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Original Article

Evaluating the Organisational Performance through the BSC-MCDM Framework in Packed Food Products Supply Chain

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Abstract: This study aims to identify effective indicators in the performance measurement of Behpakhsh firm using Balanced Scorecard (BSC) as well as weighting and ranking indicators by employing fuzzy analysis network process (FANP) and investigation on network mapping and the relationships between scorecards with fuzzy DEMATEL presenting strategies to improve performance of Behpakhsh firm. This study aims to assess the significance of the four perspectives: financial, customer, internal processes and learning and growth. About 28 indicators were identified, and after screening, 13 indicators were identified as final BSC indicators. After examining the influence of the main factors using the fuzzy DEMATEL technique, the internal processes dimension has the most impact, and customer and learning and, growth and financial dimensions have been ranked as second to fourth priorities. Also, using the fuzzy ANP technique, the weighting and ranking of dimension and performance measures indicators were examined. The dimension of customers has gained first rank, and financial, internal processes, learning, and growth have been ranked second to fourth, respectively.

Keywords: Performance measurement; Balanced Scorecard; Fuzzy DEMATEL; Fuzzy ANP.

1. Introduction

Present organisations noticed to survive in the global business environment, the quality of their products and services can attract new customers while retaining existing customers and thus increase their income. It is possible only through the application of correct management. Quality is restored; management also needs various tools to improve quality, and one of these tools is the implementation of quality systems. Originally, total quality was a culture that became a tool. It should form comprehensively in the mind of each employee so that after a while, mental concepts can become actions and be used as a tool for enhancing quality in organisations (Falsafi et al., 2010). In recent years, new models have been provided for organisational performance measurement due to the weakness of traditional assessment methods and changes in the competitive environment. The BSC approach is one of the new models. BSC has evolved

into a strategic management system over the years since its introduction as a pure performance measurement tool in 1992 (Tahniyat and Said, 2020).

Previous studies show that this model provides a suitable framework for measuring performance, and many companies worldwide have attempted to implement it. This method added three dimensions to traditional financial evaluation: customers, internal business processes, learning and growth (Kateb and Hasanabadi, 2007). Advanced organisations confront the challenge of characterising targets and organising forms that adjust to the client's changing needs and guarantee their cooperation in a progressively competitive advertisement (Acuña-Carvjat et al., 2019). For this, later ponders have proposed single and crossover strategies and methods to overcome criticisms (Palominos and Oddershede, 2018; Lopez Ospina et al., 2017)

Unlike traditional organisations, present organisations believe that they must constantly improve their own cycle based on Deming's logic, which is a continuous program. Behpakhsh Company is one of these organisations. It is a reliable wholesaler and distributor that imports and exports a wide range of pharmaceuticals, healthcare products, cosmetics, and medical devices. The company has developed robust internal management systems to ensure full traceability of products and batches that may be affected. In identifying effective indicators, various aspects of performance measurement and planning of this firm can be obeyed. One of the important concepts in literature can be based on the BSC approach. As mentioned above, this approach can measure four dimensions of financial, customer, activities and training (growth) for each system or subsystem.

However, various indicators and criteria can always be used in the field to assess the confusing dimensions to senior decision-makers. For this purpose, it is necessary for the organisations and the system under study, to identify possible indicators based on a logical evaluation. A quality management system is one of the most effective for delivering high-quality products or services. It will have an undeniable role, which ought to be based on surveying the commitment of each framework for accomplishing the purposes of the endeavor as an entire (Dynnyk et al., 2019). This system, as representative of quality management thought, can be measured by performance; hence, it is necessary in two consecutive phases but independent. First, effective factors in this field are identified and ranked based on FANP techniques and the concepts of BSC. In the second step, it is necessary to examine the relationships between variables based on FDEMATEL methods for identification and the relationship between criteria and building mapping relationships in a network. In the late 1980s, a growing number of managers in various industry units, such as commerce, concluded that traditional management and financial accounting for their companies did not have enough power to provide complete information.

In 1992, Professor Kaplan and Dr. Norton founded a new method of measurement called BSC. Traditional BSC breaks financial limitations measures organisational performance in terms of the four main features of financial, customer, internal business process and learning and training (Khorshid and Zabihi, 2010). In their research, Momeni et al. (2011) and Feizi and Solukdar (2014) evaluated the banking industry's performance. They confirmed the necessity of using multi-criteria decision-making techniques (MCDM) phase to achieve more tangible evaluation results. Also, Feizi, Monooei and Hashemi (2013), in a study to assess Tehran's municipal development company with the BSC approach, pointed to tangible results of this method (Yaghoobi & Haddadi, 2016; Kaplan et al., 2000).

According to these developments, measurement systems must be designed following the status and functions of manufacturing organisation, industrial and education and since most managers do not know the performance measurement criteria and measures have not properly developed and defined. This issue also increases the necessity and importance of this study. Despite the importance of this issue and the growing trend of different organisations and institutions, including manufacturing and service in many countries in line with the implementation and application of quality management systems, the implementation of this management approach in the Persian service companies (especially Behpakhsh Firm) has not seriously considered. Its implementation has faced several problems and obstacles. In a way causing that quality management have not successfully implemented in various service organisations that this issue, in turn, leads to stagnation and decline in the quality of various aspects of internal service. Certainly, the first step out of such a situation and taking steps towards establishing quality management in service organisations and companies to improve quality, plan and carry out studies about exact identification of key indicators is facing the implementation of quality management.

This study aims to measure the performance of firm in four perspectives (financial, customers, internal processes, learning and growth) and determine key performance indicators related to the BSC in that field and ranking indicators using the technique of fuzzy ANP so is measured amount of their impact on the firm's performance and managers can take steps with focus more on effective indicators to make decisions about

future goals of the company and also is provided a consolidated model of BSC (performance measurement tool) and fuzzy DEMATEL-ANP (tool of make decisions). DEMATEL can perform random relationships by distributing crucial topics into cause-and-effect groups, making it possible to visualise the random relationships (Avakh and Hojjat, 2019). Moreover, fuzzy can consider the optimistic/pessimistic attitudes of decision makers. Therefore, fuzzy linguistic information with a higher membership activity has been expressed by triangular numbers instead of classic. in comparison, fuzzy MCDM applications are more effective than classical methods (Asgari and Avakh, 2017). The output of this research can be considered as a comprehensive assessment of the quality management system that will provide foresight and possibly make improvements for the authorities in charge of quality.

In 1983, Professor Kaplan criticised traditional management control in general and performance measurement in particular. This thinking continued until the 1992 article by Professor Kaplan and Dr. Norton titled "The Balanced scorecard: Measures that drive performance" which introduced BSC framework. This method had such an impact on the organisation that it was expressed in 1996; BSC is the largest business development during the past 75 years. BSC, from the early 90s, has been changing from different angles. BSC provides a framework to describe strategies to create value for customers, shareholders, and citizens who need a mission and vision to fulfill their needs in any organisation.

