

# Selection of suitable bank based on quality of providing systems for internet banking services using AHP and ANP methods

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## ABSTRACT

Due to rising complexity of decision-making environments, the suitable multi-criteria methods have become important to support from decision in management and decision-making has been converted into a challenge for directors and organizations in today complicated world. Thus, more particularly during two recent decades, mathematical models and computer sciences have contributed them to solve decision-making problems and created multi-criteria decision-making techniques and decision-making supporting systems. With respect to extension and high volume of activities in national banking systems we are exposed to data production and many data that led decision-making subject to become especially important. The importance and position of internet banking and growing trend of services in this field in the country during recent years has put financial and credit institutions (especially banks) on the scene for serious competition in line with upgrading quality of service. The present study aims at ranking and order preference of banks based on effective parameters and factors on enhancement of quality of system providers for internet banking services. By conducting study to evaluate effectiveness of criteria in this paper and by means of both multi-criteria decision-making methods of AHP and ANP, we have described a model that could contribute to make suitable decision and select the best choice among options we designated for them. In order to indicate the given mechanisms by means of decision-making supporting system, it has been suggested that % banks to be classified using AHP and ANP models. Although the final result of both techniques is the same in selection of suitable bank based on quality of internet banking services, various values are observed among ranking criteria. Hence, it is suggested to employ ANP method in which dependency among criteria is considered.

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## 1. Introduction

The proper, scientific and timely decision making may play very crucial and decisive role in failure or success of any project in today advanced and complex world. Number of criteria, data complexity and environmental dynamism are some factors that have turned decision-making problem into a challenge in recent decades. Therefore, employing decision-making techniques and methods, especially multi-criteria decision-making methods (that are based on mathematical model and assumed as expertise skills for managers and in industrial engineering) have become prevalent in industrial, production, environmental, hygienic and servicing issues etc. (Meesala and Paul, 2016) It is noteworthy that firstly quantity of criteria is directly related to rate of decision complexity; more simply, as number of decision-making criteria is more (namely, human's mind has to address several parameters at the same time to find the best decision), the decision-making problem will be more complex. Secondly, making a decision requires for acceptance of related consequences. If negative, financial, economic, marketing and social and other consequences of a decision are more, then decision-making problem is assumed more important. Any organization inevitably needs to quality assessment system of performance to become aware of utility and fineness of their activities, especially in complex and dynamic environments. Also similar to other organizations in Iran, banks need to constant evaluation of quality of services in their branches to present more diverse, faster and more modern services and having potential for competition and survival in extensive communication wave and development of special banking services (AL-HAWARY and AL-SMERAN, 2016). During recent decades, banking has been exposed to several changes and developments in the field of deregulation and modern technologies of services and determination of objective by the banks, often Public Banks, may lead this system toward competitive trend. Following to increase ground for competition in Iranian banking system, the banks should always survey their performance and measure their performance using appropriate models every year. In this regard, banks may guarantee

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their success in competition with other rivals to a great extent with respect to their own competitive advantages and improving those (Khoshlahn & Sattari, 2016) and (Agha Kasiri et al. 2017).

Following to fast growth in Information and Communication Technology (ICT), E-banking will play pivotal and significant role in the field of E-payment that prepares the ground for online transaction to support from many applications of E-commerce including E-purchase, E-bid, stock purchase and sale via internet and many other cases (AL-HAWARY and AL-SMERAN, 2016). The undeniable advantages of IT in rising accuracy and speed for doing tasks, improving world quality, reducing costs and more admiration by customer have caused organizations to tend rapidly to accelerated utilization from information systems (Mozaffari, 2016). With respect to wide changes in world markets and growing serious competition, experiencing interaction with customer at world level and online is assumed as a distinctive strategy. In fact, E-banking is a path toward reducing costs and staying at competition compared to traditional banking (Othman et al. 2013). Using technology to give services to the customer is deemed important to access the basic survival goals for organizations (Wilson, 2004) and (Mahmood, 2013). With respect to aforesaid issues, in order to play their stronger role in the field of financial and economic activities, banks need to improve their competitive position and stand compared to other banks. Today, a major part of community members has to employ these systems to perform most of their ordinary and daily activities. The way of quality of these systems may play major role in their admiration and attraction of new customers and retention of previous customers. Although there are some disputes over concept of E-services regarding marketing services among researchers (Al-Hawari et al. 2012). Of course, those organizations which achieve higher level of quality of services will obtain higher levels of admiration in customers as an introduction to achieve sustainable competitive advantage (Guo et al. 2008). Thus, whereas personnel (particularly personnel in IT sectors stationed in banks) are directly interacted and related to the customers and look for their attitudes, comments, proposals and critiques constantly, they are surely more aware of customers' viewpoints and requirements as the knowledgeable and expert employees. It seems that ranking of factors relating to quality of given services for operational planning is assumed as obvious necessity to enhance quality of these systems. Given this issue, the present study aims to examine the most major and influential factors in selection of banks in terms of attitude, admiration and retention of customers of banks and related institutes based on viewpoint of experts in this field namely IT experts stationed in the branches in addition to review of literature and background of topics related to internet banking so that by aggregation of classified data and comments they are utilized in relevant plans. Accordingly, the present strategies based on research results can serve as very effective tool in improving competitive position in the field of internet banking activity and selection of suitable bank. In selection of options of course we can replace actual choices e.g. the existing banks in Iran to achieve more real decision making.

