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Supplier Selection in a Food Industry with Fuzzy Ahp and Fuzzy MOORA Methods

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ABSTRACT:*Companies should be selective for sustaining their commercial activities due to conditions of competition. So, it is a very important decision to select the supplier and sustaining cooperation with this supplier for the producers. When the producer decides for a supplier it considers many criteria and then the issue gets complicated. Supplier selection can be solved as the best methodology with multi criteria decision making methods cause of many criteria which is in the decision problem. In this study, a supplier selection problem is solved in a food company and the best supplier choosing is aimed between 5 suppliers. Firstly, the criteria of supplier selection are mentioned with the experts who work in the company. Then weights of the criterias is solved by using fuzzy Ahp. Suppliers are choosen by using Fuzzy MOORA.*
KEYWORDS: *multi criteria decision making,fuzzy analytical hierarchy method, fuzzy MOORA method,*

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I. INTRODUCTION

Supply chain is a whole process that goes from the supplier to the ultimate consumer. For this reason, all the rings in the chain are influenced by each other even if they are of different weights. In today's competition conditions suppliers can survive with the continuous improvement in their production conditions due to increasing and diversified demands of major producers. Supply chain management can be regarded as one of the first activities to return the money source in the company to a larger source of money. Namely the first activity in the process of purchasing a semi-finished product or raw material or packaging etc. at an appropriate quantity, at an affordable price, on time and on other criteria, converting it into a product, submitting it to the final consumer and making the sale and profit of the enterprise start with supply chain management.In today's conditions, companies need to offer products to the end consumers at the maximum quality with minimum cost in order to continue the business.The minimum cost and the way of maximum qualification starts with the semi-finished products supplied at the appropriate price and the appropriate quality.Multi-criteria decision-making systems that are for solving problems arising from the combination of multiple options and multiple measures.

One of the first studies on Supplier Choice was conducted by Dickson [1] in the United States.In the studies that have been done since 1960, there are many methods and programs have been used to solve supplier selection problems [2]. As categorized by Görener [3] multi-criteria decision-making systems are divided under the main headings; single-method models and hybrid models. Single methods are divided into mathematical, statistical and artificial intelligence-based methods. According to literature review; Amid et al. [4] In the study they conducted in 2011, they calculated the criterion weight for supplier selection with Ahpmethod,determined the order amounts to be received from suppliers by max-min programming method by choosing supplier. Jain et al. [5] in their study, in 2016, they used fuzzy Ahp and topsis methods to make a choice between suppliers of car fryers to the Indian automobile company. Awasti et al. [6] in their study, in 2018, global suppliers have examined sustainability and have made a choice with fuzzy Ahp and Vikormethods.Ajali et al. [7] were used fuzzyAhp and COPRAS to select suppliers. MOORA method; was first introduced by Willem Karel M. Brauers and EdmundasKazimierasZavadskas [8] in 2006. Brauers and Zavadskas [9] used the Multi-MOORA method, which is a kind of MOORA method, to aim selection of the companies in the study they conducted in 2008. Chand et al. [10] aimed choosing the best supply chain by using ANP-MOORA methods together on the green supply chain in their study in 2018. Ding et al. [11] studied the selection of a battery mode with optimum power

to enhance the efficiency of electric vehicle power chokers, using the Multi-MOORA method in his study. Domguez et al. [12] proposed an optimization with the Pythagorean fuzzy sets in the MOORA ratio method for selection of alternatives. Brauers et al. [13] in 2011, conducted a study on bank credit decision-making through the MOORA method. Vatansever et al. [14] conducted an application study on the selection of institutional resource planning systems in the manufacturing sector by using fuzzy Ahp and fuzzy MOORA methods. Dey et al. [15] studied the optimal storage location selection using the Fuzzy MOORA method to solve the problem of multi-criteria decision making in the supply chain. Sisman [16] used the Fuzzy MOORA method in his study to make multi-criteria decision for the selection of green suppliers. Akkaya et al. [17] used fuzzy Ahp and Fuzzy MOORA methods for field selection of industrial engineers.Sisman [18] evaluated the financial performances of Turkish banks using fuzzy Ahp and Fuzzy MOORA methods.Archana et al. [19] used the Fuzzy MOORA method to solve a multi-criteria decision-making problem. Balezentis et al. [20] used Fuzzy Multi-MOORA, a variant of Fuzzy MOORA, in their study on staff selection. Mandal et al. [20] used fuzzy MOORA for choosing best intelligent manufacturing system.

