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Key factors influencing the adoption of Cloud Computing Technology in the Medical Sciences University libraries

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Key factors influencing the adoption of Cloud Computing Technology in the Medical Sciences University libraries

Abstract

Purpose- The aim of this study is to prioritize the key factors influencing the adoption of Cloud Computing Technology in the Medical Sciences University libraries.

Design/ methodology/ approach- Firstly, criteria, effective dimensions and factors in implementing cloud computing technology in medical libraries were recognized through literature review integrated with the field experts' interview. Then, exploratory factor analysis using SPSS was applied to reduce the number of factors to constitute a 5-point Likert scale questionnaire and administered to 150 people. Analytical Hierarchy Process (AHP) was utilized, and data was collected through pairwise comparisons questionnaire that was distributed among 20 experts in related fields. Three criteria, five dimensions and 20 factors were identified and concluded that the most important criteria affecting on cloud computing adoption for Universities' libraries in Iran was *expenditure* followed by *effectiveness* and *applicability*. Based on each criterion, factors were ranked according to their role in implementation of cloud computing technology in medical libraries.

Findings- The outcome of the study showed that *technology* as a dimension and *hardware availability* and *software availability* as factors had the highest effect on the cloud computing adoption in medical libraries in Iran with respect to all three criteria.

Originality/value- The study is the first attempt to study and prioritize the factors responsible for the adoption of cloud computing in Medical Sciences University Libraries using AHP.

Keywords: Cloud Computing Technology, Cloud Computing in libraries, University of Medical Sciences libraries, Information Technology, Analytical Hierarchy Process, Factor analysis.

Key factors influencing the adoption of Cloud Computing Technology in the Medical Sciences University libraries

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INTRODUCTION

Nowadays, we are living in the age of information technology (Kaushik and Kumar, 2013). Libraries are one of the organizations whose effectiveness of their services mostly depends on information technology (Islam S. and Islam N., 2006). Information technology play very vital role in library science (Sahu, 2015). Libraries need information technology for their scientific research, cataloging and classification, data processing, the researchers relationships, science production and other bibliographic services (Granados et al., 2017; Adegbilero-Iwari and Hamzat, 2017). Before the emergence of information technology, the tasks in the libraries were performed manually and independently from one another (Adegbilero-Iwari and Hamzat, 2017). With the advent of information technology and computers, the services in the library are better carried out through the use of integrated library system (Adegbilero-Iwari and Hamzat, 2017). Cloud computing is a novel technological model for libraries that provides the services in a cost-effective method (Etro, 2015). Cloud computing is the newest innovation in IT that can provide many advantages such as cost reduction, scalability, cower investment, greater security and accessibility, portability and adjustable storage to the libraries (Avram, 2016; Sadiku et al., 2014).

Cloud computing also provides environment friendly green model of information landscape which is base for the accomplishment of UN goal of sustainable development in the education and research sector (Choudhary, 2012). There are several definitions of cloud computing in the literature, but maybe the best definition is provided by the National Institute of Standards and Technology (NIST). According to NIST “Cloud Computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction” (Peter and Timothy, 2011). Cloud Computing has three different service models including: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS) (Adegbilero-Iwari and Hamzat, 2017; Peter and Timothy, 2011). Recently, Cloud Computing systems have been widely studied. Richards (2017) argues that most of the enterprises look for cloud computing solutions due to its efficiency in creating a centralized technical infrastructure which is highly cost saving. However, to the best of our knowledge based and in the literature review, very few studies have been conducted in developing countries like Iran, in particular in the Medical Sciences Universities’ libraries. Our study is aimed at prioritizing the key factors influencing the adoption of cloud computing in Medical Sciences University libraries in Iran.

RELATED LITERATURE

Many studies have attempted to understand the factors that influence the decision to adopt CCT. Most of these studies survey the effective factors of the adoption of cloud computing in industries and organizations such as hospitals and health care facilities.

Low et al (2011) employed the Technology-Organization-Environment model to investigate the factors that affect the adoption of cloud computing by firms belonging to the high-tech industry. The eight factors examined in this study are: *relative advantage, complexity, compatibility, top management support, firm size, technology readiness, competitive pressure, and trading partner pressure*. The findings of this study revealed that relative advantage, top management support, firm size, competitive’ pressure, and trading partner pressure characteristics have a significant effect on the adoption of cloud computing (Low et al., 2011).

Lian et al (2014) conducted an exploratory study to understand the critical factors affecting the decision to adopt cloud computing in Taiwan hospitals. This study mainly integrates the TOE (Technology-Organization-Environment) framework and HOT-fit (Human-Organization-Technology fit) model to understand this issue. The results indicate that the five most critical factors are *data security, perceived technical competence, cost, top manager support, and complexity*. Moreover, among the dimensions proposed by Lian et al. the most important one is technology followed by human, organization and environment (Lian et al., 2014).

Harfoushi et al (2016) investigate the factors affecting the adopting cloud computing in Jordanian hospitals. The results of the study indicated that the three factors proposed by the framework, *technology, organization, and*

environment, played a role in the decision to adopt cloud computing in Jordanian hospitals. Moreover it was found that technology had the most impact on the decision of adopting the cloud computing (Harfoushi et al., 2016).

Dunne (2016) performed a study aimed to identify and evaluate the factors that affect the adoption of cloud computing in hospitals in Ireland. They used the TOE (Technology-Organization-Environment) framework. The factors that were identified as impacting adoption were: *cost, data security, perceived usefulness, available resources, organization size, regulatory & legal context and vendor support* (Dunne, 2016).

METHODS

The present study is a method that used qualitative/quantitative and cross-sectional and was conducted in 2017. In this study we identify and rank effective factors in implementing CCT in the libraries of medical sciences universities. The main methods used in this research are factor analysis and analytical hierarchy process, (AHP). The study was employed in several steps.

In the first step, factor affecting the adaption of cloud computing were determined. Secondly, factor affecting the implementation of cloud computing were determined. In the third step, factor analysis was applied to reduce the number of factors and in the fourth step, the analytical hierarchical process was performed in order to prioritize the factors affecting most in cloud computing implementation in libraries.

Factors Affecting the Adoption of Cloud Computing

The related literature review and documentary materials available from related databases including: PubMed, MEDLINE, EMBASE, SCOPUS, and Google Scholar for English articles and SID, Magiran, MedLib, and IranDoc for Persian articles from 1997 to 2018 were the primary source of the researchers to collect related information. The information then was integrated with exploratory interviews by semi-structured questionnaire from medical librarianships in the field of library and information science familiar with cyberspace and computer science, computer programmer in developing library applications, and cloud computing specialist. The interviews were conducted in Farsi language using the related keywords or terminologies from literature review in English. Each interview lasted approximately 30 minutes and continued to the next interviewee until no new data or information was obtained. Judgmental sampling methodology was employed to select 20 experts in related fields and their responses were recorded and coded with their consents accordingly. The inclusion criteria for the interviewee included a) having Master degree or higher, b) having at least five years' experience in related field of library and information science or computer science, and c) having publications or executive experiences in cloud computing . The distribution of respondents is shown in Table 1.

Table 1 Distribution of respondents		
Variables		Frequency
Affiliation	Iran UMS(University of Medical Sciences)	8
	AUT(Amirkabir University of Technology)	3
	Isfahan UMS	1
	Mashhad UMS	1
	Shahid Beheshti UMS	1
	Baqiyatallah UMS	1
	Tehran UMS	2
	Computer Programmer(Private Company)	3
Gender	Male	8
	Female	12
Education	BS	3
	MS	9
	PhD	8

Factors Affecting the Implementation of Cloud Computing

To determine the most effective factors and their validity, eighty factors, which were obtained from the previous step, were organized as the questionnaire in the form of five-point Likert scale from “very poor” to “excellent”, appended with a checklist with “Yes or No” questions. The questionnaire were evaluated by the same 20 experts in order to be critiqued and validated (see Table 2) (Avram, 2016; Adegbilero-Iwari and Hamzat, 2017; Morgan and Conboy, 2013; Islam S. and Islam N., 2006; Sadiku et al., 2014; Kaushik and Kumar, 2013; Sahu, 2015; Harfoushi et al., 2016; Low et al., 2011; Lian et al., 2014; Gangwar et al., 2015; Oliveira et al., 2014; Ratnam and Dominic, 2014; Kuo, 2011; Dunne, 2016; Klug and Bai, 2015; Priyadarshinee et al., 2017; Sultan, 2010; Gupta et al., 2013; Armbrust et al., 2010).

