

Prioritizing SWOT factors using hybrid model of BSC, SWOT, Fuzzy AHP and Fuzzy TOPSIS techniques developed for use in a large Iranian commercial bank

Mohammad Hossein Hadavi ^a, Vahid Reza Mirabi ^b

^a PhD student of Marketing management, Department of Business Administration, Faculty of management, Islamic Azad University Central Tehran Branch, Iran.

^b Associate Professor Of Islamic Azad University, Department of Business Administration, Faculty of management, Islamic Azad University Central Tehran Branch, Iran.

Abstract

The purpose of this paper is Prioritizing SWOT factors and BSC Indexes based on their relation to each of Performance measurement aspects which affects strategic marketing plans in a large Iranian commercial bank. The paper purposes a hybrid method for improving the usability of Balanced Score Card and SWOT analysis. A commonly used decision analysis method, the Fuzzy Analytic Hierarchy Process (FAHP) and Fuzzy Technique for Order Preference by Similarity to Ideal Solution (FTOPSIS) calculations framework are integrated with BSC and SWOT analysis Indexes. Fuzzy AHP's connection to BSC shows priorities for each of four Strategic aspects of organization and BSC's Related Indexes according to Balanced score card theory. also Fuzzy TOPSIS's connection to SWOT yields analytically determined priorities for the factors included in SWOT analysis based on their relation to each of BSC's aspects. In fact this research proved that applying pair wise comparisons through FUZZY MCDM techniques between various BSC' indexes which have been related to SWOT's factors cause an efficient evaluation and ranking processes of SWOT's factors which are determined as improvable elements or hindering factors for strategic marketing planning processes. The results shows that based on BSC Theory; learning and growth aspect is the most important aspect in the bank and Internal Processes has the second priority between four organization aspect by BSC theory. Also the results indicated that Weaknesses' factors are the highest priority between SWOT's factors and the next priority belong to Strengths. hence banking improvement efforts should be concentrated on decreasing Weaknesses effects and reinforcement of Strengths especially in learning and growth aspects. The present study examines a new hybrid model for improving the using Balanced Score Card and SWOT analysis in Commercial Bank of Iran, In fact combining BSC method with SWOT helps us to identify Priority of BSC aspects based on SWOT elements in Bank also determines the priority of SWOT factors from internal and external marketing environments through more accurate approach than other related researches. The researcher chose the case study method because it provides a better understanding and content theorization of the processes and context in which the practices of management control take place [16].

Keywords: Fuzzy AHP; Iranian Commercial Bank; Balanced Score Card; BSC; SWOT; Fuzzy MCDM; Fuzzy TOPSIS; Strengths; Weaknesses; Opportunities; Threats

1-Introduction

The banking and financial industry is transforming itself in Un predictable ways, powered in an important way by advances in information technology [1]. The most important activity of the management's control function is the measurement of performance. Banks, which are important institutions of financial services group, have their own reasons to measure performance. Any problem that can occur in the current system of the bank directly influences the stakeholders as well as the general economy. The growth of banking system increases in parallel with the monetization degree of markets; thus the development in the banking sector mutually and deeply affects the other sectors of the economy, particularly real economy [2-fuzzy-performance].

In the financial service sector, especially when it comes to banking activities, there is an increasing need for measuring performance. Due to increased uncertainty and competition in the global banking markets, measuring performance using fuzzy techniques provides clear and reliable information. [17]

The definitions of performance and evaluation are as follows. Performance is referred to as one kind of measurement of the goals of an enterprise, while evaluation is referred to as the goal that an enterprise can effectively obtain during a specific period [3]. Traditional techniques have a number of inherent limitations making them unsuitable for fully reflecting the increasingly complex nature of branch banking. For example, traditional financial ratio analysis does not allow for objectively combining independent evaluations into a single performance score and it is difficult to use for comparative purposes [4].

It is very important for Iranian bank institutions to have a competitive advantage, because they are all quite homogeneous. To outperform competing bank institutions, more emphasis on learning and growth also internal operational performance is required. This means it is imperative to develop an effective way to conduct performance evaluations that can measure the overall organizational performance and link it to the corporate goals. That is, a holistic evaluation model of banking performance is key to a bank's survival [3]. Kaplan and Norton, described performance evaluation as a way to review the achievements of organizations of both their financial and non-financial objectives. Evaluations of the performance of a bank can be diverse. Several previous studies on bank performance measurement examined economies of scale and scope employing traditional statistical methods such as correlation analysis. The majority of past studies have focused on customers and how they choose the bank that will offer them general bank services [3].

Traditional ratio analyses were not sufficient to measure banks' performances and they should be evaluated in a multilateral way, especially in order to identifying effects of various internal and external factors in their performance, such as Measuring the level of customers' satisfaction, getting feedback from their customers about the services they are offered, Positioning in the sector by making a comparison between themselves and their benchmarks. Being sure that decisions are made on the basis of not emotions or assumptions but on real data, Determining the areas which are open to development and might create advantage in the organization.

However, it is not always sufficient to create policies and strategic plans by taking only these financial criteria as a basis. Nowadays, we see that non-financial performance criteria show up as an emerging asset especially in performance measurement. Commercial banks carry out activities to improve themselves particularly in financial developments but, at the same time, give importance to non-financial performance criteria and particularly to customer satisfaction [2]. Unfortunately, the traditional banks merely pay attention to the profit indicators for operating evaluation. However, profit indicators are not

the only determinant factor for evaluation of banking systems. Also, the ranking and assessment methods have their own limitations and advantages [5].

In the literature, there are a large number of studies realized by different methods to measure banks' performances and the need for such studies is increasingly growing. As managers stress on short-term financial performance metrics, they have a tendency to trade off actions, such as new product development, process improvements, human resource development, information technology and customer and market development that can bring in long-term benefits, for current profitability, and this limits the investments with future growth opportunities. In the attempt to solve the problem by supplementing financial measures with additional measures that can help evaluate the long term performance of a firm. Since its introduction, BSC has been adopted by many companies as a foundation for strategic management system. [6].

In the literature, many authors have used multi-criteria decision making methods to evaluate the financial performance of the banking sector. The method that has in numerous studies been recognized as a useful and systematic tool for measuring bank performance is the Analytic Hierarchy Process — AHP (Saaty, 1980). In their study, Ta and Kar (2000) used the AHP approach to make a selection of banks in Singapore. Frei and Harker (1999) applied the AHP approach as an alternative to the DEA method in order to measure bank performance and explore the relationship between financial and operational performance.

