procedures were introduced.

The study population, consist of 15 physicians and managers from, Shahid Rajaie cardiovascular center, Tehran heart center and Jamaran heart hospital that, given the importance of the provision of services and access to information were selected. With this number of interviews, the researcher has been recognized that the data has reached the saturation point and further interviews are not required.

In choosing the number of samples, issues such as time, availability of interviewees and their cooperation is considered. So that, in this phase, 15 subjects was selected as a research samples and they were interviewed by using theoretical sampling method. In other words, in this study, 15 subjects were selected gradually. In fact, after twelfth interview, repeat in received information, was observed, but to ensure, continued until the fifteenth interview and after twelfth interview data perfectly replicates and had reached saturation. The duration of each interview (depending on subject opinion) was 30 minutes to an hour.

In this study, to analyze the data obtained from the interviews, theme analysis technique used and obtained information were analyzed by «MAXQDA» Software. In the table 1, the statistical sample is shown based on gender and age.

Table 1: The combination of the interviewees in terms of gender and age

No.	Age	The frequency		Percentage
---	---	Woman	Man	
1	25-30	1	1	13.34%
2	30-35	2	3	33.32%
3	35-40	3	3	40%
4	40-45	2	0	13.34%
Total		8	7	100%

As you can see in the above table, between interviewees we have 7 men and 8 women, and ranging in age from 35 to 40 years is most frequently.

According to the "qualitative content analysis" methodology, by continuing to analyze the data, the number of categories that extracted to identify criteria, was repeatedly modified and finally, four categories were selected as the final major categories. Given that the objective of this study is to draw Technology Acceptance Model, so after identifying the elements, in this stage, relations approach and kinship charts used and based on common characters, the main components placed in a class. The main categories were human factors, structural and technical factors, monitoring and management factors, and organization strategies.

Finally, 19 subcategories were identified associated with the main categories. For expansion of each of the components, a number of concepts, including 57 concepts, support them. In fact, the concepts, explaining the meaning of each component which should be considered during the organization evaluation.
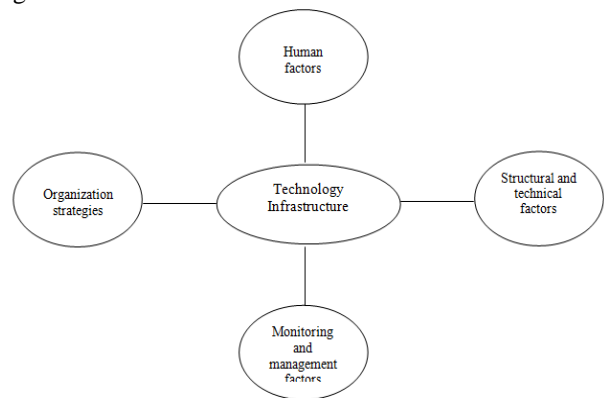

Figure 1: IT infrastructure model relationships

Table 2 shows the output stage of open coding with regard to the interviews conducted.

