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Ranking the Branches of Bank Sepah of Sistan Baluchistan Using Balanced Score Card and Fuzzy Multi-Attribute *Decision* Making Methods

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Abstract

The evaluation of the performance of the organizations and enterprises with similar activities and the study of the results of their performance in a definite period are considered as strategic process. This process besides determining the competitive role of the organization had important role in continuous improvement of the organizations. The banks as the most important symbol of monetary market are not exception. As the optimized performance of the banks had important effect on economical development of Iran, providing the required grounds to improve the quality and quantity of the performance of the banks with healthy competition can have important role in achieving the goals. There have been various methods to evaluate the performance of the banks and most of the methods considered only the financial aspects of the performance and didn't consider the quality aspects of the performance. In the present study to correct the above shortcomings, a model was presented to measure the performance of bank branches in various aspects. In this model, the performance of Bank Sepah was evaluated by Balanced score card and finally a combinational model of two methods BSC/FAHP was presented for final ranking of the branches. To evaluate the normality of the population distribution, Kolmogorov-Smirnov test was applied and finally by TOPSIS software and the results of the priority of the effective factors on the success of the strategy of marketing of the rank, the bank branches were ranked.

Keywords: Performance evaluation, Balanced score card, multi-attribute *decision* making methods, Bank branches, TOPSIS technique.

Introduction

The evaluation of the performance at various levels including organizational, department and individual was a response to the information requirements of the managers in the current era by which they can identify the weaknesses and strengths and improve the strengths and eliminate the weaknesses. Today, based on the competitive environment and technological improvement done in the service delivery processes, in banking industry, the strategic focus is one of the price items and technical aspects were changed into the services quality aspects and customer satisfaction[1]. In the studies done on evaluation of the performance of the bank branches, it is mostly based on the technical aspects of the performance and no logical performance evaluation is presented for them. The present study eliminated these shortcomings and presented a comprehensive model for the evaluation of the performance and ranking the branches in banking industry and considered the performance tangible aspects (e.g. price, service, the number of service providers, etc) and performance intangible aspects (e.g. quality from the customer perspective, etc). In the present study, to evaluate the performance evaluation, after determining various performance aspects under a conceptual and operational model with balanced score card and using fuzzy multi-attribute decision making methods in Bank Sepah branches of Sistan and Baluchistan by quantity and non-quantity indices ranked the branches and the final ranking was also done.

Review of Literature: Performance evaluation: The performance evaluation is measuring the performance via the comparison of the existing condition with the ideal condition based on the pre-defined indices with definite features[3] Some of the recognized models regarding the performance evaluation were as: Sink and Tuttle Model, Performance matrix, Performance pyramid, The Balanced Scorecard, Business process, beneficiaries analysis, organizational excellence model, Maduri and Stipple framework[3].

Balanced score card: One of the most famous models of performance evaluation system is "balanced score card" being developed by Kaplan and David Norton. The model proposed that to evaluate the performance of each organization, some of the balanced factors should be used that the top managers can have a general view of four important organizational aspects. The various aspects were financial, business process, customer and learning and innovation perspective[4].

Fuzzy logic: Zadeh[5] proposed fuzzy set theory as a method to model in case of uncertainty. In crisp sets, one member belongs to a set or it is not belonging, 0,1. But in fuzzy set, interval 0,1 and ranked membership concept is introduced[6]. The general

structure of the organized fuzzy system is including three main stages:1- Fuzzification, 2- Inference, 3- Defuzzification[7].

Analytic Hierarchy Process (AHP): AHP is one of the most famous multi-attribute decision making technique and it was developed by *Thomas* L. *Saaty* in the 1970s[8]. This method is used when decision making is done encountering some rival decision making alternatives. This decision making method is based on paired comparison. The decision maker starts by providing decision hierarchy tree. The decision hierarchy tree shows the compared factors and rival alternatives evaluated in the decision. Then, a series of compared comparisons is made. These comparisons defined the weight of each of the factors along the rival alternatives. Finally AHP logic combines the matrices of paired comparisons with each other to obtain optimum decision[9,10].