Yurdakul and Iç (2004) applied the AHP method to investigate the credibility of companies which is necessary in bilateral relationships between production companies and banks in Turkey.[17]

The majority of past studies have focused on customers and how they choose the bank that will offer them general bank services. According to the related literature, the selection criteria which customers use to evaluate and choose between banks, include price, speed, access, customer service, location, image and reputation, modern facilities, interest rates, opening hours, incentive offered, product range, and service charge policy and so on. The essential tenet of the BSC is that standard financial measures must be balanced with non-financial measures. There has been generally accepted in practice that since the introduction of the BSC by Kaplan and Norton a combination of financial and non-financial measures in a performance measurement system is favorable for both profit and non-profit organizations [3]. Ravi et al [2] developed some models for the estimation of banks' financial performances by using financial variables and they combined these models with the neural networks and statistical techniques. The more recent research of Devlin and Gerrard [3] made an attempt to address the relative importance of various choice criteria in the selection of a banking institution by applying a quantitative methodology of statistical analysis. They provided an analysis of customer choice criteria and multiple banking and made an itemized comparison of the relative importance of choice criteria which impact on the choice for main and secondary banking institutions.

The SWOT analysis is a powerful strategic tool for evaluating an Organizing internal and external key factors [3]. This method determines the best combination of strategies that maximizes the strengths and opportunities and minimizes the weakness and threats, and hence provides an excellent basis for marketing strategy formulation when it is used properly.

In spite of the broad application of SWOT analysis, the main limitation of SWOT analysis is that the importance of each factor in the decision-making can not be measured quantitatively. In other words, one of the drawbacks in SWOT analysis is to determine how to objectively rank the strategies and factors. If it is integrated with

FAHP and FTOPSIS, SWOT analysis can provide a quantitative measure for each factor of the decision making.[13]

2- Materials and Methods

2.1.BSC concept

The concept of Balanced Scorecard (BSC) was proposed by David Norton, the CEO of Nolan Norton Institute, and Robert Kaplan, a professor at Harvard University. The BSC measures organizational performance from four perspectives, including financial, customer, internal business process, and learning and growth, in relation to the four functions of accounting and finance, marketing, value chain, and human resource. The BSC provides managers with the instrumentation tools they need to navigate towards future competitive success [3]. Kaplan and Norton introduced the BSC, a performance measurement framework that provides an integrated look at the business performance of a company by a set of measures, which includes both financial and non-financial metrics [3-6]. The BSC objectives and measures are determined by organizational visions and strategies and are intended to measure organizational performance using the four perspectives as Financial, Customers, Internal business process, Learning and growth [6].

This methodology was introduced because of some weaknesses of the traditional performance evaluation that the current system overemphasizes financial parameters and other perspectives were neglected. The innovation of the BSC technique is to evaluate an organization from four perspectives.[14]

Kaplan and Norton [3] stress the importance of adhering to three principles in developing BSC: maintaining cause-and-effect relationships, comprising sufficient performance drivers and keeping a linkage to financial measures. They also emphasize that the BSC is only a template and must be customized for the specific elements of an organization or industry. The BSC concept can be applied to measure, evaluate and guide activities in specific functional areas of a business, and even at the individual project level [6]. There is abundant literature on performance evaluation demonstrating various topics and successful examples relating to performance management. The traditional performance rankings of banks is based on simple and consistent factors such as financial returns, returns on asset (ROA) and returns on earning (ROE). Nevertheless, performance rankings conducted in this way may not precisely illustrate institutions that embrace strategies for sustaining top performance. Non-financial criteria such as customer satisfaction, community and employee relations can be vital to a bank's winning strategy, because using only ROA or ROE for performance ranking may not necessarily determine which institution offers the highest returns to the investors, nor does it accurately prove which one is most profitable [6].

According to recent survey of more than 1000 organizations, 80% of the organizations that regularly use the BSC reported improvements in operating performance and 66% of them also reported an increase in profits. [14]

Based on the marketing perspective, organizations attain their objectives by fulfilling their clients with superior efficiency in comparison with their competitors.

Performance measurement is a fundamental approach to achieve this progress.

BSC framework was developed in order to assist companies to balance the financial perspectives. Financial perspectives are appropriate to explain the past occurrences which are mostly long-term categories and not appropriate for critical success. BSC was proposed to assist managers to assess the performance of their enterprise based on financial, customer, internal business, and learning and growth perspectives.[15]

Banks can save both time and money if they recognize which measures are most suitable for their needs. An important principle of the BSC is to achieve success on key non-financial measures before actualizing success on key financial measures. When considered in non-financial measures to other measures, these metrics can lead organizations to administer performance effectively and forecast their future profitability [3].

A large amount of research related to the financial industry employed the BSC to evaluate performance and has benefited from its use. Nevertheless, most of these studies focused on how to set up an effective mechanism

to select evaluation criteria rather than on calculating their relative weight[3]. Therefore, this research aims at developing an evaluation model for banking performance not only to investigate the relative importance among the selection criteria, but also to examine the critical gaps for achieving desired level through combining BSC with SWOT methods.

2.2. Literature review of FAHP

Analytic Hierarchy Process (AHP) is one of the well-known Multi criteria decision making techniques that was first proposed by Saaty [3].

Different from classical set theory, fuzzy set theory permits the gradual assessment of the membership of elements in relation to a set (described using a membership function). [20]

Zadeh (1965) is the father of the fuzzy set theory, having done most of the mathematical groundwork to formalize and handle more efficiently the imprecision of human reasoning. This was in 1971 when he published his article, "Quantitative fuzzy semantics" Zadeh (1971). [20]

The fuzzy set theory makes the comparison process more flexible and capable to explain experts' preferences [10].

Cheng proposed a new algorithm for evaluating naval tactical missile systems by the FAHP based on grade value of membership function. His methods can be summarized as: 1. Building membership function of judgment criteria for all sub-items, it is called fuzzy standard, 2. Calculate the grade of membership function by practical data to represent performance scores and 3. Use fuzzy AHP method and entropy concepts to calculate aggregate weights. Cebeci and Kahraman compared some catering firms using four attributes and fuzzy AHP. Torfi, Zanjirani, and Rezapour proposed a Fuzzy multi-criteria decision making approach (FMCDM) to evaluate the alternative options in respect to the user's preference orders[11].