Table 2: Output of open coding of criteria and sub-criteria

Main categories	Subcategories	Concepts extracted from interviews
Human factors	Communication skills	Respond quickly to customer (3 S15), literate human resources (3S1).
	Interpersonal communication	Communication within and outside the organization (2S4), Relations Between Friends and Affability (S68), Communication skills (1S6) Public Relations (6S15)
	Awareness and knowledge level	Skilled labor with high literacy and information skills (3S6),Staff attitudes to the use of technology (2S6),Use experienced staff familiar with information systems (10 S7)
Structural and technical factors	Utilizing new technology	Use all Hospital software functionality (In the field of digital resources, Informing members and users) (18S2), The use of high-performance hardware (8S12), and The use of applications those are compatible with standards. (9S12), Using the knowledge base (1 S15)
	Easy access to facilities and equipment	Minimum technical problem (2 S1), Access to inter organizational network and integrity in all parts of the organization (4 S3)
	Using the Network and Internet	Use of the network and the Internet (10 S1), Encourage the customers to use the network or the Internet (11 S1), Decreased attendance at hospital (14S2), Use the right search engines (2 S8)
	Space	Separate buildings for each section (10S4)
	Cultural factors	Promoting the use and application of computers in hospitals (14 S11)
	social factors	Should contribute to the hospital training programs and research (8 S14)
monitoring and management factors	Availability	Easy access to nurses (10S3), Ease of use by personnel (7 S1), Matching, sharing and integrating heterogeneous data sources should be included (6 S9)
	Problem management	Avoid reinventing (19 S2), Do not interfere with work (5S5), Hiring people with experience and high skills (4 S9), Increased up to date and efficient computer systems (5 S9)
	Continuity Management of Technology	Use of ICT (6S5), The project management team (12 S10)
	Time management	Spend less time and energy in the hospital (9 S1), Respond quickly to the customer (4S2), Quick access to information (6 S2), Raise computer systems speed (12 S3)
Organization strategies	Policymaking	Job training course (9 S9), Increase productivity and provide high quality services (11 S10)
	Vision	The use of long-term strategies for enhancing efficiency (1 S13), Use of the information services in the hospitals (2S13)
	Position in the organization	Coordination Center that processing the collected data (7 S8)
	Organizational support	Being regulated and healthy space (5S2), Recruitment (6S5), justice (8S3)
	Information exchange	Exchange of information between hospitals (12 S1)
	General factors (promotion and motivation)	Participatory management style (3S2), Use of incentives (3S2), Saving financial and human resources (8 S2)

Figure 2 shows the structure of implementation of technology in hospital and link between departments, main components and sub-components in the model.
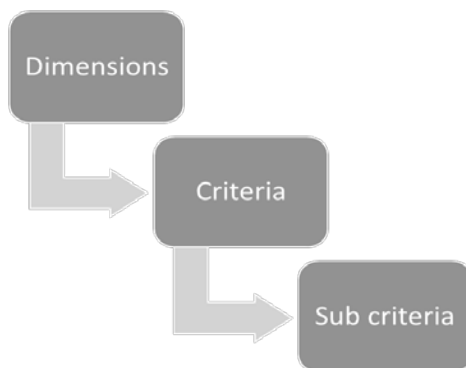

Figure 2: Model structure

Table 3 shows the main components and sub-components of the final model.

Table 3: Criteria and sub-criteria in the Technology Acceptance Model

The main components	number of Sub-components	number of concepts
Human Factors	3	10
Structural and technical factors	6	18
Monitoring and management factors	4	12
Organization strategies	6	17

A Model for Implementing Technology in Hospitals and explaining the relationship between the main components and sub-components was presented in the form of research themes. The results of the study showed that, criteria for Implementation of technology in hospital need to provide the necessary Background and context in the organization and IT-enabled services. Figure 3 shows the final model for acceptance of Technology Infrastructure.
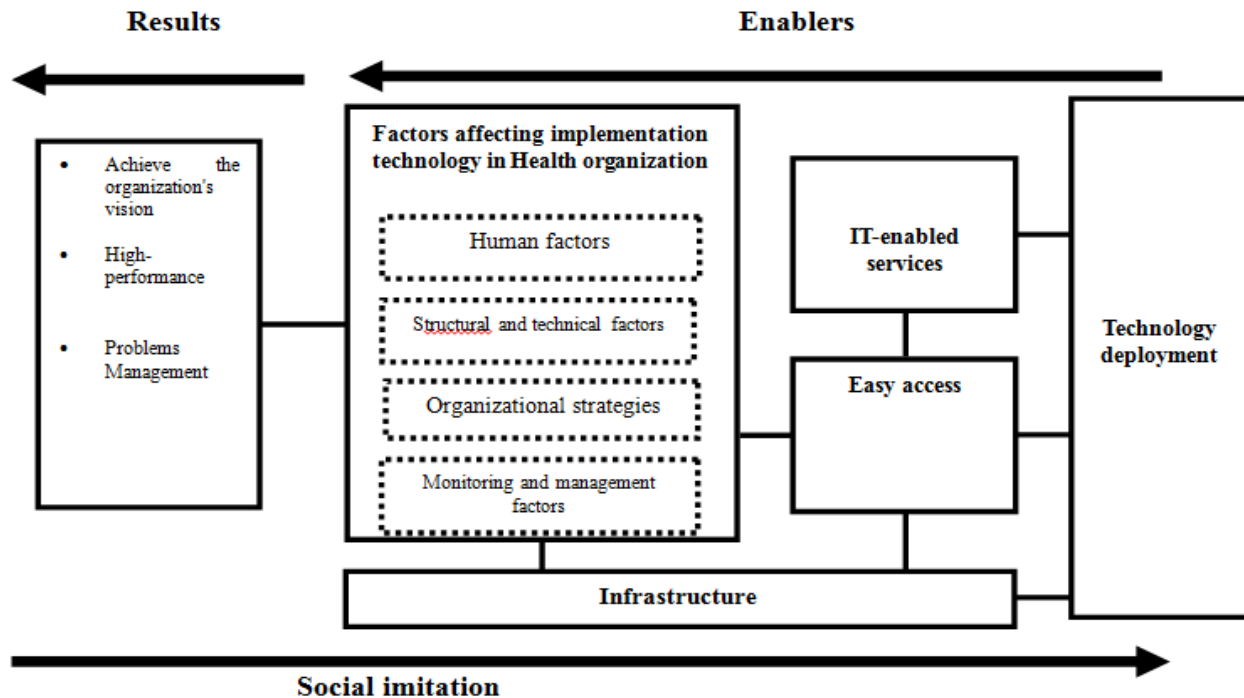
Figure 3: Hospital Technology Acceptance Model

