

## Evaluating the quality of internet services of electronic banking using the Servqual model and fuzzy logic

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### **ABSTRACT**

*Internet banking allows the customer to have more extensive and diverse services. Recognizing the dimensions of service quality and the importance of each of these dimensions to the customer and analyzing their expectations and perceptions with regard to each of these dimensions is crucial for providing high-quality service and customer satisfaction. In this study, a questionnaire was used to collect information from different groups and a multi-criteria decision support system was used to prioritize the criteria. It assesses the criteria and provides a ranking of quality criteria in Internet banking. In this study, 7 files including surveys of 7 groups on 37 criteria were collected. The simulation was performed using R language. It is a programming language and statistical computing and data analysis environment. The groups that based on their opinions, the criteria were prioritized in this study included electronic banking customers, bank employees, banking managers, and professors and experts in the electronic banking area. The results revealed that by combining the opinions of different groups, the highest priority was given to protecting the privacy and personal information, good financial content of products, and the ability to change by the customer criteria, respectively. Also, lower priority was given to fast access to Internet banking, providing diverse financial services and attitude and the ability to solve problems, respectively.*

*Keywords: Internet Banking, Service Quality, SERVQUAL Model, Fuzzy Logic*

### **Introduction**

With the rapid growth of e-commerce, internet banking is providing efficient channels for providing new financial services. This method is recommended for every bank [1]. Electronic banking is considered one of the solutions for the e-commerce boom, so that providing financial and banking services through the Internet and electronic network has been increasingly expanded in recent years [2]. Electronic banking is an inseparable part of e-commerce and plays a key role in its implementation. On the other hand, many experts believe that the concept of quality of service is ambiguous, complex, and unexplainable in electronic banking, because the quality of goods can be measured by objective criteria such as the durability or the number of defects in the goods, but the quality of the services is an abstract and ambiguous concept [3].

However, improving the quality of services is crucial, because they are effective in cutting the costs, enhancing customer satisfaction, retaining customers, increasing profitability, and increasing word-of-mouth advertising. Service quality has become a key marketing tool in achieving competitive differentiation and promoting customers' loyalty [5]. It is important for organizations to surpass other competitors to meet the needs and demands of their customers and dominate the competitive market. Under the intensified competition and to generate more customers, trading continues on the electronic banking website. Not only the operational functions must be fully implemented, but also the high-quality electronic services must be provided in this regard. Assessing the quality of electronic services of Internet banking using the SERVQUAL model and prioritizing electronic banks through the fuzzy logic technique can be useful in this regard [6]. Some studies have been conducted in this area. Liao et al (2015) followed the fuzzy hierarchy and developed a genetic algorithm-based approach to identify the important criteria for assessing the service quality [7]. Sun et al (2015) found that banking has made significant progress around the world and they raised the question of why Internet banking has been used in various countries at different levels [8].

Wong et al. (2015) empirically examined important issues with regard to the active Internet in electronic banking systems to systematically measure the factors affecting customer interactions with electronic banking services [1]. Tuney et al (2015) assessed the electronic services of internet banking by using the Fuzzy Multiple-Criterion Decision Making technique. The results obtained from their study indicated that the criteria were respectively ranked in this way: tangibility, productivity, responsiveness, continuous improvement, system availability, reliability, reputation, and protecting privacy [9]. Zeithaml et al (2015) and Parasuraman et al (2016) conducted a study on the quality of Internet services in traditional distribution channels and developed a tool called E-S-QUAL based on seven dimensions provided by Zeithaml. In this regard, many organizations are trying to obtain new techniques and tools for identifying and prioritizing quality criteria. Banks, as one of the service provider organizations, are not an exception in this regard. Quality plays a major role in banking and customers' satisfaction and meeting their needs is one of the main goals in this area [10]. In this study, using the SERVQUAL quality measurement model, we aim to develop and expand the quality requirements of customers so that we can present a combined method for solving decision-making problems in multiple criteria using fuzzy logic, and finally, comparing this method with other methods.