Table 2 Variables extracted from the review of texts					
No.	Components and factors identified during the review of texts + interview	No.	Components and factors identified during the review of texts + interview	No.	Components and factors identified during the review of texts + interview
1	Hardware availability	28	Communication Equipment	55	Applications compatibility
2	Network Topology	29	Reduce organizational costs	56	Library Management Software
3	Software availability and its configuration	30	Compliance with security standards	57	Ability to deal with cybercrime attacks
4	Compliance with design and implementation standards	31	No need for specialized technical knowledge	58	Compliance with storage and retrieval standards
5	Type of Internet	32	Reduce human interactions	59	Strategic Planning
6	Information Management System	33	Regulations and legal policy	60	Access to the desired information
7	Enriching Information	34	System Integration	61	Flexibility
8	Persuading green computing	35	Funds Allocation	62	Cost-benefit
9	Levels of service agreements between users and cloud computing supporters	36	Participation of users in the design and implementation of the system	63	Increase cross-sectoral collaboration without increasing costs
10	Hardware Configuration	37	Awareness of Managers	64	Defining different access levels
11	Information leakage	38	Optimal balancing	65	Filtering Data (which data

	Reduction (deliberately or unintentionally)		between supply and demand		to store and which to skip)
12	Increase security	39	Building Confidence	66	Flexibility and variability
13	Compatibility with the level of literacy and the ability of users	40	Location of the Cloud computing service provider	67	Organizational processes integrability
14	Permanent availability	41	Extensibility	68	Information Sharing
15	Increase system performance	42	Supportive infrastructure	69	Removes Maintenance Costs
16	Easy accessibility	43	Data Storage Availability	70	Fast information processing
17	Encryption and privacy (data, user, ...)	44	Organizational Data Portability	71	Maintenance and Confidentiality of data
18	Gender impact in Decision Making	45	Information Integration	72	Increased Data Storage
19	Environment lover	46	Interactive systems	73	Financial status
20	Time Saving	47	Data Portability	74	Redesigning processes
21	Data Recovery in Natural Disasters	48	Recovering information faster	75	Compatibility with various applications
22	Top Management support	49	Speed up information access	76	Personnel Training
23	Speed of Internet	50	Attitude of users (employees)	77	Personnel Education
24	Accumulation of electronic waste	51	Culture of employee	78	Existence of legal provisions
25	Security infrastructure	52	Scalability	79	Legal issues

26	User Acceptance	53	Users' Assurance	80	Human Factors
27	Encryption and access control	54	Convenient information exchange		

In reviewing all 80 factors considering the adaption of CCT for medical libraries, two different views were recognized by the researchers as “*Cloud Computing* adaption in libraries” was generally discussed. One view can be categorized as “factors as the advantages of implementation of cloud computing” another view was more concerned with “required factors in order to implement cloud computing technology”. These separate views were sometimes mixed in some literature reviews as factors of “adoption cloud computing ” and required in depth and careful attention in order to classifying them correctly in a list (Adegbilero-Iwari and Hamzat, 2017). Since the purpose of this study was to determine the factors that is essential for implementation of *CCT* for medical libraries, the questionnaire was designed in such a way to distinguish those items that designate as “advantages” of implementation of cloud computing versus those that designate as “required” items for implementation of cloud computing. Therefore, in the questionnaire, experts were asked to evaluate and differentiate by assigning 0 to “advantages” items and 1 to “required “ items and applied the Likert scale only for later items. Furthermore, while labeling the factors, if there were contradiction on labeling items among experts the items were returned to all 20 subjects for reconsideration. If an item scored by more than 70 percent of experts, it was included in the final questionnaire.

Out of eighty factors in the original list, twenty-five factors were identified as “advantages of adaption Cloud Computing in medical libraries “ and was listed separately from fifty-five factors marked as “required factors for adaption Cloud Computing in medical libraries”, and as so the research questionnaire were constructed. In administering the questionnaire those factors which received more than 75 percent of total scores (275), were accepted and validated through Delphi technique as potential effective factors for implementation of cloud computing in medical libraries.

Factor Analysis

The resulting factors from second step consisted of twenty factors as effective factors to implement cloud computing in University medical libraries. The five-point Likert questionnaire administered to 150 individuals in related fields in which 130 of them were chosen as “convenient sampling” and the same 20 experts from previous step were chosen objectively for determining main dimensions and factors through Factor Analysis. The questionnaire was administered through Email, or in person. Using Exploratory Factor Analysis with SPSS version 21, the variables were measured and analyzed for factors reduction. The sample distribution of participants is given in (Table 3).

Table 3 Distribution of all Participants		
Variables		percentage
Age	21-30	66) 25.(16
	31-40	34) 71.(47
	41-50	33) 32.(21
	>50	67) 22.(14
Gender	Male	34) 53.(35
	female	66) 97.(64
Education	BS	66) 70.(46
	MS	33) 56.(37
	PhD	01) 24.(16

Kaiser Meyer Olkin (KMO) Measure of Sampling Adequacy

Before analyzing the data with Factor Analysis statistic, one had to examine the variables to make sure that the sample is adequate, and variables are suitable for Factor Analysis which means data are capable of being categorized into dimension and factors. The content validity of .856 (CVR) obtained by Factor Analysis (KMO) concluded that the factor analysis is appropriate for data sample. Also, Bartlett's test and its significant level was another test to confirm the outcome of KMO statistic. Bartlett tests the hypothesis that the correlation matrix is an identity matrix, which indicates that small values less than 0.5 of significant level shows that the factor analysis may be useful with your data (Table 4).

Table 4 KMO		
Kaiser Meyer Olkin (KMO)		0.856
Bartlett's test	Chi-square	1236.017
	df	190
	Sig.	0.000

Explained Variations

After performing factor analysis and applying Varimax rotation, 5 dimensions were identified. Table 5 shows the explained variation of each factor with each item (factor loadings). Findings show how each dimension is associated with each factor and how well the factor can explain the dimension. The original 20 items (variables) were reduced and combined into five dimensions. After determining the number of dimensions, the items (variables) were categorized into factors by using the factor loading more than 0.3. If one factor was associated with two dimensions it was associated with the one with higher factor loading or more logical association.

Table 5 Dimensions resulting from factor analysis with factor loading more than 0.3						
Factor	Variable	1	2	3	4	5
1	Participation of users in Cloud Computing design					7390.
2	Top Management support	5560.				
3	Organizational processes integrability	8050.				
4	Financial status	6140.				
5	Organizational Data Portability	5720.				
6	Reduce the accumulation of electronic waste		5400.			
7	Attitude and awareness of users					3150.
8	Location of the Cloud Computing service provider	5130.				
9	Speed of Internet			6710.		
10	Data Portability			7810.		
11	Software availability and its configuration			5930.		
12	Supportive infrastructure		6710.			
13	Hardware availability and its configuration			4730.		
14	Type of Internet			4520.		
15	Maintaining the confidentiality of data				6810.	
16	Gender impact					8530.

17	Regulations and legal policy				4910.	
18	Compliance with standards				5250.	
19	Encryption and access control				5250.	
20	Persuading green computing		7300.			