Methodology of FAHP

Let $X = \{x_1, x_2, \dots, x_n\}$ be an object set, and $U = \{u_1, u_2, \dots, u_n\}$ be a goal set, According to the method of Chang's [11] extent analysis, each object is taken and extent analysis for each goal, g_i is performed, respectively. Therefore, m extent analysis values for each object can be obtained, with the following signs Eq. (1):

$$M_{g_i}^1, M_{g_i}^2, \dots, M_{g_i}^m, \quad i = 1, 2, \dots, n, \quad (1)$$

where all the $M_{g_i}^j (j=1, 2, \dots, m)$ are TFNs. The steps of Chang's extent analysis can be given as in the following:

Step 1: The value of fuzzy synthetic extent with respect to the i th object is defined as Eq. (2):

$$S_i = \sum_{j=1}^m M_{g_i}^j \otimes [\sum_{i=1}^n \sum_{j=1}^m M_{g_i}^j]^{-1} \quad (2)$$

To obtain $[\sum_{i=1}^n \sum_{j=1}^m M_{g_i}^j]^{-1}$, perform the fuzzy addition operation of m extent analysis values for a particular matrix such that Eq. (3):

$$\sum_{j=1}^m M_{g_i}^j = (\sum_{j=1}^m l_j, \sum_{j=1}^m m_j, \sum_{j=1}^m u_j) \quad (3)$$

And then compute the inverse of the vector in Eq. (4) such that Eq. (5):

$$\sum_{i=1}^n \sum_{j=1}^m M_{g_i}^j = (\sum_{i=1}^n l_i, \sum_{i=1}^n m_i, \sum_{i=1}^n u_i) \quad (4)$$

$$[\sum_{i=1}^n \sum_{j=1}^m M_{g_i}^j]^{-1} = (\frac{1}{\sum_{i=1}^n u_i}, \frac{1}{\sum_{i=1}^n m_i}, \frac{1}{\sum_{i=1}^n l_i}) \quad (5)$$

Step 2: The degree of possibility of $M_2 = (l_2, m_2, u_2) \geq M_1 = (l_1, m_1, u_1)$ Can be expressed as follows Eq. (6):

$$V(M_2 \geq M_1) = \begin{cases} 1 & \text{if } m_2 \geq m_1 \\ 0 & \text{if } l_1 \geq u_2 \\ \frac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)} & \text{otherwise} \end{cases} \quad (6)$$

where d is the ordinate of the highest intersection point D between μ_{m_1} and μ_{m_2} (see Fig. 1).

To compare M_1 and M_2 , we need both the values of $V(M_1 \geq M_2)$ and $V(M_2 \geq M_1)$

Step 3: The degree possibility for a convex fuzzy number to be greater than k convex fuzzy numbers M_i ($i = 1, 2, \dots, k$) can be defined by Eq. (7):

$$V(M \geq M_1, M_2, \dots, M_k) = V[(M \geq M_1) \text{ and } (M \geq M_2) \text{ and } \dots \text{ and } (M \geq M_k)] = \min V(M \geq M_i), \quad i=1, 2, 3, \dots, k \quad (7)$$

Assume that Eq. (8):

$$d^*(A_i) = \min V(S_i \geq S_k) \quad (8)$$

For $k = 1, 2, \dots, n$; $k \neq i$ then the weight vector is given by Eq. (9):

$$W' = (d^*(A_1), d^*(A_2), \dots, d^*(A_n))^T, \quad (9)$$

where A_i ($i = 1, 2, \dots, n$) are n elements.

Step 4: via normalization, the normalized weight vectors are given by Eq. (10):

$$W = (d(A_1), d(A_2), \dots, d(A_n))^T \quad (10)$$

where W is a non fuzzy number.

In order to integrate evaluation result by various expert. Geometric mean was used for summarizing the results of experts' fuzzy judgments in each criterion.

To calculate $M_1 = (l_1, m_1, u_1)$ to $M_i = (l_i, m_i, u_i)$, $i=1, 2, 3, \dots, k$

in geometric mean method Can be expressed as follows Eq. (11):

$$M_i = ((l_1 * l_2 * \dots * l_k)^{1/k}), ((m_1 * m_2 * \dots * m_k)^{1/k}), ((u_1 * u_2 * \dots * u_k)^{1/k}) \quad (11)$$

2.3. Fuzzy TOPSIS method

The TOPSIS method is a multiple criteria decision making technique proposed by Hwang and Yoon (1981) to identify a solution from a finite set of options. Its principle is based on the fact that, the chosen option should have the shortest distance from the positive ideal solution and the farthest distance from the negative ideal solution (Taylan et al., 2014; Beikkhakhian et al., 2015). The Fuzzy TOPSIS technique was proposed by Chen to solve multi-criteria decision making problems under fuzzy environment and to deal efficiently with uncertainty in the evaluations and judgments. [19]

Fuzzy TOPSIS provides an advantageous way to deal with incomplete and uncertain information due to the increasing complexity of the energy policy decisions under fuzzy environment.

In fuzzy TOPSIS, linguistic preferences can easily be converted to fuzzy numbers and be used in the calculations. [13]

By this technique, the options have to be evaluated with respect to a set of criteria and as the linguistic experts' opinions are subjective, vague, and imprecise in nature (Islam et al., 2013), fuzzy set theory has to be used, and TFNs can be used to express the linguistic expert's opinions. The steps of Fuzzy TOPSIS can be given as in the following steps:

Step 1. The importance weight of criteria $\tilde{w}_j$ which describes the aggregated

fuzzy weight of the j^{th} criterion with respect to the overall goal, C_j ($j=1, \dots, n$), given by the N th decision maker

and is calculated by Fuzzy AHP technique will be fed to Fuzzy TOPSIS.

