



Effective Factors on Integrating the Digital Libraries in Iranian Universities of Medical Sciences: A Conceptual Model

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Received 19 Sep 2016; Accepted 6 Jan 2017

ABSTRACT

Introduction: The goal of integration of digital libraries (DL) is to utilize various autonomous DLs in concert to provide knowledge from such island-DLs. Integrated digital libraries (IDLs) appeared after the emergence of DLs in 1990s, invention of integrated information systems from 2000 and consolidation of them during the recent decade. The Ministry of Health and Medical Education (MHME) of Iran has emphasized the integration of health services throughout the country which unavoidably requires the integration of digital libraries in Iranian universities of medical sciences. The main purpose of this investigation was to identify effective factors on such integration.

Method: The present research was conducted through analytical-descriptive approach. The related data were gathered from literature, assessed by the Delphi Panel members and analyzed by Fuzzy TOPSIS technique (Technique for Order Preference by Similarity to Ideal Situation). The research population (Delphi Panel) consisted of 15 specialists in digital library areas. The snowball method was used to determine the research statistical sampling. The data were gathered through a five-point Likert scale self-made questionnaire after its reliability and validity were evaluated.

Results: Study of related published studies in literature revealed that DLs, Integrated Information systems and IDL were three systematic related phenomena, which emerged and developed in a definite and unavoidable order. The findings showed that 34 affecting factors could be considered which influence the integration process of digital libraries in Iran Universities of Medical Sciences. The affecting factors could be classified into five main groups of strategic, technical, digital, organizational and human factors, according to their proximity and importance.

Conclusion: IDLs are the outcome of merging the experiences of DLs and integrated information systems, which have led to efficient and remarkable informatics systems. According to the findings of the present work five main factors consisting of strategic, technical, digital, organizational and human ones affect the integration process of DLs in Iranian medical science universities.

Keywords: Integrated digital library, Information systems, Medical universities, Effective factors, Conceptual model, Iran

► Please cite this paper as:

Mohsenzadeh F, Radad I, Alipour-Hafezi M. Effective Factors on Integrating the Digital Libraries in Iranian Universities of Medical Sciences: A Conceptual Model. *J Health Man & Info*. 2017;4(2):44-50.

Introduction

The goal of DL integration is to utilize various autonomous DLs in concert to provide knowledge from such island-DLs. The needs for DL integration are well known and also emphasized by the Ministry of Health and Medical Education (MHME) of Iran. IDLs are the results of consolidation of distributed collections of heterogeneous library resources which become and appear as a single union. IDLs provide the users with more comprehensive

usage of DL resources through coherent and easier to use interfaces within such interconnected library resources (1). Integration is a means for improving services in relation to access, quality, user satisfaction and efficiency (2). Integration of physically separate and disparate systems which are related to each other for providing services and/or seeking similar goals has resulted in great achievements (3). New technologies helped to connect such systems and bring different parts of the world closer to form a global village where every body is a stakeholder. One of the most

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demanding areas for providing services in Iran, like other parts of the world, is health service organizations such as hospitals.

Health service centers need cooperation and coordination in their activities. They have always suffered from lack of essential information leading to inefficiency in their services (4). At the present era, the main challenge is not lack of information, but the problem is how to have access to information (2, 5). To have desirable health services, it is essential to have quick and easy access to information which is attainable by a suitable integrated information system. Such information is obtainable in DLs provided that their efficiency improves through their integration. Therefore, integration of DLs in medical science universities will definitely lead to improvement in health care services. In fact, lack of IDL is a barrier for the development of efficient health care system (6).

The contents of "The Scientific Map of Health Systems" announced by the MHME of Iran have emphasized the integration of health services all over the country (7). The above-mentioned document consists of priorities, policies, strategies and requirements of health ministry. Hospitals and health service providers belong to medical universities or supervised by them in the case of private sector hospitals. In fact, medical universities play an important role in health service system as they produce and use knowledge and technologies in health services area. Therefore, the integration of DLs in medical universities is the most effective way to improve the services of hospitals and medical centers.

It is interesting to note that in an important document of the Ministry of Health and Medical Education of Iran it has been mentioned that medical universities are responsible for innovations, producing health knowledge and integration of health services. The policies have been announced as follows:

- Increasing capability of producing knowledge.
- Developing publication and sharing of production of knowledge.
- Accessibility to integrated knowledge and information (8).