Analytical Hierarchical Process

The Analytical Hierarchical Process (AHP) process employed to rank the five dimensions and 20 factors resulted from previous steps in order to determine the most important dimensions as well as the least number of essential factors needed for implementation of the Cloud Computing at Medical Science University' libraries. Table 6 represents each main dimension and its related multiple factors along with mean and standard deviations of each factor obtained from experts' point of view. As it is demonstrated in the table, the five main dimensions include *Technology, Organization, Culture, Legal-security, and Environment*. The *Technology* and *Organization* dimensions each with five factors and *Cultural* and *Environmental* dimensions each with three factors and *Legal-Security* dimension with four factors constitute all twenty factors of implementation of cloud computing.

factors	dimensions	variable	Mean	Standard Deviation
1	Environmental Factors	Reduce the accumulation of electronic waste	34.3	17.1
2		Supportive infrastructure	34.3	29.1
3		Persuading green computing	55.3	15.1
4	Legal Security Factors	Maintaining the confidentiality of data	68.3	08.1
5		Regulations and legal policy	63.3	20.1
6		Compliance with standards	42.3	15.1

7		Encryption and access control	50.3	22.1
8	Cultural Factors	Participation of users in Cloud Computing designing	50.3	21.1
9		Attitude and awareness of users	40.3	23.1
10		Gender impact	36.3	26.1
11	Organizational Factors	Top Management support	61.3	17.1
12		Organizational processes integrability	52.3	21.1
13		Financial status	50.3	26.1
14		Organizational Data Portability	62.3	36.1
15		Location of the Cloud computing service provider	58.3	25.1
16	Technology Factors	Speed of Internet	58.3	34.1
17		Data Portability	42.3	38.1
18		Software availability and its configuration	69.3	28.1
19		Hardware availability and its configuration	58.3	20.1
20		Type of Internet	39.3	19.1

In order to work with AHP methodology, first the tree structure should be drawn where the main objective of the research question or main solution to the problem would be determined and located at the root of the “tree”. The main objective or the root of the tree should only contain one parameter for decision making. The next layer consists of multiple criteria in which the alternatives in the third or fourth layers are being evaluated based on. The AHP structure could comprise from one level of criteria or multiple level of criteria and sub-criteria.

In this study, we have one level of criteria with no sub-criteria, explicitly, *expenditure*, *applicability*, and *effectiveness*. These three criteria were determined upon the interview part of the data gathering. The interviews with 20 experts from previous section as was mentioned before were conducted by semi-structured questions. The last

question in interview were simply asked: “In your opinion, what would be the three most important criteria that has the most impact on implementation of cloud computing regarding factors you just named?” The list of criteria was then given to the same 20 experts in later step and the three items with highest rating were selected by administering the five-point Likert questionnaire.

Finally, the hierarchy of all dimensions, factors, and criteria were classified into four levels as shown in (Fig. 1).

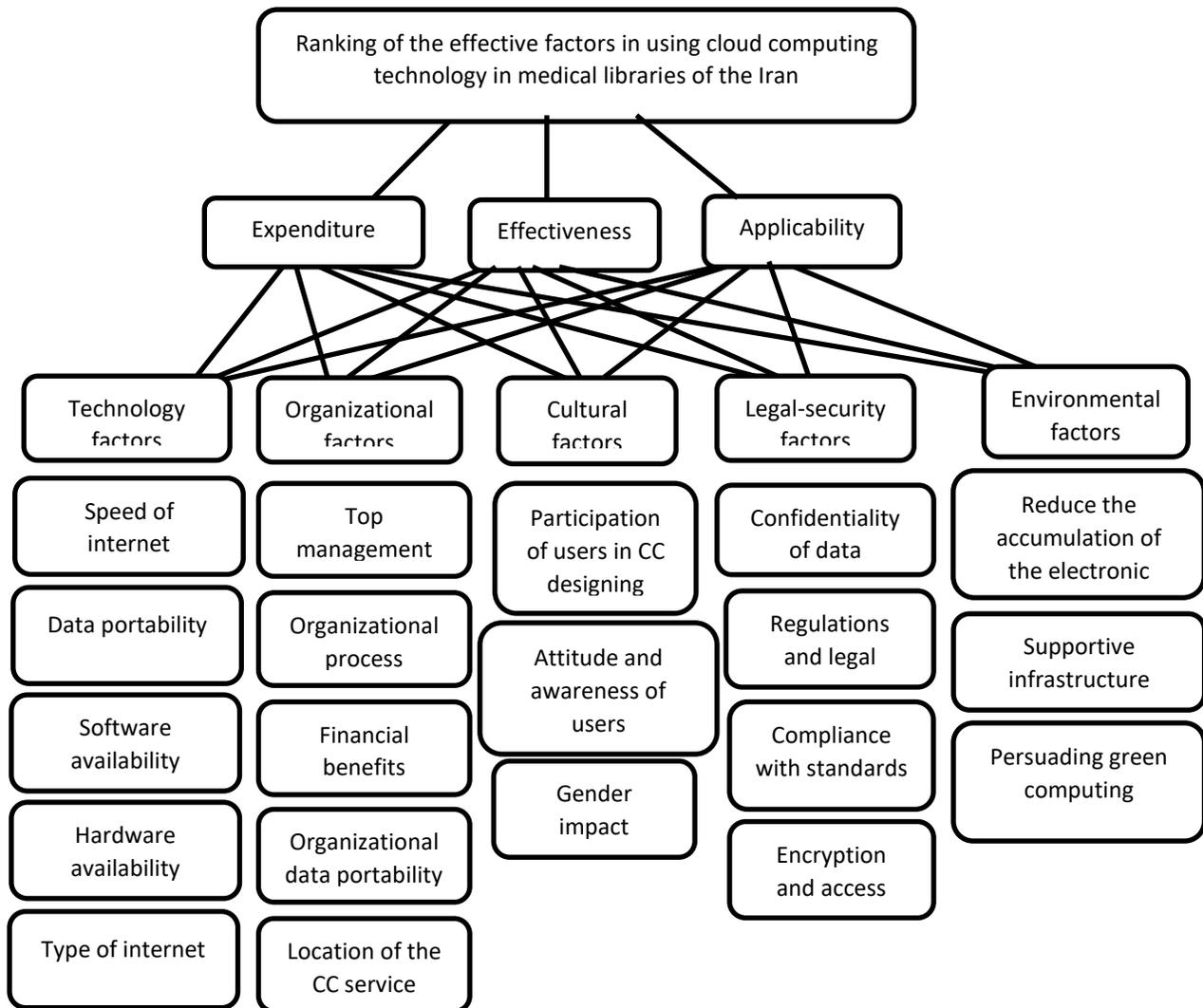


Fig. 1 Hierarchy Model of effective factors on implementation of Cloud Computing Technology in medical libraries in Iran

To analyze the factors using AHP methodology, a pairwise comparisons questionnaire was designed to determine the priority of effective factors on cloud computing implementation. Four-level hierarchy employed in the questionnaire in order to collect the pair-wise comparison judgment from our sample. The sample was composed of

the same 20 experts with the same method as we used before. The researchers used the Saaty's nine point scale to collect relative scores for pair-wise comparisons among different factors (Table 7).

Table 7 Pairwise Comparison Scale	
Rating	Description
1—Equal	Both alternatives have equal importance
3—Moderate	One of the alternatives is slightly more important than the other one.
5—Strong	One of the alternatives is strongly more important than the other one.
7—Very Strong	One of the alternatives is very strongly important compared to the other one.
9—Extreme Importance	One of the alternatives is strictly superior to the other one.

Data analysis was performed using Expert Choice software version 11. The consistency ratio calculated by the Expert Choice controls the validity of the paired comparisons, which were calculated and found to be less than 0.1; this indicator designates the validity of the pairwise comparison questionnaire.

RESULTS

In this study, three criteria, five dimensions and 20 factors were identified. The five main dimensions were labeled as *environment*, *legal and security*, *culture*, *organization* and *technology* in which each had composed of multiple factors. The three criteria in which the alternatives were compared against each other with respect to, were *expenditure*, *applicability* and *accessibility*.

