Int. J. Nonlinear Anal. Appl. 15 (2024) 12, 157–172
ISSN: 2008-6822 (electronic)
http://dx.doi.org/10.22075/ijnaa.2023.31453.4634

Designing a model for improving the quality of banking technological services in Iran using structural equations and thematic analysis method (Case study: Industry and Mine Bank)

Ali Mehri, Saber Khandan Alamdari*, Neda Farah Bakhsh

Faculty of Management and Accounting, Roudehen Branch, Islamic Azad University, Roudehen, Iran

(Communicated by Javad Vahidi)

Abstract

The very important role of electronic services and online services in every society is not hidden from anyone, among them, what is important is the quality of these services. Electronic service quality refers to how effectively and efficiently a particular Internet banking service can facilitate online transactions. Therefore, in this research, the design of the quality improvement model of banking technological services in Iran has been discussed. The current research is based on the fundamental goal and based on the method of data collection, survey-cross-sectional. Data collection tools were library studies, interviews, structural-interpretive modelling and researcher-made questionnaires. In the qualitative part of the article, 11 banking experts were purposefully selected. In the quantitative part, 384 questionnaires were distributed among the customers of Sanat and Madan Bank in the form of simple stratified sampling. The analysis of data in the qualitative part was through thematic analysis and in the quantitative part interpretive structural modeling, self-interaction structural matrix, achievement matrix, an adaptation of the achievement matrix, determination of relationships and levelling of indicators as well as structural equations. Eight main themes of the qualitative section: technological banking management, technological banking marketing, system and electronic service quality, improving the quality of technological banking services, technological hardware and software infrastructure, customer experience management, organizational culture and risk management were identified. The quantitative part showed the technological software and hardware infrastructure on technological banking management, technological banking management on risk management and organizational culture, risk management on technological banking marketing and customer experience management, organizational culture on technological banking marketing and customer experience management, and technological banking marketing. On the systemic and electronic quality of services, customer experience management on the systemic and electronic quality of services, the systemic and electronic quality of services have a positive and significant effect on improving the quality of banking technological services.

Keywords: information technology, electronic banking, digital banking, service quality, structural equations
2020 MSC: 62B86, 68P20

*Corresponding author
Email addresses: ali1987mehri@yahoo.com (Ali Mehri), sabersum@yahoo.com (Saber Khandan Alamdari), neda_farahbakhsh@yahoo.com (Neda Farah Bakhsh)

Received: June 2023 *Accepted:* September 2023

1 Introduction

Today, banks are one of the active and dynamic elements in the economy of countries, which are under the pressure of a lot of competition [11]. Organizations that seek to gain the satisfaction and loyalty of their customers should have more interaction with them. Information technology and the use of various trading and storage databases and the dissemination of customer information and knowledge provide a platform for organizations and companies to become aware of the needs and interests of their customers more quickly [5].

A large number of banks are looking for innovative ways, such as online banking, to provide their services, to make these services more convenient and efficient for customers. It is important for banks to ensure that customers understand the quality of service and are satisfied with online banking. Banks face many challenges that limit their provision of electronic services, such as electronic signature, personal identification, confidentiality and security, customer privacy, electronic banking contracts, etc. [8]. Technology helps to reduce costs and improve relations between the bank and its customers and encourages them to use various electronic services. Following the technological advancements in the banking sector, new banking services such as electronic transfer, talking bank, short message services, electronic trading of securities, electronic credit cards, ATMs and many other electronic services have been introduced [10]. Paying attention to factors affecting the performance and quality of technological services is a vital issue in modern banking. Iran has one of the highest penetration coefficients of banking services and the high speed of money transfer in the banking system, the high number of bank branches in proportion to the population and the large number of transactions show the high capacity of the Iranian banking system. Also, the large number of university graduates in the fields of finance and software and the low cost of specialized human resources put Iran in a special position in the region in terms of specialized human resources, but despite the mentioned potentials due to low awareness Among the capabilities and potentials of this industry among economic activists, the lack of clarity of the laws and regulations governing the activity of financial technologies in all areas and the incompatibility of these laws with the development of financial technologies, the absence of technical, legal and banking infrastructures for Expanding the security of the beneficiaries, there is actually a long way to the development and prosperity of this industry [17]. However, there is still little desire on the part of banks to establish a relationship with technological service providers, and they still tend to communicate with their customers simultaneously as both producers and distributors of banking services in the form of a specific communication channel and platform. Concerns such as the security of customer information, charging fees by these companies, etc., have caused them to turn away from cooperation with financial technology service providers, and this issue slows down the development cycle of banking services and innovation in the field of financial services. And it may remove them from the competition in the future [22]. According to what has been said, changes and developments in the field of creation and development of such systems are also observed in our country, but the point that has received less attention is consumer satisfaction with electronic banking services. For banks, this research is necessary due to the fact that according to the investments made by these banks for the development of electronic banking services, it should seek to identify consumers' satisfaction with the quality of these services in order to obtain information It is possible to present this new technology in ways that are more consistent with the demands and expectations of customers. Considering that there are many logical reasons that make this research unavoidable, one of the most important of them is the result of a survey and study in this field, during which it has been proven that by identifying the factors affecting the quality and provision of electronic services with The quality according to the expectations of the customers can affect the satisfaction of the customers and consequently their future purchasing behavior. It is obvious that if the quality of electronic services in state-owned banks is not given due attention and the level of communication with customers is not improved, the negative effects of this dissatisfaction on the bank's profitability will be obvious.

Therefore, in this research, we want to answer the question of what factors are effective in improving the quality of banking technology services in Iran, considering the spread of technological banking services such as digital banking, corporate banking, etc. in banks? Then let's design the model and validate it.

2 Theoretical foundations

Electronic banking has created new ways of banking in the fields of distribution, production, payment and trade. From the perspective of banks, internet banking helps them maintain profitable growth by reducing operational and fixed costs. In addition, Internet banking enhances marketing and communication, as it provides service 24 hours a day and the customer can be guided through a catalog of products and services. In addition, an Internet banking system allows banks to expand their business geographically without investing in the creation of new branches, thereby expanding the customer base [9]. Examining the factors affecting the choice of electronic banking by customers is also a strong point in today's information technology and success in this competition. Mwiya et al.'s research [16] showed

that usefulness, ease of use, and perceived trust each significantly positively affect the attitude toward electronic banking and its use by customers. In this regard, the development of innovative solutions with new technological concepts leads to a new business model [6]. The growth of emerging transformative innovations is changing the course of many industries leading to business transformation [20]. Digital transformation has opened a place for itself in every industry and society. banking, finance, manufacturing, medical, healthcare, remote retail, etc., which leads to the creativity and innovation of transformative digital technologies with a completely new business model that changes the competitive landscape [2]. In order to succeed in digital transformation, leading companies focus on two complementary activities: transforming customer value propositions and changing their activities using digital technologies to interact and collaborate more with customers [4]. The basic point in electronic banking is to pay attention to the quality of technological services and improve the performance of the bank. Nowadays, providing high quality services to customers is one of the most important challenges facing many organizations. No organization can continue to survive unless it can attract and retain a sufficient number of satisfied customers [18].