II. FUZZY AHP AND FUZZY MOORA METHODS

In this study, fuzzy Ahp method was used while weight values of supplier selection criteria were calculated. Then the Fuzzy MOORA Ratio Method was used to select the most suitable supplier between five suppliers.

Fuzzy Ahp ;

According to Chang's [22] study of 1996, the fuzzy Ahp steps are based on the Rank Analysis Technique:

Step 1: Synthetic rank is defined like below due to value i;

$$S_{\text{i}} = \sum_{j=1}^{m} M_{g_i}^{j} \times \left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{g_i}^{j}\right]^{-1} \quad (1)$$

In order to obtain $\sum_{j=1}^{m} M_{g_i}^{j}$ equvalent fuzzy addition process is applied as seen in the m-order analysis value.

$$\sum_{j=1}^{m} M_{g_i}^{j} = \left(\sum_{j=1}^{m} l_j \, , \sum_{j=1}^{m} m_{j,} \, , \sum_{j=1}^{m} u_j\right) \quad (2)$$

$$\sum_{i=1}^{n}\sum_{j=1}^{m} M_{g_i}^{j} = \left(\sum_{i=1}^{n} i, \; \sum_{i=1}^{n} m_i, \sum_{i=1}^{n} u_i\right) \quad (3)$$

Then the vector is inverted and obtained as follows.

$$\left[\sum_{i=1}^{n}\sum_{j=1}^{m} M_{g_i}^{j}\right]^{-1} = \left(\frac{1}{\sum_{i=1}^{n} u_i}, \frac{1}{\sum_{i=1}^{n} m_i}, \frac{1}{\sum_{i=1}^{n} l_i}\right) \quad (4)$$

Step 2: $M_2 = (l_2, m_2, u_2) \geq M_1 = (l_1, m_1, u_1)$ is defined as follows.

$$V(M_2 \geq M_1) = sup_{y \geq x}\left[\min(\mu_{M1}(x), \mu_{M_2}(y))\right] \quad (5)$$

This definition can also be expressed by the following equation:

$$\mu_{M_2}(d) = \begin{cases} 1, & m_2 \geq m_1, \\ 0, & l_2 \geq u_2, \\ \dfrac{l_1 - u_2}{(m_2 - u_2) - (m_1 - l_1)}, & other \end{cases} \quad (6)$$

Step 3: If a convex fuzzy number (k) is greater than other fuzzy numbers the likelihood degree is defined as below;

$$(M \geq M1, M2, \ldots, Mk) = V[(M \geq M1) \text{ ve } (M \geq M2) \text{ ve } \ldots \text{ ve}(M \geq Mk)] \quad (7)$$

$$= minV(M \geq M_{\text{i}}), i = 1,2, \ldots k \quad (8)$$

If it is assumed that for k = 1,2,L,n; k ≠ i below expression is true;

$$d'(A_{\text{i}}) = minV(S_i \geq S_k) \quad (9)$$

The weight vector is as follows;

$$W' = (d'(A_1), d'(A_2), \dots, d'(A_n))^T \quad (10)$$

Here A_i(i=1,2,...,n) consists of n elements.

Step 4: Each element of the weight vector is normalized such that the result is divided by (0, 1) and the sums are 1, as in the following equation. The normalized weight vector is as follows. Here W is not a fuzzy number.

$$W = (d(A_1), d(A_2), \dots, d(A_n))^T \quad (11)$$

Fuzzy MOORA;

MOORA method; was first introduced by Willem Karel M. Brauers and EdmundasKazimierasZavadskas [8] in 2006. In this study, Fuzzy MOORA Ratio Method was applied. The steps of Fuzzy MOORA Ratio method which is formed by using fuzzy set theory together with MOORA method are as follows [23].