Based on the AHP method, every entity would be compared with every other entity within its' level in a matrix form as a paired comparison. Therefore, each variable, would it be dimension, factor or criteria, were compared with another variable to evaluate its' priority with respect to a certain criterion. For example, the variable *technology* was compared with every other variable in the second level that is with *environment*, *legal and security*, *culture*, and *organization* with respect to the criteria *expenditure*. That simply means that the respondents should decide whether the cost of providing technological requirements of implementation of cloud computer in libraries is higher than or less than organizational requirements or any of the other five dimensions when evaluated in paired comparison. Similar comparison will take place for all other variables and with respect to other criteria (Fig. 2).

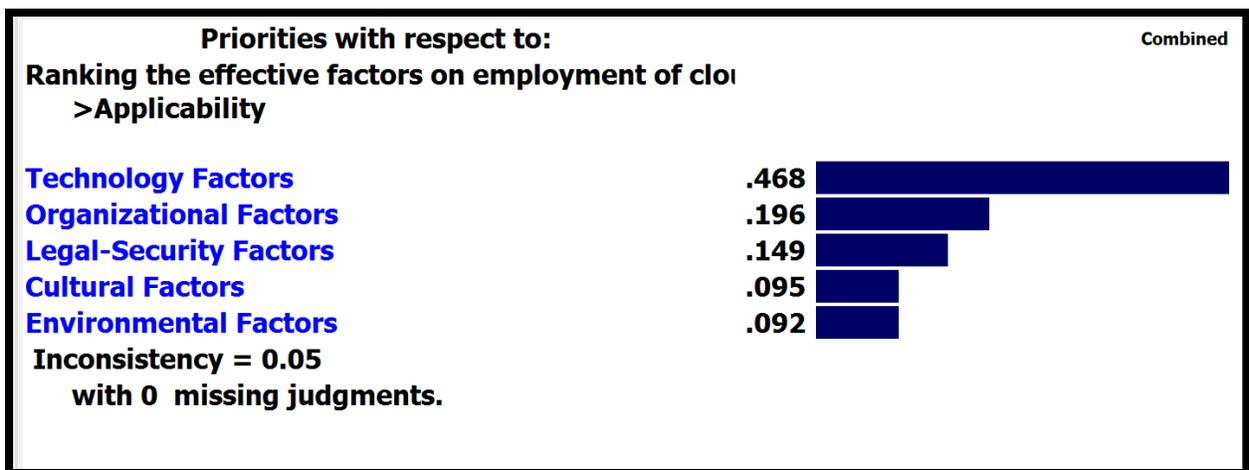
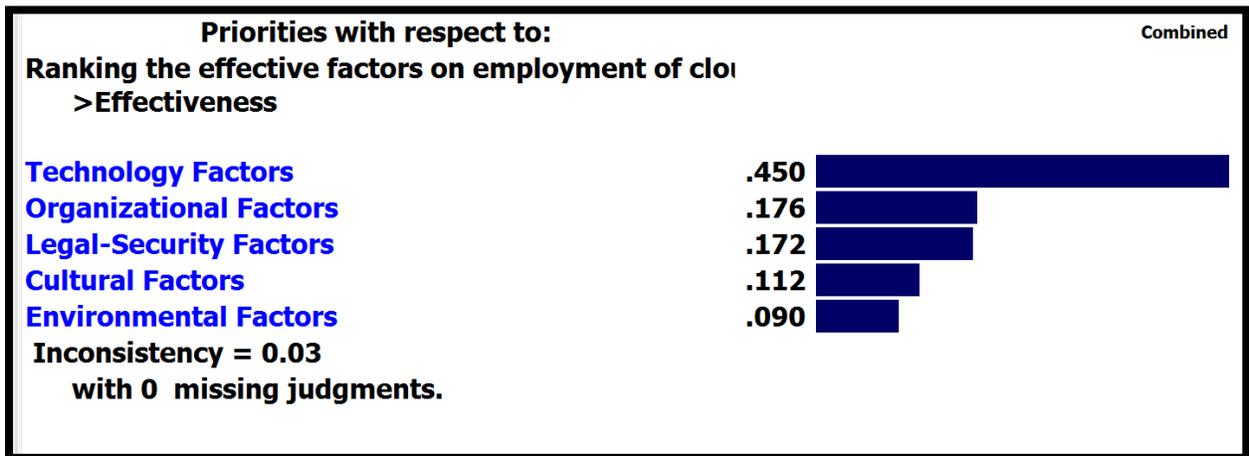
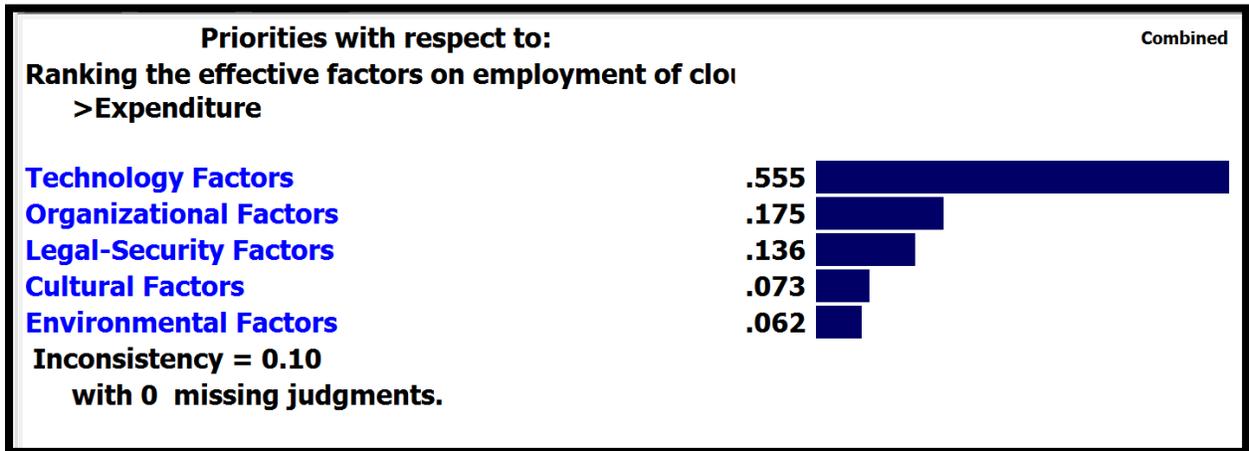


Fig. 2 Priority of factors with respect to expenditure, effectiveness and applicability criteria of implementing cloud computing.

As shown in the figure 2, the highest priority of dimensions with respect to the *expenditure*, *effectiveness* and *applicability* when implementing CCT in medical libraries was related to *technology* with the weighs of 0.555, 0.450 and 0.468 respectively. In all criteria, *environment* had the lowest priority. Nevertheless, the criteria themselves would also be evaluated in comparison with each other with regard to their impact on the implementation of cloud computing in Medical libraries. Figure-3 shows the result for the AHP on the three criteria, *Expenditure*, *Effectiveness* and *Applicability*.