New service development refers to service innovations or new services that achieve superior performance and competitive advantage because new service development is defined as innovations in services or service processes that achieve efficient operation and superior performance. The side of scientific research reflects the increasing focus on service innovation among researchers and policy makers [15].

Now, banks around the world provide electronic services in addition to conventional services. There are different names for these electronic services, such as electronic banking, online banking, digital banking, and internet banking. Today, most customers use these digitized services on computers and mobile phones without any human interaction. These digital and electronic services save the time and money of bank customers [26]. In this study, we conceptualize the quality of electronic services as "the extent to which the bank's website and electronic services facilitate efficient and effective purchasing behavior and provide products and services accordingly" [23].

Also, the performance of the company as a variable plays an important role. Therefore, organizational performance is one of the most important structures in management research and also the most important measure of success in commercial companies [19]. Performance measurement brings a number of behavioral and outcome benefits to professionals. Performance measurement can help management to facilitate work and create decision-making processes along with restructuring strategies. As the use of performance measurement can increase performance, there is a fundamental relationship between strategy and performance. Ideally, performance measurement should be aligned with the overall business strategy and include a comprehensive set of criteria. Therefore, performance measurement is one of the most important activities related to strategic planning [24].

Considering that our research is fundamental and is done with an exploratory approach, and the researcher does not know before conducting the research what factors affect the quality of banking technological services, therefore, the research lacks a hypothesis and a theoretical model, and the theoretical model is practically up to After qualitative interviews with experts and banking experts, it is not possible to enumerate the following questions for this research:

1- What are the effective factors on banking technological services in Iran? 2- What are the effective factors in improving the quality of banking technological services in Iran? 3- What is the model of factors affecting the quality of banking technological services in Iran? 4- Is the designed model valid?

3 Research methodology

The present research is a mixed research. In the mixed research method, a combination of qualitative and quantitative methods is used simultaneously, and this research is based on the purpose of an exploratory research and based on the method of data collection, it is a survey-cross-sectional research. The main research data collection tools were library studies, semi-structured interviews, structural-interpretive modeling questionnaires and researcher-made questionnaires. The sample size in the qualitative section that deals with interviews with experts is usually between 5 and 15 people, and the sampling continues until we reach theoretical saturation. The sampling method was purposive sampling.

Data analysis in the qualitative part through thematic analysis and the quantitative part included interpretive structural modeling, self-interaction structural matrix, achievement matrix, adapting the achievement matrix, determining the relationships and leveling of indicators and the structural equation model, which are:

- Quality Control

  In order for the researcher to be able to use the qualitative findings in the analysis, he must code them.

Inter-coder reliability is a widely used term that refers to the degree of agreement that independent coders obtain when evaluating the features of a message or text. The specific term for consistency in content analysis is "agreement between coders". Determining validity and reliability is a critical step in the qualitative data analysis process.

The Kappa method is one of the statistical decision-making tools that examines the amount of agreement and coordination between two individuals, phenomena, or sources of decision-making, each of which is measured separately.

Kappa coefficient is a numerical measure between -1 and +1, the closer to +1 indicates the presence of proportional and direct agreement, the closer to -1 indicates the presence of inverse agreement, and the opposite and values closer to zero indicate the opposite of agreement. to give

$$k = \frac{p_o - p_e}{1 - p_e}$$

in this regard, p_o is equal to the ratio of the units about which there is an agreement p_e is also the ratio of units that are likely to be a random agreement.

- Fuzzy AHP method

Fuzzy hierarchical analysis has two well-known methods, which are Chang's method and Yager's method. Chang's method is the most famous and common method in Iran, which we teach in this section.

levels AHP Fuzzy according to Chang's method is as follows :

Step 1: Draw a hierarchy diagram

In any multi-criteria analysis, drawing a hierarchical diagram (decision tree) is one of the first and important steps. Because it is after drawing this diagram that we clearly know the goal, the structure of the hierarchy of indicators and sub-indices, and options .

Step 2: Define fuzzy numbers to perform pairwise comparisons

At this stage, it is necessary to define your fuzzy numbers, which are needed to perform pairwise comparisons, so that the experts can provide their answers accordingly.

Step 3: Formation of pairwise comparison matrix by using fuzzy numbers

At this stage, the questionnaires have been provided to the experts and they have answered it. Therefore, we now have the matrix of pairwise comparisons that contain fuzzy numbers.

Now the point is, what should we do when we are faced with several respondents? The most reliable thing is to find the answer in the main source of this method, that is, in Chang's main article Let's search. in the article AHP Fuzzy Chang mentioned that when we are faced with several respondents (which is the case in 99% of cases), we should take the arithmetic mean of the opinions, that too in only one half of the matrix.

Step 4: Calculate the matrix S For each row of the pairwise comparison matrix

S are triangular fuzzy numbers that are calculated from the following equation:

$$S_i = \sum_{j=1}^{m} M_{gi}^{j} \bigotimes \left[\sum_{i=1}^{n} \sum_{j=1}^{m} M_{gi}^{j} \right]^{-1}$$

in the above relation, M The triangular fuzzy numbers inside the matrix are pairwise comparisons. In fact, when calculating the matrix S, we add each component of the fuzzy numbers one by one and multiply the total sum by the fuzzy inverse.

Step 5: Calculate the magnitude S to each other

In this step, the S is are compared with each other in terms of magnitude, based on the following formula:

$$V(M_2 \geq M_1) = hgt(M_1 \cap M_2) = \mu_{M_2}(d) = \begin{cases} 1, & \text{if } m_2 \geq m_1 \\ 0, & \text{if } l_1 \geq u_2 \\ \frac{l_1 - u_2}{(m_2 - u_2)(m_1 - l_1)}, & \text{otherwise.} \end{cases}$$

that in the above relation,

$$M_2 = (l_2, m_2, u_2) \quad and \quad M_1 = (l_1, m_1, u_1)$$

Two fuzzy numbers are triangular.

Step 6: Calculating the weights of criteria and options in pairwise comparison matrices

In this step, it is enough to obtain the unnormalized weight vector by calculating the lowest value calculated in the previous step.

Step 7: Calculate the final weight vector

In the last step, we normalize the weight vector obtained from the previous step, which was not normalized, to obtain the final weight vector, which is our final goal of fuzzy calculations.

- Interpretive structural method. Interpretive structural modeling method is an interactive learning process. In this technique, a set of different elements are structured in the form of a comprehensive systematic model. Such a model that is formed, draws the structure of a complex issue or a problem in the form of a carefully designed pattern in the form of a diagram. This method is an interpretive model in which a group of experts decide whether and how the elements are related, and it is a structural model in that it extracts complex components based on the relationship of the structure and specific relationships through the modeling method. and explains the overall structure as a diagram model. This method is a tool to create order in the complexity of relationships between variables and is a suitable option for dealing with complex issues, especially when using systematic and logical thinking. The various steps involved in the ISM technique are shown in the figure above. These steps ultimately lead to the creation of an ISM model , which are explained in the following steps:

  Step 1) Identification of variables related to the problem: The ISM method begins with the identification of variables that are related to the problem or topic under discussion. These variables are obtained through the study of the subject literature, past studies, through receiving the opinions of experts or through questionnaires.