3. Discussion

We found that human factors, structural and technical factors, monitoring and management factors, and organization strategies are the most important factors which should be taken into account in implementation of technology in healthcare centers. Each of these factors were defined and explained by components and sub-concepts that might help to get a better understanding about them.

Conceptual model of this study is based on Technology Acceptance Model (TAM) and Information Technology Infrastructure Library (ITIL). These models explained the factors affecting the acceptance of computer by the user and are at the level of individual factors. Davis et al. (1989) found that exogenous variables such as organizational factors, social factors, method of teaching, and other variables should be included in the model of technology acceptance and examined their effects on technology acceptance.

Technology acceptance model is one of the important theoretical frameworks that widely applied in the field of information technology and computer. This model is a simplified interpretation of beliefs that affecting on technology acceptance. The theoretical bases of this model are two kinds of belief: perceived ease of use, and perceived usefulness. Perceived ease of use refers to the belief that using a particular system would be free of physical and mental effort, and perceived usefulness has been defined as the degree to which an individual believes that using a particular system would enhance his or her job performance.

4. Conclusion:

To compare the designed model with literature and theoretical foundations must be stated that, the constituent elements of the model, like the key performance models (Davis et al., 1989, Lee et al., 2003, Legris et al., 2003 and Li, 2009) includes core values, criteria and sub-criteria and evaluation rationale. It should be mentioned that in identifying core values and criteria of a health organization's Technology Acceptance Model, the core values and top criteria of the above models have been used. The findings of our study suggest that: 1) senior hospital managers should pay more attention to the space and structure of their organization. One of the factors mentioned by the interviewees was the organizational structure and procedures. For the establishment of the technology infrastructure, appropriate structure should be provided either. In this regard, senior managers can facilitate this process by defining the appropriate channels of technology and the adoption of right policies, 2) health organizations should incorporate four effective factors (human factors, structural and technical factors, monitoring

and management factors, and organization strategies) in their decision-making and provide supportive policies, 3) according to the interviews, it seems that in the technology deployment, social and cultural issues such as the culture of using and application of new technologies in hospitals, get the least attention (unlike technical aspects that is considered as the most important factor in technology acceptance), while end-user acceptance, plays a huge role in the final acceptance of technology and social and cultural issues directly affect on perceived ease of use and perceived usefulness. Therefore, paying more attention to the end users and their demands and also create culture of using the new technologies among them, can assist in the implementation of new technology in the organization. 4) Taking the importance of establishing appropriate infrastructures for technology deployment into account, we recommend that more attention should be paid to experts, professional attitude to work, and also a separate space to the hospital wards. In this regard, conducting job training courses and workshops might be useful.