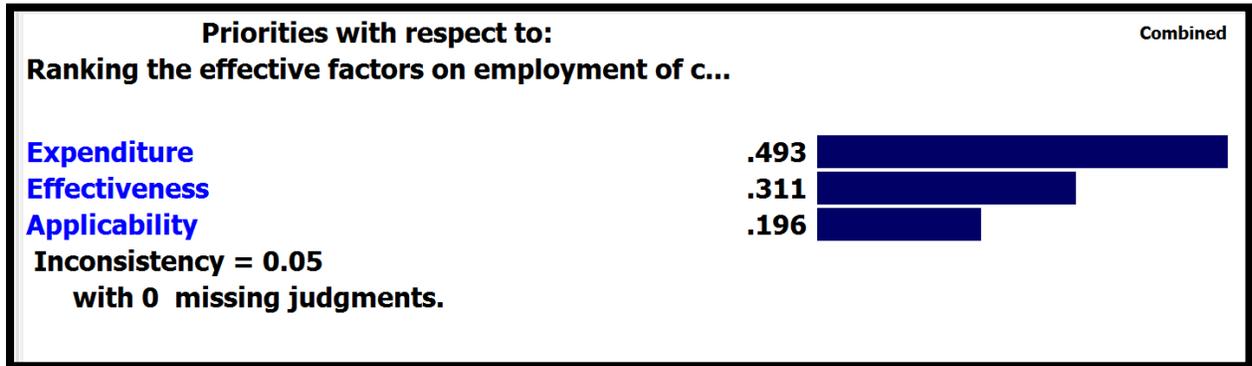
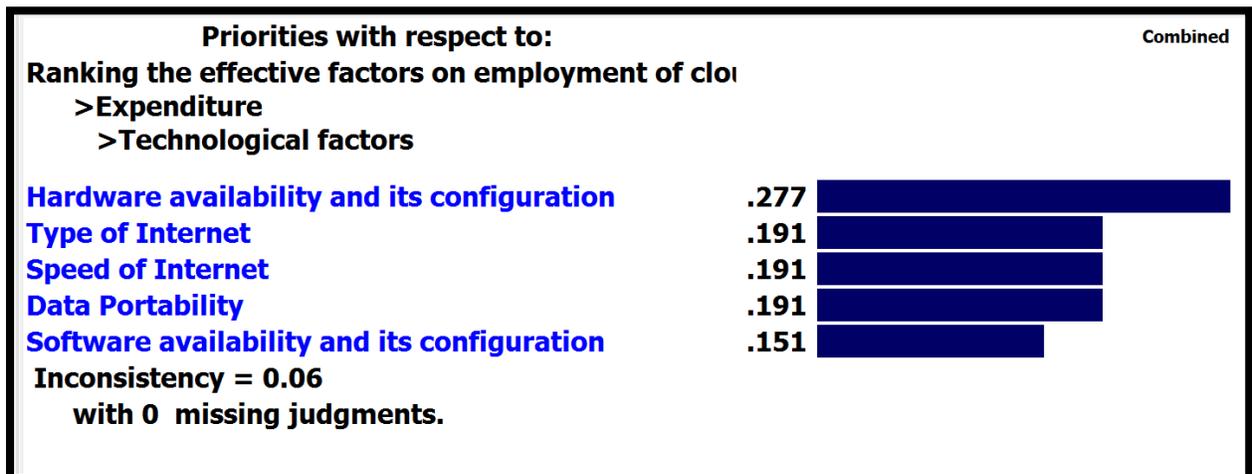
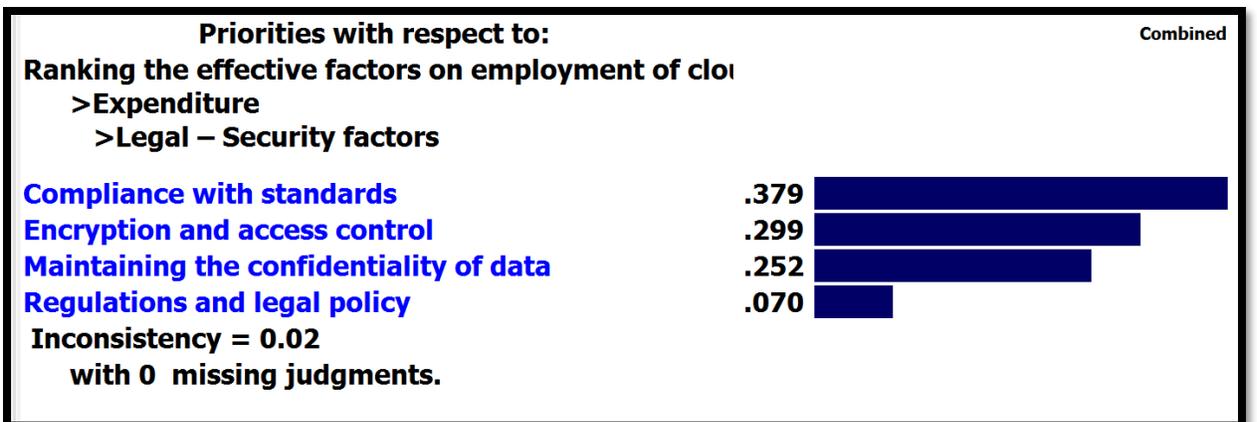
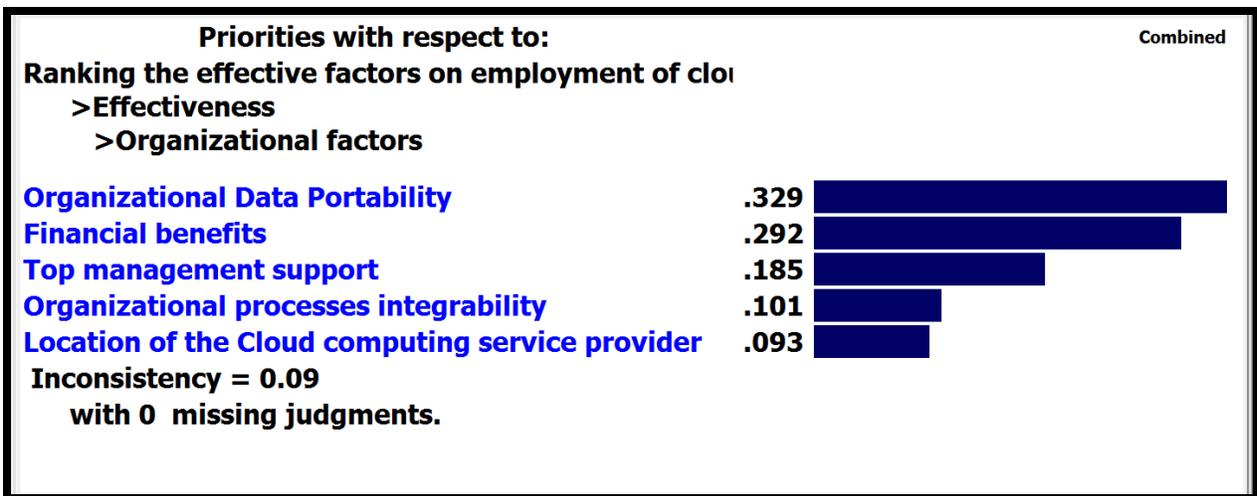
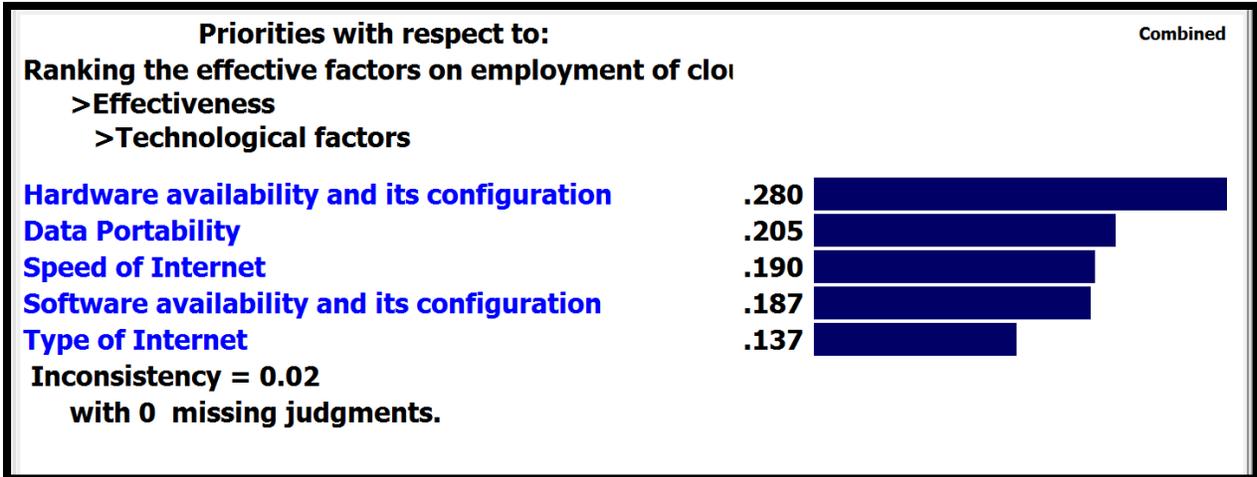