Step 1: Preparation of the fuzzy decision matrix in the direction of decision makers using triangular membership functions. In the matrix X^l_{ij}, X^m_{ij}, X^n_{ij} values seems respectively the fuzzy numbers with small, medium and large values.

$$\begin{bmatrix} [X^l_{11}\ X^m_{11}\ X^n_{11}][X^l_{12}\ X^m_{12}\ X^n_{12}] \dots [X^l_{1n} X^m_{1n} X^n_{1n}] \\ [X^l_{21}\ X^m_{21}\ X^n_{21}][X^l_{22}\ X^m_{22}\ X^n_{22}] \dots [X^l_{2n} X^m_{2n} X^n_{2n}] \\ \dots \\ \dots \\ [X^l_{m1}\ X^m_{m1}\ X^n_{m1}][X^l_{m2}\ X^m_{m2}\ X^n_{m2}][X^l_{mn} X^m_{mn} X^n_{mn}] \end{bmatrix} \quad (12)$$

Step 2: With vector normalization, a fuzzy decision matrix is formed as below.

$$r^l_{ij} = \frac{x^l_{ij}}{\sqrt{\sum_{i=1}^m \left[\left(X^l_{ij}\right)^2 + \left(X^m_{ij}\right)^2 + \left(X^n_{ij}\right)^2\right]}} \quad (13)$$

$$r^m_{ij} = \frac{x^m_{ij}}{\sqrt{\sum_{i=1}^m \left[\left(X^l_{ij}\right)^2 + \left(X^m_{ij}\right)^2 + \left(X^n_{ij}\right)^2\right]}} \quad (14)$$

$$\mathrm{r}^{\mathrm{n}}_{\mathrm{ij}} = \frac{\mathrm{x}^{\mathrm{n}}_{\mathrm{ij}}}{\sqrt{\sum_{\mathrm{i}=1}^{\mathrm{m}} \left[\left(\mathrm{X}^{\mathrm{l}}_{\mathrm{ij}}\right)^2 + \left(\mathrm{X}^{\mathrm{m}}_{\mathrm{ij}}\right)^2 + \left(\mathrm{X}^{\mathrm{n}}_{\mathrm{ij}}\right)^2\right]}} \quad (15)$$

Step3: Weighted and normalized fuzzy decision matrix is generated with below formulations.

$\mathrm{v}^{\mathrm{l}}_{\mathrm{ij}=\mathrm{w_j r^l_{ij}}}$ (16)

$\mathrm{v}^{\mathrm{l}}_{\mathrm{ij}=\mathrm{w_j r^l_{ij}}}$ (17)

$$v^n_{ij=w_j r^n_{ij}} \quad (18)$$

Step 4: The order of each alternative is calculated in terms of benefit and cost criteria. For the benefit criteria, the following equations are used.

$$s_i^{+l} = \sum_{j=1}^{n} v^l_{ij} \,|j \in J^{max} \quad (19)$$

$$s_i^{+m} = \sum_{j=1}^{n} v^m_{ij} \,|j \in J^{max} \quad (20)$$

$$s_i^{+n} = \sum_{j=1}^{n} v^n_{ij} \,|j \in J^{max} \quad (21)$$

For the cost criterion, the following equation is used.

$$s_i^{-l} = \sum_{j=1}^{n} v_{ij}^{l} \,|\, j \in J^{min} \qquad (22)$$

$$s_i^{-m} = \sum_{j=1}^{n} v_{ij}^{m} \,|\, j \in J^{min} \qquad (23)$$

$$s_i^{-n} = \sum_{j=1}^{n} v_{ij}^{n} \,|\, j \in J^{min} \qquad (24)$$

Step 5: For each alternative, the S_i index is determined. This indexing phase uses the vertex method for refinement [24].

$$S_i(s_i^{+}, s_i^{-}) = \sqrt{\frac{1}{3}\left[(s_i^{+l} - s_i^{-l})^2 + (s_i^{+m} - s_i^{-m})^2 + (s_i^{+n} - s_i^{-n})^2\right]} \qquad (25)$$

Step 6: The results are sorted from small to large according to the performance index and the highest value is considered as the best option.