Step 2. Aggregating ratings of options: To build the decision matrix, the linguistic ratings of an option by different decision makers expressed in terms of TFNs have to be aggregated. In case, there

are N decision makers, and the rating of the i^{th} option for j^{th} criterion is $\tilde{X}_{ij} = (x_{ija}, x_{ijb}, x_{ijc})$, the aggregated rating can be expressed by the following equations:[19]

$$\begin{cases} \tilde{X}_{ija} = \frac{1}{N}(x_{ija}^1 + x_{ija}^2 + \dots + x_{ija}^N) \\ \tilde{X}_{ijb} = \frac{1}{N}(x_{ijb}^1 + x_{ijb}^2 + \dots + x_{ijb}^N) \\ \tilde{X}_{ijc} = \frac{1}{N}(x_{ijc}^1 + x_{ijc}^2 + \dots + x_{ijc}^N) \end{cases} \quad (12)$$

Step 3. Building and normalizing the fuzzy decision matrix from the aggregated ratings of options as follows:

$$\widetilde{DM} = \begin{bmatrix} \tilde{X}_{11} & \tilde{X}_{12} & \dots & \tilde{X}_{1n} \\ \tilde{X}_{21} & \tilde{X}_{22} & \dots & \tilde{X}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{X}_{m1} & \tilde{X}_{m2} & \dots & \tilde{X}_{mn} \end{bmatrix} \quad (13)$$

where, $\tilde{X}_{ij}$ is the aggregated fuzzy rating of i th option with respect to j^{th} criterion and, $i=1, 2, 3, \dots, m, j=1, 2, 3, \dots, n$. The normalization of the decision matrix $\widetilde{DM}$ has to be carried out by the linear scale transformation as follows:

$$c_j^+ = \text{Max } x_{ijc}, \quad j \in B; \quad \bar{u}_{ij} = \left(\frac{x_{ija}}{c_j^+}, \frac{x_{ijb}}{c_j^+}, \frac{x_{ijc}}{c_j^+} \right) \quad (14)$$

$$a_j^- = \text{Min } x_{ija}, \quad j \in C; \quad \bar{u}_{ij} = \left(\frac{a_j^-}{x_{ijc}}, \frac{a_j^-}{x_{ijb}}, \frac{a_j^-}{x_{ija}} \right) \quad (15)$$

where, c_j^+ is used for criteria “with positive effect” and a_j^- is used for criteria “with negative effect”. $\bar{u}_{ij}$ is the normalized rating of the option, and the normalization matrix is as follow:

$$\tilde{U} = \begin{bmatrix} \tilde{u}_{11} & \tilde{u}_{12} & \cdots & \tilde{u}_{1n} \\ \tilde{u}_{21} & \tilde{u}_{22} & \cdots & \tilde{u}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \tilde{u}_{m1} & \tilde{u}_{m2} & \cdots & \tilde{u}_{mn} \end{bmatrix} \quad (16)$$

Step 4. The fuzzy weighted normalized decision matrix will be calculated by multiplying the weights of the evaluation criteria $\tilde{w}_j$ by the elements of the normalized fuzzy decision matrix $\tilde{u}_{ij}$ according to the following equations:

$$\bar{v}_{ij} = \tilde{u}_{ij} \times \tilde{w}_j = \left(\frac{x_{ija}}{c_j^+}, \frac{x_{ijb}}{c_j^+}, \frac{x_{ijc}}{c_j^+} \right) \times (w_1, w_2, w_3) \quad (17)$$

$$\bar{v}_{ij} = \tilde{u}_{ij} \times \tilde{w}_j = \left(\frac{a_j^-}{x_{ijc}}, \frac{a_j^-}{x_{ijb}}, \frac{a_j^-}{x_{ija}} \right) \times (w_1, w_2, w_3) \quad (18)$$

$$\bar{V} = \tilde{U} \times \tilde{W} = \begin{bmatrix} \bar{v}_{11} & \bar{v}_{12} & \cdots & \bar{v}_{1n} \\ \bar{v}_{21} & \bar{v}_{22} & \cdots & \bar{v}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \bar{v}_{m1} & \bar{v}_{m2} & \cdots & \bar{v}_{mn} \end{bmatrix} \quad (19)$$

where, $i=1, 2, 3, \dots, m, j=1, 2, 3, \dots, n$, and the element of $\bar{v}_{ij}$ is a weighted normalize fuzzy number, and their elements are in the range of $[0, 1]$.

Step 5. Defining the Fuzzy Positive Ideal Solution (FPIS, S^+), and the Fuzzy Negative Ideal Solution (FNIS, S^-): the positive ideal solution (PIS) allows maximizing the benefit attributes and minimizing the cost attributes. On the contrary, the negative ideal solution (NIS) does the opposite, by minimizing the benefit attributes and maximizing the cost attributes. The option which is closer to the PIS, and farther from the NIS is the leading solution (Islam et al., 2013; Junior et al., 2014). The (FPIS, S^+) and (FNIS, S^-) can be defined according to the following equations:

$$S^+ = (\bar{v}_1^+, \bar{v}_2^+, \dots, \bar{v}_n^+), \bar{v}_j^+ = (\text{Max } \bar{v}_{ija}, \text{Max } \bar{v}_{ijb}, \text{Max } \bar{v}_{ijc}) \quad (20)$$

$$S^- = (\bar{v}_1^-, \bar{v}_2^-, \dots, \bar{v}_n^-), \bar{v}_j^- = (\text{Min } \bar{v}_{ija}, \text{Min } \bar{v}_{ijb}, \text{Min } \bar{v}_{ijc}) \quad (21)$$

Step 6. Computing the separation distances of each option from the FPIS and the FNIS to provide a measure of the closeness of the options from the FPIS and the FNIS according to the following equations, which provide separation distance for two TFNs by the vertex method:

$$d(\bar{v}_{ij}, \bar{v}_j^+) = \sqrt{\frac{1}{3} [(\bar{v}_{ija} - \text{max } \bar{v}_{ija})^2 + (\bar{v}_{ijb} - \text{max } \bar{v}_{ijb})^2 + (\bar{v}_{ijc} - \text{max } \bar{v}_{ijc})^2]} \quad (22)$$

$$d(\bar{v}_{ij}, \bar{v}_j^-) = \sqrt{\frac{1}{3}[(\bar{v}_{ija} - \min \bar{v}_{ija})^2 + (\bar{v}_{ijb} - \min \bar{v}_{ijb})^2 + (\bar{v}_{ijc} - \min \bar{v}_{ijc})^2]} \quad (23)$$

$$D_i^+ = \sum d(\bar{v}_{ij}, \bar{v}_j^+), \quad i = 1, 2, 3, \dots, m, \quad j = 1, 2, 3, \dots, n \quad (24)$$

$$D_i^- = \sum d(\bar{v}_{ij}, \bar{v}_j^-), \quad i = 1, 2, 3, \dots, m, \quad j = 1, 2, 3, \dots, n \quad (25)$$

Step 7. Computing the relative closeness coefficient (CC_i) of each option with respect to the (FPIS, S^+), and (FPIS, S^-) using the following equation:

$$CC_i = \left[\frac{D_i^-}{D_i^+ + D_i^-} \right], \quad i = 1, 2, \dots, m \quad (26)$$

Step 8. Defining the ranking of the options according to the values of closeness coefficients (CCs), in descending order. The best option will be the closest to the FPIS and the farthest to the FNIS.