BSC perspectives that traditionally have been introduced by Kaplan and Norton need to be reformed and reviewed to encompass two new areas (the employee satisfaction perspective and the perspective of the environment and society) (Kumar & Harms, 2004). These two areas are related specifically to human resources teams. However, these two perspectives were not considered in the original model by Norton and Kaplan. Having an employee satisfaction perspective separately among BSC perspectives will indicate the importance of this factor and key driver in organisation. The perspective of the environment and society (communication) helps to create a large investment for the team of human resources and in this regard, helps to the organisation (Rezaei Ghahraman and Aghahosseini, 2011). Table 1 shows six perspectives of BSC (Rezaei Ghahraman and Aghahosseini, 2011; Nilipour Tabatabaei et al., 2007; Khakbaz and Karbasian, 2011).

Table 1. Six BSC perspective

Internal processes Dimension	**Customers Dimension**	**Financial Dimension**
-The timely delivery of goods -Optimisation of technology -Effective relationship with customers	-Increase customer satisfaction -Targeting customers who create the most profitable.	-Use assets -Optimisation of working capital
Environment and society (communication) Dimension	**Employee satisfaction Dimension**	**Learning and growing dimension**
-Local business support -Leadership of communications -Connection with possible future employees	-Positive organisational culture -contact with key customers	- Increase skills and capabilities of flexibility -The validation and authorisation

In this section, to introduce quality management requirements, some of the important features of a quality system are (i) Quality objectives and policies formulated; (ii) focus to the customer; (iii) directing all the activities to achieve objectives; (iv) Appropriate expertise of personnel tasks to achieve quality; (v) control activities of specific customers; (vi) having criteria such as costs of quality and other criteria and standards of quality components; (vii) Corrective affirmative action; and (viii) Continuous control of system includes a feed-forward and feedback information and analysis of the results and to compare current standards, periodic audit of the system actions (Ahire et al., 1996).

As in the performance evaluation system, BSC used experts and specialists as quality, and in terms of words, measuring and collecting opinions of the statistical population included by certain practices and non-fuzzy can be criticised for two reasons: to ignore the ambiguous and subjective judgment. Using fuzzy concepts in the assessment can use verbal expressions as expressions with natural dialogue language to assess the performance measurement indicators. By linking these expressions with the appropriate membership functions can be applied to a more convenient and more accurate analysis of values of indicators (Brennan, 2010).

Although the four BSC perspectives examines performance of organisations at different levels of organisational to the level of business and personal, there are disadvantages and obstacles in implementing this model. First, there is no appropriate comprehensive perspective common to all organisations and business units. Hence, user experience and background are important in implementing this model. Secondly, diverse and abundant quantitative indicators in the scorecard have introduced specific and appropriate indicators. Traditional BSC does not express the quantitative relationship among higher levels (perspective and vision); in practice, users should intuitively perform it.

According to recent studies, the causal relation between the indicators before and after is often overlooked in organisations that use the BSC to assess their performance. Although various information and opinions about strategy role and its impact in the BSC is available, most organisations studied have not achieved good results aligning their strategy with operational terms (Kaynak, 2003). In other words, the procedure ignores the foremost noteworthy viewpoint, assessing feasible execution. Consequently, numerous analysts have changed the BSC, advertising a hybrid strategy (Ming-Tsang Lu et al., 2018)

Multi-criteria decision-making methods can be combined to solve the problems stated with BSC. This can overcome vulnerability and uncertainty within the professionals' replies to obtain the most trustworthy agreement of observations about the estimation indicators (Ming-Tsang Lu et al., 2018). Decision-makers have expressed their opinions that reflect their real priorities to achieve the target because an incomplete hierarchy can lead to inappropriate conclusions (Wu et al., 2009). Stewart and Mohammad (2001) used the hierarchy and multi-attribute utility theory in the scorecard model and developed a new method for evaluating the performance of organisations. Clinton Weber and Hösle (2002) used hierarchical method to complete BSC. They pertained that since the first level of the scorecard includes four perspectives and second level contains measurable indicators that are used in every aspect of it, hierarchical methods can be used to select measurement indicators and help to understand the relative importance of indicators.

Dincer and Yuksel (2019) studied the examination of investment decisions based on BSC for sustainable energy alternatives. In addition, they benefited from a comparative inspection based on fuzzy hybrid decision making. During their strategy, DEMATEL was used to weight different dimensions BSC model is used to define the four perspectives related to select suppliers and thus develop measurement indicators of perspectives.

2. Literature Review

Feizi and Solukdar (2014) in their study “performance evaluation of banking industry using FTOPSIS-BSC approach”, introduced a new approach of strategic and decision-making techniques to assess banks in Alborz Province (Iran) in six perspectives: financial, customer, internal processes, learning and development, employee satisfaction and environment and society. In researcher’s opinion, the reason for adding two dimensions to four dimensions of performance measurement proposed and used by Professor Kaplan and Norton is too much importance due to employee satisfaction for organisational success and in achieving the organisation's objectives and environment of changing and dynamic. The results of this research show that using combined approach of decision-making and strategic and use of the expressive spectrum in Poll of experts can provide optimal assessment method and efficiency in the banking industry. In 2019, Dincer et al., (2019) worked on European energy investment strategy by focusing on BSC and fuzzy decision-making procedure to analyse the functions.

In like manner, the priorities and energy needs of the Europeans were examined to conduct the foremost productive operations to enhance the energy segment. Feizi and Solukdar (2014) in study with title: providing a model for Performance Measurement of municipalities and Select Construction Companies in Tehran selection using techniques of fuzzy AHP and fuzzy TOPSIS and BSC, the results of the study show that using combined approach of Fuzzy multiple criteria decision making with the BSC method can provide more tangible and practical results. Rodriguez et al., (2020) developed a powerful supply chain based on BSC technique to progress business efficiency. They just wanted to illustrate how to impartially set up the procedure for activating the future action plans. This strategy adjusted all the endeavors of a entirety supply chain.

In the introduction, Zarei Nejad and hojati (2013) suggested that the role of information technology in today's business and to improve its performance is imperative. Information technology unit structure is significantly important, and it introduces an approach based on fuzzy multi-criteria decision-making methods (FMCDM) and BSC (BSC) for evaluating the performance of IT departments using the banking system. The results will be used as a guide to improve the performance of IT departments in the banking system that support YASUJ (Iran) manufacturing industry and to improve the performance of the

manufacturing industry and services of banks. Formed information systems can also be used as an effective tool for solving problems Multi Attribute Decision Making.