  Step 2) Formation of the structural matrix of internal relations of variables (SSIM): This matrix (structural self-interaction matrix) is a matrix with the dimensions of the variables, in which the variables are mentioned in the first row and column respectively. To determine the type of relationship, use the symbols in the table below.

Table 1: Conceptual relationships in the formation of the structural self-interaction matrix

Symbol	**Conceptual symbol**
V	I leads to J (the agent of the i row leads to the j column)
A	j leads to i (the factor of row j that leads to column i)
X	Two-way relationship between I and j There is (both are the basis of each other)
O	No relationship between two elements i and j Does not exist

Step 3) Create the achievement matrix (RM) or the received matrix: by converting the symbols of the SSIM matrix to the numbers zero and one, the achievement matrix can be reached. By following these rules, the initial acquisition matrix is prepared. These rules are as follows:

Table 2: How to convert conceptual relationships into numbers

Conceptual symbol	**i to j**	**j to i**
V	1	0
A	0	1
X	1	1
O	0	0

Step 4) Adapt the achievement matrix: After the initial achievement matrix is obtained, its internal consistency should be established. For example, if variable 1 leads to variable 2 and variable 2 leads to variable 3, then variable 1 should also lead to variable 3, and if this state was not established in the initial achievement matrix, the matrix should be modified and the relationships that were missed be replaced. If we have n criteria as described in $c_1, c_2, ..., c_n$ and their pairwise comparison matrix is as follows:

$$A = [a_{ij}], \quad i, j = 1, 2, ..., n$$

where a_{ij} shows the preference of element c_i over c_j, if we have in this matrix:

$$a_{ik} \times a_{kj} = a_{ij}, \quad i, j, k = 1, 2, 3, ..., n.$$

Then we say that the matrix A is consistent.

In this part, we want to know that if the matrix of pairwise comparison is inconsistent, what is the amount of inconsistency of the matrix and how do we measure it. Before stating the inconsistency measurement criterion, some important issues about each pairwise comparison matrix are mentioned:

Theorem 3.1. If $\lambda_1, \lambda_2, ..., \lambda_n$ are eigenvalues of the pairwise comparison matrix A, the sum of its values is equal to n:

$$i = \sum \lambda_n.$$

Theorem 3.2. The largest of this special value ($\max \lambda$) is always greater than or equal to n, in this case some λ's will be negative.

$$n \geq \max \lambda.$$

Theorem 3.3. If the elements of the matrix deviate a little from the compatible state, its eigenvalues will also deviate a little from their compatible state.

$$A \times w = w \times \lambda$$

where λ and w are the eigenvalue and eigenvector of matrix A, respectively. In the case that matrix A is consistent, one eigenvalue is equal to n (greater than eigenvalue) and the rest are equal to zero. Therefore, in this case it can be written:

$$A \times w = n \times w.$$

In the case that the pairwise comparison matrix A is inconsistent, according to Theorem 3.3, $\max \lambda$ is slightly different from n, which can be written:

$$\max \lambda \times w = A \times W$$

The reason for using $\max \lambda$ according to theorem 3.3 is that it will have the smallest distance from n. Since $\max \lambda$ is always greater than or equal to n, and if the matrix deviates from the compatibility mode, $\max \lambda$ will deviate from n, so the difference between $\max \lambda$ and $n - \max \lambda$) depends on the value of n, and to solve this dependence, the scale can be defined as follows, which we call the inconsistency index (I.I.).

$$n - \max \lambda / n - 1 = I.I.$$

For each matrix, the result of dividing the inconsistency index (I.I.) by the inconsistency index of the random matrix (II R.) is then a suitable criterion for judging the inconsistency, which we call the inconsistency rate (I.R.). If this number is smaller than 0.1, the compatibility of the system is acceptable, otherwise you should reconsider your judgments.

To calculate the inconsistency rate we have the following steps:

Step 1. Calculation of the weighted sum vector: Multiply the matrix of pairwise comparisons by the "relative weight" column vector. Call the new vector that you get in this way, the weighted sum vector.

Step 2. Calculation of compatibility vector: Divide the elements of the weighted sum vector by the relative priority vector. The resulting vector is called Consistency Index.

Step 3. Obtaining $\lambda_{\max}$ gives the average of the elements of the compatibility vector $\lambda_{\max}$.

Step 4. The formula for calculating the compatibility index: The compatibility index is defined as follow:

$$CI = \frac{\lambda_{\max} - n}{n - 1}.$$

n is the number of options in the problem.

Step 5. Compatibility ratio calculation formula: The compatibility ratio is obtained by dividing the compatibility index by the random index.

$$CR = \frac{CI}{CR}.$$

A compatibility ratio of 0.1 or less indicates compatibility in comparisons [12].

Step 6. Determining the level and priority of variables: In this step, using the final achievement matrix, the set of output and input for each variable is obtained. To determine the level and priority of the variables, the achievement set (output) and the prerequisite set (input) are determined for each variable.

Step 7. Drawing the model: after determining the relationships and level of the variables, they can be drawn in the form of a model. For this purpose, first, the variables are adjusted according to their level from top to bottom. At this stage, according to the levels obtained from the variables and the final matrix, an initial model is drawn and the final model is obtained by removing transferability in the initial model. The relationship between the variables and the direction of the arrow is determined from the final matrix.

Step 8. Analysis of penetration power and degree of dependence (MICMAC): MICMAC or the mutual influence of matrix multiplication applied for classification; The purpose of this analysis is to identify and analyze the power of penetration and the dependence of the variables. At this stage, by summing the entries of ((1)) in each row, the power of penetration and also the sum of the entries of ((1)) in each column, the amount of the dependence of the variables is obtained confirmed through substantive description, homogeneity matching (three-way) and reflection , acceptance and cooperation, and reliability was calculated through Holstein's coefficient, and the number of this coefficient was 0.712. It is greater than 0.6, so the result of the qualitative part is favorable. In the quantitative part, the viewpoint of 30 people was used to measure the validity of the quantitative part. Because the point of view of 30 people has been used, the value of CVR must be above 0.33, which is true in all cases. Also, the necessary condition for accepting indices based on CVI is that this value must be greater than 0.79. This condition is also valid for all indicators. The results of validity calculation in the quantitative section are shown in Table 3.