2.4. SWOT analysis

SWOT _the acronym standing for Strengths,Weaknesses, Opportunities and Threats. Analysis is a commonly used tool for analyzing internal and external environments in order to attain a systematic approach and support for a decision situation [7]. SWOT analysis comprised internal factors (strengths ,weaknesses),which examine the assets within the organization in which could impact successor failure, and external factors(opportunities ,threats),which investigates factors in the environment which are typically outside of the organizations control that may affect the performance of the organization [8]. If used correctly, SWOT can provide a good basis for successful strategy formulation. Nevertheless, it could be used more efficiently [7].

SWOT analysis is one of the most reliable, and most commonly used strategic planning tools. It allows managers to investigate the situation by defining external opportunities and threats and internal strengths and weaknesses in order to develop an action plan . [13]

SWOT analysis In order to stay effective and successful in the market place, every organization include commercial banks have to be aware of internal and external forces which could impact their success or failure. Conducting a SWOT analysis is a simple but effective strategic planning tool to allow the organization to be recognizant of these factors. When using SWOT, the analysis lacks the possibility of comprehensively appraising the strategic decision making situation; merely pinpointing the number of factors in strength, weakness, opportunity or threat groups does not pinpoint the most significant group. The further utilization of SWOT is, thus, mainly based on the qualitative analysis, capabilities and expertise of the persons participating in the planning process [8].

Though this seems an obvious way for the utilization of the SWOT technique, most of the organizations use its results in neither one of the mentioned stages of the second part of the whole process –analysis of alternatives and selection of the most convenient one. They use it only to obtain a description of the actual situation of the organization and its environment [9]. Some shortcomings of SWOT have been pointed out by some authors [7]. Applications for gaining extra value from SWOT analysis in further strategic planning processes have been presented [8]. Weihrich [7], presented the TOWS matrix, which helps to systematically identify relationships between threats, opportunities, weaknesses and strengths, and offers

a structure for generating strategies on the basis of these relationships. Some examples of weighting and subdividing SWOT lists have been presented [8]. Kotler [7] presented that external factors could be classified according to their attractiveness and success probability (opportunities) and seriousness and probability of occurrence (threats). Internal factors could be rated by their performance and importance. In addition, he subdivided SWOT by business unit.

2.5. Linguistic variable

Linguistic variables are variables whose values are words or sentences in a natural or artificial language. In other words, they are variables with lingual expression as their values [3]. Through expert questionnaires, each expert is asked to assign linguistic terms by TFN (as shown in Table 1) to the pair wise comparisons among all criteria in the dimensions of a hierarchy system. The possible values for these variables contains: 'Equally important', 'Weakly important', 'Essentially important', 'Very strongly important', and 'Absolutely important'. The evaluators are asked to conduct their judgments, and each linguistic variable can be indicated by a triangular fuzzy number (TFN) within the scale range of 1–9. An example of membership functions of nine levels of linguistic variables is shown in Fig. 3. For instance, the linguistic variable 'Absolutely important' can be represented as (7, 9,9). Besides, each evaluator can personally define his/her subjective range of linguistic variables. The use of linguistic variables is applied widely. In this paper, linguistic variables expressed by TFN are adopted to stand for evaluators' subjective measures to determine the degrees of importance among evaluation criteria in BSC aspects, BSC's Related Indexes and SWOT Factors.

2.6. The Hierarchy of Hybrid model

The hierarchy for our problem has been structured in four levels (Fig.2), as we describe next. The first level, as usual, is the goal to be achieved by the decision; the second level is constituted by the four aspects of organization processes as defined by the BSC approach: Finance, Customer, Internal Processes, Learning and Growth; the third level is constituted by related indexes to each aspect of BSC and the fourth level is constructed by the four groups of factors as defined by the SWOT technique: Strengths (S), Weaknesses (W), Opportunities (O) and Threats (T); the fourth level factors describes elements which can help to execute marketing strategic plans better or may hinder success in execution.

2.7. An overview of the methods employed

This study proposes a fuzzy performance evaluation model based on financial and non-financial indicators for banking sector. When a combination between BSC's aspects and related indexes and SWOT factors with FAHP and FTOPSIS techniques are constructed, prioritizing all of them deeply accomplished.

The integration of fuzzy AHP and fuzzy TOPSIS is constructed without losing the generality of the fuzzy AHP and fuzzy TOPSIS.

Based on the objective and approach, the study consists of five following steps:

- 1- we used fuzzy AHP method to properly rank the BSC aspects, in this method the priority weights of the criteria were determined using Fuzzy AHP. (Table 2)
- 2- we used BSC to identify all of the relevant Indexes, which can then be grouped into Finance, Customer, Internal Processes, Learning and Growth. (Table 3)
- 3- we used fuzzy AHP method to properly rank the BSC Indexes. (Table 3)
- 4- we used SWOT analysis to identify all of the relevant factors, which can then be grouped into strengths (S), weaknesses (W), opportunities (O), and threats (T) according to internal and

external perspectives and calculate their weights in relation with BSC indexes by FTOPSIS method. (Table 4)

- 5- we used fuzzy TOPSIS method to properly rank of the SWOT factors.(Table 5)

Note: In both steps 2 and 4; a desk study was performed and opinions of experts were used to identify the factors affecting the Balanced Score Card and SWOT. [13, 18]

3-Results

A Large Iranian Commercial Bank was evaluated by the experts based on the selected evaluation criteria. In this research every level of developed Hierarchy's model elements was evaluated by a TFN with a range of 1-9. Fuzzy judgment of criterions in each level, integrated by competence experts through Eqs. (1) -(11), are summarized in Tables 2-5 as have been described in the following sentences.