Fuzzy AHP method: The existing uncertainty in preferred judgments increased the uncertainty of the priority of the alternatives and made determining the agreement (logical stability) of the priorities[11].

To eliminate some problems as application of AHP regarding the exact issues and the need to have full information of all the dimensions of the problem, Kahraman[12], Haq and Kannan[13] (2006), and Nazari-Shirkouhi et al.[14] were the people who combined AHP method with fuzzy set theory and since then fuzzy set theory was applied for formulation and solving the various problems: Artificial intelligence, Robotic, sample identification, etc. Buckley[15] combined fuzzy theory with AHP and it was called fuzzy analytic hierarchy process (FAHP). AHP fuzzy stages are as following: 1- Building decision hierarchy tree, 2- Paired comparison, 3- The calculation of consistency rate[16].

Fuzzy TOPSIS: TOPSIS is one of the multi-attribute decision making methods ranking m alternatives with n criteria. This method is based on selection of a suitable alternative with the shortest distance from the positive ideal solution and the longest distance with the negative ideal solution[17]. As the data of a production process or a service providing mechanism are complex and the collection of correct data from them is problematic, it seems that to work with the non-crisp data or an interval of the data, special methods are used[18]. Thus, fuzzy logic is used in TOPSIS technique and by applying fuzzy logic, it is converted to fuzzy TOPSIS technique. The main logic is the application of decision making techniques as fuzzy and the effect of uncertainty with human thinking in the decision making[12].

The similar literature in ranking the performance of the organizational units: Fadzlan Sufian for the first time investigated the efficiency of Malaysia banking in financial crisis in Asia by Data Envelopment Analysis. Frei and Harker[19] applied hierarchy analysis as an index for Data Envelopment Analysis and measurement of bank performance and evaluated the relation between operational and financial performances. Secme et al.[20] evaluated banking sector in Turkey by TOPSIS and AHP method.

Other researches were: Javanmardi Kashan, Alireza, full ranking of the branches providing the items introduced by Basijian by (AHP/DEA) method. Mohamadian, Zohre, ranking the results of data research analysis model-Abolalipur, Amirhossein, The evaluation of the trading organizations of the provinces by MADM-Nematollahi, Amirhossin, Evaluation and selection of the providers by Data Envelopment Analysis-Jafarmanesh, Mostafa, The evaluation of the performance of Bank Melat branches based on financial indices-Arman, Hossein, Evlauation of the efficiency of Bank Keshavarzi branches by Data Envelopment Analysis-Niknemat, Zahra. The evaluation of the efficiency of the head of Bank Tejarat by DEA-Khodaveisi,Mohammad, The study of the technical efficiency of Bank Sepah branches.

The similar review of literature on evaluation of the efficiency and ranking bank units (international review of literature): Tozum measured the banks performance by ratio analysis. Li and Liv and Li and whitmore compared China banks in terms of performance by 9 financial ratios. Assoulih, Boussofiane, Dyso applied AED and ratio analysis in measurement of bank performance. Kaya performed the performance analysis of banking sector of Turkey via SLEMAC evaluation system. Raviand kurniawan and kumar innovated some models to estimate the financial performances of the banks by financial variables and combined these models with neural networks and statistical techniques. Soteriou, zenios measured Service quality and operating efficiency by AED. Other words in this regard were: -Darat et al. ‘s studies were done with the aim of evaluation of the efficiency of the banks in Mena of Kuwait. The efficiency of the cost and techniques of Al-Hala Bank, Burkan, Kuweit, Middle East business, industry, Real estate during 1994 to 1997 were evaluated by Data Envelopment Analysis[21]. Alirezayi et al. (extensive study) study was done on 1280 CIBC banks in Canada by DEA method. – The study of Sherman and landino (productivity management with DEA), this study was done on 80 banks to reduce the costs. The study of Jiwkas, the analyses were done about the evaluation of the efficiency of Bank branches via AED as empirical and by the data of a small branch network including 44 branches of a great business bank all over Greece.