III. SUPPLIER SELECTION APPLICATION

The producer company to which the supplier selection is made operates in the food sector. By taking the opinions of experts who have minimum 5 years experience in the procurement department, firstly criterias that are specific to the company has beendetermined. In this study, supplier selection was made based on 21 criteria under 5 basic headings. The steps taken in the study are summarized as in Figure 1.

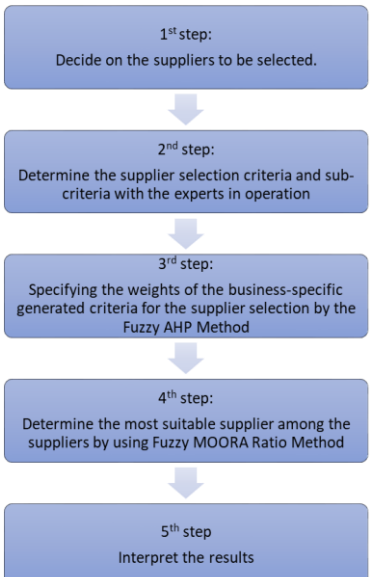

Figure 1. Supplier selection steps.

Supplier selection criteria are as in Table 1. Between these criterias, there are 5 sub-criterias in terms of quality criteria. Due to Akman et al [25] quality of a finished product is on the responsibility of the supplier as well as the responsibility of the main producer. In these days that just in time is becoming more important the delivery criteria get more important as well. Due to Sari et al [26] on time delivery is very important cause of preference of the companies to work with minumum stock level. The financial situation is one of the most important criteria in terms of supplier selection. Companies earns profits where they can reduce their costs. That's why price criteria is very important to choose the best supplier. Another topic that is evaluated in the supplier selection is the service criteria. Today, companies have to develop new products, services and processes on a regular basis in order to compete in a complex global environment and to strengthen competition. At this point, decision maker should consider technology criteria when choosing the supplier.

Table 1. Supplier selection criterias

Main Criteria	SubCriteria
Quality	Rejectedmaterialratio
	Qualityimprovementperformance
	The rate of providingtherequesteddocumentations
	FoodSafety Control Score
	SupplierQuality Team Visits
Delivery	On time delivery
	Obeytoorderquantity
	Flexibilityforurgentorders
	Lead time
Finance	Best price
	ImprovementStudiesforCostReduction
	Priceupdateaccordingtochange of rawmaterialprices
	Place in the market
	Paymnetterms
Service	Customersatisfaction
	Technical support
	Capacityadequacy of supplier
	Requesttoimprovethebusiness
	Procedurecompliance
Technology	Innovationsuggestions
	Clarity in technologicalchanges

3.1. Weighing Supplier Selection Criteria with The Fuzzy Ahp Method

In the company A where the problem will be solved, it is aimed to select the most suitable supplier among the 5 suppliers for the B material. In this problem, suppliers are defined as S1, S2, S3, S4, S5 while the criteria are expressed by K1, K2, K3, ..., K21 respectively. The practice has progressed by taking the expert opinion on the basis of the weight of the criteria of operation. Experts have 4-12 years of experience. The responses to the questions to make binary comparisons have been turned into a single group decision. Analysis of the data was done in MS Excel program. The summary of the criterial weights obtained by the fuzzy Ahp method is as shown in Table 2. Among them, the most significant among the criterial weights are the price, the process compliance and the rejected material ratio.