## **Theoretical foundations of research**

### **Electronic banking**

Electronic banking can be defined as providing the conditions for customers to access banking services through safe intermediaries without physical presence. Expanded access to worldwide networks has created revolutions in communications, which can result in savings in time and money and access to multiple channels for banking operations. If we look at electronic banking in Iran from macro and micro perspectives, we realize that electronic banking has not been implemented at the macro level, and it has been implemented incompletely at the micro-level. Lack of complete implementation of electronic banking in the country is due to a range of problems, such as lack of necessary telecommunication structures, lack of software and hardware needed for a comprehensive e-payment system, and most importantly, problems in the banking system of the country [11]. Moving towards electronic banking requires infrastructure and integrated software and hardware. Banks are also looking for developing a comprehensive and integrated automation system and they have achieved good progresses in this regard [12]. Nowadays, electronic banking is a necessity rather than an advantage and due to market needs and rapid environmental changes, banks and their customers want to access different electronic approaches [13]. The advantages of electronic banking can be addressed from two aspects of customers and financial institutions. From the customers' point of view, its advantages are savings in costs and time and access to multiple channels for banking operations. From another point of view, the advantages of electronic banking include using account balances at any time and place, savings in time, reducing referrals to the bank, reducing unnecessary travel, reducing air pollution, and reducing energy consumption and helping increase social security. As a result, as electronic banking technology requires fewer employees and physical branches, banks can provide the

best services at low cost, so recognizing customers' needs will be helpful in developing electronic banking. Also, the factors effective in electronic banking should be recognized to keep pace with other countries in this regard [14].

### **Quality of services**

Services include those economic activities that create value for customers at a certain time and place and thus transfer a favorable and positive interpretation to the recipient of services. Services cannot be stored and there is no inventory of assets. Time plays a key role in service delivery and service delivery systems can include both electronic and physical channels [15]. Linden et al viewed quality as a combination of customer perception of the two dimensions of "process" quality and "outcome" quality. These observations were similar to the conceptualization of Gronroos, who focused on two key dimensions of service quality, namely the technical quality of what customers perceive and operational quality of how a service is provided. However, the operational quality of service is not emphasized in its model [16]. The quality of service in the marketing literature is a general assessment by customers. Generally, understanding the quality of services is the result of comparing customers' expectations of services and their perception of service experience [17]. Parasuraman et al believe that customers assess service quality based on components such as reliability, responsiveness, competence, accessibility, goodwill, and tangibility [18]. Ghasem et al examined the relationship between dimensions of electronic services, customer satisfaction, and trust. Results showed that the quality of service has a direct impact on customer satisfaction. They also showed that customer satisfaction has a positive impact on electronic trust [19].

Mister believes that customers judge the quality of service by comparing their perceptions of what they received and what they expected to receive. The nature of many services is such that the customer is present in its delivery process, so the perception of service is affected not only by the "output of a service" but also by the "service delivery process" [20]. Quality of service refers to the difference between the customer's expectations of what the company should deliver (i.e., expectations) and the performance of the service received. Giffen defines service quality as customers' mental comparison of the quality of service they want to receive what they really receive. Quality of a service is considered an organizational asset and it is considered as an important factor in the financial performance and marketing of a company [21, 22]. Most researchers introduced three channels of the Internet, ATMs, and telephones as new channels for the banking industry. Studies show that customer acceptance of new channels, including internet banking, ATMs, and telephone bank has made major changes in the banks so that customers' participation with the bank is possible through various ways and different channels. Hence, researchers require new methods for assessing the quality of all electronic banking services [23].

### **Quality of electronic service and its measurement**

Quality of electronic service can be defined as the evaluation and general judgment of the customer on the advantage and quality of transfer of electronic services in the virtual market [24]. Various studies have been carried out on the dimensions and development of electronic service quality scales. Studies conducted in this area are basically classified into two categories based on their focus: quality of electronic retailing website services and the quality of website design [25]. Zeithaml et al [26, 27] define the quality of electronic services as the extent to which a web site can facilitate the purchasing and delivering effectively. Wolfenbarger & Gilly [28] in 2002 focused on electronic and offline groups consisting of 64 users and one electronic group consisting of 1013 members of the comQ scale panel and introduced 4 dimensions of website design, reliability, privacy / security, and customer service. Coxel and Dill [6] developed six dimensions in the quality of electronic retailing services and compared them with traditional dimensions of service quality. They showed that the traditional dimensions of service quality (such as competence, friendship, convenience, order, and courtesy) were not related to electronic sales. Madu [15] proposed 15 dimensions of electronic service quality. Yaug and Jun [31] identified two groups of perceived service quality dimensions in Internet purchasers and non-electronic customers and separated them, using a survey of internet service provider (ISP) subscribers in the southwestern United States. Yoo & Donthu [32] also conducted a study on a sample of university students and presented the SERVQUAL scale, which is a tool to assess the perceived quality of an online shopping site. It includes four dimensions of easiness, beauty

design, processing speed, and security. In the research conducted by Minjun and Shaohan, 38 factors were identified as the most important factors in internet banking. These factors are divided into 17 dimensions that ten dimensions are used for assessing customer service quality, six dimensions are used for assessing electronic system quality, and one dimension is used to assess the quality of banking products. Table 1 presents the variables to assess the factors increasing the quality of electronic banking services based on the *E-S-QUAL* and *E-SERVQUAL* models with some degree of adjustment and localization. Also, factors to assess the quality of electronic banking services with some degrees of adjustment and localization are presented in Table 2.