It has been emphasized that the knowledge produced in Iran and abroad should be available for all target groups and universities, which may result in full of knowledge and information in universities and systems. The above policies seek for sharing of knowledge and information to upgrade medical universities (9).

Access to integrated medical contents and, therefore, providing medical information sources may lead to suitable health care and better health services. Need for information in medical centers and time limitation for making decisions by health center staff have made it crucial for them to have access to reliable information (10). It is important to realize that information is a key, but missing, component in health service systems. Obtaining and accessing the required information substantially improve health services, which is feasible through an integrated information system (11, 12). Easy and prompt access to required information is an essential need in the present development era. Nowadays, people seek their

needed information from databases by searching tools (13). Separate DLs cannot satisfy such needs, but the integration of them may lead to their improved performance. Integration process of DLs, therefore, should be definitely in any modern library system including the universities of medical sciences in Iran.

Integrating DLs will improve their performance through increase of information interchange and provide the required standards (14). However, this process may face with new and long term challenges in Iran (15). The probable challenges may, in turn, lead to new solution which will satisfy interesting users. To overcome new challenges, new studies and new plans are required, in which the time and place of the project should be precisely considered (16, 17).

Seeking information from isolated systems is not recommended. Instead, non-compatible information systems are continuously converted into integrated systems all over the world. Integrating DLs has been one of the most attractive fields for research activities in recent years (18). Integration of DLs in Iranian Universities of Medical Sciences is essential and crucial for implementation of "The Scientific Map of Health Systems" announced by the MHME of Iran. The present study aimed to identify and rank the factors affecting the implementation of integrating DLs in Iranian universities of medical sciences which may provide a framework for it. Accordingly, the key questions for the present research were as follows:

1. What are the factors affecting the integration process of DLs in Iranian medical sciences universities?
2. What are the ranks of the factors affecting the integrations process of DLs in Iran medical sciences universities?

Method

The present research consists of two parts. First, a systematic literature review was done to identify the factors affecting the integration process of digital libraries. The reviewed documents consisted of books, journals and dissertations related to the research title and available in the databanks and databases. All the factors affecting the development of DLs and IDLs, quoted in the literature, were identified. These factors consisted of 35 cases which formed the basis of the present research hypotheses.

In the second step, after identifying the factors effective on DLs and IDLs extracted from literature, as main variables of research, they were classified into four groups of technical, humanity, organizational and digital categories. These variables were organized in a five-point Likert scale self-made questionnaire. Then, its reliability and validity were evaluated. The questionnaire was emailed to all participants and its face validity (easy comprehension) and content validity (with scoring of 3 aspects: importance, clearance and accountability based on Likert scale) were confirmed (18). The snowball method was used to determine the research statistical sampling, in which each person introduced the next qualified one. Accordingly, a Delphi Panel consisting of 15 experts and experienced people who were familiar enough with the present research topic was assigned. These people were

qualified as being academic staff who were engaged in education and research activities in the field of DLs and IDLs. The first questionnaire consisting of four main affecting factors and 25 sub-factors (variables) was sent to the Delphi Panel members. They were subsequently contacted and satisfied to answer the questionnaire. Their responses were considered as original data of the present work. It is important to mention that some additional effective factors were proposed by Delphi Panel members, which were classified into a separate group as strategic factors. In the third step, the new improved questionnaire, in a new five-point Likert questionnaire consisting of five main factors and 34 sub-factors, was sent to the Delphi panel experts to extend their assessment on all affecting factors. The effective factors with their details are presented in Table 2.