Table 2 shows Balanced Score Card aspects and Table 3 shows their related indexes.

Also Related weights of indexes to each one of four aspects of BSC are summarized in Tables 2,3. in order to determining final weights for each BSC's index in Level 3, calculated weights for every BSC's aspect in level two have been multiplied with every BSC's indexes related weights and its results was shown in Table 3.

Each one of four groups of SWOT (Strengths, Weaknesses, Opportunities, Threats) and final FTOPSIS weights in Level 4 which calculated by Eqs. (12) -(26), are summarized in Tables 4.

Table 5 shows the Ranking of the priority of all SWOT's factors individually in every factors and their overall priority.

4-Discussion and Conclusion Conclusion

The measurement of bank performance is of key importance to the economy. The uncertainty and complexity of the global market, as well as an increase in the flow of information, represent the greatest obstacles for accurate measurement of performance. In such conditions, traditional performance measurements fail to produce satisfactory results. However, a fuzzy multi-criteria approach has been successfully used to overcome this problem.[17]

Many organizations limit value of SWOT technique to the stage of strategic design, but its value could be increased substantially when SWOT factors combined with techniques for evaluation of performances, especially for banks [12]. In this work, we have proved that combining BSC as an efficient performance measurement framework with SWOT factors through Fuzzy MCDM techniques (FAHP and FTOPSIS). Using the hierarchy model provides an integrated approach to effective factors in banking manager decisions.

In fact this research express that applying pair wise comparisons through FUZZY MCDM techniques between various BSC' indexes which have been related to SWOT's factors cause an efficient evaluation and ranking processes for these factors.

The results of Table 2 implies that learning and growth is the most important aspects of organization's processes , the second important aspect of BSC are Internal processes , Customer is third priority in BSC's aspects , Finally Financial processes have not any considerable importance. It indicates that although banks are financial institution, but results shows that in referee's bank paying attention to financial processes has not any priority between four aspects of performance measurement.

The results of Table 3 implies that managerial Performance Improvement is the most important index between all related indexes to BSC aspects, the second important index is customer satisfaction and employee satisfaction has third priority between all related indexes.

The results of Table 4 implies that Weaknesses are the most important factors of SWOT (Total factors weight is 0.3481), the second important factors are Strengths(Total factors weight is 0.3006), , Threats are third priority in SWOT's elements (Total factors weight is 0.2124), Finally Environmental Opportunities has not any considerable importance (Total factors weight is 0.1389). It indicates that in present situation

internal factors are more important for this Bank (Total factors weight is 0.6487), So in order to build marketing strategies Bank should pay attention them more than External factors. For example opportunities in comparisons of other SWOT's factors have no effect in achieving BSC indexes related goals.

Results of Tables 4. Were summarized in Table 5, this table implies that most of important factors are related to Human Resource consideration (W6, W4, W5), this factors' weight are higher than other factors. in fact bank should be concentrated on Increasing employee satisfaction. The fourth priority of factors is "Sanctions against the bank (T4)" So bank should try to develop relationship with other banks and other financial; transactions channels. Fifth priority of factors is "Privatization of Bank (S3)". Privatization is unique opportunity for changing and improvement of internal processes and increasing relationship with customers.

results of this study shows that the most important aim which should be implemented is reforming in human resource management view. This approach could be achieved effectively through conducting activities in order to reduce the negative effects of important identified weaknesses and External Threats which have been prioritized in this research, although based on extracted results; Privatization of bank is an important strength that could be applied for improving managerial performances based on BSC perspectives like customer, internal business process, learning and growth through innovative solutions, Otherwise performing marketing strategic plan may have so limitation to achieve their objectives.

Finally this study could be a good direction for future researches about other fields which are related to planning marketing strategies.

References

1. M. Haghighi, Divandari, A., and Keimasi, M. (2010), " The impact of 3D e-readiness on e-banking development in Iran: A fuzzy AHP Analysis", *Expert Systems with Applications*, Vol 37, pp. 4084 - 4093.
2. N Y. Secme, Nese., Bayrakdaroglu, A. and Kahraman, C. (2009), " Fuzzy performance evaluation in Turkish Banking Sector using Analytic Hierarchy Process and TOPSIS", *Expert Systems with Applications*, Vol 36, pp. 11699 - 11709.
3. Hung-Yi. Wu, Tzeng, G.H. and Chen, Y.H. (2009), "A fuzzy MCDM approach for evaluating banking performance based on Balanced Scorecard", *Expert Systems with Applications*, Vol 36, pp. 10135 - 10147.
4. J C. Paradi, Rouatt, S., and Zhu, H. (2011), "Two-stage evaluation of bank branch efficiency using data envelopment analysis", *Omega*, Vol 39, pp. 99-109.
5. A. Azadeh, Ghaderi, S.F., Mirjalili, M., and Moghaddam M. (2011), "Integration of analytic hierarchy process and data envelopment analysis for assessment and optimization of personnel productivity in a large industrial bank", *Expert Systems with Applications*, Vol 38 No.5, pp. 5212 - 5225.
6. A.H.I. Lee, Chen, W.C. and Chang, C.J. (2008), "A fuzzy AHP and BSC approach for evaluating performance of IT department in the manufacturing industry in Taiwan", *Expert Systems with Applications*, Vol 34, pp. 96-107.
7. M. Kurttila, Pesonen, M., Kangas, J., and Kajanus, M. (2000), "Utilizing the analytic hierarchy process (AHP) in SWOT analysis - a hybrid method and its application to a
8. forest-certification case", *Forest Policy and Economics*, Vol 1, pp. 41-52.
9. S. Lee and Walsh P. (2011), "SWOT and AHP hybrid model for sport marketing outsourcing using a case of intercollegiate sport", *Sport Management Review*, Vol 14 No.4, pp. 361-369.
10. E.E. Osuna, Aranda, A. (2007), " COMBINING SWOT AND AHP TECHNIQUES FOR STRATEGIC PLANNING", *ISAHP 2007*, Viña del Mar, Chile, August 2-6.