## 2. Research literature

### 2.1. *Quality of Service (QoS) and E-services*

Tendency to quality of service may play essential role in servicing industries e.g. insurance and banking services etc. because quality of service is assumed as vital for organizational survival and profitability. Regarding banking services, quality of service is defined as customer's idea or notion about rate of preference of a service given in bank environment (AL-HAWARY and AL-SMERAN, 2016). Category of 'Quality of Service' was also noticed as main characteristic of competition between organizations so that paying attention to quality of service has made organization distinct from the rivals and caused acquiring competitive advantage. Concept of E-service is not simply composed of terms 'services' and 'electronic (E)'. In fact, E-services convey specific conceptual load that includes interaction among service-provider and customer thereby these services are presented via internet.

Quality of service is expressed in two dimensions including technical and functional qualities. Technical quality refers to rate of main organizational services in accordance with customers' expectations while functional quality represents perceived process of service-giving (Lien et al. 2017). Rust and Lemon have considered E-services as information services that are exchanged between two groups (buyer and seller) and internet is a network that enables execution of this exchange.

Exchange of information services in internet environment may fulfill customer's requests and needs in the same path and higher customized information from other paths (Rust and Lemon, 2001). Basically, internet is utilized to compensate for need to information and data access potential is one of key advantages for internet purchase versus traditional purchase canals (Lim et al. 2006). The practical E-services are soothing more than order for execution and response to request, email and demand modes. It can be implied generally E-services are said to the services proposed on internet platform and they aim to present services quickly and to perform rapidly all activities with no need to physical presence in site. Whereas information is the exchanged value between two sides thus some theories refer to E-services as informational services. Moreover, some experts have noted this point that E-services is not a face-to-face relation because this is an interaction of customer-to-organization type not customer-to-person. In other words, unlike traditional mode, E-services do not depend on certain place, time and hours and therefore it is presented easily.

Rowley assumes E-services including all media and all types of interactions. E-services are transformed by practices, efforts or functions including indirectly and by IT the web of data exhibitions and mobile equipment. Likewise, E-sale, customer's support and services and delivery of public services are included in E-services (Rowley, 2006). Similarly, it is important to imply this point that quality of E-services may noticeably affect admiration in customers so that their admiration may lead to improvement and enhancement of organizational performance (Namin, 2017).

### 2.2. *E-banking*

E-banking comprises of providing some facilities for the personnel to increase their performance speed and efficiency to give banking services and also inter-branch and interbank processes throughout the world and to present advanced network/ telecommunication-based hardware and software facilities to exchange financial sources and data to customers thereby they can perform their favorite banking operation via secure and reliable communication canals at any time round-the-clock (Bahrami et al. 2016). In fact, E-banking namely as optimal integration of all activities of a bank by using modern IT based on banking process compliant to organizational structure of banks may provide for presentation of needed services for customers (Davar & Mokhtaran,

2002). E-banking includes all electronic canals used by customers to access their accounts and for deferral of funds between accounts and or payment of their invoices. These canals include internet, mobile, phone, digital TV and Automatic Teller Machines (ATMs) (Dandapani, 2008). Ever-increasing attention paid by great banks in developed and developing nations to presentation of banking services via electronic canals and development of virtual banks and financial institutes have led to increase competition in banking industry so that other banks have also tended to develop various approaches toward E-banking (Mattila et al. 2003).

Lee (2009) addresses E-banking services based on three dimensions and argues customers of banks can receive E-banking services at all three levels. These three levels are as follows:

1. **Communication:** This is the most primary level for receiving E-banking services. At this level, the bank introduces the information about his/her banking services and operation by public or private networks.
2. **Interactional:** This level of E-banking services enables transactions among banking system and customer. This level of E-banking services includes more risk than traditional method and it needs to suitable tools to control access for users to banking network.
3. **Transactional:** At this level, customer can perform some activities including drawing cheque, fund deferral and opening account using a controlled secure system. This level of E-banking services includes the highest risk rate.

### 2.3. Internet banking

Internet banking is an electronic payment system that give access to their customers to financial transactions done by financial institute e.g. retailer banks, virtual banks and credit union. Advent of internet has dramatically affected E-banking. The banking has no longer any time and geographic limits by using internet. Using web and internet technology, internet banking enables customers to perform their financial activities in a virtual environment.

Internet banking differs from household banking in that there is no need to install certain application to access banking services via internet, but banking services may be available by internet public network and it related customer to his/her banking account via internet (Alsajjan and Dennis, 2010). Internet has prepared the ground thereby banks could present banking services to customers in their homes. For example, customers can receive the information relating to deposit accounts and loan, deferral between accounts and communication with other banks via email. Even the potential has been provided by internet for purchase and sale of stocks and bonds, receiving programs of facilities and wage by internet banking device. Likewise, internet banking reduces cost and improves productivity of banks and creates added-value for customers (Laukkanen et al. 2008).