Fuzzy TOPSIS technique was applied to analyze the received data to rank the effectiveness of affecting factors on the implementation of IDLs. It was first developed by Hwang and Yoon (19), based on the concept that the chosen alternative should have the shortest distance from the positive ideal solution (PIS) and the farthest from the negative ideal solution (NIS) for solving a multiple criteria decision making problem. In short, the ideal solution is composed of all best values attainable based on criteria, whereas the negative ideal solution is made up of all worst values attainable based on criteria. Fuzzy TOPSIS is a powerful technique for ranking, which is done in six steps. Step 1: Construct the fuzzy decision making (DM) matrix; Step 2: Normalize the DM; Step 3: Constructing weighted normalized DM; Step 4: Determining the Fuzzy positive and negative ideal solutions; Step 5: Calculating the distance between each alternative and Fuzzy positive and negative ideal solutions; and Step 6: Ranking the effective factors (20). Finally, based on the systematic literature review results, the findings obtained from Delphi Panel responses and their analysis by Fuzzy TOPSIS technique a conceptual model, illustrating all effective factors (variables), was suggested. The validity of the research method was achieved by literature review and confirmed by the opinions of experts. The reliability of the present research method was tested through SPSS using Cronbach's alpha coefficient.

Results

The findings of the first step of the present research, the systematic review of related literature, are presented in Table 1. The gathered data were arranged in an almost chronological manner which reflects historical development trend of DLs and their subsequent integration events. These published works in the period of 1996 to 2012 are mainly concerned with the factors affecting the development and performance of DLs. The effective factors on the development of DLs, integrated information systems and IDL obtained from systematic review of related literature are presented in the third column of Table 1. Technical, human and organizational factors were the main challenges for the development of DLs during the early years.

The findings revealed that the second topic which was

systematically related to the present work was concerned with integrated information systems. These studied published works are presented in the middle rows of Table 1, which have been published during the period of 2007 and 2012. Integration of information systems was a crucial requirement in that period to improve the capability and performance of many different systems. It is interesting to note that almost all factors which have been quoted as effective ones on the development of integrated information systems are the same as those affecting the development of DLs, as seen in the middle section of Table 1. The last section of Table 1 presents the data related to IDL during the period of 2002 to 2015. Integration of digital libraries was the main concern in the third period of DL development. As seen, effective factors on integrating DLs are almost the same as those mentioned for DLs and integrated information systems. The topics are: standards, protocols, technology, infrastructures, interoperability, metadata formats, online resources and so on. These factors are crucial in consolidation process of DLs. The findings of the first step consist of 27 published works related to the research domain, which are presented in Table 1. As indicated in Table 2, 34 sub-factors affect the implementation process of integrating DLs in Iranian medical universities. These affecting factors have been classified into five main factors as follows: strategic, technical, digital, organizational and human groups. The results of assessment of all factors effective on the integration process of DLs, analyzed by Fuzzy TOPSIS technique based on the responses of the Delphi Panel members, are also presented in Table 2. Each main group consists of several factors which are also presented in Table 2 with their relative weights and ranks. As shown, the most effective main factor is strategic factor and the last one is human factor group.

Discussion

The findings of the present work (displayed in Table 1) show a chronological manner which reflects the historical development trend of DLs and their subsequent integration events. A group of published works in the period of 1996 to 2012 are mainly concerned with the development and performance of DLs. Technical, human, and organizational factors were the main challenges for the development of DLs during early years. The second stage of development which paved the way for more development in the field of DLs was the emergence of integrated information systems. It mainly took place in the period of 2007 to 2012 (21-23). Integration of information systems was a crucial requirement in that period to improve capability and performance of many different systems (24, 25). It is interesting to note that almost all factors which have been quoted as effective ones on the development of integrated information systems are the same as those which affect the development of DLs, as seen in Table 1.

Integration of DLs occurred in the third stage of the above-mentioned trend from 2005 onward. Effective factors on the integration process of DLs mentioned in the literature are mainly the same as those mentioned for the development of DLs and integrated information systems.

Table 1. The information obtained from systematic literature review stage of the present research