The review of the evaluation of the performance of the bank’s branches by Balanced score card and multi-attribute decision making method.

The review of literature in Iran: Mehregan Mohammad Reza and Shahbandarzade Hamid presented a method to evaluate the performance of bank branches by multi-attribute decision making technique by BSC model in 2006[22].

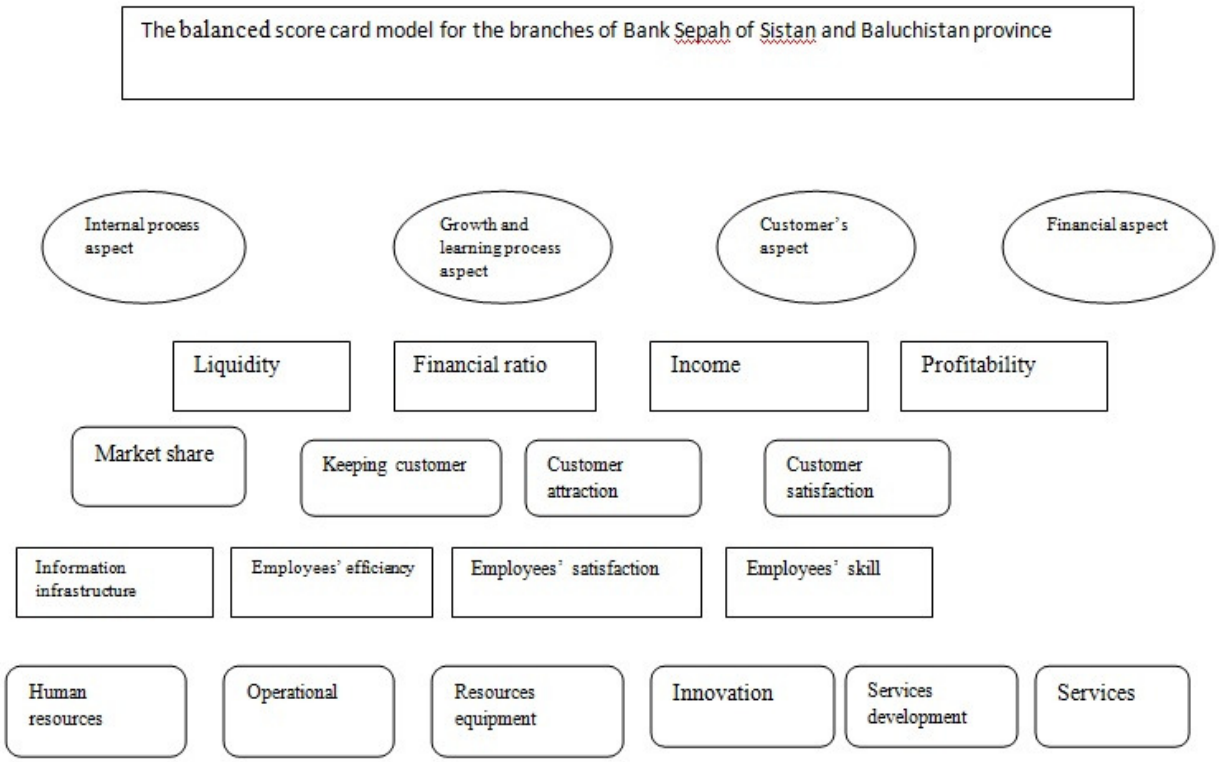

Figure-1
Conceptual model of the study

International review of literature : Stewart and Mohammad[23] proposed that a framework for evaluation of the performance is designed by AHP, BSC. Clinton, Weber and Hassel applied AHP in implementation of BSC.

The studies of davis and Albrigt[24]: The study was done with the aim of relation between implementation of balanced score card and financial performance of various branches of a bank.

Woo, Tezeng and Chen studies[25]: This is a performance analysis on three banks and it was done by FMCDM based on BSC perspectives.