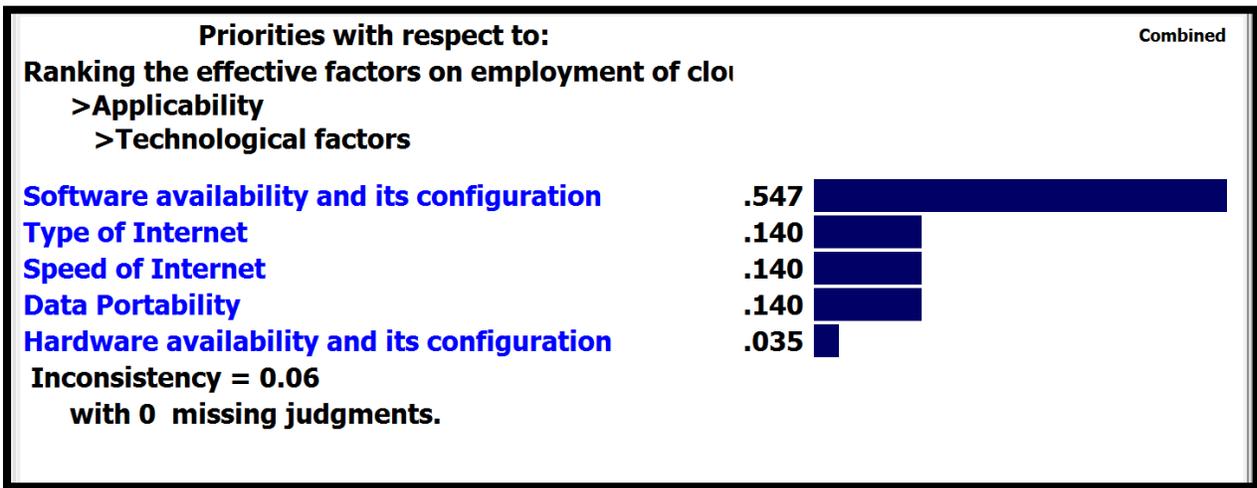
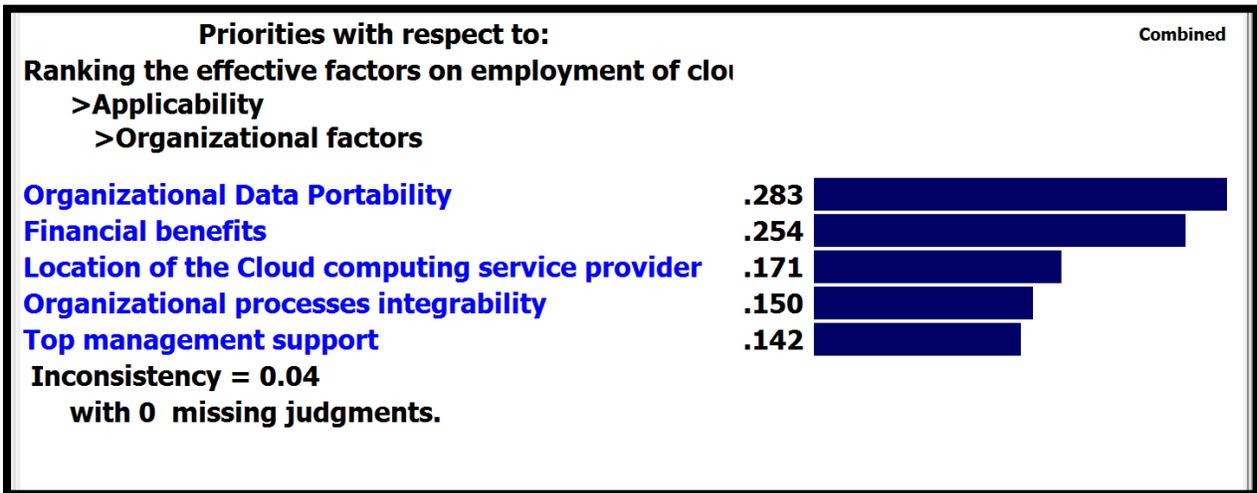
Fig. 3 Priority of criteria affecting implementation on Cloud Computing Technology in medical libraries

The highest priority was related to the *expenditure* with a weigh of 0.493. The second priority was related to the *effectiveness* with the weight of 0.311. The lowest priority was related to the *applicability* with the weight of 0.196.

In order to rank the factors for each dimension, The AHP methodology was applied to factors of each dimension individually and ranking among factors with respect to each criterion were performed and calculated. Selected resulting prioritizations are given in Fig. 4.







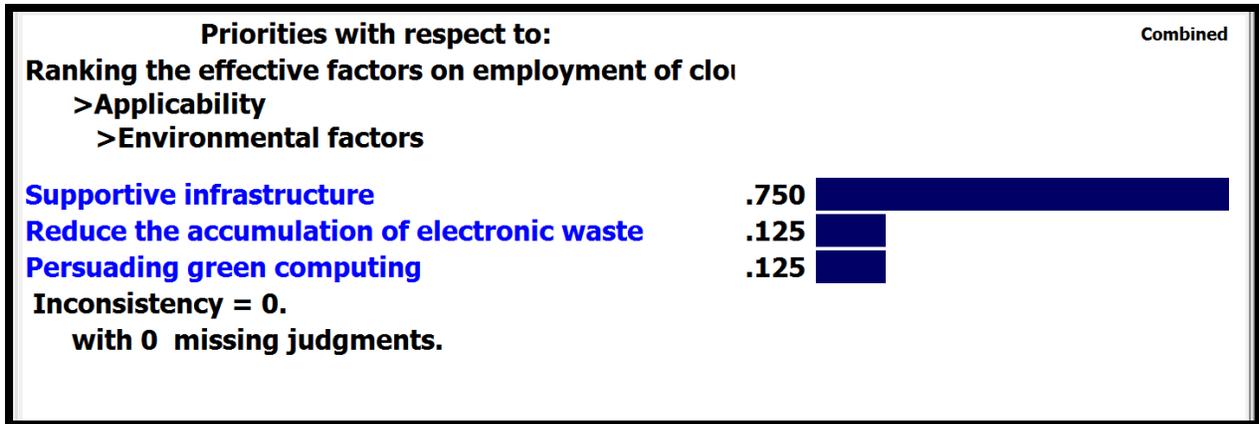
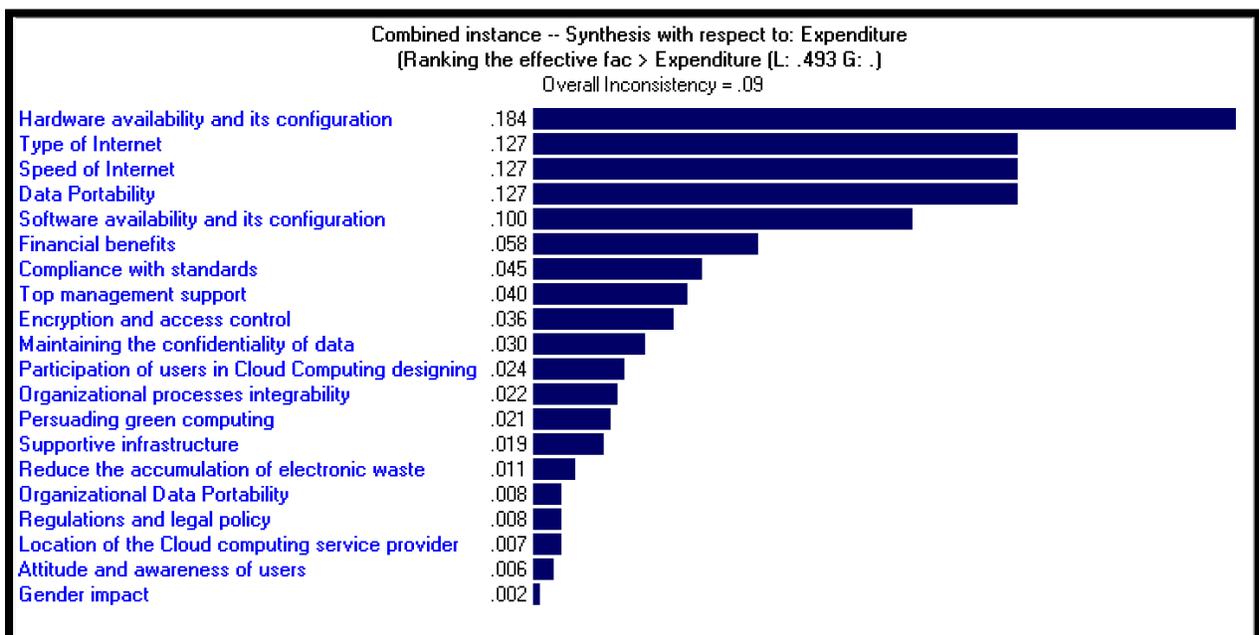