Table 3: Content validity ratio and questionnaire indicators

Result	**CI**	**CR**	**Questionnaire items**
acceptance	0.80	0.80	Support of bank managers for innovative activities
the reception	0.93	0.67	Using the mechanisms of M Novin in the middle Banking systems
the reception	0.87	0.93	Application of artificial intelligence in providing banking services
the reception	0.90	0.80	Using strategies that are suitable for the purpose of attracting and retaining customers.
the reception	0.87	0.60	The attraction of a specific human face p
the reception	0.83	0.40	Behavioral competence of employees
the reception	0.87	0.40	Increased presence in the media and competitive market
the reception	0.87	0.53	The ability to answer and react fast to events
the reception	0.93	0.60	Development and use of new technologies
the reception	0.90	0.47	Increasing the professional skills of employees
the reception	0.80	0.87	Accuracy and concentration of the system and employees in providing banking services
the reception	0.97	0.60	Technological facilities and equipment
the reception	0.97	0.60	Reliability
the reception	0.93	0.67	Ease of receiving and providing banking services
the reception	0.90	0.40	Ease of interaction
the reception	0.80	0.73	Improving accountability and clarifying performance
the reception	0.87	0.73	Development of technological financial planners and consultants
the reception	0.93	0.40	Using cloud technologies with security, reliability and high compatibility constant need for software updates
the reception	0.83	0.80	Strengthening the ability, competence, flexibility and speed of services
the reception	0.97	0.80	Formulation of software and hardware infrastructure strategy
the reception	0.100	0.87	Formulation of software and hardware infrastructure strategy
the reception	0.80	0.53	Flexible information technology infrastructure
the reception	0.93	0.67	Diversification of the sector to the portfolio of products and services
the reception	0.80	0.60	Providing consulting services regarding financial income, payments, savings and investments.
the reception	0.97	0.53	Protecting the privacy of customers
the reception	0.100	0.67	24-hour follow-up, guarantee and service
the reception	0.87	0.80	Gaining trust and increasing customer loyalty to the bank
the reception	0.97	0.73	Improving customer satisfaction
the reception	0.80	0.100	Change in culture technologically Our system
the reception	0.87	0.73	Flexible culture – Acceptance and inclination To correct – Service T
the reception	0.90	0.60	Establishing a culture of change
the reception	0.83	0.73	Implementation of learning culture
the reception	0.93	0.67	Adapt With the rapid change in the needs and preferences of customers
the reception	0.90	0.40	Inflation reduction and tax regulations
the reception	0.83	0.40	Reduction of exchange rate fluctuations
the reception	0.83	0.40	Adapt with Changes My fashion They are not strong a banker
the reception	0.93	0.80	Removing political and economic obstacles

The statistical population in the general quantitative section were the customers of different branches of Industry and Mine Bank, who use the bank's technological services in some way. According to the statistics announced by

the informatics unit of Industry and Mine Bank at the end of the months of 2021, the total number of customers of Sanat and Mine Bank was about 262,000 people, of which 40,000 were salary and 222,000 were Y. Y. Y About 70% of customers use the bank 's technological services. Therefore, Cochran's formula was used to determine the sample size

$$n = \frac{\frac{z^2 pq}{d^2}}{1 + \frac{1}{N}\left(\frac{z^2 pq}{d^2} - 1\right)}$$

in the above formula usually; The maximum permissible error (d) is equal to 0.1, the confidence coefficient is 0.90, t or z=1.96, and the p and q values are equal to 0.5 each, and the population size is considered to be N. P value is considered equal to 0.5. Because if P=0.5, n finds its maximum possible value and this causes the sample to be large enough [25].

A number of 384 questionnaires were distributed among the customers of Industry and Mine Bank in a simple random way in the form of simple stratified sampling. It is impossible to collect data from the entire statistical population and to measure the reliability in the quantitative part, a preliminary questionnaire was distributed among 30 people, and Cronbach's alpha was calculated for all dimensions above 0.7, and after ensuring the validity and reliability, the questionnaire was distributed. Cronbach's alpha is generally calculated using one of the following relationships.

$$\alpha = \frac{k\overline{C}}{\overline{V} + (k-1)\overline{C}}$$

or

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum_{i=1}^{k} S_i^2}{\sigma^2}\right)$$

in these relationships, k is the number of questions, S_i^2 is the variance of the i-th question, σ^2 is the variance of the total number of questions, $\overline{C}$ is the average variance between questions, and $\overline{V}$ is the average variance of the questions [25]. In Table 4, Cronbach's alpha related to each dimension of the questionnaire is presented:

Table 4: Cronbach's alpha related to each dimension of the questionnaire

Cronbach's alpha	**Main structures**
0.757	Technological banking management
0.796	Banking technological marketing
0.863	Gaining a competitive advantage
0.881	Improving the quality of banking technological services
0.865	Technological hardware and software infrastructure
0.804	Customer Experience Management
0.854	Organizational Culture
0.759	Risk management

4 Research results

In this research, based on previous studies, a code was considered for all the extracted information, and then, considering the concept of each of these codes, it was categorized in a similar concept. The improvement components K.F.T — Services technologically banks were discovered and labeled in this research. In the table below, the final extracted codes related to each category and concept are shown.

4.1 Prioritizing variables using fuzzy AHP approach

In these methods, fuzzy and hierarchical concepts have been used in a combined manner. In the first stage, a questionnaire was prepared for pairwise comparisons and given to 15 experts, which was explained in the previous chapter, and the results of the questionnaire were It has been analyzed using MATLAB software. The results are as follows:

According to the above table , the management of the Technological Bank Improving the quality of the bank's technological services has the highest priority and risk management has the lowest priority. Also, the compatibility rate is equal to 0.02, so the compatibility of the criteria with the purpose of the research is acceptable.

The output of MATLAB software for prioritizing the subsets of improving the quality of banking technological services according to the answers of the experts is as follows:

Table 5: Improvement categories and concepts K.F.T — Services technologically Bank Y

The subject of N sub	The subject of N Main
Support of bank managers for innovative activities	Technological banking management
Using the mechanisms of M Novin in the middle Banking systems	
Using artificial intelligence in providing banking services	
Using strategies that are suitable for the purpose of attracting and retaining customers	
Recruiting specialized human resources	
Behavioral competence of employees	Banking technological marketing
Increased presence in the media and competitive market	
The ability to answer and react fast to events	
The ability to respond and react quickly to events	
Development and use of new technologies	Systemic and electronic service quality
Accuracy and concentration of the system and employees in providing banking services	
Technological facilities and equipment	
Reliability	
Ease of receiving and providing banking services	
Ease of interaction	Improving the quality of the bank's technological services
Improving accountability and clarifying performance	
Development of technological financial planners and consultants	
Using cloud technologies with security, reliability and high compatibility	
Strengthening the ability, competence, flexibility and speed of services	
Constant need for software updates	Technological hardware and software infrastructure
Formulation of software and hardware infrastructure strategy	
Flexible information technology infrastructure	
Diversification of the sector to the portfolio of products and services	
Providing consulting services regarding financial income, payments, savings and investments.	Customer Experience Management
Protecting the privacy of customers	
24-hour follow-up, guarantee and service	
Gaining trust and increasing customer loyalty to the bank	
Improving customer satisfaction	
Change in the technological culture of the organization	Organizational Culture
A culture of flexibility and willingness to improve services.	
Establishing a culture of change	
Implementation of learning culture	
Adapt with the rapid change in the needs and preferences of customers	Risk management
Inflation reduction and tax regulations	
Reduction of exchange rate fluctuations	
Adapt with Changes My fashion They are not strong a banker	
Removing political and economic obstacles	

Table 6: Final weights of criteria for improving the quality of banking technological services with the AHP approach (Inconsistency rate: 0.02)

Criteria	Technological banking management	Banking technological marketing	Systemic and electronic service quality	Improving the quality of the bank's technological services	Technological hardware and software infrastructure	Customer Experience Management	Organizational Culture	Risk management
Weight	0.191	0.178	0.169	0.188	0.151	0.161	0.168	0.123

4.2 Interpretive-structural modeling

The structural-interpretive modeling method has been used to design the quality model of technological banking services.