The conceptual model of the study: By fuzzy analytic hierarchy process (FAHP) and balanced score card (BSC), the success of the marketing strategy of Bank Sepah of Sistan Baluchistan was evaluated. Thus, the conceptual model of the study with the criteria, indices and sub-indices were presented as schematic in figure-1.

Statement of the problem: More attempts are made to evaluate the performance of the various branches of the banks for ranking them but mostly it is emphasized on technical aspects of the performance[22]. Thus, a comprehensive model was presented to evaluate the performance and ranking of the branches in Banking industry and besides the quantity and tangible aspects of the performance, the quality and intangible aspects of the performance as customer satisfaction and employees productivity and the relations between the various aspects were considered. In this study, to evaluate the performance after determining various aspects of performance under a conceptual and operational model with balanced score card approach and fuzzy multi-attribute decision making methods were applied in Bank Sepah of Sistan and Baluchistan by quantity and non-quantity indices, the branches were ranked and final ranking was also done.

Materials and Method

The study method in the present study in terms of nature was descriptive and fuzzy technique was used. In terms of aim, the study was applied and in terms of time, it was cross section study. As it was done in a definite organization, it was a case study. To do the stud y, the information during 2006 to 2010 in Bank Sepah of Sistan and Baluchestan was applied. The study population was all the experts, group managers, branches managers and Bank Sepah employees of Sistan and Baluchestan. The number of the managers and employees of the study population were 75 in the central region of Bank Sepah of Sistan and Baluchestan. Based on Morgan Table for population 75 people (N=75), 55 people were estimated.

Regarding the data collection in the present study, it can be said that about the theoretical aspects of the study, library data collection method was used. By referring to the reference, the books, libraries, internet and archive of the branches, the data

were collected. In the phase 3and4 of the study, a questionnaire was designed and the comments of the members of the study population including the managers and employees of the bank were collected.

For data analysis in the present study, descriptive statistics including demographic data of the study sample such as frequency distribution tables, descriptive chart, etc was applied. Inference statistics including FAHP, BSC methods were used for alternatives weighting. To determine the weights by FAHP method, TOPSIS method with fuzzy inputs was used for ranking the bank branches.

In this study, to estimate the validity of the study instrument and questionnaire, the comments of the supervisor and advisor and experts were used and they were also corrected. To determine the reliability of the questionnaire, Cronbach's alpha was used. Cronbach's alpha was obtained for all the factors and study variables above 0.83 and the mean of this index was 0.89 and the reliability of the questionnaire was supported.

Results and Discussion

The evaluation of the descriptive statistics of the study
In Table 1, descriptive statistics of the number (N), Mean, Standard Deviation, Standard Error Mean, Kurtosis and Skewness and maximum and minimum based on each of the variables and factors were shown.

The analysis of demographic data of the questionnaire: Regarding the demographic data of the study sample, the condition of the respondents in terms of age was 38% below 30 years, 35% ranging 30 to 40 years old and 27% above 40 years old. In terms of gender, there were 58% men and 42% women. In terms of education, there were 4% diploma, 18% associate, 64% BA and 14% MA. In terms of work experience, there were 15% below 2 years, 27% between 2 to 5 years, 36% between 5 to 10 years and 22% above 10 years of work experience.

The evaluation of the normality of the data: In this study, Kolmogorov-Smirnov test was used to test the normality of the variables. Based on the results of the study, it can be said that significance level (Sig) of all the variables of the study was above 0.05. In other words, the normality of the data was supported and the tests and parametric models were applied without any problem.

Ranking the main factors by BSC and FAHP combined approach: In the balanced score card (BSC), to prioritize four factors of BSC by fuzzy AHP, at first the alternatives were weighted from the view of one of the respondents as stepwise. Then, based on 55 respondents, the general results of Expert Choice software were estimated.

After the factors preference tables were completed by the respondents, at first the coefficients of each of the paired comparison matrices were calculated (sk). Sk value is a triangular number calculated as following:

$$S_K = \sum_{i=1}^{n} M_{kj} * \left[\sum_{i=1}^{m} \sum_{i=1}^{n} M_{ij} \right]^{-1}$$

Where K denoted the number of row, i,j denoted the alternatives and criteria.