## 3. Research literature

By analysis on impact of quality of E-services (reliability, effectiveness, ease of use, privacy, design and replication), Al-HAWARI and Al-SMERAN (2016) have studies admiration of customers of Islamic bank to target northern territory in Jordan and findings of this study suggest that with respect to dimensions of reliability potential this parameter has little impact on customers' admiration while according to viewpoint of customers parameter of ease of access has been evaluated at higher level (Mollahosseini et al. 2016). In an investigation titled 'recognition and ranking of important criteria of quality of E-services in internet banking', they have identified the foremost influential features in encouraging individuals for using internet banking and proposed a predicator model for success of agriculture bank in this field. After data analysis research findings suggested variables of constant improvement and profit had the highest weight and parameters of contact and replication included the lowest weight among effective variables in quality of internet banking services. Classification of WEBQUAL variables based on Kano's model in evaluation of customers' admiration for quality of internet banking services is a title of a study conducted by Shaemi et al. (2012) in Mellat bank. Findings of their study showed that the related bank was poor in terms of service-giving in some features of quality of E-services e.g. information, perceived ease, innovation. Emotional attraction and suitable relations that were assumed a required and attractive properties and the relevant directors should take appropriate strategies to fill gap of quality of service. In another survey titled 'recognition of influential key factors on quality of internet banking services' done by Cal and John looked for identifying influential key factors on quality of internet banking services by employing content analysis technique for viewpoints of customers of internet banking regarding their experiences in utilization from these services. After conducting several analyses, seven effective factors on quality of internet banking services were identified and classified in three categories.

Variables of ease of use of systems, their reliability and lack of error, attractiveness of systems, their security and information about the given services were explored and assumed as basis for design of hypotheses (Minjoon & Shaohan, 2001). Also in another investigation, Ravi et al. (2007) studied on effective factors in acceptance of internet banking in Indian banks. Way of replication, ease of receiving services, replication speed, reliability, interest and facilities, physical facilities and innovation are some factors (Mozaffari et al. 2017) they have mentioned as influential factors on quality of service in their survey. Using research bases and literature regarding acceptance and by benefitting from theories of technological acceptance model, theories of reasoned action, counted behavior and distribution of innovations in this study, researchers interpreted behavior of consumers and ranking effective factors in acceptance of internet banking by banking customers in India. Based on findings of this study, ranking of effective factors in acceptance of internet banking is respectively as follows: decision to use internet banking, customer's belief, subjective norms, trust in bank, and tendency to use, profitability (benefit), security and ease of use.

In addition to review of relevant investigations to research subject in current study, ranking and selection were considered. Rather than presentation of the mode, each of these factors will be discussed in the followings.