The interpretative-structural model included: formation of the structural self-interaction matrix, formation of the received matrix, creation of the final access matrix and determination of relationships and leveling of dimensions and indicators, according to this case, the variable of improving the quality of banking technological services (C04) is at the first level. Systemic and electronic service quality variable (C03) is at level two. The variables of banking technology marketing (C02) and customer experience management (C06) are at level three. The variables of organizational culture (C07) and risk management (C08) are at level four. The technological banking management variable (C01) is at level five. The software and hardware infrastructure variable (C05) is also at level five. The final model of the levels of the identified variables is shown in Figure 1. In this diagram, only the meaningful relationships of the elements of each level on the elements of the lower level and also the meaningful internal relationships of the elements of each row were considered.

Based on the results of this analysis, technological software and hardware infrastructures affect technological

Table 7: Ranking of dimensions and components

rank	Weight	The subject of N sub	The subject of N Main
2	0.082	Support of bank managers for innovative activities	Technological banking management
3	0.078	Using the mechanisms of M Novin in the middle Banking systems	
14	0.050	Using artificial intelligence in providing banking services	
5	0.074	Using strategies that are suitable for the purpose of attracting and retaining customers	
8	0.069	Recruiting specialized human resources	
12	0.058	Behavioral competence of employees	Banking technological marketing
1	0.104	Increased presence in the media and competitive market	
34	0.018	The ability to answer and react fast to events	
7	0.071	The ability to respond and react quickly to events	
10	0.059	Development and use of new technologies	Systemic and electronic service quality
36	0.016	Accuracy and concentration of the system and employees in providing banking services	
3	0.078	Technological facilities and equipment	
35	0.017	Reliability	
28	0.028	Ease of receiving and providing banking services	
13	0.055	Ease of interaction	Improving the quality of the bank's technological services
16	0.048	Improving accountability and clarifying performance	
37	0.012	Development of technological financial planners and consultants	
17	0.047	Using cloud technologies with security, reliability and high compatibility	
30	0.026	Strengthening the ability, competence, flexibility and speed of services	
19	0.043	Constant need for software updates	Technological hardware and software infrastructure
20	0.044	Formulation of software and hardware infrastructure strategy	
21	0.042	Flexible information technology infrastructure	
22	0.040	Diversification of the sector to the portfolio of products and services	
26	0.034	Providing consulting services regarding financial income, payments, savings and investments.	Customer Experience Management
24	0.036	Protecting the privacy of customers	
25	0.035	24-hour follow-up, guarantee and service	
23	0.038	Gaining trust and increasing customer loyalty to the bank	
27	0.030	Improving customer satisfaction	
11	0.057	Change in the technological culture of the organization	Organizational Culture
29	0.027	A culture of flexibility and willingness to improve services.	
18	0.045	Establishing a culture of change	
31	0.025	Implementation of learning culture	
15	0.049	Adapt with the rapid change in the needs and preferences of customers	Risk management
33	0.021	Inflation reduction and tax regulations	
5	0.074	Reduction of exchange rate fluctuations	
9	0.060	Adapt with Changes My fashion They are not strong a banker	
32	0.022	Removing political and economic obstacles	

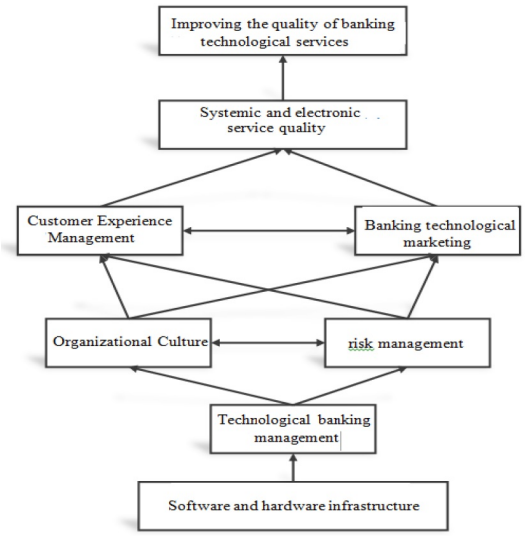

Figure 1: Quality model of technological banking services

banking management. Technological banking management also affects risk management and organizational culture, and in the same way, these variables also affect technological banking marketing and customer experience management. Finally, the system and electronic quality of services leads to the improvement of the quality of banking technological services.

The final stage of interpretive-structural modeling was the analysis of influence-dependence power. In the ISM model, the interrelationships and influence between criteria and the relationship of criteria of different levels are well shown, which leads to a better understanding of the decision-making space by managers. In order to determine the key criteria, the power of influence and the dependence of the criteria are formed in the final access matrix. The power-dependence diagram for the studied variables was shown in Figure 2.

Table 8: The power of penetration and the degree of dependence of the quality variables of technological banking services

Research variables	**The degree of dependence**	**Penetration power**	**level**
Technological banking management (C01)	2	7	5
Banking technological marketing (C02)	6	4	3
Systemic and electronic quality of services (C03)	7	2	2
Improving the quality of banking technological services (C04)	8	1	1
Software and hardware infrastructures (C05)	1	8	6
Customer Experience Management (C06)	6	4	3
Organizational culture (C07)	4	6	4
Risk management (C08)	4	6	4

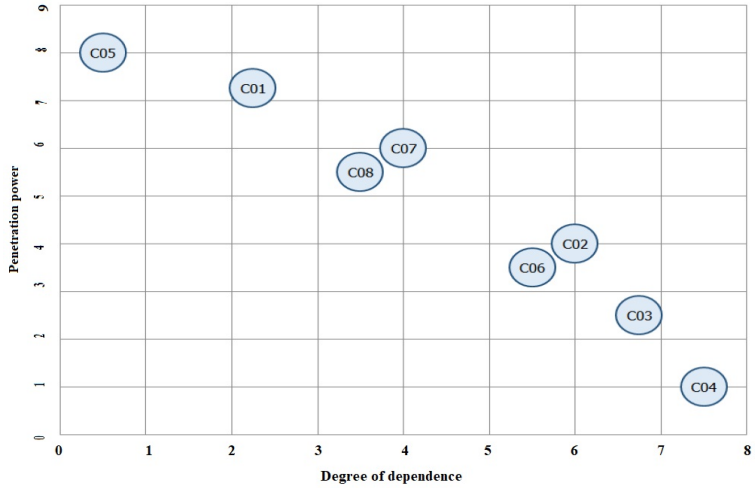

Figure 2: Diagram of penetration power and degree of dependence (Mik-Mak output)

Based on the strength of dependence and influence of the variables, in this analysis the variables are divided into four independent, dependent, linked and independent groups.

Based on the influence-dependence diagram, the variables of technological banking management (C01) and software and hardware infrastructure (C05) have a high influence and low influence and are placed in the area of independent variables. The variables of system and electronic service quality (C03) and improving the quality of banking technological services (C04) also have high dependence but little influence, so they are considered dependent variables. The variables of organizational culture (C07), risk management (C08), banking technology marketing (C02) and customer experience management (C06) have similar influence and degree of dependence, so they are linked variables. It should be noted that no variable has been placed in the first quadrant, i.e. the autonomous region.