No	Sources	Effective factors	Systems
1	Hastings, K. and Tennant, R. (1996).	IT specialists	Digital library
2	Paepcke, A., Chang, K. C., Garcia-Molina, H. and Winograd, T. (1998)	Interoperability	Digital library
3	Arms, W. Y., Hillmann, D., Lagoze, C., Krafft, D., Marisa, R (2002).	Agreement in three levels of technical, organizational, and content factors	Digital library
4	Shiri, Ali (2002)	Organizational, economic, social and legal factors, Architecture of digital library, systems and technologies, digital collections, metadata, Interoperability, Standards and systems of knowledge establishing users	Digital library
5	Deegan, M. and Tanner, S. (2002)	Metadata	Digital library
6	Tennant, R. (2004)	Budget	Digital library
7	Chang, Naicheng (2005)	XML and Metadata	Digital library
8	Zhang, Ying (2010)	Appropriate technical decisions, effective management, continuous assessment, management of data and contents	Digital library
9	Harun, N. H. (2010)	Technology infrastructure, Budget, training ICT, human factors, Programming standards, a national information organization	Digital library
10	Liangxian, Du; Junxia, Qi (2012)	Technology infrastructure	Digital library
11	Chang, I. C., H. G. Hwang, M. C. Hung, M. H. Lin, & D. C. Yen. 2007	Organizational factors	Integrated information system
12	Zhu Y, Li W, Wang W, Chen J (2010).	Programming, the definition of work strateg , organizational factors, Technical factors, The support of the senior manager	Integrated information system
13	Bakker, K. Boonstra, A (2010)	Budget	Integrated information system
14	Hakim, A. Hakim, H. (2010)	Suitable technology	Integrated information system
15	Lin, A., and N.-C. Chen. (2012)	Organizational factors: resources, budget	Integrated information system
16	Kereyer (2002)	organizational factors: Financial resources, appropriate policies	Integrated digital library
17	Waterhouse, J (2005)	Specialists librarians	Integrated digital library
18	Shi, Rong. (2005)	Standards, protocols and technology infrastructures.	Integrated digital library
19	Rathje, B. D., McGrory, M., Pollitt, C. and Voutilainen, P. (2005)	Digital objects, budget, skills of staff, culture and organizational long-term aims, needed standards and protocols, regulation.	Integrated digital library
20	Dahl, M; Banerjee, K and Spalti, M. (2006)	Technology infrastructures and standards like: XML, Open URL, Z39.50, and so on	Integrated digital library
21	Shen, Roa (2006)	Interoperability, standardization and Agreement in levels of technical, organizational and content	Integrated digital library
22	Saumure, K. and Shiri, A. (2006)	Technology infrastructures. Online resources, Specialists librarians,	Integrated digital library
23	Deb, Subrata (2006)	digital objects, software, Technology infrastructure, manpower and budget	Integrated digital library
24	Martinez, E. F; Chen, S. Y; Macredie, R.D and Liu, X. (2007)	Specialist manpower	Integrated digital library
25	Roknuzzaman, Md (2009)	Digital resources, Technology infrastructure and Experience and expertise of staff.	Integrated digital library
26	Alipour-Hafezi, Mehdi (2012)	Models, protocols, metadata formats and context-based layer	Integrated digital library
27	Scientific map of the Ministry of Health and Medical Education (2015)	Priorities, aims, policies, strategies and necessities of the Ministry of Health	Integrated digital library

But some factors seem to be specially related to the integration process, such as standards, protocols, interoperability, online resources, digital resources, metadata formats. These factors, in fact, form the basis of integration of DLs.

As shown in Table 2, all the factors affecting the implementation of IDL have been classified into five main groups. The weight and importance of these five groups have been assessed by the Panel Delphi and scaled by Fuzzy TOPSIS technique. Strategic factors are the most effective ones among all factors. It is interesting to remember that these factors were rarely found in the