Ghorbani (2013) identifies the key success factors in the establishment of a comprehensive quality management in the automotive industry in Germany, researcher after careful study in relation to the other researchers studies the key success factors in the establishment of a comprehensive quality management in the automotive industry divided into four dimensions: process, management, quality and organisational. In dimension of process, factors such as product design, customer satisfaction, process of quality management and continuous improvement, in dimension of management factors such as: permanent support of senior management, building team consulting, continuing professional training and consulting employees, in dimension of organisational factors such as: teamwork, planning, structures and in the dimension of quality: focus on customer needs, quality culture and the role of the department of quality, supplier quality management be considered.

After reviewing the results of his research in the automotive industry in Germany showed that each of the four factors mentioned are effective in the implementation. The establishment of quality management and factors of management, process, quality and organisational are respectively ranks of first to fourth and continuous support of senior management, supplier quality management and continuous training of employees, respectively in terms of importance are in rank of first to fourth. Hypotheses and factors were ranked using the means of a society and Friedman test. Bentes et al. (2012) measured organisational performance of Brazilian Telecom Company provided Integration of the BSC method and analytic hierarchy process (AHP). Table 2 shows a summary of research on using BSC and fuzzy decision techniques.

Table 2. Summary of accomplished research about the evaluation of BSC

Author	Year	Research subject	Tools used
Feizi & et al	2013	Evaluation of construction companies in Tehran Municipality-Iran	BSC-FAHP-FTOPSIS
Boroojeni & Mirfakhroldini	2012	BSC in Hotel services	FTOPSIS
Zarei Nejad & Hojati	2013	BSC to assess IT departments of banking system	FMCDM
Shahroodi & et al	2011	BSC in private banking of Iran	FAHP, TOPSIS, ELECTRE, VIKOR
Moemeni & et al	2011	BSC in private banks listed in the Tehran Stock Exchange	SAW& VIKOR & TOPSIS
Feizi & Soloukdar	2014	Performance Evaluation of Banking Industry using BSC	FTOPSIS
Shavandi & et al	2012	Performance Evaluation of three Non-public banks	FMCDM
Faramarz & et al	2012	Prioritisation of entrepreneurship indicators based on BSC	VIKOR
Jamshidian & et al	2012	Performance evaluation of Telecommunication Company in Ilam-Iran	Use of documents and statistical analysis
Tahari Mehrjerdi	2011	Performance Evaluation of Cooperative General Office in Yazd province	VIKOR, FANP
Nazemi,Kazemi, Okhravi	2010	Key success factors in TQM	AHP
Moetameni & et al	2010	Strategic Performance Evaluation of banks	FAHP , TOPSIS
Mehrgan	2010	Performance evaluation in 10 branches of banks	MCDM
Mehrgan & Nayeri	2008	Performance Evaluation of top management colleges in Tehran province	TOPSIS, BSC
Hemati & Mardani	2012	Designing BSC in an industrial unit	FTOPSIS
Alvandi & Mansoori	2007	BSC impact on the management of business processes in two Iranian Organisation	BSC

Author	Year	Research subject	Tools used
Hemati & Mardani	2012	Applying fuzzy theory in the BSC to evaluate the strategy of an organisation	FUZZY
Barata	2021	Designing BSC to Financial Deputy in Malek Ashtar University	BSC
Sila, Ebrahimpour	2002	Research-oriented quality management	25 factors of quality management approach
Bentes	2012	BSC in a Brazilian telecommunication company	AHP

3. Materials and Methods

To address the research problem and recommend better approaches, this study employs a hybrid fuzzy MCDM as stated below:

Step 1: Fuzzy DEMATEL Technique

DEMATEL technique is a decision-making method provided by Gabos and Fontela (1971). It is based on paired comparisons, with the benefit of experts' judgment in the extraction of a system factor and systematically structuring them using the principles of graph theory which provides a hierarchical structure of factors existing in the system with interaction relationships of impression and the effect so that is defined the intensity of mentioned relations as a numerical score. When experts express their opinions using fuzzy numbers, we use FDEMATEL techniques (Kaplan et al., 2000). The DEMATEL method is described as follows:

1. Preparing a questionnaire and collecting relative information of indicators from the expert's points of view;
2. Calculate direct relations matrix (Z);
3. Calculate the normal direct relations matrix (S);
4. Calculate total relation matrix (direct and indirect dependence) (T);
5. Calculate total relation normal matrix with the threshold of acceptance;
6. The mapping consists of a network relationship based on two vectors D and R.

Also, to compare standards with each other, five verbal expressions equivalent to their fuzzy values are shown in Table 3.

Table 3. Verbal expressions used in research and equivalents values

Fuzzy value	Verbal Phrase
(0.00,0.10,0.30)	No impact
(0.10,0.30,0.50)	Very little impact
(0.30,0.50,0.70)	Less impact
(0.50,0.70,0.90)	High impact
(0.70,0.90,1.00)	Very high impact

First step: Consider the opinion of all experts, according to relation (1), and take their arithmetic mean.

$$\tilde{Z} = \frac{\tilde{x}^1 \oplus \tilde{x}^2 \oplus \tilde{x}^3 .... \oplus \tilde{x}^p}{p} \quad (1)$$

In this relation, p is number of experts and$\tilde{x}^1, \tilde{x}^2, \tilde{x}^p$ are respectively paired comparison matrix of expert 1, expert 2 and expert p and $\tilde{z}$ is triangular Fuzzy as. $\tilde{z}_{ij} = (l'_{ij}, m'_{ij}, u'_{ij})$

Second Step: relation (2) normalises the matrix obtained.

$$\tilde{H}_{ij} = \frac{\tilde{z}_{ij}}{r} = (\frac{l'_{ij}}{r}, \frac{m'_{ij}}{r}, \frac{u'_{ij}}{r}) = (l''_{ij}, m''_{ij}, u''_{ij}) \quad (2)$$

That r is obtained from (3):

$$r = \max_{1\le i\le n}(\sum_{i=1}^{n} u_{ij}) \tag{3}$$

Third Step: calculate the above matrix, the matrix of fuzzy relations is obtained due to the relations (4, 5, 6, 7).

$$T = \lim_{k\to+\infty}(\tilde{H}^1 \oplus \tilde{H}^2 \oplus ... \oplus \tilde{H}^K) \tag{4}$$

That each element of a fuzzy number is as $\tilde{t}_{ij} = (l_{ij}^t, m_{ij}^t, u_{ij}^t)$ and is calculated with relations (5, 6, 7):

$$\left[m_{ij}^t\right] = H_m \times (I - H_m)^{-1} \tag{5}$$

$$\left[l_{ij}^t\right] = H_l \times (I - H_1)^{-1} \tag{6}$$

$$\left[u_{ij}^t\right] = H_u \times (I - H_u)^{-1} \tag{7}$$

In these formulas, I is unit matrix and H_1, H_m, H_u each of them are matrix n x n that its element form respectively lower number, middle number and high number of triangular fuzzy numbers for matrix H