References:

[1]   Joseph M, Stone G. An Empirical Evaluation of US Bank Customer Perceptions of the Impact of Technology on Service Delivery in the Banking Sector. International Journal of Retail & Distribution Management 2003;31(4):12.

[2]   Collen MF, Detmer DE. Multi-Hospital Information Systems (MHISs). In: Collen FM, Ball JM, editors. The History of Medical Informatics in the United States. London: Springer London; 2015. p. 459-502.

[3]   Hyun Joon K, Bretschneider S, editors. Local government information technology capacity: an exploratory theory. System Sciences, 2004 Proceedings of the 37th Annual Hawaii International Conference on; 2004 5-8 Jan. 2004.

[4]   Kamal MM. IT innovation adoption in the government sector: identifying the critical success factors. Journal of Enterprise Information Management. 2006;19(2):192-222.

[5]   Wang R, Gu D, Tao F, editors. A study on the construction and management of cloud-based patients accessible hospital information systems. Computer and Computational Sciences (ICCCS), 2015 International Conference on; 2015 27-29 Jan. 2015.

[6]   Landsbergen D, Wolken G. Realizing the Promise: Government Information Systems and the Fourth Generation of Information Technology. Public Administration Review. 2001;61(2):12.

[7]   Ebrahim Z, Irani Z. E - government adoption: architecture and barriers. Business Process Management Journal. 2005;11(5):589-611.

[8]   Simon A, Davey B, Flaiz B, Karpathiou V, Wickramasinghe N. A Multi-centred Empirical Study to Measure and Validate User Satisfaction with Hospital Information Services in Australia and Germany. In: Wickramasinghe N, Troshani I, Tan J, editors. Contemporary Consumer Health Informatics. Cham: Springer International Publishing; 2016. p. 91-100.

[9]   Pan S, Jordan-Marsh M. Internet use intention and adoption among Chinese older adults: From the expanded technology acceptance model perspective. Computers in Human Behavior. 2010;26(5):1111-9.

[10]   Alikhani A, Bahrami A. Identify barriers to the implementation of electronic insurance in the Iran insurance industry and providing proper solutions. insurance industry. 2007;2(86):26.

[11]   Philips Z, Ginnelly L, Sculpher M, Claxton K, Golder S, Riemsma R, et al. Review of guidelines for good practice in decision-analytic modelling in health technology assessment. 2004.

[12]   Spacey R, Goulding A, Murray I. Exploring the attitudes of public library staff to the Internet using the TAM. Journal of Documentation. 2004;60(5):550-64.

[13]   Li C-F. Extending the technology acceptance model to investigate the factors affecting the user satisfaction in internet banking. Business and information. 2009:06-8.

[14]   Morris MG, Dillon A. How user perceptions influence software use. IEEE software. 1997;14(4):58.

[15]   Davis FD, Bagozzi RP, Warshaw PR. User acceptance of computer technology: a comparison of two theoretical models. Management science. 1989;35(8):982-1003.

[16]   Conrad ED. WILLINGNESS TO USE IT INNOVATIONS: A HYBRID APPROACH EMPLOYING DIFFUSION OF INNOVATIONS AND TECHNOLOGY ACCEPTANCE MODELS: Southern Illinois University Carbondale; 2009.

[17]   Sallé M. IT Service Management and IT Governance: review, comparative analysis and their impact on utility computing. Hewlett-Packard Company. 2004:8-17.

[18]   Lee Y, Kozar KA, Larsen KR. The technology acceptance model: Past, present, and future. Communications of the Association for information systems. 2003;12(1):50.

[19]   Legris P, Ingham J, Collerette P. Why do people use information technology? A critical review of the technology acceptance model. Information & management. 2003;40(3):191-204.

[20]   King WR, He J. A meta-analysis of the technology acceptance model. Information & management. 2006;43(6):740-55.

[21]   Alvani S, Azar A, Danaeefard H. Qualitative research methodology in management: a comprehensive approach. Saffar, Tehran, Iran. 2004.

[22]   Merriam SB, Tisdell EJ. Qualitative research: A guide to design and implementation: John Wiley & Sons; 2015.

[23]   Creswell JW, Clark VLP. Designing and conducting mixed methods research. 2007.