Table-1
The descriptive statistics indices of the study variables

Factor	N	Mean	Std. Deviation	Std. Error Mean	MAX	MIN	(Skewness)	(Kurtosis)
Financial	55	6.0085	0.74962	0.11852	9	3.67	-0.19	-1.24721
Customers	55	5.9390	0.65800	0.10404	8	3.56	-0.45	-0.63151
Internal process	55	6.3005	0.83988	0.13280	9	3.33	-0.01	0.37307
Learning and growth	55	6.3438	0.69956	0.11061	7	3.75	-0.16	0.279843

Source: The study results, the output of SPSS,EXCEL software

Table-2
The matrix of fuzzy paired comparisons of the main factors from the view of a respondent

BSC criteria	Customer	Processes	Financial	Learning and growth
Customer	(1,1,1)	(2/5,1/2,2/3)	(1,3/2,2)	(1/2,1,3/2)
Processes	(3/2, 2, 5/2)	(1,1,1)	(3/2, 2, 5/2)	(3/2, 2, 5/2)
Financial	(1/2, 2/3, 1)	(2/5, 1/2, 2/3)	(1,1,1)	(1/2, 2/3, 1)
Learning and growth	(2/3, 1, 2)	(2/5, 1/2, 2/3)	(1, 3/2, 2)	(1,1,1)

In EA method, after the calculation of SK, their magnitude in compare to each other shall be calculated. In general if

M1 and M2 are two triangular fuzzy numbers, magnitude of M1 to M2 is shown with V (M1 ≥ M2) and is defined as follows:

If M1 $\geq$ M2 $V(M_1 \geq M_2) = 1$ Otherwise, V (M1 ≥ M2) = *hgt* (M1 * M2) Also there is,

$$hgt(m_1 \cap m_2) = \frac{u_1 - l_2}{(u_1 - l_2) + (m_2 - m_1)}$$

The magnitude of a triangular fuzzy number from k other triangular fuzzy number as follows:

$$v(m_1 \geq m_2 \text{ و} \ldots \text{و} m_k) = mi\left[v(m_1 \geq m_2) \text{ و} \ldots \text{و} v(m_1 \geq m_k\right]$$

In EA method, to calculate the weight of the indices in paired comparison matrix, the following is used.

$$w'(x_i) = \min\{v(s_i \geq s_k\}, k = 1,2,\ldots,n, k \neq i$$

Thus, index weight vector is as following.

$$w' = \left[w'(c_1), w'(c_2) \text{ و} \ldots \text{و} w'(cn)\right]^t$$

That is the non-normalized weight vector of fuzzy AHP.
The numbers obtained in the previous stage of the non-normalized weight are the criteria of the hierarchy analysis table. Thus, the normalized weights of the criteria (indices) were obtained based on the following formula.

$$W_j = \frac{W_i'}{\sum W_i} \quad w(x,x,x,\ldots)^t$$

As it was said, 55 respondents completed the tables of weighting the alternatives of the questionnaire. For final prioritization of the alternatives (four factors of BSC model) should combine the paired comparisons of the entire group (55 people). One of the best methods is using geometry averaging. Table 3 is the final combinational table of 55 respondents being obtained of the geometry averaging of the elements of 55 fuzzy paired comparisons table of the respondents.

After providing the paired comparison matrix as fuzzy number, the relative and final weights were calculated. One of the calculation methods was Extent Analysis Method that was presented by Chang. The final results were stated in table-4[26].

In this stage, the indices of each main perspective of the balanced score card were prioritized by FAHP method. As each of the indices of each of the factors of BSC model were measured by the variables and the determining variables didn't have equal importance in evaluation of the performance and strategies of marketing of Bank Sepah of Sistan and Baluchestan. Then, each of the mentioned variables were weighted based on their importance and due to the high frequency of the variables and the high amount of calculations, the priority of them in the study is not mentioned.