Validation of the model with the structural equation model method:

T-value has been used to check the significance of the relationships of model variables, which gives the t-statistic. At the 5% error level, if the value of the bootstrapping statistic is greater than 1.96, the observed correlations are significant. The t-statistic and bootstrapping value to measure the significance of relationships are also shown in Figure 3.

The impact factor of technological software and hardware infrastructure on technological banking management has been obtained as 0.72. Also, the value of t statistic is 10.06. Therefore, it can be claimed with 95% certainty:

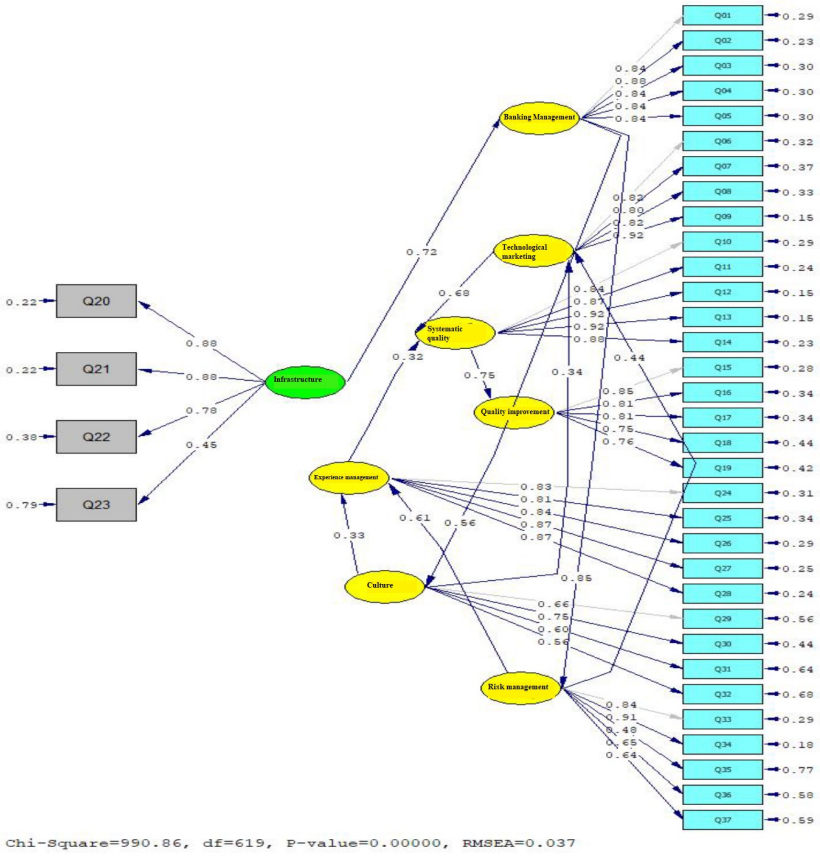

Figure 3: Output of model validation with structural equation model method

technological software and hardware infrastructures have a positive and significant effect on technological banking management. The impact coefficient of technological banking management on risk management has been obtained as 0.85. Also, the value of t statistic is 12.33. Therefore, it can be claimed with 95% certainty: technological banking management has a positive and significant impact on risk management. The coefficient of impact of technological banking management on organizational culture has been obtained as 0.56. Also, the value of t statistic is 7.78. Therefore, it can be claimed with 95% certainty: technological banking management has a positive and significant impact on organizational culture. The coefficient of impact of risk management on banking technological marketing has been obtained as 0.44. Also, the value of t statistic is 20.6. Therefore, it can be claimed with 95% certainty: risk management has a positive and significant effect on banking technological marketing. The coefficient of influence of organizational culture on banking technological marketing has been obtained as 0.34. Also, the value of t statistic is 5.59. Therefore, it can be claimed with 95% certainty: organizational culture has a positive and significant effect on banking technological marketing. The impact factor of risk management on customer experience management has been obtained as 0.61. Also, the value of t statistic is 8.06. Therefore, it can be claimed with 95% certainty: risk management has a positive and significant impact on customer experience management. The coefficient of influence of organizational culture on customer experience management has been obtained as 0.33. Also, the value of t statistic is 3.47. Therefore, it can be claimed with 95% certainty: organizational culture has a positive and significant effect on customer experience management. The impact coefficient of banking technological marketing on the system and electronic quality of services has been obtained as 0.68. Also, the value of t statistic is 9.77. Therefore, it can be claimed with 95% certainty: Bank technological marketing has a positive and significant effect on the system and electronic quality of services. The coefficient of impact of customer experience management on the quality of system and electronic services has been obtained as 0.32. Also, the value of t statistic is 5.54. Therefore, it can be claimed with 95% confidence: customer experience management has a positive and significant effect on the system and electronic quality of services. The coefficient of influence of system and electronic service quality on improving the quality of banking technological services has been obtained as 0.75. Also, the value of t statistic is 9.42. Therefore, it can be claimed with 95% confidence: the system and electronic quality of services has a positive and significant effect on improving the quality of banking technological services. The fitness indices are used to determine the validity of the

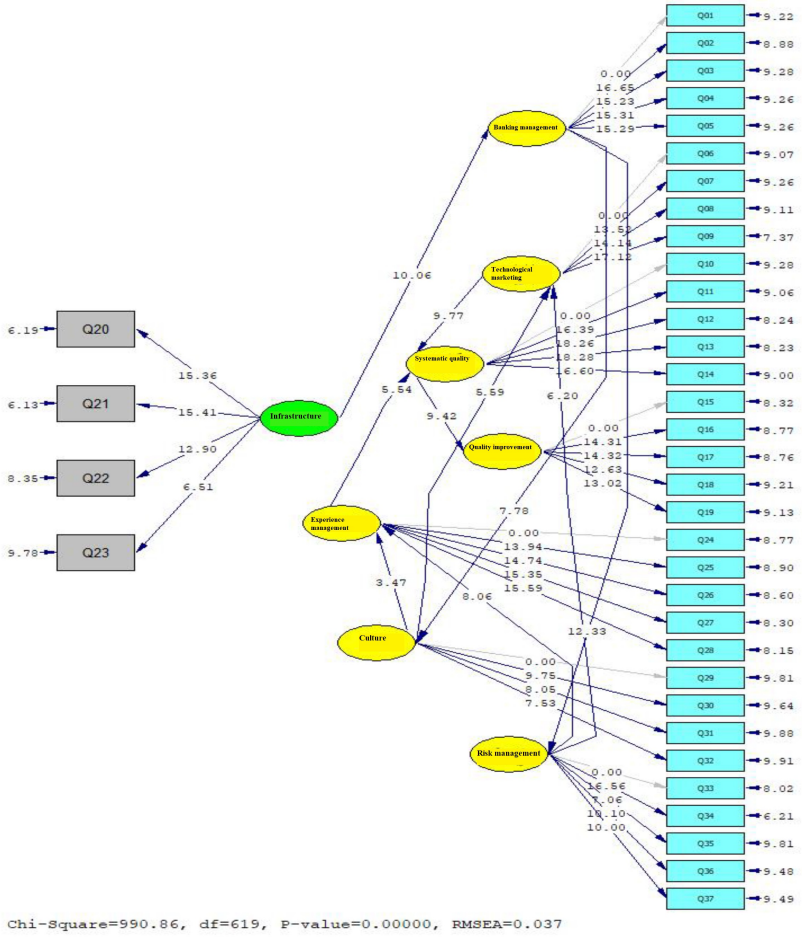

Figure 4: Significance of relationships of variables with structural equation model method (T-Value)

designed models. Several indicators are used to measure the suitability of the model, but usually using 3 to 5 indicators is sufficient. The values related to the goodness of fit criteria of the teachers' quality of life model along with the range of acceptable fit are presented in Table 9.