**Table 1: Seven Components [34]**

Researchers	Model	Dimensions of quality	Description of quality dimensions
Parasuraman, Zeithaml and Malohorta	Main dimensions of E-S-QUAL and E-SERVQUAL	Efficiency	Speed and ease of use of services
		Implementation	Providing all possible services and products
		Accessibility	Proper functioning, all time and in all places
		Confidentiality	Level of system security and customer information protection
	Dimensions of improving E-SERVQUAL	Responsiveness	Effectively solving of problems and demands through the system
		Compensation for services	Compensation of problems created for customers
		Communication	Helping customers through mobile or electronic operators

**Table 2: Eight components [34]**

Researchers	Model	Quality dimensions	Description of quality dimensions
Parasuraman, Zeithaml and Malohorta	Main dimensions of ES-QUAL	Efficiency	Speed and ease of use of services
		Implementation	Providing all possible services and products
		Accessibility	Proper functioning, all time and in all places
		Confidentiality	level of system security and customer information protection
		Design beauty	Appearance beauty and attractiveness of site
	Dimensions of improving E-SERVQUAL	responsiveness	Effectively solving of problems and demands through the system
		Compensation for services	Compensation of problems created for customers
		Communication	Helping customers through mobile or electronic operators

**Methodology**

First, the criteria that are important in assessing the quality of electronic banking are presented and described in *SERVQUAL*. Then, the people who can comment on different criteria are classified and the way of receiving and recording their opinions is studied. Finally, an algorithm based on Fuzzy *VIKOR* is presented for prioritizing and ranking the electronic services quality indicators. Parasuraman et al [35] developed electronic service assessment criteria. These criteria are described in Table (3).

**Table 3: Assessment the quality of electronic banking services [35]**

Criterion	Description
Productivity	Ease of use and speed of access to the website
System accessibility	Correct technical performance of the site
Responsiveness	Effectively resolving of problems affecting customers
Compensation	Compensation of losses imposed on customers for suspicious transactions
Contact	Availability of different communication channels for response to customer
Tangibility	The site should have regular pages to provide complete customer information.

Privacy	Protecting privacy and customer information
Trust building	Promising service and accuracy of information
Credibility	The credit of the physical bank related to it should be known and its reputation should be good
Continuous improvement of the current status	Services should be constantly updated
Customization	Providing customized service (meeting the specific needs of some customers)
Advantages	Attracting customers to visit the site through accessible channels (e.g., email)

However, each of the above-mentioned criteria has different aspects and characteristics as shown in Table 4.

**Table 4: Characteristics of electronic banking services**

Aspect	Characteristics
Productivity $C_1$	Fast access to internet banking $C_{1,1}$
	Easy access to pages $C_{1,2}$
	Fast loading of pages $C_{1,3}$
	Easy access of the customer to his or her needs $C_{1,4}$
	Simple software services method $C_{1,5}$
	Ease of use $C_{1,6}$
	fast completion of transactions $C_{1,7}$
System accessibility $C_2$	System stability $C_{2,1}$
	Pages should not be blocked during the transaction $C_{2,2}$
	Internet banking should be always accessible $C_{2,3}$
Responsiveness $C_3$	Fast informing when the transaction is done $C_{3,1}$
	Fast solving of customer problems $C_{3,2}$
	Courtesy $C_{3,3}$
	Emphasis on services to complete transactions $C_{3,4}$
	Providing immediate information and guidance on incomplete transactions $C_{3,5}$
	Fast repair of website failures $C_{3,6}$
Loss compensation $C_4$	
Contact $C_5$	
Tangibility $C_6$	Getting available information from each item $C_{6,1}$
	Clear and comprehensible information $C_{6,2}$
	Providing complete information $C_{6,3}$
	Updating news and information $C_{6,4}$
	Attractive visual and audio virtualization $C_{6,5}$
	Characteristic of complete search of information $C_{6,6}$
	Providing formulas used in financial services (e.g. credit transfer) $C_{6,7}$