The study of the effective factors on ranking the branches: To respond the third question of the study and identification of the effective factors on ranking the branches, besides the performance measures, the respondents presented their comments regarding the performance measures as some suggestions. These comments are shown in table-5.

Ranking the branches by Fuzzy TOPSIS: In this section, at first to form structural interaction matrix, a 4*4 matrix including the dimensions of BSC model was used. Then, to obtain the interaction matrix, the coefficients of the variables of each sub-index from the view of BSC were multiplied by sub-index coefficient and then it was added. Then, the numbers obtained from each perspective of BSC (customers, processes, financial and growth and learning) presented four, six, four and four new technical coefficients, respectively. It was done again for the sub-indices of each BSC perspective with the coefficients obtained for each perspective and finally four main technical coefficients were obtained for BSC dimensions.

In the second step, the weighted scale less matrix was determined based on the technical coefficient of each branch in BSC model. To obtain the weighted scale less matrix, at first the matrix was converted to scale less by norm scale less method ($n_{ij} = a_{ij} / (\sqrt{a^2_{ij}})$ ∀i). Then, by formula ($V = N * W_{n*n}$), the weighted scale less matrix was extracted. IN the next step, to determine the positive and negative ideals, weighted scale less matrix was applied.

The results of the calculation of the ranking of the branches of Bank Sepah of Sistan Baluchestan by Fuzzy TOPSIS (the coefficients were fuzzificated in Fuzzy AHP already) are shown in table-6.

Table-3
The final matrix of the fuzzy paired comparisons of the main factors by FAHP method

BSC criteria	**Learning and growth**	**Financial**	**Processes**	Customer
Customer	(1, 1, 1)	(1, 3/2, 2)	(2/5, 1/2, 2/3)	(1/2, 1, 3/2)
Processes	(1/2, 2/3, 1)	(1, 1, 1)	(2/5, 1/2, 2/3)	(1/2, 2/3, 1)
Financial	(3/2, 2, 5/2)	(3/2, 2, 5/2)	(1, 1, 1)	(3/2, 2, 5/2)
Learning and growth	(2/3, 1, 2)	(1, 3/2, 2)	(2/5, 1/2, 2/3)	(1, 1, 1)

Table-4
Ranking the main factors by FAHP method

BSC criteria	**Weight**	**Priority**
Customer	**0.237**	2
Processes	**0.079**	4
Financial	**0.440**	1
Learning and growth	**0.241**	3

Table-5
The recommendations of the performance measures

No.	Recommendations	The evaluation of the recommendations
1	The number of concentrated accounts being opened	It is considered in the list of the indices in opening different kinds of the accounts.
2	The number of people receiving wages	It is considered in the list of the indices in services section.
3	Exceptional facilities	It is considered in the list of the indices in loan section.
4	Rls guaranty	It is considered in the list of the indices in loan section.
5	The number of credit files of the branch	It is considered in the list of the indices in loan section.
6	The issued checks	It is considered in the list of the indices in documents section.
7	Considering the education condition of the staff	This item is applied in terms of costs and learning in the new plan.
8	Not considering the condition of the branches ownership	This item is considered in terms of cost in the new plan.
9	Calculation of profit and loss at the end of year	It is considered in the list of the indices in profit and loss of the branch.
10	Upcoming fund	It is not related to ranking issue.
11	E-services	It is considered in the list of the indices in leadership of the product of the branch.
12	Bills of exchange	It is considered in the list of the indices in documents section.
13	Selling and purchasing participation papers	It is not considered as an index in ranking due to the lack of comprehensibility in all the branches.
14	Trust fund	It is not considered as an index in ranking due to the lack of comprehensibility in all the branches.
15	Not considering negative score for exceptional outstanding claims	Following up the outstanding claims as exceptional or non-exceptional is the responsibility of the branch performance and it should be considered in ranking.
16	Reduction of the outstanding claims compared to the previous year	It is considered in the list of the indices in claims section.
17	The number of the recommendations presented from the branches	As the number of the recommendations of each branch was not extracted and it was not considered in the ranking.
18	The views of the regions management	The comments of the regional managements are used in extraction of the indices and it is continued by scientific techniques.
19	Other deposits	It is considered in the operational excellence section.
20	Notification of the ranking regulations to the branches	It should be considered in the implementation.