Table 9: goodness of fit criteria of the main constructs of the research

observed value	**Acceptable fit**	**index name**
0.93	Greater than 0.9	goodness of fit index (GFI)
0.92	Greater than 0.9	Modified Goodness of Fit Index (AGFI)
0.96	Greater than 0.9	Non-Normalized Fit Index (NNFI)
0.95	Greater than 0.9	Normalized Fit Index (NFI)
0.96	Greater than 0.9	Comparative Fit Index (CFI)
0.96	Greater than 0.9	Incremental Fit Index (IFI)
0.95	Greater than 0.9	Relative Fit Index (RFI)
0.91	Greater than 0.9	Normalized parsimonious fit index (PNFI)
0.039	Less than 0.05	Root Mean Square Residual (SRMR)
0.037	Less than 0.05	Root mean square error of estimation (RMSEA)
1.60	Smaller than 2	Chi-square to degrees of freedom (χ^2/df)

The results of the examination of the fit indices show the appropriate fit of the model.

5 Conclusion

The results showed that technological software and hardware infrastructures have a positive and significant effect on technological banking management. Digital banking starts with the development of digital culture. The migration to digital banking has requirements that involve the entire banking ecosystem. In a word, to create digital banking

infrastructures, it can be said that smart software, integrated architectures, transferring customers to the digital space, integrating the information technology team with the business and marketing team and technological banking management were requirements.

Technological banking management has a positive and significant impact on risk management. The present hypothesis was consistent with the research conducted by Messing et al. [13]. Building a digital bank from the beginning provides the possibility of creating a flexible technology infrastructure and proper management of information technology banking, which leads to the creation of an ideal state of risk management. It also helps to optimize the bank balance sheet to achieve a higher return on investment than income and ensures compliance with the continuous changes in banking laws instantly.

Technological banking management has a positive and significant impact on organizational culture. The current hypothesis was consistent with the research done by Mirspasi and Farshchi [14]. Today's digital architecture at its most transparent, when it doesn't just strive to be amazing and glorious, has come to the point that the main part of its agenda is to explore the shifting boundaries between the physical and electronic worlds. The boundary change that is fully connected with the new experiences in the postmodern era. Architecture strives to preserve its traditional body, and the digital age uses powerful tools to express itself. By accepting the current human condition, and being loyal to preserving the body of architecture, we can consider a type of architecture that can explain and interpret new spaces in the form of its own body. But this will be possible only by examining and giving importance to the new culture that has entered human life under the title of digital culture.

Risk management has a positive and significant impact on banking technological marketing. Applying related behaviors to achieve greater effectiveness in decisions, reducing information processing costs, achieving greater recognition in accordance with their decisions and reducing risk related to choice are now among the desires of consumers in the digital environment. After a few successful transactions, consumers trust service providers and goods suppliers. When their trust is gained, they know that these virtual companies are able to provide their needs and desires and they believe in them. The digital environment helps consumers spend less time making decisions by providing wide selection, information evaluation, accuracy and product comparison. The digital environment provides comparative and evaluated information and may reduce the cost of searching for information and trying to make a purchase decision. Organizational culture has a positive and significant effect on banking technological marketing. The present hypothesis was in line with the research conducted by Eftekhari Sinjani et al. [3].

AlQahtani [1] investigated the impact of cultural differences on the acceptance of technology in the people present in the organization, while cultural values play an important role in their technological readiness. Therefore, the different cultural background of the employees affects their readiness and acceptance towards technology and therefore overshadows their service when using technology in their daily activities. Hofstede [7] introduced a five-dimensional measure of cultural value that is an effective guide for determining culture. Hofstede's criterion, which determines the complexities and diversity of intercultural relations, is referred to as a background variable of cultural values. It can be argued that the population of countries is determined by the diverse cultural background and heterogeneity of individuals while tending to generalize specific cultural characteristics among a nation and then generalize to a unique and national cultural identity. In this regard, studying the national identity of the people of a country can be very helpful in using Hofstede's criteria; However, the appropriate departure point is to know that the impact of cultural values on the use of technology in the organization is based on the personal views of individuals. The diverse cultures of users is an important and significant point in the discussion and studies related to the use and acceptance of technology. Therefore, until today, most of the efforts have been focused on the impact of cultural values on the use of technology.

Risk management has a positive and significant impact on customer experience management. When risk aversion prevails, the result is insufficient investment in strategic opportunities and slow responses to customer needs. When there is no unified understanding of the customer, companies try to mobilize their employees around unified experiences and touchpoints, and in the end, they often cannot identify where to take risks. Organizational culture has a positive and significant effect on customer experience management. The present hypothesis was in line with the research done by Mirsepasi and Farshchi [14]. Every successful organization has a desire to provide as much customer satisfaction as possible for the services it provides. Creating a culture in the organization based on keeping customers in the long term is more beneficial than attracting new customers. Because the customers who are highly satisfied with the organization describe their positive experiences to others and become a means to advertise the organization and thus reduce the cost of advertising to attract new customers. In the competitive world, the customer is never dependent on the organization, but the organization is dependent on the customer. This issue is especially important in banks that are in constant contact with customers. On the other hand, the competition between banks and financial institutions is increasing. Critical issues in most service industries are customer satisfaction and service quality. The continuous supply of quality

services at the right price at a high level creates a competitive advantage and creates a culture based on the creation of this advantage for such organizations. Marketing costs and setting higher prices are mentioned. Considering the increase in the choice of customers due to the existence of a large number of private and public banks and financial and credit institutions, identifying factors affecting customer satisfaction by these banks is necessary, important and inevitable. Banking technological marketing has a positive and significant effect on system and electronic quality. The present hypothesis was consistent with the research conducted by Patrick et al. [21]. Digital marketing can be called as one of the tools of e-commerce. In order for companies to remain in this competitive market, there are loopholes to maintain customer loyalty. One of these loopholes is the optimal and continuous use of information technologies in marketing. Marketing based on information technology, which is digital marketing, is a web-based service that allows people to create a public or semi-public profile within a limited system, communicate with other users and view pages and details that other users create within the system. Technological marketing has become a powerful force in shaping different aspects of business. This effect can be evaluated from various aspects. The movement of customers towards new media, the low effectiveness of advertising, the importance of word-of-mouth advertising, especially in the virtual space, access to a large number of audiences and markets, unique opportunities of the virtual space in creating and developing communication, the capacities of the digital marketing platform in Providing and selling products, strengthening the brand, etc. are among the most important effects of the Internet in the field of business. Customer experience management has a positive and significant effect on the system and electronic quality of services. The present hypothesis was consistent with the research conducted by Khatoon et al. [8].