Fourth step: it is to obtain the total rows and columns of a matrix $\tilde{T}$. Total rows and columns are obtained due to the relations (8 and 9).

$$\tilde{D} = (\tilde{D}_i)_{n\times 1} = \left[\sum_{j=1}^{n} \tilde{T}_{ij}\right]_{n\times 1} \tag{8}$$

$$\tilde{R} = (\tilde{R}_i)_{1\times n} = \left[\sum_{j=1}^{n} \tilde{T}_{ij}\right]_{1\times n} \tag{9}$$

That $\tilde{D}$ and $\tilde{R}$ are respectively matrix nx1 and 1xn. The next step determines the importance of index $(\tilde{D}_i + \tilde{R}_i)$ and the relationship between criteria $(\tilde{D}_i - \tilde{R}_i)$. If $\tilde{D}_i - \tilde{R}_i > 0$, related criterion is affecting and if $\tilde{D}_i - \tilde{R}_i < 0$ related criterion is affected.

In the next step, fuzzy numbers $\tilde{D}_i + \tilde{R}_i$ and $\tilde{D}_i - \tilde{R}_i$ obtained from previous step that we defuzzify according to (relation 10)

$$B = \frac{(a_1 + a_3 + 2\times a_2)}{4} \tag{10}$$

B defuzzified is number $\tilde{A} = (a_1, a_2, a_3)$.

Step 2: Fuzzy ANP technique

Network analysis process or ANP is another series of decision-making techniques presented by Saati to develop Analytical Hierarchy Process and is very similar to AHP method. Each of the methods is based on a set of assumptions. For example, if the criteria are independent of each other and pairwise comparisons are possible, a suitable decision-making model is an AHP model. But if the criteria are not independent, ANP method is better because criteria and sub-criteria are estimated in that internal relationship. When we

use expressive numbers and fuzzy to fill the matrix of paired comparisons, fuzzy ANP technique must be used (Momeni et al., 2011).

3.1. Case study

Survey research is the most common type of social science research, and it is based on surveys of those who are directly involved in research issues (Bourne et al., 2003; Neely, 1999). Considering that this study aims to identify effective indicators in performance measurement of Behpakhsh firm using the BSC approach, the survey research will be used for the first part of this study. The most important benefit of this research is the ability to generalise the results. The purpose of this research is motivated by its expected outcome, which can be used to adjust the organisation's future (Behpakhsh firm). The statistical population of the current study includes 150 experts and managers of Behpakhsh firm. This study's sample size (managers and experts) is 108 persons using the Cochran formula.

For this study, data was collected using two sets of questionnaires: questionnaires of pairwise comparisons and fuzzy DEMATEL techniques, as well as questionnaires for the ranking indicators to evaluate Behpakhsh firm that uses fuzzy ANP techniques. The present study used content validity to determine the validity (verification of the quantity and quality of questions in terms of experts and professors related to the field of research). Gogus and Boucher applied the compatibility technique to determine the reliability of the questionnaire. A complete review of a management phenomenon requires a suitable conceptual model. Framework or conceptual model shows theoretical relationships between important variables studied (Liand, 2007). After reviewing secondary information and extracting service companies' performance evaluation indicators from previous research, indicators were extracted from Figure 1 of the executive model and Figure 2, which shows a conceptual model of this research.

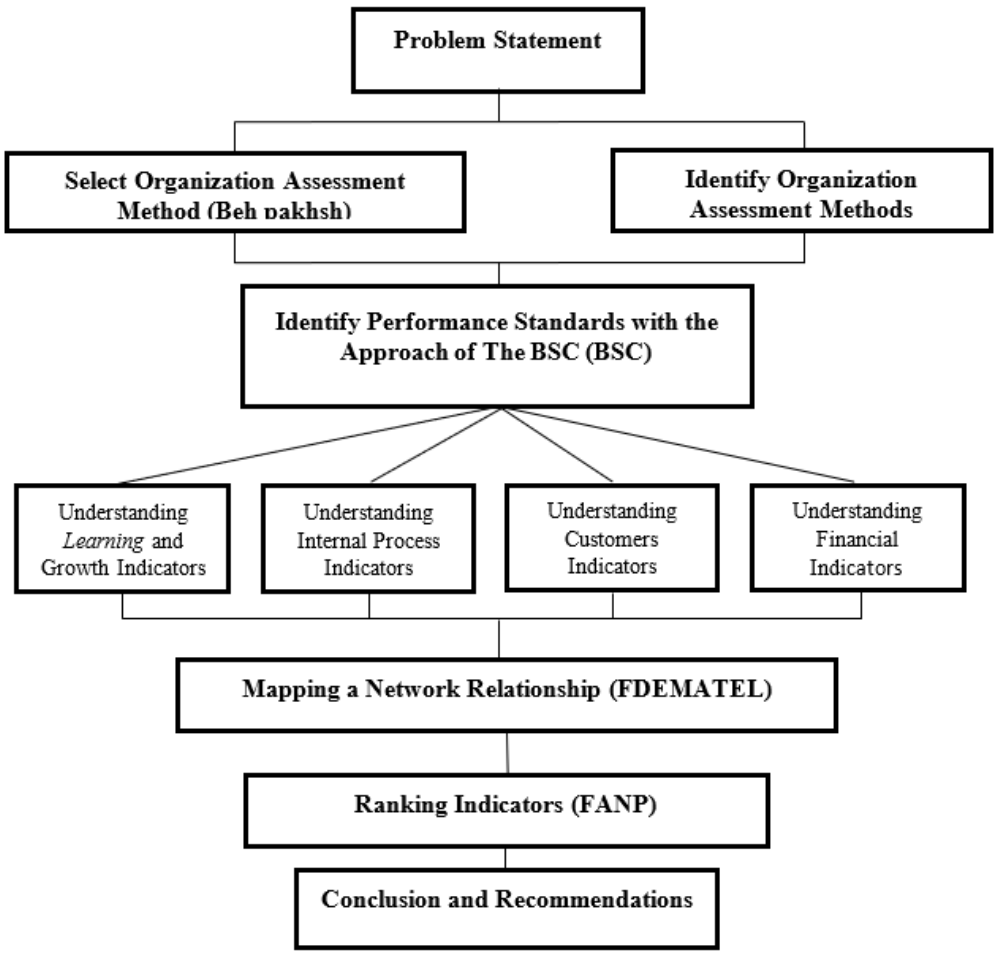

Figure 1. Research Framework

In the conceptual model, perspectives include 4 dimensions of the BSC. Column 3 determines research tools, and column 4 determines proper weighting and ranking.