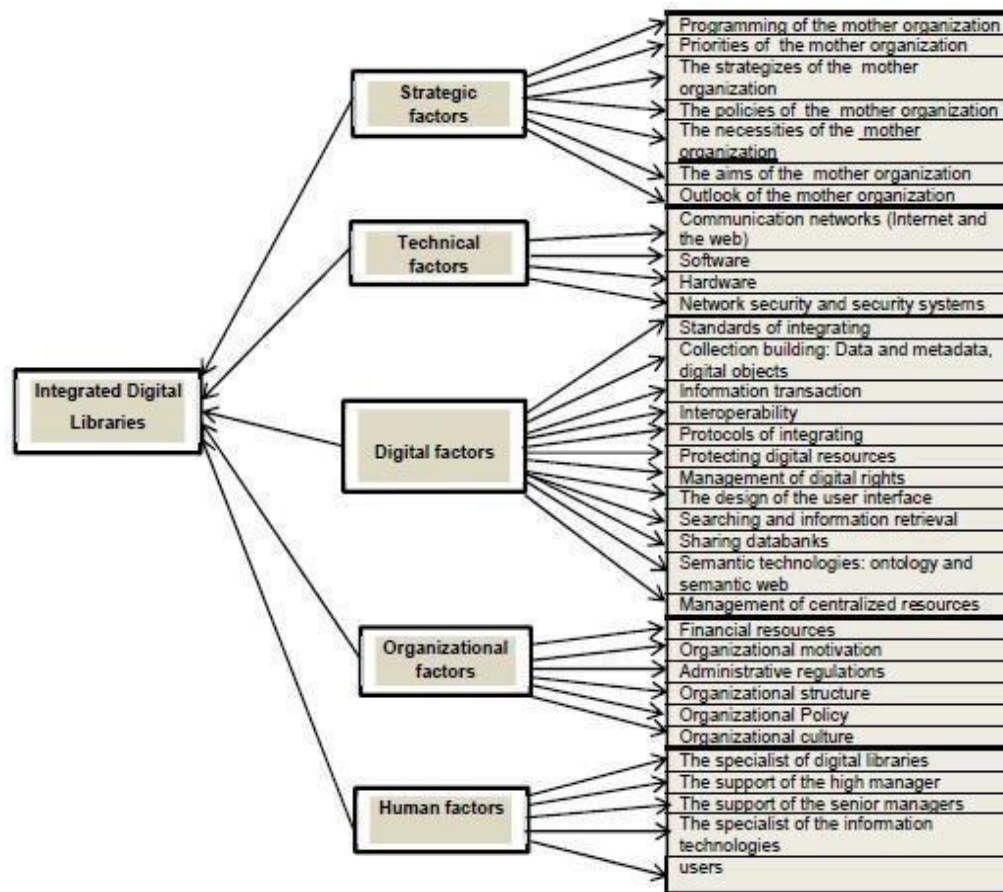
literature and even they were not considered in the first questionnaire of the present work.

These factors were mainly proposed by the members of the Delphi Panel. It is required to stress that these factors, which had been proposed individually by some Delphi Panel members, were subsequently assessed by all members through the second questionnaire.

Table 2. Ranks of the factors and sub-factors affecting the integration process of IDLs, obtained by Fuzzy TOPSIS technique

No	Factors	Sub-factors	Weight	Normalized weight	Ranking
1	Main factors	Strategic factors	0.516	0.203	1
2		Technical factors	0.515	0.202	2
3		Digital factors	0.506	0.199	3
4		Organizational factors	0.503	0.198	4
5		Human factors	0.500	0.197	5
6	Strategic factors	Programming of the mother organization	0.552	0.150	1
7		Priorities of the mother organization	0.547	0.148	2
8		The strategizes of the mother organization	0.540	0.146	3
9		The policies of the mother organization	0.532	0.144	4
10		The necessities of the mother organization	0.525	0.142	5
11		The aims of the mother organization	0.499	0.135	6
12		Outlook of the mother organization	0.491	0.133	7
13	Technical factors	Communication networks (Internet and the web)	0.528	0.255	1
14		Software	0.528	0.255	1
15		Hardware	0.513	0.248	2
16		Network security and security systems	0.501	0.242	3
17	Digital factors	Standards of integrating	0.554	0.0889	1
18		Collection building: Data and metadata, digital objects	0.549	0.0880	2
19		Information transaction	0.534	0.0857	3
20		Interoperability	0.530	0.0851	4
21		Protocols of integrating	0.530	0.0850	5
22		Protecting digital resources	0.523	0.0839	6
23		Management of digital rights	0.523	0.0839	6
24		The design of the user interface	0.518	0.0830	7
25		Searching and information retrieval	0.514	0.0825	8
26		Sharing databanks	0.510	0.0818	9
27		Semantic technologies: ontology and semantic web	0.496	0.0795	10
28		Management of centralized resources	0.452	0.0725	11
29	Organizational factors	Financial resources	0.561	0.183	1
30		Organizational motivation	0.541	0.176	2
31		Administrative regulations	0.513	0.167	3
32		Organizational structure	0.490	0.159	4
33		Organizational Policy	0.486	0.158	5
34		Organizational culture	0.481	0.156	6
35	Human factors	The specialist of digital libraries	0.528	0.209	1
36		The support of the high manager	0.523	0.207	2
37		The support of the senior managers	0.520	0.205	3
38		The specialist of the information technologies	0.500	0.198	4
39		users	0.457	0.181	5