	Providing a variety of financial services (e.g. insurance, loans, etc.) $c_{6,8}$
Privacy $c_7$	Secure and safe transactions $c_{7,1}$
	Protecting the privacy and personal information $c_{7,2}$
Trust building $c_8$	Providing accurate information of transactions $c_{8,1}$
	Providing accurate financial information $c_{8,2}$
	Bank specialist personnel $c_{8,3}$
Reputation $c_9$	Good reputation $c_{9,1}$
	Many customers should have a good evaluation of bank $c_{9,2}$
Continuous improvement of current situation $c_{10}$	Performance and operations system $c_{10,1}$
	Attitudes and abilities to solve problems $c_{10,2}$
	Good financial content of products $c_{10,3}$
Customization $c_{11}$	
Profit $c_{12}$	

However, it should be noted that all of these criteria have a positive burden and are useful, and those with a negative burden and cost are not included in these characteristics.

The groups that based on their opinions, the criteria have been prioritized include:

-Customers who are using electronic banking services, which are divided into two groups,  $f_{1,1}$ . customers who are familiar with the tools and methods, and  $f_{1,2}$ . customers who inevitably use electronic banking services and are not familiar with their technology and needs

-Bank employees who are divided into two groups:  $f_{2,1}$ . IT sector employees and electronic banking specialists and  $f_{2,2}$ . employees working in other sectors of the bank who are more in contact with customers.

-Bank managers who are divided into two groups:  $f_{3,1}$ . bank IT managers who are more involved with the challenges of this sector:  $f_{3,2}$ . branch managers who are in contact with individuals and users in bank branches.

-Electronic banking professors and experts.  $f_4$ . These people are outside the banking system but have research on the subject of electronic banking.

In this study, a fuzzy evaluation matrix is formulated, which is shown in Table 5.

**Table 5: Fuzzy evaluation of linguistic variables**

Fuzzy equivalent	Linguistic variable
(0,0,20)	Not important
(0,20,40)	Less important
(20,40,70)	Moderate
(50,80,90)	Important
(80,100,100)	Very important

After obtaining one’s opinions using fuzzy numbers, we must combine the opinions of different people in the same group. In this study, the fuzzy mean of people's opinions is applied to a group as the final

opinion of that group. For example, if three people in the group  $f_{2,1}$  give three different opinions for the criterion  $c_{1,1}$  as follows,

$$N_{c_{1,1}}^{f_{2,1}}(1) = (n_{1,l}, n_{1,m}, n_{1,u})$$

$$N_{c_{1,1}}^{f_{2,1}}(2) = (n_{2,l}, n_{2,m}, n_{2,u})$$

$$N_{c_{1,1}}^{f_{2,1}}(3) = (n_{3,l}, n_{3,m}, n_{3,u})$$

The combination of opinions in this group will be applied in this way

$$\widetilde{N}_{c_{1,1}}^{f_{2,1}} = \left( \min(n_{1,l}, n_{2,l}, n_{3,l}), \frac{n_{1,m} + n_{2,m} + n_{3,m}}{3}, \max(n_{1,u}, n_{2,u}, n_{3,u}) \right) \quad (1)$$

Accordingly, we can combine the opinions of the individuals in each group and apply one opinion of each group to the next stage of the algorithm. Then, the matrix is created based on the users' opinions and this matrix is called a decision matrix. In other words, the opinions of these people were combined through averaging. The Vlse Kriterijumsk Optimizacija Kompromisno Resenje (VIKOR) method, which is one of the most extensively-used models in decision making and selection of the best option, was used to rank the criteria. In fact, the VIKOR model prioritizes or ranks the options by evaluating the options based on indices. In this model, the indices are not weighted, but the indices are evaluated by other methods, and then, the options are evaluated and ranked based on the indices and by combining the value of indices. The VIKOR method can model uncertainty caused by a lack of information, or in some cases, lack of accurate information. On the other hand, the fuzzy method is one of the most powerful and useful methods in modeling complex and ambiguous environments and its capabilities in this area have been proven. Therefore, the VIKOR method is combined with the fuzzy method and it is known as fuzzy VIKOR. The fuzzy VIKOR process and methodology include the following steps.