Table 2. Weights of the criterias

Criterias		Weights
Rejectedmaterialratio	K1	0.06
Qualityimprovementperformance	K2	0.057
The rate of providingtherequesteddocumentations	K3	0.05
FoodSafety Control Score	K4	0.068
SupplierQuality Team Visits	K5	0.011
On time delivery	K6	0.065
Obeytoorderquantity	K7	0.045
Flexibilityforurgentorders	K8	0.018
Lead time	K9	0.049
Best price	K10	0.076
ImprovementStudiesforCostReduction	K11	0.047
Priceupdateaccordingtochange of rawmaterialprices	K12	0.047
Place in the market	K13	0.003
Paymnetterms	K14	0.057
Customersatisfaction	K15	0.022
Technical support	K16	0.05
Capacityadequacy of supplier	K17	0.067
Requesttoimprovethebusiness	K18	0.05
Procedurecompliance	K19	0.072
Innovationsuggestions	K20	0.055
Clarity in technologicalchanges	K21	0.03

3.2. Supplier Selection with Fuzzy MOORA Method

- Step 1: The initial matrix is as shown in Table 3. In the initial matrix, the data on the criteria and suppliers are given.
- Step 2: Using the equations (13), (14) and (15), the vector normalization and the normalized fuzzy decision matrix are constructed. This decision matrix is shown in Table 4.
- Step 3: sing the equations (16), (17) and (18), the weighted normalized matrix is found. The weighted normalized matrix is obtained as shown in Table 5. In this step, the criterion weight values obtained by the fuzzy Ahp method were used.
- Step 4-5: The criteria are grouped in terms of benefit cost values and the process is performed according to Step 4. Then the data are clarified. Supplier rankin is shown in Table 6.

Table 3. Initial Matrix

		K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	K17	K18	K19	K20	K21
T1	l	1	5	3	1	1	3	1	3	1	1	1	1	3	5	1	3	1	3	3	1	5
	m	3	7	5	1	3	5	3	5	3	3	1	1	5	7	3	5	3	5	5	1	7
	n	5	9	7	3	5	7	5	7	5	5	3	3	7	9	5	7	5	7	7	3	9
T2	l	3	1	1	5	1	3	5	3	3	3	3	3	3	1	3	1	3	5	5	1	5
	m	5	3	1	7	3	5	7	5	5	5	5	5	5	3	5	1	5	7	7	1	7
	n	7	5	3	9	5	7	9	7	7	7	7	7	7	5	7	3	7	9	9	3	9
T3	l	1	1	7	7	5	1	1	5	1	1	5	7	5	5	3	7	7	5	5	1	5
	m	1	3	9	9	7	1	1	7	1	1	7	9	7	7	5	9	9	7	7	3	7
	n	3	5	9	9	9	3	3	9	3	3	9	9	9	9	7	9	9	9	9	5	9
T4	l	7	7	5	3	3	1	3	3	5	7	1	1	1	3	1	1	1	1	3	1	3
	m	9	9	7	5	5	3	5	5	7	9	1	3	3	5	3	3	1	3	5	3	5
	n	9	9	9	7	7	5	7	7	9	9	3	5	5	7	5	5	3	5	7	5	7
T5	l	5	3	1	1	1	5	7	3	7	5	1	5	3	1	1	5	5	1	3	1	1
	m	7	5	3	3	1	7	9	5	9	7	1	7	5	1	1	7	7	3	5	3	3
	n	9	7	5	5	3	9	9	7	9	9	3	9	7	3	3	9	9	5	7	5	5