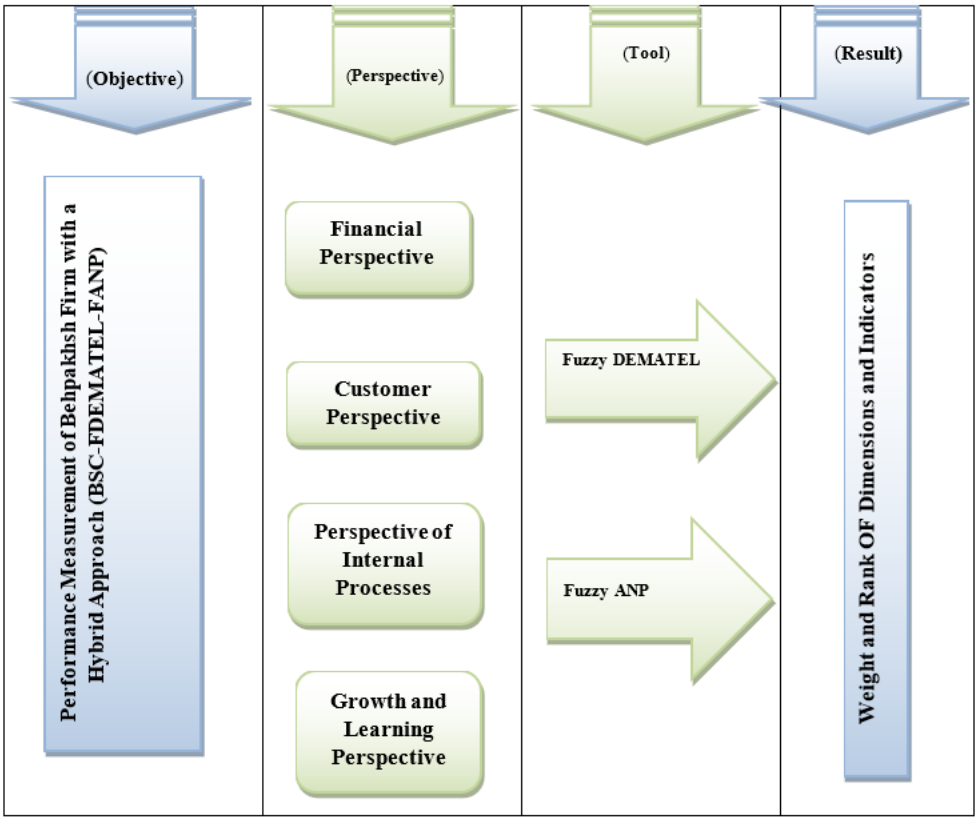

Figure 2. Conceptual model of research

4. Results

The purpose is to weigh and rank indicators to assess the Behpakhsh firm's performance.

4.1. Behpakhsh firm

Behpakhsh firm was established as part of the sale of Behshahr Industrial Company in 1955. Behpakhsh has a history of more than half a century of leadership in Iran broadcast industry. As the largest and oldest distribution company in food, pharmaceutical, and health, it has achieved a special place in the distribution field in the Middle East. Purchasing, packaging, distributing and selling a variety of goods, road transportation, import and export, the exclusive representative of goods, investment in shares of companies, banks and financial institutions to create exhibitions, shops, agencies and branches within the country and abroad are the main business activities "Behpakhsh" and its subsidiaries.

4.2. Statistical population

They include 150 experts and managers of Behpakhsh firm that in this study, to estimate the sample size is used from the formula determining the sample size with a finite population. The following relation determines a finite population sample size (Moemeni and Ghaumi, 2011).

$$\mathbf{n} = \frac{\mathbf{N}\times\left(\mathbf{Z}_{\alpha/2}\right)^{2}\times\mathbf{pq}}{(\mathbf{N}-\mathbf{1})\times(\boldsymbol{\varepsilon})^{2}+\left(\mathbf{Z}_{\alpha/2}\right)^{2}\times\mathbf{pq}} \tag{11}$$

Z= Trust Factor to Trust Factor (1.96)
ε= Error (typically from 0.05 to 0.1)
N= the number of people in society
P= the ratio of success in society (To maximise sample size p=q=0.5)
n= sample size

$$n = \frac{150 \times (1.96)^2 \times 0.5 \times 0.5}{(149) \times (0.05)^2 + (1.96)^2 \times 0.5 \times 0.5} \cong 108 \quad (12)$$

So, the number of samples is calculated as 108 people.

4.3. Identification and Evaluation of the relationship between measures and the mapping of network relationships with fuzzy DEMATEL

Step-1: Form a matrix of pairwise comparisons and the meaning of expert's importance.

After confirming questionnaire (1) of research (validity and reliability), was distributed among 108 experts of Behpakhsh firm. After collecting judgments, Table (4) shows a pairwise comparison mean obtained from expert opinion about dimensions.

Table 4. The mean of expert opinion about dimensions of BSC

Dimensions	Financial	Customers	Internal processes	Growth and learning
Financial	(0,0,0)	(0.567,0.767,0.900)	(0.567,0.767,0.900)	(0.500,0.700,0.867)
Customers	(0.067,0.233,0.433)	(0,0,0)	(0.267,0.433,600)	(0.267,0.433,0.600)
Internal processes	(0.1,0.233,0.433)	(0.485,0.549,0.645)	(0,0,0)	(0.167,0.367,567)
Growth and learning	(0.267,0.433,0.633)	(0.500,0.700,0.867)	(0.567,0.767,0.933)	(0,0,0)

Step-2: normalising group decision matrix

Table (5) shows matrix normalised (normalised matrix)

Table 5. Matrix normalised relative to the dimensions of BSC

Dimensions	Financial	Customers	Internal processes	Growth and learning
Financial	(0,0,0)	(0.025,0.0340,0.040)	(0.025,0.034,0.040)	(0.022,0.031,0.039)
Customers	(0.003,0.010,0.019)	(0,0,0)	(0.012,0.019,0.027)	(0.012,0.019,0.027)
Internal processes	(0.004,0.010,0.019)	(0.022,0.031,0.039)	(0,0,0)	(0.007,0.016,0.025)
Growth and learning	(0.012,0.019,0.028)	(0.022,0.031,0.039)	(0.025,0.034,0.042)	(0,0,0)

Step-3: Calculate Matrix $\tilde{T}$

Table 6 shows matrix t.

Table 6. Total relationships Matrix of BSC dimensions

Dimensions	Financial	Customers	Internal processes	Growth and learning
Financial	(0.018,0.072,0.588)	(0.049,0.122,0.712)	(0.046,0.116,0.688)	(0.042,0.111,0.676)
Customers	(0.018,0.074,0.559)	(0.020,0.078,0.618)	(0.030,0.092,0.622)	(0.029,0.090,0.613)
Internal processes	(0.021,0.080,0.589)	(0.044,0.155,0.690)	(0.020,0.079,0.629)	(0.027,0.094,0.644)
Growth and learning	(0.028,0.087,0.596)	(0.044,0.114,0.688)	(0.044,0.111,0.668)	(0.019,0.076, 0.618)

Step-4: obtain sums of rows and columns of a matrix

Table (7) shows the importance and effectiveness of BSC dimensions with fuzzy numbers.