### 1-Combining opinions of people

Since the opinions of different people on each bank are considered, we first combine the opinions of customers. In this study, like other studies, we did in this way for the lower limit, middle limit and upper limit of triangular fuzzy numbers. Then, for different groups, the opinions of people on the criteria are combined.

$$low \left( \widetilde{N}_{c_{1,1}}^{f_{2,1}} \right) = \min_{i \in f_{2,1}} \left( \widetilde{N}_{c_{1,1}}^{f_{2,1}}(i) \right) \quad (2)$$

$$middle \left( \widetilde{N}_{c_{1,1}}^{f_{2,1}} \right) = \frac{\sum_{i \in f_{2,1}} \left( \widetilde{N}_{c_{1,1}}^{f_{2,1}}(i) \right)}{|f_{2,1}|} \quad (3)$$

$$up \left( \widetilde{N}_{c_{1,1}}^{f_{2,1}} \right) = \max_{i \in f_{2,1}} \left( \widetilde{N}_{c_{1,1}}^{f_{2,1}}(i) \right) \quad (4)$$

$$\widetilde{N}_{c_{1,1}}^{f_{2,1}} = \left( low \left( \widetilde{N}_{c_{1,1}}^{f_{2,1}} \right), middle \left( \widetilde{N}_{c_{1,1}}^{f_{2,1}} \right), up \left( \widetilde{N}_{c_{1,1}}^{f_{2,1}} \right) \right) \quad (5)$$

## 2. Formulation of fuzzy decision matrix

The decision matrix, or scoring matrix of options, is formed based on criteria in this way:

$$DM_0 = \begin{bmatrix} \widetilde{N}_{c_{1,1}}^{f_{1,1}} & \dots & \widetilde{N}_{c_{1,1}}^{f_4} \\ \vdots & \ddots & \vdots \\ \widetilde{N}_{c_{12}}^{f_{1,1}} & \dots & \widetilde{N}_{c_{12}}^{f_4} \end{bmatrix} \quad (6)$$

## 3. Data normalization

The next step is the normalization of the decision matrix. It results in a normalized matrix of  $DM_1$  which is in this form:

$$DM_1 = \begin{bmatrix} \widetilde{G}_{c_{1,1}}^{f_{1,1}} & \dots & \widetilde{G}_{c_{1,1}}^{f_4} \\ \vdots & \ddots & \vdots \\ \widetilde{G}_{c_{12}}^{f_{1,1}} & \dots & \widetilde{G}_{c_{12}}^{f_4} \end{bmatrix} \quad (7)$$

Where

$$\widetilde{G}_{c_{1,1}}^{f_{1,1}} = \frac{\widetilde{N}_{c_{1,1}}^{f_{1,1}}}{\widetilde{N}_{c_{1,1}}^{f_{1,1}} + \dots + \widetilde{N}_{c_{1,1}}^{f_4}} \quad (8)$$

In this study, several defuzzification methods were investigated, and finally, a new fuzzy technique was proposed as an appropriate defuzzification method in multi-criteria decision-making techniques. In the proposed algorithm, for defuzzification of fuzzy numbers  $\tilde{A} = (a_l, a_m, a_u)$ , the following method is used.

$$Crisp(\tilde{A}) = \frac{(a_u - a_l) + (a_m - a_l)}{3} + a_l \quad (9)$$

By defuzzification of  $DM_1$ , the matrix of  $DM_2$  is obtained in this way:

$$DM_2 = \begin{bmatrix} h_{c_{1,1}}^{f_{1,1}} & \dots & h_{c_{1,1}}^{f_4} \\ \vdots & \ddots & \vdots \\ h_{c_{12}}^{f_{1,1}} & \dots & h_{c_{12}}^{f_4} \end{bmatrix} \quad (10)$$

It should be noted that the  $h_{c_{1,1}}^{f_{1,1}}$  is defuzzified value of  $\widetilde{G}_{c_{1,1}}^{f_{1,1}}$  obtained by using the Equation (9).

## 4- Determining of positive and negative ideal

For each criterion, the best and worst of each of the options are determined and they are called positive and the negative ideals, respectively. Since the criteria are utility criteria, we will have:

$$Id^+ = \max \left( h_{1,1}^{j_1}, \dots, h_{1,1}^{j_j} \right) \quad (11)$$



$$Id^- = \min(h_{1,1}^{j_1}, \dots, h_{1,1}^{j_j}) \quad (12)$$

### 5-Determining of utility and regret

Utility (S) and regret (R) are two basic concepts in VIKOR calculations. The utility value represents the relational distance of option  $j$  from the ideal point and the regret value represents the maximum regret of sadness of  $j$  from distance from the ideal point.

$$S_j = \tilde{w}_1 \times \frac{Id^+ - h_1^j}{Id^+ - Id^-} + \dots + \tilde{w}_{12} \times \frac{Id^+ - h_{12}^j}{Id^+ - Id^-} \quad (13)$$

$$R_j = \max \left[ \tilde{w}_1 \times \frac{Id^+ - h_1^j}{Id^+ - Id^-}, \dots, \tilde{w}_{12} \times \frac{Id^+ - h_{12}^j}{Id^+ - Id^-} \right] \quad (14)$$