Social networks can be used as one of the important platforms for promoting and even selling products and services of various businesses. This platform creates a suitable opportunity for banks to move to a social business model and coordinate with emerging markets on the one hand, and on the other hand, to analyze customer behavior by analyzing a large amount of customer data. Consider and provide better, personalized and new products and services. Banks need an integrated infrastructure to retrieve, store and distribute information and data without disclosure. Cloud technologies with their high security, reliability and compatibility can play an important role in digital innovations and implementation of digital banking. In addition, cloud technology can act as a flexible integrator layer and match and coordinate the applications of different layers that need to be placed in the digital architecture. Systemic and electronic service quality has a positive and significant effect on improving the quality of banking technological services. The roof of the quality house can provide results to the researcher. In this way, if one of the strategies has a positive effect on a larger number of strategies, it should be considered as a basic and main solution because with its implementation, a number of other strategies will also approach their goals. The desirability of the quality of banking services is a permanent process that should always be under control and supervision and strive to improve its level by removing existing obstacles and problems. This process is an interdisciplinary science that must be synchronized with other business development channels of the bank. In order to be included in this general program, one can also use sub- and side programs. If this component is implemented correctly, a special advantage will be created for the bank compared to other competitors and financial institutions. This feature has been present in a secure IT architecture since the beginning and prevents misuse and sale of data to third parties.

References

[1] Y. AlQahtani, *The effect of cultural differences on the acceptance of technology in the people present in the organization*, J. Cultur. Manag. **8** (2007), 130–145.

[2] F.N. AlQahtani, *Identifying the critical factors that impact on the development of electronic government using TOE framework in Saudi e-government context: A thematic analysis*, Ph.D. Thesis, De Montfort University, 2016.

[3] S.S. Eftekhari Sinjani, A. Rusta, and A. Naami, *Evaluation of the impact of factors affecting the acceptance of financial technology by bank customers (Case study of Pasargad Bank)*, Invest. Sci. Res. Quart. **10** (2021), no. 38, 135–153.

[4] H.M.M. Fairooz and C.N. Wickramasinghe, *Innovation and development of digital finance: A review on digital transformation in banking and financial sector of Sri Lanka*, Asian J. Econ. Finance Manag. **1** (2019), no. 2, 69–78.

[5] S. Fazli and M. Rashidi Astana, *The role of effective factors on the success of customer relationship management strategy in car dealerships in Gilan province*, **6** (2014), no. 1, 125–144.

[6] P. Gomber, J.-A. Koch, and M. Siering, *Digital finance and FinTech: Current research and future research directions*, J. Bus. Econ. **87** (2017), no. 5, 537–580.

[7] G. Hofstede, *Culture's Consequences: Comparing Values, Behaviors, Institutions, and Organizations Across Nations*, Thousand Oaks, CA: SAGE Publications, 2001.

[8] S. Khatoon, X. Zhengliang, and H. Hussain, T*he mediating effect of customer satisfaction on the relationship between electronic banking service quality and customer purchase intention: Evidence from the Qatar banking sector*, SAGE Open **10** (2020), no. 2.

[9] J. Klewes, D. Popp, and M. Rost-Hein, *Digital transformation and the challenges for organizational communications: An introduction*, Out-thinking Organizational Communications: The Impact of Digital Transformation, Springer International Publishing, 2016, pp. 1–6.

[10] K. Madavan and C. Vethirajan, *Customer satisfaction on e-banking services of public and private sector banks in Puducherry region– an empirical analysis*, Int. J. Manag. **11** (2020), no. 6, 649–664.

[11] H. Malekian and M. Soltani, *Investigation of factors shaping customer experience and its effect on Ansar Bank customer satisfaction*, Sci. J. Monetary Bank. Manag. Dev. **3** (2014), no. 7, 51–57.

[12] M.R. Mehrgan, *Advanced Operational Research*, Academic Book Publishing, 2013.

[13] V. Messing, *Technological banking on risk management*, J. Risk Manag. **6** (2010), no. 1, 94–145.

[14] N. Mirsepasi and S. Farshchi, *Agility of banks and preparation of a tool to measure the level of organizational agility in Iran's state-owned banks); Measuring the level of readiness of Iran's Saderat Bank*, Manag. Fut. Res. **23** (2017), 11–24.

[15] H. Mokhtari, M. Akbari, and M.A. Moradi, *The effect of service innovation on the performance of travel agencies in Tehran, the mediating role of service quality and customer satisfaction*, Urban Tourism Quart. 6 (2018), no. 2, 99–116.

[16] B. Mwiya, C. Felix, S. Chanda, K. Edna, K. Bernadette, and S. Beenzu, *Examining factors influencing e-banking adoption: Evidence from bank customers in Zambia*, Amer. J. Ind. Bus. Manag. **7** (2017), 741–759.

[17] F. Najafi, M. Irandoost, H. Sultan Panah, and A. Sheikh Ahmadi, *Identification and ranking of factors affecting the interaction of banks and new financial technologies (Fintechs) with a hybrid approach*, Innov. Manag. **9** (2019), no. 3, 171–196.

[18] A. Namin, *Revisiting customers' perception of service quality in fast food restaurants*, J. Retail. Consum. Serv. **34** (2017), 70–81.

[19] A. Noami and A. Gholampour, *Investigation of the factor structure of social responsibility, customer satisfaction, organizational reputation and performance in economic enterprises - a case study of Shahr Bank*, Quart. Econ. Urban Manag. **5** (2016), no. 17, 1–12.

[20] A. Omarini, *Banks and Banking: Digital Transformation and the Hype of Fintech: Business Impacts, new Frameworks and Managerial Implications*, McGraw Hill, 2019.

[21] D. Patrick, *Digital marketing strategies, online reviews and hotel performance*, Int. J. Hospital. Manag. **72** (2018), 47–55.

[22] M.H. Qolizadeh and M. Ghasemnejad, *Banking and fintech: challenge or opportunity?*, Bimonth. J. Bus. Stud. **14** (2016), no. 80, 31–39.

[23] A. Raza, R. Ahmad Rather, and U. Saeed Bhutta, *An assessment of corporate social responsibility on customer company identification and loyalty in banking industry: A PLS-SEM analysis*, Manag. Res. Rev. **43** (2020), no. 11, 1337–1370.

[24] R. Sainaghi, P. Phillips, and E. Zavarrone, *Performance measurement in tourism firms: A content analytical meta-approach*, Tourism Manag. **59** (2017), 36–56.

[25] B. Sarmad and A. Bazargan, and E. Hijazi, *Research Methods in Behavioral Sciences*, Aghah Publications, Tehran, 2002.

[26] A. Shankar and C. Jebarajakirthy, *The influence of e-banking service quality on customer loyalty: A moderated mediation approach*, Int. J. Bank Market. **37** (2019), no. 5, 1119–1142.