Table 7. The importance and effectiveness of BSC dimensions (fuzzy numbers)

Dimensions	$\tilde{D}_i + \tilde{R}_i$	$\tilde{D}_i - \tilde{R}_i$
Financial	(1.994,5.547,35.2,2)	(-15.369, +0.580, 17.839)
Customers	(2.091,5.748,36.,75)	(-17.967,-372,16.017)
Internal processes	(2.1, 2,5.778,36.359)	(-17.169,-0.068,17.084)
Growth and learning	(2.040,5.673,36.037)	(-16.444,+0.3.306,17.614)

Step-5: Defuzzify fuzzy numbers $\tilde{D}_i + \tilde{R}_i$ and $\tilde{D}_i - \tilde{R}_i$

Table (8) shows numbers defuzzified of Table (7).

Table 8. Importance and influence of dimensions (absolute numbers)

Dimensions	$\widetilde{\boldsymbol{D}}_{\boldsymbol{i}} + \widetilde{\boldsymbol{R}}_{\boldsymbol{i}}^{\boldsymbol{def}}$	$\widetilde{\boldsymbol{D}}_{\boldsymbol{i}} - \widetilde{\boldsymbol{R}}_{\boldsymbol{i}}^{\boldsymbol{def}}$
Financial	12.073	0.907
Customers	12.416	-0.673
Internal processes	12.504	0.014
Growth and learning	12.355	0.091

Figure (3) also shows the importance of influencing between dimensions. The horizontal axis shows the importance of dimensions, and the vertical axis shows the influence of BSC dimensions.

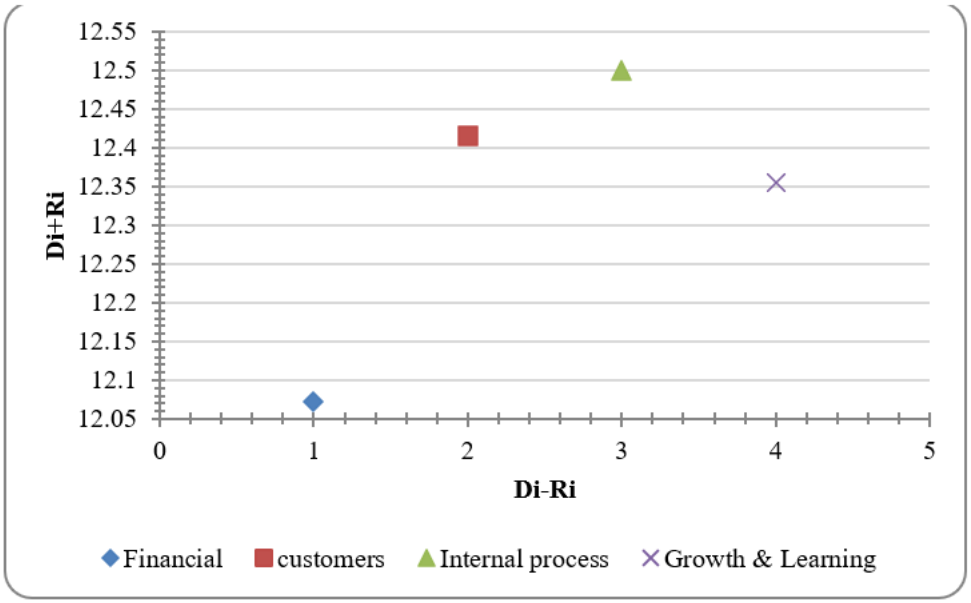

Figure 3. The relationship and the importance of BSC dimensions

4.4. Achieving the weight of indicators and dimensions using fuzzy network analysis:

Step-1 and 2: weight of indicators and dimensions using fuzzy network

The geometric means of experts pairwise comparisons and calculate eigenvector. In order to gather expert opinions, the geometric mean is calculated from the pairwise comparisons of respondents. The logarithmic least squares method is used to calculate the eigenvector of aggregated tables paired comparisons.

$$w_k^s = \frac{\left(\prod_{j=1}^{n} a_{kj}^s\right)^{1/n}}{\sum_{i=1}^{n}\left(\prod_{j=1}^{n} a_{ij}^m\right)^{1/n}}, \quad s \in \{l, m, u\} \tag{13}$$

So that:

$\widetilde{w}_k = (w_k^l, w_k^m, w_k^u) \quad k = 1,2,3,...,n$

Table 9 shows the geometric meaning of expert opinions. The last line of the table shows the incompatibility rate of dimensions.

Table 9. Mean of pairwise comparisons to BSC dimensions

Ranking	Financial	Customers	Internal processes	Growth and Learning	Eigenvector
Financial	(0,0,0)	(0.816,1.155, 1.414)	(1,1.225,1.225)	(0.309,0.371,0.397)	(0.419,0.464,0.552)
Customers	(0.707,0.866, 1.225)	(0,0,0)	(1,1.414,1.414)	(0.295,0.354,0.397)	(0.451,0.536,0.593)
Internal processes	(0.816,0.816, 1)	(0.727,0.707, 1)	(0,0,0)	(0.275,0.275,0.331)	(0.482,0.634,0.634)
Growth and learning	(0.823,0.816, 1)	(0.297,0.602, 1)	(0.542,0.314,0.743)	(0,0,0)	(0.366,0.366,0.482)
CRm =0.009 Harmonic		CRg =0.006			

Step 3: the formation of eigenvector matrices (W_{ij})

These matrices include eigenvectors that were obtained pairwise comparisons in second step.

In general, these matrices can be divided into two categories:

- Matrix with eigenvector shows relationship between levels (vertical). If there is no relationship between the two components and between the levels of the two components. In confluence of these two components in the matrix are values (0, 0, 0). In other elements, too, according to the vertical relationship of component are eigenvector values obtained from the second step.
- Matrix with eigenvector that show horizontal relationships (within levels). This matrix is square, and its diagonal is (0, 0, 0) if between two components there is no relationship within levels at the confluence of the two components in the matrix, is the value (0, 0, 0).
- Note that if in the eigenvector matrix within the levels, one or more elements in the main diameter don't become (0, 0, 0) because that column has been normalised. Normalisation is when all fuzzy numbers of the columns are divided into the sum of the median values of fuzzy numbers in that column.