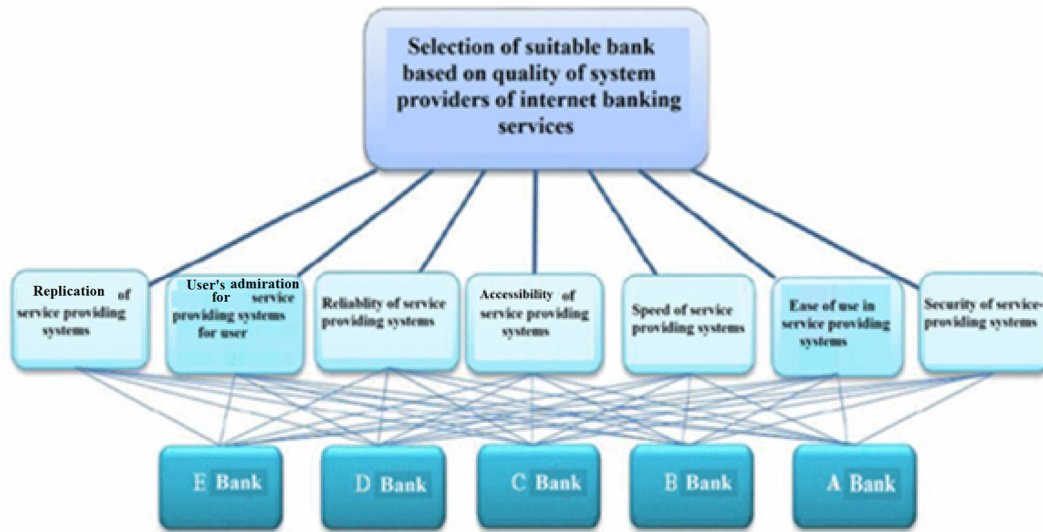


Fig 1. AHP (Analytical Hierarchy Process) structure used in this study

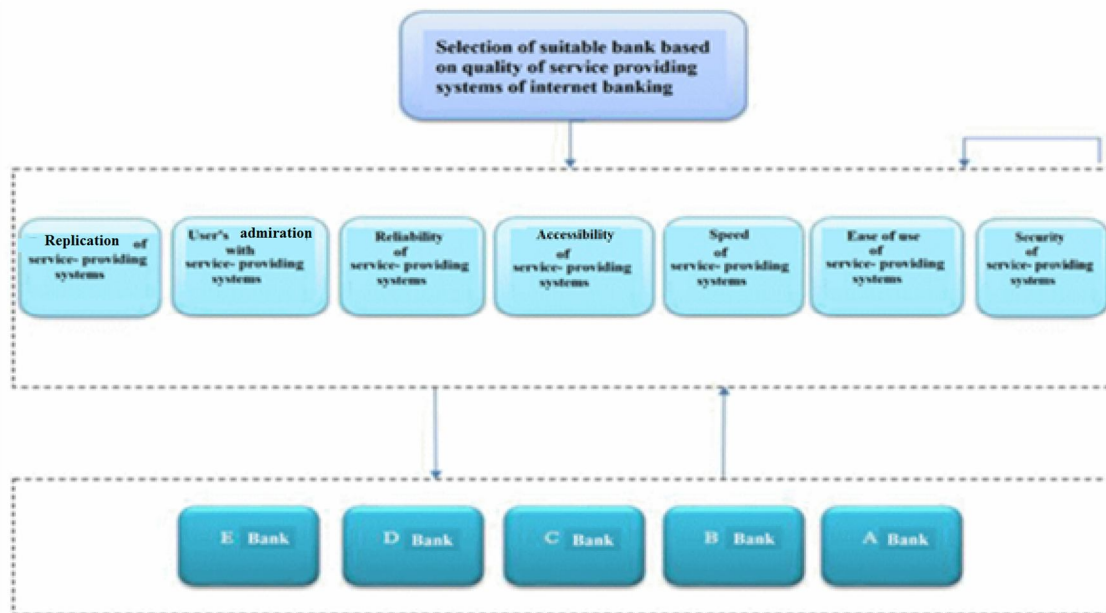


Fig 2. ANP (Analytical Network Process) structure used in this study

**Security of systems:** The security of privacy demotes protection from customers against fraud and hacking of their personal information (Chi Shing et al. 2007). Importance protection from privacy is one of the capabilities of internet services to create trust among customers.

**Ease of use of systems:** Ease of use from systems is the foremost element that encourages customers to frequent use of website and it includes web structure, resolution of orders and processes of measures.

**Speed of systems:** The suitable speed of used systems in giving services to customers during network traffic times;

**Accessibility of systems:** Systems are available for proper technical performance to meet user's need.

**Reliability of systems:** It is potential of used technical systems in giving services constantly and definitely without error as well as commitment to services and accuracy of information.

**Satisfactory service providing systems for user:** Design of systems refers to frame of features and content and aesthetic characteristics and evaluation of apparent beautiful standards.

**Replication of systems:** It denotes effective managing of issues and feedback to customers and also availability of services on time and with respect to necessary conditions for customers to reach to the quick answer.

Thus, the major question of current study is as follows:

How is ranking of effective factors on quality of internet banking service providing systems to select suitable bank?

#### 4. Methodology

The current study was carried out at three basic processes. At first step, main parameters were gathered by administration and collection of questionnaires. Namely, by review of literature of conducted studies on effective factors in quality of internet banking service providing systems and initially utilization from their findings as well as librarian studies, the effective parameters on quality and their relation have been codified and presented within a model. Then, these parameters were included in an AHP questionnaire to put it at disposal of samples and parameters were ranked by order-preference using AHP technique and modeling and computations were done using Expert Choice software. Afterward, we have studied on parameters by Analytical Network Process (ANP) method to determine rate of impact and significance of parameters with each other and used Super Decision software for modeling and computations and compared the given results from both methods with each other.

Whereas both these methods do not need to statistical population with great sample size, about 20 IT experts from banks were chosen as respondents. The present research is of applied type in terms of goal and descriptive surveying type in terms of data collection.

##### **First step: Identifying effective factors in selection of suitable bank based on ranking quality of service providing systems**

At this phase, research literature was initially reviewed and quality criteria were analyzed and then questionnaire was prepared and put at disposal of experts to express their comments.

##### **Second step: Order-preference of effective factors in selection of suitable bank based on ranking quality of internet banking service providing systems using AHP technique**

*AHP*: This evaluation technique was proposed for the first time by Thomas El Saaty (1980). This method is one of the most comprehensive MADM model. By considering all intervening criteria and comparison of their scores, AHP multi-criteria evaluation method deals with order-preference of choices and determines the favorable choice using the introduced relations. This method is based on three principles including drawing hierarchy tree, codification and determination of preferences and logical consistency of judgments. One may refer to some advantages of this method as followings: It enables formulating problem as multilevel hierarchy structure. It shows high adjustment of this technique with individuals' mind and the main problem with hierarchy structure more easily. Similarly, since this technique has been founded according to pairwise comparisons thus it enables managers to analyze various scenarios. Fig (1) indicates drawing hierarchy tree and dividing it to three parts of objective, criteria and choices. It needs to numerical comparison for pairwise comparison to determine rate of significance of a choice versus another by considering a criterion. These scales are given in the following table where according to Saaty, rate of inconsistency should be less than 0.1 for system consistency (Saaty, 2008).

**Table 1. Pairwise preference scales for comparison**

Preference	Numerical values
Equal importance	1
Little or weak importance	2
Medium importance	3
Higher than medium importance	4
Strong importance	5
Higher than strong importance	6
Very strong importance	7
Very high strong importance	8
Maximum importance	9
If activities are very close together	1.1-1.9

Using Expert Choice software, we indicate process of execution of this algorithm to order-preference of parameters using Expert Choice software by considering choices and their results within framework of the following diagrams.