11. S. Mahmoodzadeh, Shahrabi, J., Pariazar, M., and Zaeri, M.S. (2007), "Project Selection by Using Fuzzy AHP and TOPSIS Technique", *World Academy of Science, Engineering and Technology* 30.
12. R. Rostamzadeh, and Sofian, S. (2011), "Prioritizing effective 7Ms to improve production systems performance using fuzzy AHP and fuzzy TOPSIS (case study). ", *Expert Systems with Applications*, Vol 38 No.5, pp. 5166-5177.
13. H. Rezaie Dollatabadi, H., Ketabi, S., and Hadavi, M.H. (2011), "Hybrid Approach of Fuzzy AHP and SWOT Marketing Strategies Formulating in a Large commercial Bank.", *Interdisciplinary Journal Of Contemporary Research In Business.*, Vol 3 No.7, pp.315-329.
14. B.C. Ervural, Zaima, S. Demireld, O.F., Aydinb, Z., and Delenc, D. (2018), "An ANP and fuzzy TOPSIS-based SWOT analysis for Turkey's energy planning", *Renewable and Sustainable Energy Reviews*, Vol 82 No.1, pp. 1538-1550
15. Rabbani, Zamani, M. Yazdani-Chamzini, A., Zavadskas, E.K. (2014), "Proposing a new integrated model based on sustainability balanced scorecard (SBSC) and MCDM approaches by using linguistic variables for the performance evaluation of oil producing companies", *Expert Systems with Applications*, Vol 41 No.16, pp. 7316-7327.
16. M. Rahiminezhad Galankashi, Helmi, S.A., and Hashemzahi, P. (2016), "Supplier selection in automobile industry: A mixed balanced scorecard-fuzzy AHP approach", *Alexandria Engineering Journal*, Vol 55 No.1, pp. 93-100.
17. A.M.S. da Costa Ferreira, (2017), "How managers use the balanced scorecard to support strategy implementation and formulation processes", *TÉKHNE - Review of Applied Management Studies*, Vol15, pp. 2-15.
18. K. Mandic, Delibasic, B., Knezevic, S., and Benkovic, S. (2014), "Analysis of the financial parameters of Serbian banks through the
19. application of the fuzzy AHP and TOPSIS methods", *Economic Modelling*, Vol 43, pp. 30–37.
20. H. Sayyadi Tooranloo, Azadi, M.H., and Sayyahpoor, A. (2017), "Analyzing Factors Affecting Implementation Success of Sustainable Human Resource Management (SHRM) using a Hybrid Approach of FAHP and Type-2 Fuzzy DEMATEL", *Journal of Cleaner Production*, Vol 162, pp. 1252-1265.
21. J. Seyedmohammadi, Sarmadian, F., Jafarzadeh, A.A.,
22. Ghorbani, M.A., and Shahbazi, F. (2018), "Application of SAW, TOPSIS and fuzzy TOPSIS models in cultivation priority planning for maize, rapeseed and soybean crops", *Geoderma*, Vol 310, pp. 178–190.
23. S. Kubler, Robert, J., Derigent, W., Voisin, A., and Le Traona, Y., (2016), "A state-of the-art survey & testbed of Fuzzy AHP (FAHP) applications", *Expert Systems with Applications*, Vol 65, pp. 398–422.

Appendix

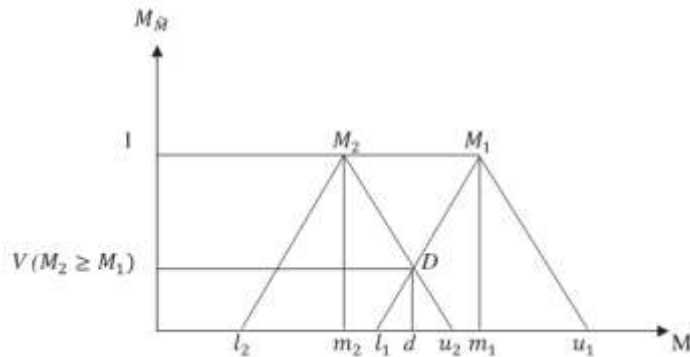


Fig. 1: The intersection between M_1 and M_2 .

Table1: Membership function of the linguistic scale (Wu, 2009).

Table 1

Membership function of the linguistic scale.

Fuzzy number	Linguistic scales	TFN ($\tilde{a}_0$)	Reciprocal of a TFN ($\tilde{a}_0$)
9	Absolutely important	(7,9,9)	(1/9, 1/9, 1/7)
7	Very strongly important	(5,7,9)	(1/9, 1/7, 1/5)
5	Essentially important	(3,5,7)	(1/7, 1/5, 1/3)
3	Weakly important	(1,3,5)	(1/5, 1/3, 1)
1	Equally important	(1,1,3)	(1/3, 1, 1)
2, 4, 6, 8	Intermediate value between two adjacent judgments		