Step 4: calculate the final weights of levels

To calculate the final weighing of the components (W_i^*), One must multiply the eigenvector matrix by internal eigenvector at the same level in the final weight of a higher level.

$$W_i^* = W_{ii} \times W_{i(i-1)} \times W_{i-1}^* \tag{14}$$

If there is no level, a matrix of W_{ii}, a unit matrix with the same degree must replace it. In other words, it should use from relation (13).

$$W_i^* = I \times W_{i(i-1)} \times W_{i-1}^* \tag{15}$$

After gaining fuzzy weights of performance measurement dimensions for Behpakhsh, the firm should become fuzzy numbers to defuzzification (absolute). Various methods exist for definitive fuzzy numbers, including the mean method and center of gravity. The present study uses center of gravity for the defuzzification of fuzzy numbers. Relation (14) shows how to calculate the definitive fuzzy numbers.

$$CA = \frac{(c-a)+(b-a)}{3} + a \tag{16}$$

Tables (10 and 11) and Figures (5 and 6) show the final weights of dimensions and indicators of performance measurement in Behpakhsh firm using the BSC approach.

Table 10. The final weights matrix of BSC dimensions with fuzzy ANP

Rank	Final Decisive Weight of BSC Dimensions	Weight of final phase	Dimensions
2	0.483	(0.07,0.6,0.78)	Financial
1	0.617	(0.7,0.8,0.35)	Customers
3	0.463	(0.7,0.63,0.06)	Internal processes
4	0.377	(0.06,0.35,0.72)	Growth and learning

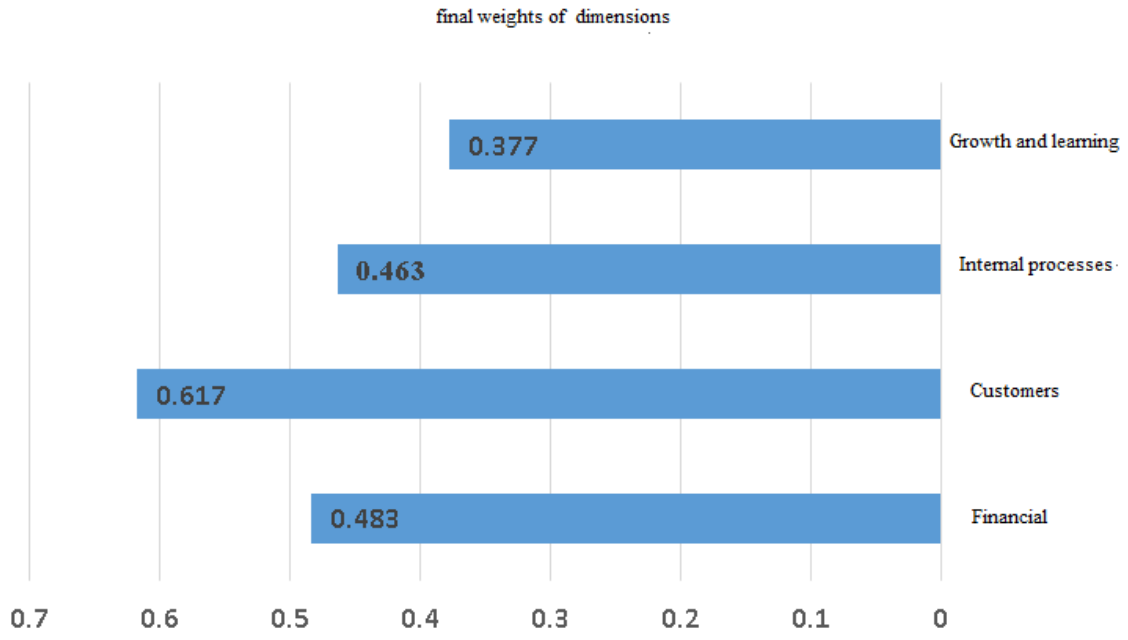

Figure 4. The final weights for BSC dimensions

Table 11. The final weights matrix of BSC indicators with fuzzy ANP

Indicators	Weight of final phase	final decisive Weight of BSC dimensions	Rank
Correct management of Portfolio and risk	(0.751,1,1)	0.450	3
Reporting and Permanent monitoring of financial indicators	(1,1,1)	0.464	1
Survey Statistics of purchases and sales and interested in the stock market to brand	(0.799,1,1)	0.463	2
Continuous surveys of customers about the quality	(0.723, 1,1)	0.437	4
Survey chain stakeholders as major distributor, retailer and recycler	(0.605,1,1)	0.430	6
Identify the best brands, successful experiences and models from the client as benchmarking	(0.616,1,1)	0.432	5
Investigate customer complaints	(0.481,0.799,1)	0.426	7
Using the system of Performance management and reward	(0.182,0.655,0.731)	0.402	10
The existence of information technology tools for continuous monitoring	(0.188,0.825,1)	0.420	9
Regular processes of review and implementation of policy	(0.188,0.845,1)	0.425	8
Training and capacity building	(0.149,0.799,1)	0.395	11
Identify vision, mission and main objectives	(0.123,0.731,1)	0.394	12
Review and training lessons learned	(0.109,0.731,1)	0.385	13

According to Table 11, reporting and permanent monitoring of financial indicators obtain first rank, and other indicators obtain ranks of second to thirteenth.

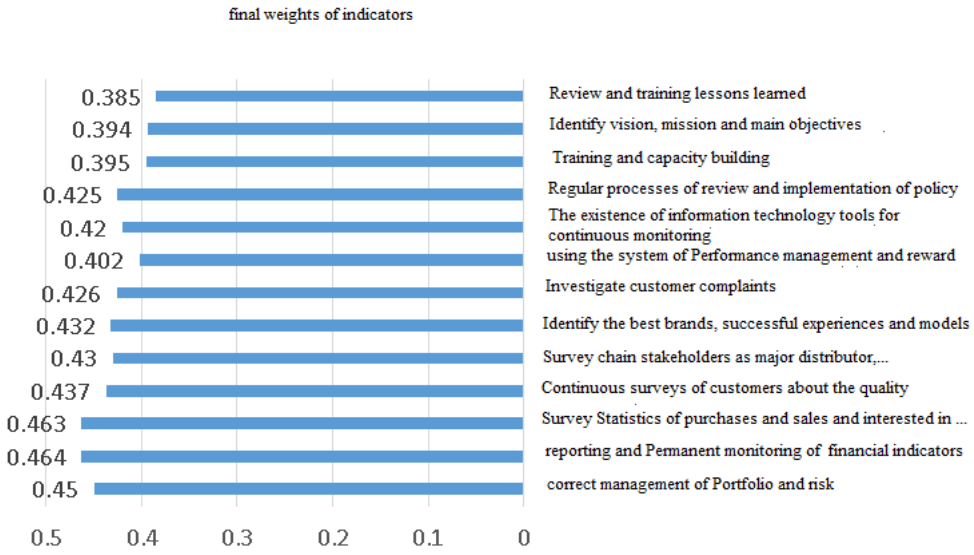

Figure 5. The final weights chart of BSC indicators.