In this stage, positive and negative ideals of utility and regret are calculated that are equal to

$$S^- = \min(S_j) \quad (15)$$

$$S^+ = \max(S_j) \quad (16)$$

$$R^+ = \min(R_j) \quad (17)$$

$$R^- = \max(R_j) \quad (18)$$

### 6. Calculating the VIKOR index

The next step is to calculate the VIKOR index (Q) for each option.

$$Q_j = v \left[ \frac{S_j - S^+}{S^- - S^+} \right] + (1 - v) \left[ \frac{R_j - R^+}{R^- - R^+} \right] \quad (19)$$

### 7- Decision making with VIKOR technique

In the final stage, using the VIKOR technique, the options are arranged in groups from small to large based on values of Q, R, S. The best option is to have the smallest Q, provided that the following two conditions are met:

Condition one or acceptable advantage: If the option  $A_1$  and  $A_2$  is ranked first and second among the options, the following relationship must be established:

$$Q(A_2) - Q(A_1) \geq \frac{1}{J - 1} \quad (20)$$

Condition two or acceptable stability in decision making: The option  $A_1$  must be recognized as the top rank in at least one of the groups of R and S.

### Results

In this study, 7 files containing surveys of 7 groups of 37 criteria were collected. Simulation was performed using R language, which is a programming language and statistical computing environment. Nowadays, this language is considered an unofficial standard for statistical data mining. In fact, this

language is the open text version of S software. The R core in the CRAN network is available to users. It is one of the most important tools for analyzing and visualizing access to data and it is extensively used in academic and business areas. The value for the group of customers who are familiar with tools customer is shown in the following table.

**Table 6- Result of the survey for the a group of customers who are familiar with tools**

Option	s	R	Q	RANK
1	1	1	1	38
2	0.041825095	0.041825095	0.041825095	5
3	0.022813688	0.022813688	0.022813688	3
4	0.155893536	0.155893536	0.155893536	19
5	0.235741445	0.235741445	0.235741445	32
6	0.233840304	0.233840304	0.233840304	31
7	0.102661597	0.102661597	0.102661597	8
8	0.119771863	0.119771863	0.119771863	13
9	0.045627376	0.045627376	0.045627376	6
10	0.19391635	0.19391635	0.19391635	25
11	0.117870722	0.117870722	0.117870722	12
12	0.235741445	0.235741445	0.235741445	33
13	0.140684411	0.140684411	0.140684411	16
14	0.041825095	0.041825095	0.041825095	4
15	0.287072243	0.287072243	0.287072243	36
16	0.131178707	0.131178707	0.131178707	15
17	0.157794677	0.157794677	0.157794677	20
18	0.11026616	0.11026616	0.11026616	10
19	0.144486692	0.144486692	0.144486692	17
20	0.098859316	0.098859316	0.098859316	7
21	0.203422053	0.203422053	0.203422053	27
22	0.104562738	0.104562738	0.104562738	9
23	0.007604563	0.007604563	0.007604563	2
24	0	0	0	1
25	0.197718631	0.197718631	0.197718631	26
26	0.273764259	0.273764259	0.273764259	35
27	0.121673004	0.121673004	0.121673004	14
28	0.214828897	0.214828897	0.214828897	28
29	0.159695817	0.159695817	0.159695817	21
30	0.148288973	0.148288973	0.148288973	18
31	0.1121673	0.1121673	0.1121673	11
32	0.178707224	0.178707224	0.178707224	23
33	0.355513308	0.355513308	0.355513308	37
34	0.226235741	0.226235741	0.226235741	30
35	0.190114068	0.190114068	0.190114068	24
36	0.235741445	0.235741445	0.235741445	34
37	0.178707224	0.178707224	0.178707224	22
38	0.220532319	0.220532319	0.220532319	29

In this group, Criterion 24 or the feature of complete searching for information obtained the highest priority, followed by Criterion 23, which is attractive visual and audio virtualization and Criterion 3, which is fast loading of pages, respectively. However, the group was familiar with the use of Internet banking tools. In this group of customers, access to Internet banking had the lowest priority, which may be due to the fact that many other customers have installed internet banking software on their mobile devices.

The second group is the customers who inevitably use electronic banking services and are not familiar with its technology and needs. The results for this group are shown in the following table.