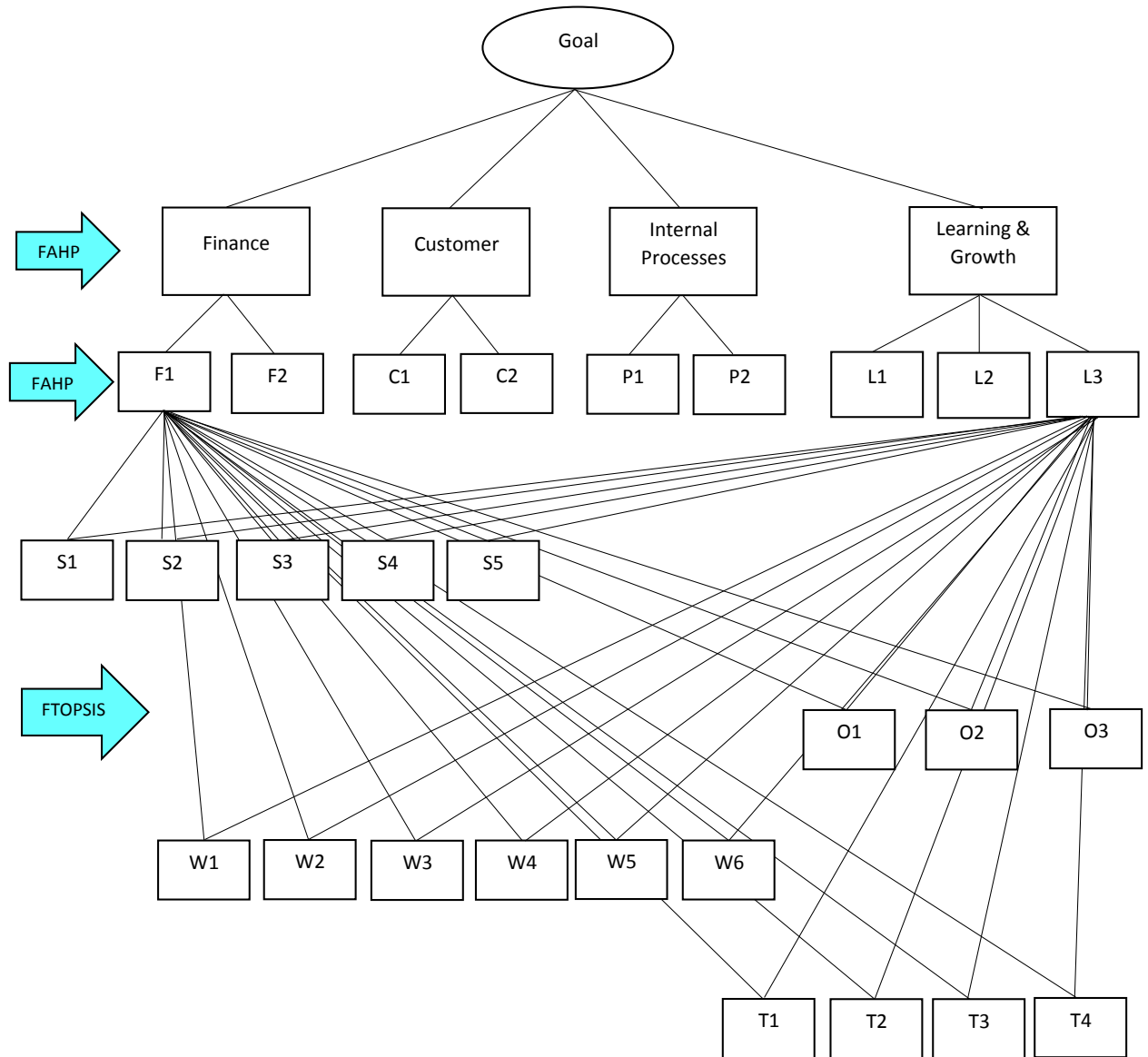


Fig 2: Hierarchy model diagram

Table 2: weights of BSC evaluation elements by FAHP

Criteria	Level 2 weights	Rank
Finance	0	4
Customer	0.31	3
Internal Processes	0.33	2
Learning and Growth	0.36	1

Table 3: weights of BSC Indexes by FAHP

BSC's Criteria Name	BSC's weights	SWOT 's Factors (Level 3)	Level 3 factors 's weight	General weights in Level 3' factors
Finance	0	Income Increasing	0.56	0
		Net Profit	0.44	0
Customer	0.31	Customer Satisfaction	0.64	0.20
		Market share	0.36	0.11
Internal Processes	0.33	Speed in Banking Services	0	0
		managerial Performance Improvement	1	0.33
Learning and Growth	0.36	High Quality Professional Training courses	0	0
		Employee satisfaction	0.52	0.19
		Learning enthusiasm in Employee	0.48	0.17

Table 4: weights and ranking of SWOT Factors by FTOPSIS method.

Criteria Type	Identity	SWOT Factors	Distance to the PIS	Distance to the NIS	Closeness coefficients	Standard Closeness coefficients	Total weights in Groups
Strengths	S1	Numerous Customer Contact Points	3.00	2.34	0.51	0.0536	0.3006
	S2	Qualified Experts	2.51	2.63	0.51	0.0624	
	S3	Privatization of Bank	2.45	2.58	0.51	0.0626	
	S4	Appropriate IT Infrastructures	2.49	2.56	0.51	0.0619	
	S5	Multiple Branches and Related Banks in abroad of country	2.55	2.47	0.49	0.0601	
Weaknesses	W1	Insufficient knowledge of employee in modern Banking	2.47	2.55	0.51	0.0620	0.3481
	W2	Low returns branches	3.03	1.74	0.36	0.0446	
	W3	Shortage Income in Service activities	3.20	1.48	0.32	0.0386	
	W4	Distance between benefits of employee and organization	2.23	2.76	0.55	0.0677	
	W5	Management Instability	2.30	2.76	0.55	0.0666	
	W6	Not to use Suitable Managerial Potentials	2.19	2.80	0.56	0.0686	
Opportunities	O1	People's Gradual Approach to Using New Banking Services	2.60	2.41	0.48	0.0587	0.1389
	O2	Need for bank facilities to optimize energy consumption	3.12	1.47	0.36	0.0437	
	O3	Non-monetary asset growth due to inflation	3.32	1.42	0.30	0.0365	
Threats	T1	Unrealistic rate of banking services	3.19	1.49	0.32	0.0389	0.2124
	T2	Increasing the number of certified competitors	2.67	2.22	0.45	0.0555	
	T3	Payment of imperative loans from the bank's internal resources	2.67	2.21	0.45	0.0553	
	T4	Sanctions against the bank	2.41	2.45	0.51	0.0627	

Table 5: Ranking SWOT's Factors

SWOT 's Factors	Identity	SWOT's Group	Rank in Group	General Rank
Not to use Suitable Managerial Potentials	W6	Weaknesses	1	1
Distance between benefits of employee and organization	W4	Weaknesses	2	2
Management Instability	W5	Weaknesses	3	3
Sanctions against the bank	T4	Threats	1	4
Privatization of Bank	S3	Strengths	1	5
Qualified Experts	S2	Strengths	2	6
Insufficient knowledge of employee in modern Banking	W1	Weaknesses	4	7
Appropriate IT Infrastructures	S4	Strengths	3	8
Multiple Braches and Related Banks in abroad of country	S5	Strengths	4	9
People's Gradual Approach to Using New Banking Services	O1	Opportunities	1	10
Increasing the number of certified competitors	T2	Threats	2	11
Payment of imperative loans from the bank's internal resources	T3	Threats	3	12
Numerous Customer Contact Points	S1	Strengths	5	13
Low returns branches	W2	Weaknesses	5	14
Need for bank facilities to optimize energy consumption	O2	Opportunities	2	15
Unrealistic rate of banking services	T1	Threats	4	16
Shortage Income in Service activities	W3	Weaknesses	6	17
Non-monetary asset growth due to inflation	O3	Opportunities	3	18