5. Discussion

Records indicated numerous research studies on the performance measurement of manufacturing and business service companies using the BSC approach and decision-making techniques. Feizi and Solukdar (2014) assess construction companies in Tehran Municipality with the approach of FTOPSIS-FAHP-BSC. Shahverdi et al. (2011), with the BSC approach, identify indicators in every perspective and weighting with

fuzzy AHP and decision-making techniques TOPSIS, ELECTRE and VIKOR evaluate and ranking private banks; Moemeni et al. (2011) evaluate, and rank banks listed in Tehran Stock Exchange with BSC approach and decision-making techniques of SAW, VIKOR and TOPSIS weighted indexes and ranked banks. In the following section, the similarities and differences between the results of this study and the researchers described above, as well as the possible reasons for the similarities and differences, will be discussed. Hemati and Mardani (2012) designed BSC using fuzzy TOPSIS. They concluded that techniques for Multiple Attribute Decision Making (MADM) fuzzy, such as fuzzy TOPSIS, can use by a structured methodology in the design of the BSC as a system of measurement and performance management based on strategy. In addition, they concluded that the model of proposal scorecard based on fuzzy TOPSIS by providing systematic solutions obtained from the feedback system creates improvement in almost all indicators defined and has positively impacted organisational performance in all dimensions.

The present study has investigated the importance and impact dimensions of performance measurement in Behpakhsh firm in four perspectives of financial, customers, internal processes and learning growth with the approach of BSC and weighting dimensions and indicators with fuzzy DEMATEL approach and ranking dimensions and its indicators with fuzzy ANP approach. Shahverdi et al., (2011) evaluate the performance of private banking in Iran using the BSC and fuzzy multi-criteria decision-making approach that the present study is in organisation and financial services that in both customer role is very important. These researchers, from four perspectives (financial, customer, internal processes and learning and growth) were studied to evaluate the performance of banking and the present study investigates weighing of four dimensions and indicators. Shahverdi et al., ranked customers perspective as first. Similarly, the present study also ranked the customer dimension as first. This indicates the great importance of this dimension in terms of experts' and senior management's views in both financial and goods services organisations.

Also, Shahverdi et al. (2011) showed that in customers perspective after ranking indicators, index of customer complaints has been first rank, in this study has seventh rank. Moemeni et al., (2011) in study evaluated the performance of private banks listed in Tehran Stock Exchange using fuzzy multi-criteria decision approach and BSC which reflects the differences this study with present study in weighing of indicators and perspectives of the scorecard. The present study uses the FANP technique for weighting, but Moemeni et al. used the FAHP technique for weighting and ranking performance measurement indicators. Other differences including select the type of organisations, as well as the method of using multi-criteria decision-making techniques Moemeni et al. (2011) in their study used techniques of SAW, VIKOR and TOPSIS for ranking banks and Brada techniques used for consensus of views while in this study FDEMATEL-FANP techniques have used to rank the indicators and dimensions.

Feizi and Solukdar (2014) have reviewed the performance of Construction Company in Tehran Municipality with the BSC approach in six perspectives: financial, stakeholder, processes, learning and growth and employee satisfaction and the environment and community and present study has identified measurement indicators in Behpakhsh firm in four common perspectives. In study Feizi and Solukdar, used the technique of fuzzy AHP for weighting and ranking of indicators and perspectives but in present study use Fuzzy ANP techniques. The strengths of the present study compared to research of Feizi and Solukdar, is in the use of fuzzy network analysis and considering network relationship between dimensions and indicators of BSC that not been considered in their research. Also the use of fuzzy DEMATEL technique that determines the relationship between mapping network among dimensions of influencing percentage and experts focus on more important dimensions that study of Feizi and Solukdar, has been deprived of it then financial dimension had gained first rank and in current study customers dimension gain first rank using ANP technique that derived from differences in territory of subject and experts views and the role of customers in Behpakhsh firm and service companies. According to the results of this study and surveys from domestic and foreign articles for the development of this research, the following recommendations are offered:

- Establishing the customer's voice to investigate the customers' comments, censorship, and suggestions will satisfy them more.
- Evaluation of the training needs of staff and in-service courses to enhance employees' capabilities at work and dealing with customers.
- Supplying and distributing of proper training packages in the branches and providing accurate and complete information about every person related to the job duties.
- More attention to the strategic plans and targeted and check the performance of service company due to the program established.

Although Random questionnaire distribution is one of the research methods that has been able to meet the investigator’s demand, It is recommended to use fewer questionnaires in the mentioned topic and use

other methods of questionnaire distribution that are unknown to the researcher. Another recommendation is to use fewer criteria in future research and to use other decision-making methods such as TOPSIS and then compare the results with these results.

6. Conclusion

This study investigated the performance measurement dimensions of the Behpakhsh firm using the Balanced Scorecard (BSC) approach alongside fuzzy DEMATEL and fuzzy ANP techniques for weighting and ranking the dimensions and indicators. The findings reveal important similarities and differences when compared to previous research. Notably, the study found that the customer perspective was ranked first in this study, Shahverdi et al. (2011) highlighted its significant role in financial and non-financial services. However, there were differences in how certain indicators were ranked, such as customer complaints, which ranked seventh in this study compared to first in Shahverdi et al. (2011) work. This reflects the unique context and expert opinions within each organisation. In comparing this study with Moemeni et al. (2011) and Feizi and Solukdar (2014), several key distinctions emerge, including the choice of multi-criteria decision-making techniques and the specific focus on different types of organisations. While Moemeni et al. used SAW, VIKOR, and TOPSIS techniques for ranking, this study applied fuzzy DEMATEL and fuzzy ANP. Additionally, the present study employed a network analysis approach, which better captured the relationships between dimensions and indicators of the BSC—a feature not explored in earlier studies. The study's findings have important implications for improving the performance measurement systems of service-oriented companies like Behpakhsh. Based on the results and the existing literature, the following recommendations are made:

- Establishing a voice of the customer initiative to gather feedback, complaints, and suggestions enhances customer satisfaction.
- Evaluating training needs for employees to improve their customer relations and operational efficiency skills.
- Providing targeted training packages for employees ensures they are well-informed and can perform their duties effectively.
- Paying closer attention to strategic plans and ensuring the alignment of performance assessments with company objectives.

Lastly, it is suggested that future studies explore alternative data collection methods, such as more targeted questionnaire distribution, and use fewer criteria to simplify analysis. Incorporating other decision-making methods like TOPSIS and comparing the results with those obtained in this study could provide further insights into the performance measurement process across different sectors.

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