Fig. 4 Priority of factors with respect to expenditure, effectiveness and applicability of using CCT in medical libraries.

The results shows that the highest impressible factor of *technology* with respect to *expenditure* and *effectiveness* was *hardware availability* for using CCT in medical libraries with the weigh equal to 0.184 and 0.156 respectively. However, with respect to *applicability*, *software availability* ranked first among factors of *technology* (weigh=0.211). The outcome of the study showed that *gender* factor of *culture* dimension was the least important factor affecting the implementation of CCT in medical libraries regarding all three criteria (weigh=0.002, 0.002 and 0.003 respectively). Figure 5 shows the ranking of factors altogether with respect every criterion.



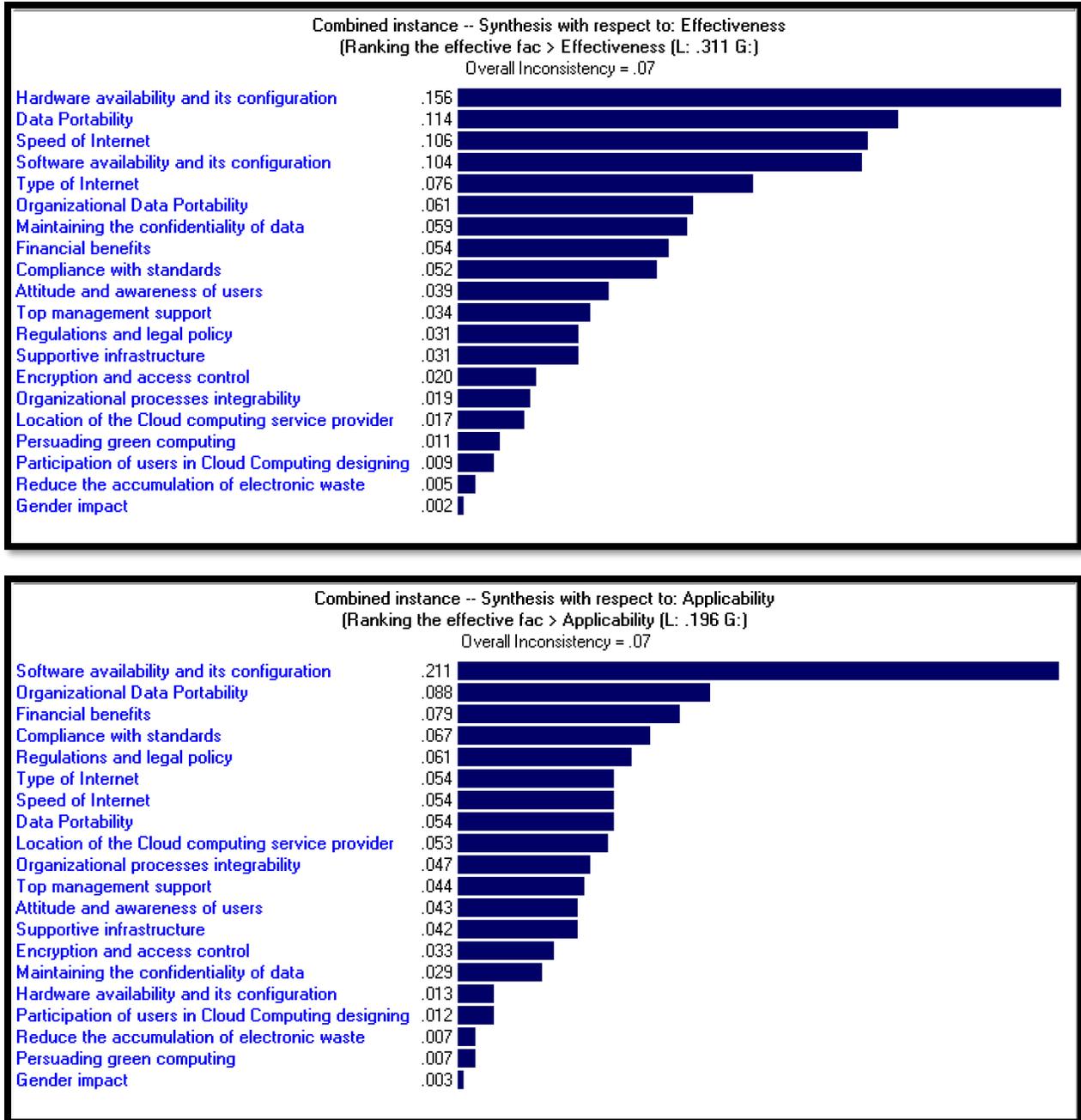


Fig. 5 Ranking of all factors with respect to each criterion namely Expenditure, Effectiveness, and Applicability.

DISCUSSION AND CONCLUSION

Many studies attempt to understand different factors that are expected to influence the decision to adopt cloud computing technology (CCT). However, most of studies performed in the literature of Cloud Computing adoption, surveyed the effective factors of adoption of CCT in industry and organizations such as hospital.

The present study was a mix method qualitative/quantitative cross-sectional study conducted on 2017. Identifying and ranking the effective factors in implementation of CCT in medical libraries using factor analysis and Analytical Hierarchy Process (AHP), was the main purpose of this study and was employed in several steps.

This study acknowledged a list of potential factors involving in adaption of CCT based on several literature reviews and experts 'interviews. The primary list (80 items) composed of factors that represent different aspects of adaptations of Cloud Computing. Nevertheless, some factors demonstrated the "advantages" of adaption of CCT and some factors designated the "requirements" for adaption of CCT. Although, in related literatures where all the factors were drawn, they were listed as "factors influencing the adaption of Cloud Computing Technology".

Since the objective of this research was to identify the minimum requirements for deploying the CCT in Medical Science University' Libraries, the original list were carefully reviewed, assessed, and revised in multiple stages by experts participating in the study and as a result, the original list of eighty items of potential factors reduced by twenty items and the eliminated items labeled as "advantageous factors" of CCT. The list of these items is shown in Table 8 and they were put aside from further investigation. Other fifty-five factors in this study are referred to as "requirement" in adaption of CCT (Table 9). Therefore, care must be taken when one would interpret the word *adaption* of CCT to differentiate between implementation of CCT which means the technology has not been installed yet in contrast to benefits of using already installed CCT.