Table 4. Normalized fuzzy decision matrix

		K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	K17	K18	K19	K20	K21
T1	l	0,11	0,54	0,33	0,11	0,16	0,45	0,11	0,38	0,11	0,11	0,16	0,11	0,41	0,64	0,22	0,33	0,11	0,38	0,34	0,45	0,54
	m	0,23	0,53	0,39	0,08	0,31	0,48	0,23	0,41	0,23	0,23	0,11	0,08	0,43	0,61	0,36	0,39	0,23	0,42	0,38	0,19	0,52
	n	0,32	0,56	0,45	0,19	0,36	0,48	0,32	0,42	0,32	0,32	0,24	0,19	0,44	0,57	0,40	0,45	0,32	0,43	0,40	0,31	0,51
T2	l	0,33	0,11	0,11	0,54	0,16	0,45	0,54	0,38	0,33	0,33	0,49	0,33	0,41	0,13	0,65	0,11	0,33	0,64	0,57	0,45	0,54
	m	0,39	0,23	0,08	0,54	0,31	0,48	0,54	0,41	0,39	0,39	0,57	0,39	0,43	0,26	0,60	0,08	0,39	0,59	0,53	0,19	0,52
	n	0,45	0,31	0,19	0,57	0,36	0,48	0,57	0,42	0,45	0,45	0,56	0,45	0,44	0,32	0,56	0,19	0,45	0,56	0,51	0,31	0,51
T3	l	0,11	0,11	0,76	0,76	0,82	0,15	0,11	0,64	0,11	0,11	0,82	0,76	0,69	0,64	0,65	0,76	0,76	0,64	0,57	0,45	0,54
	m	0,08	0,23	0,70	0,70	0,73	0,10	0,08	0,57	0,08	0,08	0,80	0,70	0,61	0,61	0,60	0,70	0,70	0,59	0,53	0,56	0,52
	n	0,19	0,31	0,57	0,57	0,65	0,21	0,19	0,54	0,19	0,19	0,72	0,57	0,57	0,57	0,56	0,57	0,57	0,56	0,51	0,52	0,51
T4	l	0,76	0,76	0,54	0,33	0,49	0,15	0,33	0,38	0,54	0,76	0,16	0,11	0,14	0,38	0,22	0,11	0,11	0,13	0,34	0,45	0,33
	m	0,70	0,68	0,54	0,39	0,52	0,29	0,39	0,41	0,54	0,70	0,11	0,23	0,26	0,43	0,36	0,23	0,08	0,25	0,38	0,56	0,37
	n	0,57	0,56	0,57	0,45	0,51	0,34	0,45	0,42	0,57	0,57	0,24	0,32	0,31	0,45	0,40	0,32	0,19	0,31	0,40	0,52	0,39
T5	l	0,54	0,33	0,11	0,11	0,16	0,75	0,76	0,38	0,76	0,54	0,16	0,54	0,41	0,13	0,22	0,54	0,54	0,13	0,34	0,45	0,11
	m	0,54	0,38	0,23	0,23	0,10	0,67	0,70	0,41	0,70	0,54	0,11	0,54	0,43	0,09	0,12	0,54	0,54	0,25	0,38	0,56	0,22
	n	0,57	0,43	0,32	0,32	0,22	0,62	0,57	0,42	0,57	0,57	0,24	0,57	0,44	0,19	0,24	0,57	0,57	0,31	0,40	0,52	0,28