Prioritization of the criteria according to IT department employees and experts in electronic banking: according to this group, criterion 28, privacy and personal information, and then criterion 34, system performance and operations, have the highest priority, and attitudes and abilities to solve problems and fast access to the Internet Bank have the lowest priority.

Then a survey was conducted on the employees working in other sections of the bank who are more in touch with customers, managers of the bank IT department who are more involved with the challenges of this section, and branch managers who are in contact with people and users in the bank branches and classification of professors and experts in e-banking. As already stated, these people are outside the banking system but have some studies on e-banking.

At the end, the opinions collected from various groups are combined with each other and shown in the table below. However, the share of all these groups in the study was assumed to be the same and equal to one to seven.

**Table 7: Combining the prioritization opinions of different groups with equal weighting**

Option	S	R	Q	Rank
1	0.8283874	0.14285714	1	38
2	0.3931804	0.0897504	0.27831835	18
3	0.3399945	0.0998613	0.31102499	22
4	0.3773599	0.08633842	0.24129479	10
5	0.4027516	0.09570042	0.32901683	29
6	0.3939573	0.08356449	0.23386532	8
7	0.4888975	0.14285714	0.7387449	35
8	0.4130357	0.09009009	0.29607196	20
9	0.3286242	0.09187467	0.24410972	12
10	0.4119546	0.08564494	0.26286666	17
11	0.354711	0.09049931	0.2541683	15
12	0.3270042	0.08668516	0.20506871	6
13	0.3331743	0.08599168	0.20476639	5
14	0.2743665	0.08737864	0.16961177	4
15	0.3887603	0.11234397	0.43946191	32
16	0.3784069	0.09188627	0.28250452	19
17	0.3767265	0.08656399	0.24245014	11
18	0.3690157	0.0887656	0.25255025	14
19	0.4142142	0.09084605	0.30248438	21
20	0.4182726	0.11325611	0.4688162	33
21	0.4163435	0.09346787	0.32321729	27
22	0.4217873	0.09257975	0.32093854	25
23	0.4478148	0.0981276	0.38137208	31
24	0.3877976	0.09612321	0.32058803	24
25	0.3659449	0.08868826	0.24962389	13
26	0.611508	0.14285714	0.83310008	37

27	0.4251389	0.09774436	0.36113072	30
28	0.1786586	0.08497079	0.07842364	1
29	0.3343605	0.08656399	0.20984734	7
30	0.365799	0.08656399	0.23404088	9
31	0.3904065	0.09612321	0.32259574	26
32	0.3912733	0.09665428	0.32713048	28
33	0.3908755	0.09506107	0.31522131	23
34	0.4645959	0.14285714	0.72004358	34
35	0.5875942	0.14285714	0.81469715	36
36	0.2414231	0.07852412	0.0797742	2
37	0.2897372	0.0742025	0.08548071	3
38	0.376392	0.08921933	0.26153109	16

This table shows that by combining the opinions of different groups, the highest priority is given to the following criteria, respectively.

- 1- Protecting the privacy and personal information
- 2- Good financial content of products
- 3- Ability to change by the customer

The following criteria had the lowest priority

- 1- Fast access to Internet banking
- 2- Providing various financial services (e.g. insurance, loan, etc.)
- 3- Attitudes and abilities to solve problems

## Conclusion

In this study, different groups related to internet banking were studied and quality criteria were investigated. In the group of customers who inevitably used electronic banking services and was unfamiliar with its technology and needs, results showed that Criterion 36 or the ability to change (Probably, simplifying the system) was ranked first. Criterion 28, which is protecting the privacy and personal information, was ranked second. According to this group, Criterion 9 or non-blockage of pages during the transaction was ranked third. According to this group, fast access to Internet banking and attitude and the ability to solve problems had the lowest priority. According to this group, Criterion 28 that is protecting the privacy and personal information and Criterion 34 that is the performance of the system and operations were ranked first and second, respectively, and the criteria of attitude and ability to solve problems and fast access to the Internet bank had the lowest priority. Accordingly, other groups were surveyed. Then, the weights of various groups were combined based on the opinions of the experts. In this research, the researcher proposed a new method to combine opinions in the assessment of the quality of the SERVQUAL services. In this method, different groups were surveyed using the SERVQUAL model. Then, the fuzzy VIKOR tool was used to combine the opinions of different groups. Also, the researchers presented a case study to evaluate their proposed method. Using the proposed method with low complexity can be effective for combining opinions.