Table 8 Identified variables "Advantages of using Cloud Computing Technology"			
No	Advantages	No	Advantages
1	Removes Maintenance Costs	14	Access to the desired information
2	Increase security	15	Reduce organizational costs
3	Extensibility	16	Compatibility with various applications
4	Permanent availability	17	Reduce human interactions
5	Increase system performance	18	No need for specialized technical knowledge
6	Easy accessibility	19	Cost-benefit

7	Time Saving	20	Flexibility and variability
8	Interactive systems	21	Convenient information exchange
9	Environment lover	22	Information Sharing
10	Increase cross-sectoral collaboration without increasing costs	23	Information leakage Reduction (deliberately or unintentionally)
11	Fast information processing	24	Recovering information faster
12	Information Integration	25	Speed up Information access
13	Increased Data Storage		

Table 9 Identified variables "Requirements for using Cloud Computing Technology"					
No	"requirements"	No	"requirements"	No	"requirements"
1	Hardware availability	20	Strategic Planning	39	Applications compatibility
2	Communication Equipment	21	System Integration	40	Software availability and its configuration
3	Library Management Software	22	Information Management System	41	Ability to deal with cybercrime attacks
4	Network Topology	23	Funds Allocation	42	Compliance with storage and retrieval standards
5	Type of Internet	24	Awareness of Managers	43	Compliance with security standards
6	Participation of users in the design and implementation of the system	25	Optimal balancing between supply and demand	44	Compliance with design and implementation standards
7	Enriching Information	26	Building Confidence	45	Flexibility

8	Persuading green computing	27	Encryption and access control	46	Filtering Data (which data to store and which to skip)
9	Levels of service agreements between users and Cloud Computing supporters	28	Compatibility with the level of literacy and the ability of users	47	Defining different access levels
10	Hardware Configuration	29	Supportive infrastructure	48	Encryption and privacy (data, user, ...)
11	Data Storage Availability	30	Financial status	49	Security infrastructure
12	Organizational Data Portability	31	Redesigning processes	50	User Acceptance
13	Maintenance and Confidentiality of data	32	Regulations and legal policy	51	Location of the Cloud Computing service provider
14	Gender impact in Decision Making	33	Personnel Training	52	Existence of legal provisions
15	Data Portability	34	Personnel Education	53	Legal issues
16	Data Recovery in Natural Disasters	35	Attitude of users (employees)	54	Human Factors
17	Top Management support	36	Culture of employee	55	Organizational processes integrability
18	Speed of Internet	37	Scalability		
19	Accumulation of electronic waste	38	Users' Assurance		

After extracting the fifty-five factors of CCT adaption, the researchers were interested in the most vital and possibly minimum number of factors for installing CCT in medical science university's libraries in Iran.

The outcome of the study showed that there are five influential dimensions which outline the minimum requirements necessary to implement cloud computing at Medical Science University' libraries in Iran. This research also identified the three following major criteria: expenditure, effectiveness and applicability affecting implementation of CCT. The formerly stated five dimensions' ranking is highly correlative and based heavily upon each criterion when calculating their role in implementation of CCT on Medical libraries.

For instance, when comparing *technology dimension* versus *culture* with respect to expenditure, we are comparing the cost of lunching technological services versus the cost of some cultural innovations. Alternatively, as another example, when comparing the *technology* versus the *organization* with regard to effectiveness, it means that the providing technological requirements will be more effective for implementation of Cloud Computing than facilitating organizational apprehensions.

The results of the Analytic Hierarchy Process and paired comparisons confirmed that the *technology* especially *hardware and software* were the most essential component for supporting CCT for Medical Libraries and were ranked highest with respect to all criteria. This result is consistent with other studies. Klug et al performed a study aimed to survey on factors affecting cloud-computing adoption among universities and colleges in the United States and Canada. The result indicated that there are three effective factors on cloud computing adoption including technology readiness, complexities of technology and institutional size (Klug and Bai 2015)

On the other hand, *expenditure* also ranked highest among the three criteria regarding current status and all the existing obstacles of the medical libraries in Iran. This result indicated that for University Science libraries in Iran, budget is an important issue, and cost of providing the necessary and primary equipment to implement CCT, is of the main challenge. Nevertheless, one should realize that cloud computing adaption for any organization or institute would result reduction of costs once it is equipped (Huang and Hsu 2017). CCT and services has been frequently reported in studies with cost-benefit advantages since the main expense of purchasing the servers and costly computers is no longer upon the organization, and not only that but the cost of maintenance of the equipment is also the responsibility of CCT provider. Hence, in long run, setting up CCT system would have a considerable saving. Mu-Hsing Kuo in a study with title "Opportunities and Challenges of Cloud Computing to Improve Health Care Services" concluded that the main advantage of Cloud Computing is its low cost (Kuo 2011).

Furthermore, according to the outcome of this research, technological services for implementation of CCT were the most effective factor among all other factors also. The finding suggests that not only *effectiveness* ranked second, but also *technology* was ranked highest with respect to *effectiveness criteria* and was recognized as most effective component to secure the likelihood of installing Cloud Computing in medical libraries. Ratnam et al in their study surveyed the effective factor in CCT adoption in the Malaysian healthcare sector, the results showed that the adoption of cloud computing could help to achieve cost reduction with effective service (Ratnam and Dominic 2014). Petrescu conclude that low cost and low investment, real-time accessibility, standardization and flexibility are leading to lower transaction costs and more efficient levels of market integration which are the main advantages of cloud computing (Petrescu 2012). Armbrust et al showed that the efficiency and effectiveness are significant

factors in cloud computing adoption (Armbrust et al. 2010). Other studies showed that cloud computing provides services over the Internet in a cost-effective method and with high quality. Some expected benefit of cloud computing services includes the effective provision of services, effective access to information and increase the scalability, flexibility, and cost effectiveness of infrastructure (Armbrust et al. 2010). These results are consistent with the findings of this research results. cloud computing can reduce electronic health record (EHR) startup expenses, such as hardware, software, networking, personnel, and licensing fees, and therefore will encourage its adoption. (Adegbilero-Iwari and Hamzat 2017)

By the same token, *technology* is also more applicable than others. For example, it would probably be much harder and time consuming to change some cultural factors such as *attitude and awareness* of personnel than installing and upgrading the hardware and software equipment. The *applicability* was third important criteria, and once again its impact on *technology* component of CCT was remarkable. The outcome of this study revealed that technological services are more applicable than any other factors according to experts' view thus; spending more money on this end will pay off reasonably well. Likewise, the outcome of this investigation shows that when all the factors were compared based on each criterion, almost all *technology factors* were ranked higher than others, subsequently, *organization* and its factors followed next. In conclusion, in this study, the highest priority of factors with respect to the effect of all three criteria explicitly, *expenditure*, *effectiveness* and *applicability* for installing CCT in medical libraries was related to *technology* with the weighs of 0.555, 0.450 and 0.468 respectively. Technological services for Medical Science university's libraries were recognized as essential key factors of CCT. Nevertheless, the factors of *technology* were also the main factors essential for CCT among all other factors regarding almost all three criteria. *Hardware availability and its configuration* were ranked highest with respect to *expenditure* and *effectiveness*, while *software availability* was ranked top regarding *applicability*. This finding is very legitimate since without hardware there would be no use of software and the cost of hardware equipment are more than software. Similarly, hardware without proper software is useless. Therefore, once we acquire the necessary hardware and its configuration, we can provide enough and compatible software to build cloud computing upon. Furthermore, since all five dimensions were ordered the same for all three criteria, the suggestion for medical science university's libraries in Iran or any comparable library with limited resources is to follow the results of this study. One last note, it is time for libraries think seriously for libraries services with cloud-based technologies. It is recommended that the cloud computing adoption in libraries will provide reliable and rapid services with cost reducing.

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