Table-6
The ranking table of the branches of Bank Sepah of Sistan and Baluchestan province

Branches	CL	Rank	Branches	CL	Rank
Zahedan	0.654	16	Sistan st. of Zahedan	0.347	29
Zabol	0.345	31	Shahid of Zabol	0.225	35
Iranshahr	0.758	7	Velayat st. of Iranshahr	0.138	40
Alavi of Zahedan	0.618	17	Zahak	0.468	21
Rasuli intersection of Zahedan	0.738	9	Imam Khomeini of KHash	0.711	11
Southern Shahid Beheshti of Zabol	0.378	25	Imam Khomeini Blv.d of Chabahar	0.346	30
Khash	0.462	22	Nobovat of Saravan	0.612	18
Saravan	0.249	33	Azadegan Blvd of Iranshahr	0.519	20
Imam Khomeini of Zahedan	0.678	15	Shahid Mirhosseini Blvd of Zabol	0.735	10
Chabahar	0.681	14	Saadi intersection of Zahedan	0.456	23
Kenarak	0.246	34	Imam Ali sq. of Zahedan	0.159	37
Khayam of Zahedan	0.698	12	Shahid Marzi Blv. of Zahedan	0.357	27
Shahid Tabatabayi of Zahedan	0.381	24	Jihad sq. of Zabol	0.258	32
Imam Hossein sq. of Zabol	0.691	13	Jomhuri Blv. of Zahedan	0.147	39

Branches	CL	Rank	Branches	CL	Rank
Padegan sq. of Zabol	0.782	4	Modares Blv of Zabol	0.369	26
Besat st. of Zabol	0.349	28	Kosar St. of Zahedan	0.963	1
Iranshahr market	0.215	36	Daneshju Blvd of Zahedan	0.741	8
Panzdah Khordad Sq. of Zahedan	0.879	2	Sib and Suran	0.852	3
Nikshahr	0.548	19	Hirmand	0.759	6
Mostafa Khomeini of Zahedan	0.765	5	Sarbaz	0.157	38

Conclusion

The present study applied valid parametric models of AHP and fuzzy TOPSIS for exact analysis. At the beginning of the analysis, the normality of the population distribution was evaluated by Kolmogorov-Smirnov test. The reliability of the questionnaire was supported by Cronbach's alpha coefficient. Then, by balanced score card and field study, the results of 55 questionnaires were used as the input of fuzzy AHP model. Then, the weights obtained of fuzzy hierarchy analysis were applied as fuzzy input of TOPSIS model for ranking the branches of Bank Sepah branches of Sistan Baluchistan province.

The conclusion of this study was useful for the investors, stockholders and private sector owners. Also, it helped the other banks to identity their position in banking industry as accurately and uses the required strategies to keep the existing condition or improving it. The combinational model can be available in all the decisions of ranking, modeling and selection of the correct alternatives among other available alternatives.

Recommendations

As the general factors of balanced score card are prioritized in ranking the variables of each factor, the focus can be on the factors with high priority and also concentrate on the policies of these factors. The mentioned model was used for ranking the branches in other provinces and to consider the legal benefits and corrective measurements to improve the inefficient branches. In the branches in which the employees' satisfaction is low, more educational and motivational measurements are performed. The profitability, income growth and development of the resources and the number of the accounts opened in each branch showed the efficiency and these indices can be the basis of assigning reward and benefits.

Recommendations for further study: It is recommended that a similar study is done in Iran banking level and this requires the collection of information more extensive than the big study population. It is recommended to apply other methods including neural network, Fuzzy DEA combinational model and BSC and the results of each study are evaluated with other simialr cases to implement the best model for evaluation.

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