Figure 1. The proposed model of the factors affecting the implementation of integrated digital library in Iranian Universities of Medical Sciences



Although there is an obvious difference between effective factors on integration of DLs in Iran and those found in the literature, the obtained data are real and reliable. The members of the Delphi Panel, as emphasized, are experienced and qualified people. Therefore, their opinions reflect the importance and real positions of senior managers in decision makings of strategic planes in the Ministry of Health and Medical Education of Iran. As seen in Table 2, among strategic factors the most effective one is programming of the mother organization, namely the Ministry of Health and Medical Education. Priorities of mother organization are the second in importance, which again reflects the role of senior managers.

As expected, technical factors are the second main important factor group in the process of integration of DLs. The importance of technical aspect of the integration process is obvious since integrating information technologies are essential for supporting such integration process and they have to mesh smoothly with operational workflow and human organizational systems. It means that to establish IDL in Iran, it is crucial to develop the required technology infrastructure. Digital factors are those intimately related to integration process which, in fact, connects technical aspects to organizational and human aspects. Digitally technical factors are important enough to be considered separately from technical factors. They have more digital nature compared to technical factors. These factors are also very crucial in integration process of DLs. Organizational factors consisting of financial resources, regulations, structural, policy and culture have occupied the fourth order in the main groups.

The policies of organization may lead to easier implementation of IDL. Financial and investment resources are among the most important factors in IDL development, which are usually controlled by organizational policies (26). IDL requires a common managing system among different organizations. Therefore, financial resources should be obtained and decision makings should be done with coordinated manner among different organizations (27). Human factors and their effects cannot be ignored in the integration process of DLs. These factors are unavoidably important since technology and machines are created and used by people. Therefore, their development and efficiency certainly depend on human performance. The performance of human resources such as IT specialists, managers, users, librarians, designers, programmers and editors determine the performance of IDLs (28, 29). It has been even suggested that DLs have changed their approach from digital sources to digital librarians.

Considering the above mentioned results from the Delphi Panel assessment and scaling of the relative weights of affecting factors by Fuzzy TOPSIS technique, a conceptual model has been suggested, as illustrated in Figure 1. It shows all affecting factors with their ranks and weights which can be found in Table 2. The suggested model consists of five groups of affective factors. Each group contains many sub-factors to cover all the problems in the integration process of DLs. The presented model may be considered as a guideline by executive managers in their planning and running of their projects.

The study of available literature revealed that it is the first research work of this kind in Iran. Therefore, it may pave the way for further similar and related works, which may result in a framework for implementation of the integration process of DLs in Iranian medical sciences universities. However, because of lack of similar research, it is not possible to compare the present results with the other similar studies in Iran to outline the weak points of the present research.

Conclusion

IDL was the outcome of merging the results of activities and performances of DLs and integrated information systems. 33 factors affecting the implementation of IDL in the universities of medical sciences in Iran may be considered. They can be classified into five main groups of strategic, technical, digital, organizational and human factors according to their importance and effectiveness on the integration process. According to the findings of the present study, strategic factors are profoundly effective on the integration process, which reflect the definite role of senior managers of the Ministry of Health and Medical Education in Iran. It indicates an obvious and interesting difference between the integration process of DLs in Iranian medical universities and previously similar projects in other countries. It is recommended that a research work should be conducted to investigate the effects of the integration of medical sciences digital libraries in Iran on the national health care services.

Study limitations:

There were some limitations in doing the present study as follows:

- Receiving responses from the members of Delphi panel took a long time, which delayed summarizing and analyzing the data.
- Lack of similar researches performed in Iran made it difficult to compare the present research results with other studies.

Limitations

There were no limitations in collecting the data.

Acknowledgement

This research paper is a part of a PhD dissertation under the title of: identifying affective factors on integration of DLs in Iranian Universities of Medical Sciences. The PhD program was supported by Imam Reza International University, Mashhad, Iran.

Conflict of interest:

None declared

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