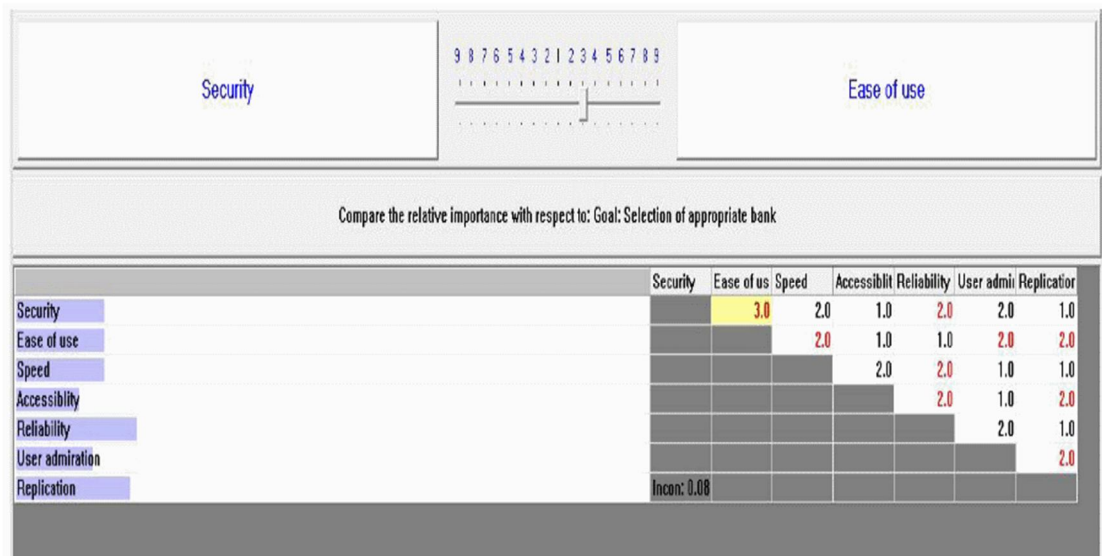


Fig 3. Analysis on rate of importance of parameters compared to the goal in Expert Choice

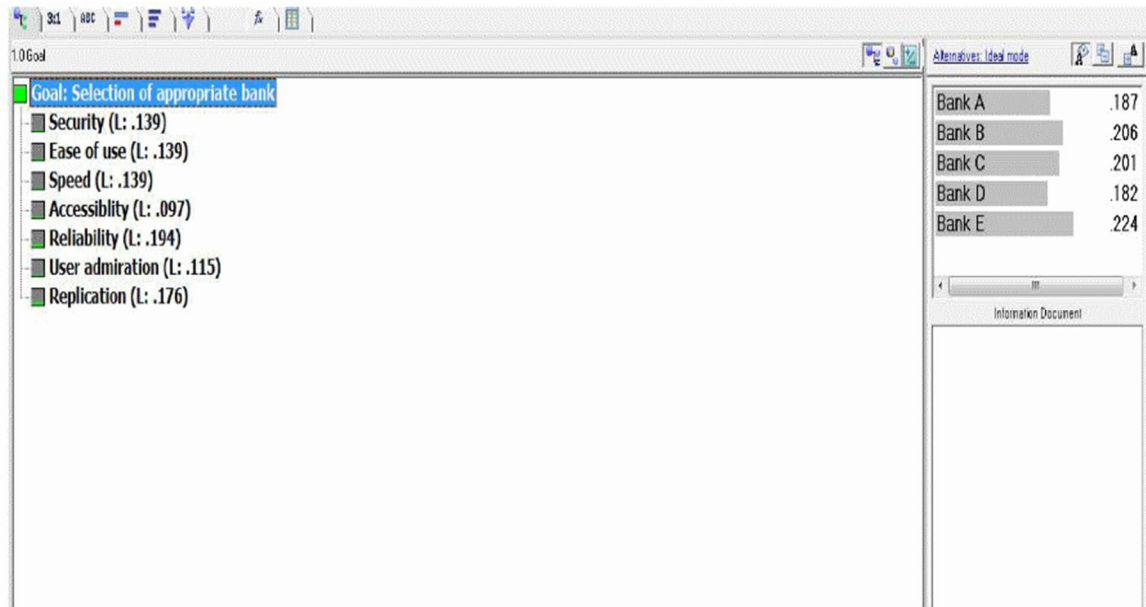


Fig 4. Ranking of choices versus parameters using pairwise comparisons at a glance in Expert Choice software