Table 5. Weighted normal to fuzzy decision matrix

		K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	K11	K12	K13	K14	K15	K16	K17	K18	K19	K20	K21
	W	0,06	0,06	0,05	0,07	0,01	0,06	0,05	0,02	0,05	0,08	0,05	0,05	0,00	0,06	0,02	0,05	0,07	0,05	0,07	0,06	0,03
T1	l	0,01	0,03	0,02	0,01	0,00	0,03	0,00	0,00	0,01	0,01	0,01	0,01	0,00	0,04	0,00	0,02	0,01	0,02	0,02	0,02	0,02
	m	0,01	0,03	0,02	0,01	0,00	0,03	0,01	0,01	0,01	0,02	0,01	0,00	0,00	0,03	0,01	0,02	0,02	0,02	0,03	0,01	0,02
	n	0,02	0,03	0,02	0,01	0,00	0,03	0,01	0,01	0,02	0,02	0,02	0,01	0,00	0,03	0,01	0,02	0,02	0,02	0,03	0,02	0,02
T2	l	0,02	0,01	0,01	0,04	0,00	0,03	0,02	0,01	0,02	0,02	0,02	0,02	0,00	0,01	0,01	0,01	0,02	0,03	0,04	0,02	0,02
	m	0,02	0,01	0,00	0,04	0,00	0,03	0,02	0,01	0,02	0,03	0,02	0,02	0,00	0,01	0,01	0,00	0,03	0,03	0,04	0,01	0,02
	n	0,03	0,02	0,01	0,04	0,00	0,03	0,03	0,01	0,02	0,03	0,02	0,02	0,00	0,02	0,01	0,01	0,03	0,03	0,04	0,02	0,02
T3	l	0,01	0,01	0,04	0,05	0,01	0,01	0,00	0,01	0,01	0,01	0,01	0,04	0,00	0,04	0,01	0,04	0,05	0,03	0,04	0,02	0,02
	m	0,00	0,01	0,04	0,05	0,01	0,01	0,00	0,01	0,00	0,01	0,00	0,03	0,00	0,03	0,01	0,03	0,05	0,03	0,04	0,03	0,02
	n	0,01	0,02	0,03	0,04	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,03	0,00	0,03	0,01	0,03	0,04	0,03	0,04	0,03	0,02
T4	l	0,05	0,04	0,03	0,02	0,01	0,01	0,01	0,01	0,03	0,06	0,04	0,01	0,00	0,02	0,00	0,01	0,01	0,01	0,02	0,02	0,01
	m	0,04	0,04	0,03	0,03	0,01	0,02	0,02	0,01	0,03	0,05	0,03	0,01	0,00	0,02	0,01	0,01	0,01	0,01	0,03	0,03	0,01
	n	0,03	0,03	0,03	0,03	0,01	0,02	0,02	0,01	0,03	0,04	0,03	0,02	0,00	0,03	0,01	0,02	0,01	0,02	0,03	0,03	0,01
T5	l	0,03	0,02	0,01	0,01	0,00	0,05	0,03	0,01	0,04	0,04	0,03	0,03	0,00	0,01	0,00	0,03	0,04	0,01	0,02	0,02	0,00
	m	0,03	0,02	0,01	0,02	0,00	0,04	0,03	0,01	0,03	0,04	0,03	0,03	0,00	0,00	0,00	0,03	0,04	0,01	0,03	0,03	0,01
	n	0,03	0,02	0,02	0,02	0,00	0,04	0,03	0,01	0,03	0,04	0,03	0,03	0,00	0,01	0,01	0,03	0,04	0,02	0,03	0,03	0,01

Table 6. Supplier ranking

Supplier	S+			S-			S	Ranking
T1	0,19	0,20	0,24	0,09	0,12	0,14	0,10	3
T2	0,25	0,24	0,27	0,12	0,14	0,16	0,12	2
T3	0,40	0,39	0,35	0,04	0,04	0,08	0,33	1
T4	0,21	0,24	0,26	0,20	0,20	0,18	0,06	4
T5	0,21	0,24	0,27	0,21	0,21	0,20	0,05	5

IV. CONCLUSION

Today, when competition is increasing day by day, companies examine all input processes and output processes to survive and intervene in missing points. Every ring in supply chain process are growing or shrinking at a certain rate according to the trend of the main producer. Therefore, improvements in supply chain effect every member of the chain. Companies are developing sales network and marketing networks but are also obliged to take into consideration the factors that may cause money outflows in the company and develop their networks. Supplier selection, for the main producer whose completed their selection process, which suppliers will increase business partnership volume, which supplier will decrease. In this way, the main producer works more with the most suitable suppliers, making the output of the company more economical and minimizing the negative effect of the supply chain caused by the supplier and production downtime. Once a supplier selection has been made, this selection should be updated to be up-to-date at certain times and updated by the main producer to work with the most appropriate supplier. One of the most important criteria at this point is that main producer should aim for a supplier that is primarily working or other suppliers, encourages to the continuous improvement program, and that suppliers are better positioned then present. In this study, the problem of multi-criteria decision making regarding which supplier or suppliers to choose for supply of a very frequently purchased material in an enterprise operating in the food sector. In the study, firstly supplier selection criteria were determined by taking the opinions of the experts working in the company, and then supplier selection criteria were weighted by the fuzzy Ahp Method. Then, the most suitable supplier among 5 suppliers was selected by Fuzzy MOORA Ratio Method. Supplier T3 has been identified as the preferred supplier for the company.

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