The difference and the superiority of the study compared to other similar studies is that as a new study using SERVQUAL model, as the best model to examine the quality of electronic services, it has surveyed from different groups related to the bank. Then using Fuzzy Vicor tool, a much more accurate tool compared to other tools such as fuzzy TOPSIS and other non-fuzzy tools, it combines the opinions of various groups and extracts a much more accurate result.

The following is suggested for future studies.

Some studies should be conducted on demographic factors (age, education, and gender) and its effects on service quality. It is suggested that future studies should be conducted in other geographical areas to generalize the results to other populations. It is suggested to use other tools besides the questionnaire like the interviews and personal reports to obtain more valid results. Comparative study should be conducted

on the quality of services provided to customers using electronic banking services and customers using traditional banking services as in the past. Comparative evaluation of the service quality should be conducted in a sample of public and private banks.

## References

- [1] Safavi, S, "Presenting solutions for the development of security measures in Electronic Banking, 2nd World Conference on Electronic Banking, 2008.
- [2] Rabbani Nia, R and Motahhari, M, "Presenting a security model for Internet Banking, The First National Conference on Information Technology and Computer Networks Payam-e Noor University, 2012.
- [3] Safaroo Kiani, A, Unarkhani, H, Amini, H, "Presentation of customer satisfaction model in the sustainable use of electronic banking services", National Conference on Accounting and Management, 2013.
- [4] Salimi, N, Morrovati Sharif Abadi, F, Tagavi, VA, Farhadi, A, "Presentation of a model to assess electronic satisfaction of electronic customers of Melli Bank of Kerman Province," International Conference on Management, Economics and Industrial Engineering, 2015
- [5] Borhani, L, Nouri, A, Noori, A, and Molavi, H, Samavatian, H, "Investigating the relationship between organization image, brand image, service quality, and customer satisfaction with loyalty of Banking Industry customers," Cognitive and Behavioral Sciences Research, Volume 1, Issue 4, pp. 115-130, 2014
- [6] Heydari, H and Musakhani, M, "Developing a model of factors affecting customer satisfaction in traditional and electronic banking," Modern Marketing Research, Volume 1, Issue 5, pp. 201-218, 2015
- [7] Hamidzadeh, MR and Ghamkhari, SM, "Identifying of factors affecting customer loyalty based on fast-response organizations model," Business Research Journal, Volume 1, Issue 13, pp. 187-210, 2009
- [8] Sorraei, A, Sajjadi, S, and Sajjadi, SM, "Evaluation and comparison of Internet banking technology acceptance among Melli Bank and Saman Bank customers according to TAM Model," First Iranian Student Information Technology Conference, 2010.
- [9] Vazifedoost, H, Omidzadeh, R "Investigating the impact of automated service quality on customer commitment in the banking industry," Marketing Management, Volume 0, Issue 0, pp. 67-84, 2013
- [10] h Vazifedoost, H, Akbarpour, Z, Hamdi, K Mohammadzadeh Rostami, J, "Investigating the relationship between customer satisfaction and quality of service provided in Iran's Private Banking Industry (Analysis Based on SERVQUAL Integrated Model)," Marketing Management, Volume 0, Issue 6, pp. 1-24, 2014
- [11] Faryabi, M, Mahmoodi, M, "Measuring service quality and investigating its relationship with market share based on SERVQUAL Model (Case Study: Tabriz Saderat Bank)," Productivity Management, Vol. 0, no. 7, pp. 143-166, 2013
- [12] Ahmadi, A, Khabiri, M, Naderian Jahromi, M, Alidoust, A, "Fans' satisfaction with the quality of service provided at Tehran Azadi Stadium," Sport Management Studies, vol. 1, no. 8, pp. 65-76, 2011
- [13] Hassanzadeh, A and Sadeghi, T, "Investigating the effects of electronic banking on the development of the banking system," Economic Journal, vol. 1, no. 3, pp. 26-31, 2003
- [14] Hosseini, M, Ahmadinejad, M, Ghaderi, S, "Investigating and assessing service quality and its relationship with customer satisfaction; A Case Study of Tejarat Bank," Business Investigations, vol. 1, no. 8, pp. 88-97, 2010
- [15] Hosseini, M and Ghaderi, S, "Modeling the factors affecting the quality of banking services," Business Management Perspective, vol. 3, no. 9, pp. 89-115, 2010
- [16] Assarian Nejad, H, Shirazi, H, "Assessing Police Services: Assessing the Quality of Police + 10 Services Using the SERVQUAL Analysis Model," Police Management Studies, vol. 2, no. 6, pp. 208-221, 2011