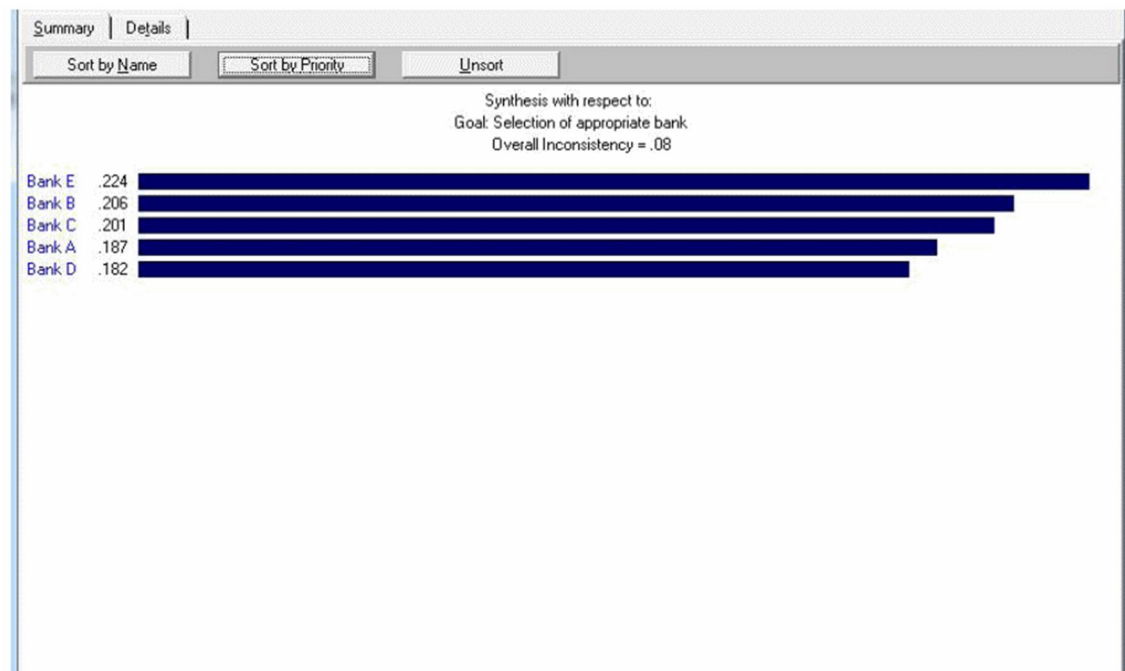


Fig 5. Order preference of all choices and their final weights versus goal in software

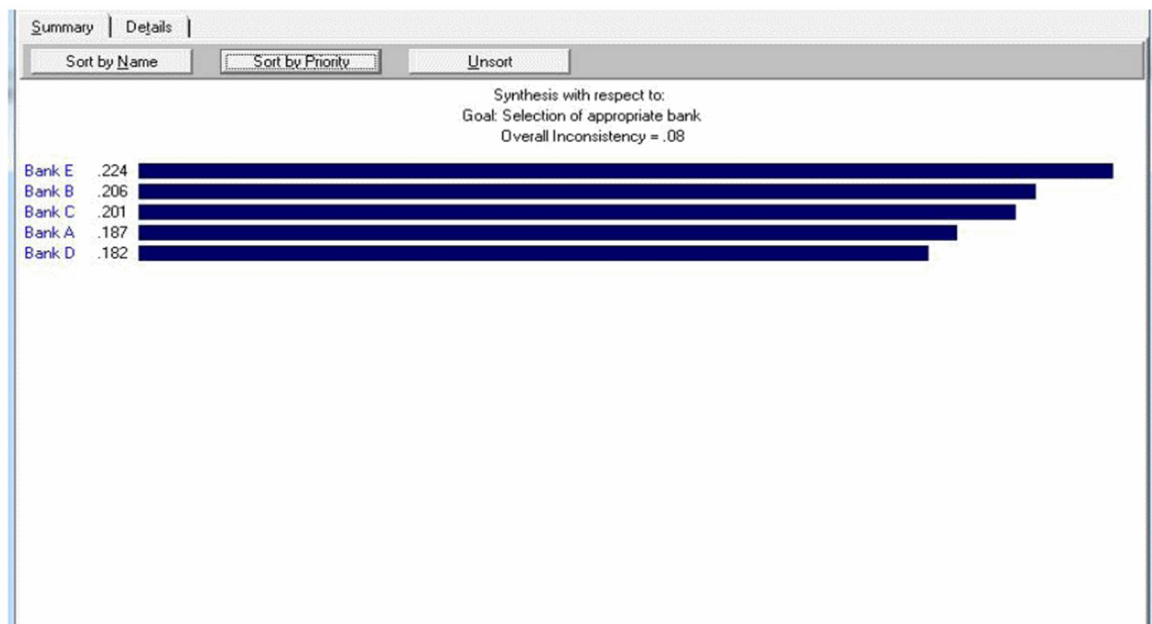


Fig 6. Normalized results for all choices versus each of parameters in software



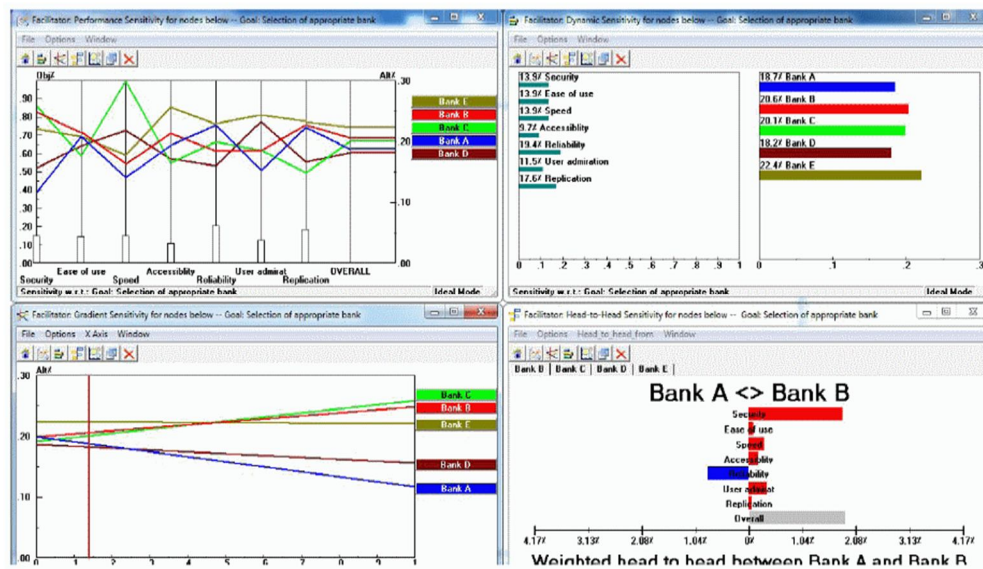


Fig 7. Survey on sensitivity analysis diagrams for choices versus goal at a glance in Expert Choice

Based on the results observed in tables at above, E-bank is the fittest bank based on experts' viewpoint and is placed at first rank and importance of criteria for selection of a suitable bank based on quality of banking services are reliability and replication respectively as main preferences and parameters of security, ease of use, and speed of these systems are placed at the next position in a single rank and parameters of user's satisfactory services and accessibility of these systems are placed at lower positions.

### Third step: Order preference of effective factors on selection of suitable bank based on ranking of quality of electronic banking service systems using ANP technique

ANP technique is developed from AHP method and it is considered as new and basic step in decision-making problems (Saaty, 1996). ANP technique resolves defects of classic methods. Unlike AHP technique, many decision-making problems are not practical by hierarchy relationship among main goal, modeling criteria and choices with this structure. In ANP techniques, a network structure is used in which criteria in lower levels can also affect criteria of higher levels and at the same levels (Yaqubi et al. 2017).

#### Phase of Analytical Network Process (ANP) method

1. **Building research network diagram:** At this step, the problem should be divided into criterion levels and sub-criterion and choice (if any) and determine relations between them.
2. **Formation of matrix of pairwise comparisons:** At this phase, the elements at any level have been compared in pairwise with other related elements at higher level and pairwise comparison matrices are formed. Likewise, at the end pairwise matrix should be also build for internal relations.
3. **Calculation of inconsistency rate:** We calculate inconsistency rate in ANP matrix at this step. If this rate is lesser than 0.1 it represents consistent matrix.
4. **Formation of initial super matrix:** Using the given weight of pairwise comparisons, we form initial super matrix.
5. **Building of weighted super matrix:** The weighted super matrix should be built after creating initial super matrix.
6. **Creation of boundary super matrix:** The weighted super matrix should be set to infinity power to converge any row of this matrix to a certain number and that number is the weight of that criterion or sub-criterion and or choice.

All phases of ANP technique are done automatically by Super Decision matrix. Here, similar to AHP technique, a numerical scale is needed for pairwise comparison to determine importance of a choice versus another by assuming a certain criterion that was given in Table (1).



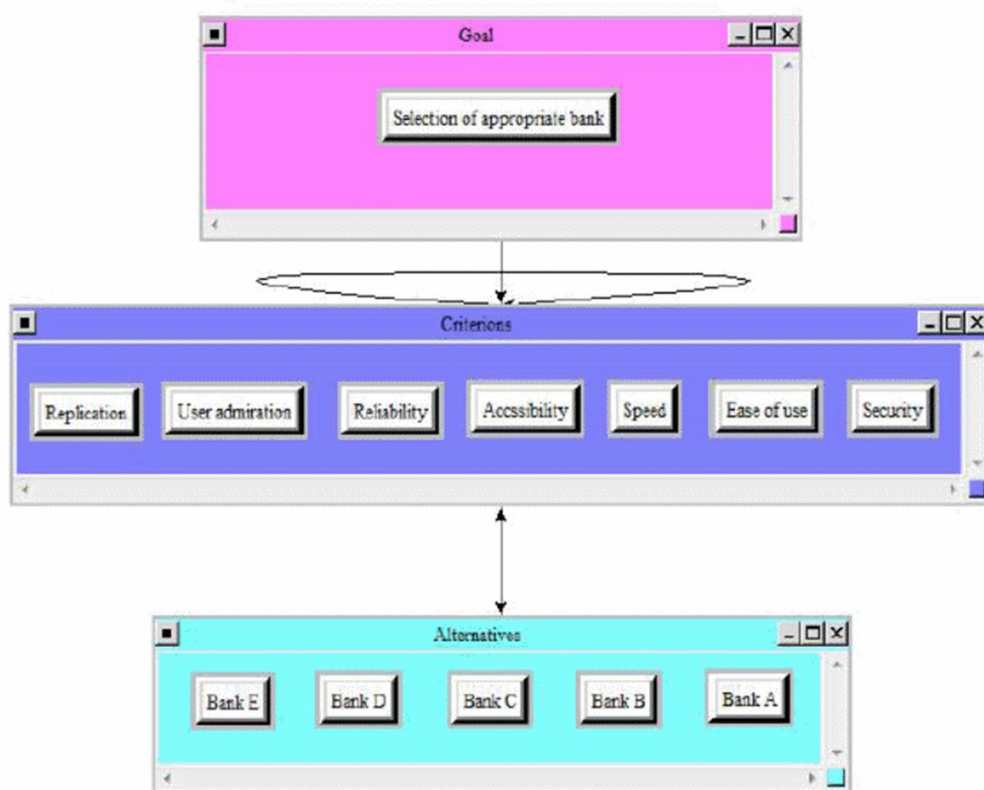


Fig 8. Clustering of goal, criteria and choices using Super Decision software

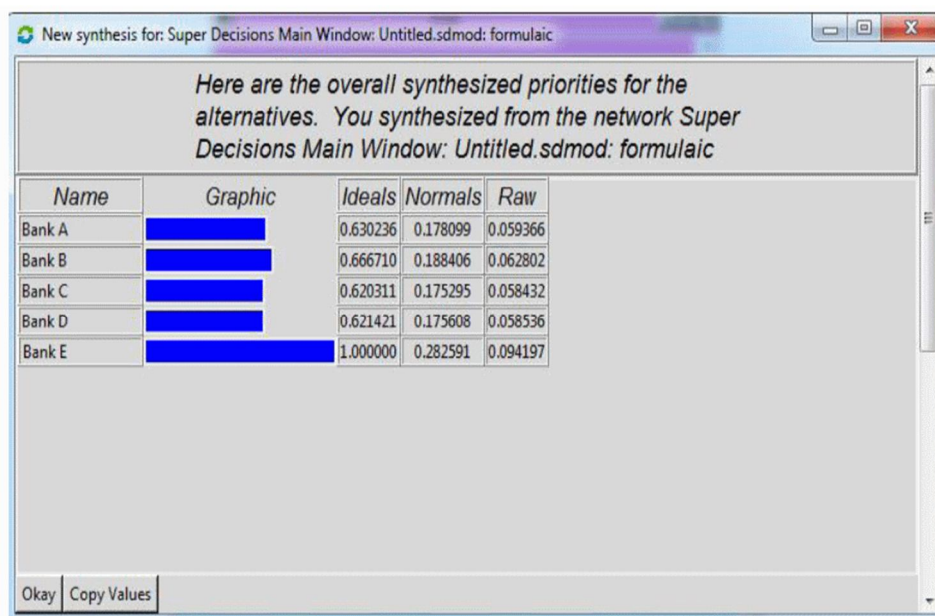


Fig 9. Selection of E-Bank as suitable bank based on quality of E-banking service giving by means of Super Decision software

Cluster Node Labels		Alternatives					Criteria		
		Bank A	Bank B	Bank C	Bank D	Bank E	Accessibility	Ease of use	Reliability
Criteria	Accessibility	0.131918	0.118266	0.125145	0.127802	0.096231	0.063851	0.059664	0.061622
	Ease of use	0.101691	0.097027	0.149418	0.151288	0.106567	0.037335	0.051270	0.046088
	Reliability	0.228229	0.237937	0.235737	0.242235	0.263998	0.130246	0.140066	0.140291
	Replication	0.089109	0.110260	0.094037	0.110978	0.090737	0.055878	0.040915	0.043694
	Security	0.240644	0.253325	0.205821	0.203419	0.280249	0.128135	0.131840	0.107134
	Speed	0.107008	0.105279	0.107318	0.077666	0.087041	0.048703	0.042768	0.059135
	User admiration	0.101402	0.077906	0.082524	0.086612	0.075176	0.035852	0.033478	0.042037
Goal	Selection of appropriate bank	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000

Fig 10. Matrix for analysis of rate of impact of criteria on each other and their ranking by means of software

## 5. Conclusion and suggested works for future

The world transformations caused by IT, internet and thus E-government and E-commerce, which are, in turn, derived from IT, have created deep and dramatic change in communications and data transfer process. The subject of interaction is deemed highly importance in ICT technology because of saving in time and cost and rising significance of data-sharing (Mollahosseini et al. 2016). In the past decade, IT had dramatic impacts on banking industry. This has enabled the banks to present services to customers by their branches, but following to advent of modern technologies, nature of giving financial services to customers has been transformed. Statistics represent ever-increasing and remarkable growth of E-banking in the world and pervasive spread of this technology caused developing infrastructures and broad-based growth of related technologies and codification of standards at international levels. Based on researching report presented by Data Minor Institute (Banking data analysis center in Europe), the number of users of E-banking systems in eight countries (France, Germany, Netherland, Spain, Sweden, Switzerland and UK) has been increased from 4. million in 1999 to about 22 million peoples in 2004. More than 75% of active enterprises in developed nations use at least one of E-banking services since 2005.

With respect to aforesaid issues, banks need to play stronger role in the field of financial and economic activities to improve their competitive position and stance compared to other banks. Accordingly, it was tried in the present paper to examine, analyze and prioritize the foremost effective factors on quality of internet banking service providing systems which are involved in branches of banks by taking attitude polling from knowledgeable experts namely IT experts in banks.

This study aims at weighting and ranking effective factors on quality of internet E-banking services in branches of various banks. The results of this study showed that these factors were not important at the same level and they should be ranked versus each other. The research findings suggested that the final result has selected first position for E-bank by choosing the best bank among A, B, C, D and E- banks in both Analytical Hierarchy Process (AHP) and Analytical Network Process (ANP) techniques, but at the same time, there was significant difference among two methods between results of ranking criteria. It is recommended that whereas ANP technique also considers internal relations between criteria and their relative importance thus it can be said that criteria of security, ease of use, speed, accessibility, reliability, user's admiration and replication have devoted the first to seventh positions in ranking quality of electronic service providing systems respectively.

Based on findings of the study, the following strategies are recommended for development as well as enhancement of quality of internet banking services in the banks:

- Providing suitable infrastructures to distribute services via virtual networks (internet and mobile), 7/24 branches, active presence in social networks and suitable applications etc. with the minimum need to training customers (even those customers who are less-literate.)
- Training, culture-building, giving information to customers and performing efficient processes in using E-banking services and products e.g. confidence-building, potential for testing products etc. may be some important factors to present services with higher quality.
- User's admiration for service working processes and easy, short and reliable services and E-banking products are very effective.
- E-banking marketing sector can prepare the needed platforms for qualitative enhancement and related balanced development in bank in addition to integrated management of these services and products.
- IT sector, which the basic cornerstone in E-banking, can be isolated from non-professional activities to reveal importance of using E-banking versus traditional technique more than ever.

In this way, one could expected for satisfied and loyal customers, updated, high-quality and value-driven, profitable, economic, digital and competitive healthy and sound products and services.

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