EVALUATION OF DAIRY PRODUCT SUPPLIERS FOR TOURISM INDUSTRY IN TURKEY BY USING THE SECA APPROACH

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Abstract: The tourism industry encounters many complicated decision-making problems on supplier selection. Companies have to make a very comprehensive collaboration with many suppliers to give quality hospitality services. However, selecting appropriate suppliers is not easy, as many conflicting criteria affect the evaluation processes. Furthermore, complexities are ever-increased depending on the number of alternatives and criteria. This paper proposes a novel multi-criteria decision-making (MCDM) framework to solve these decision-making problems encountered in the tourism and hospitality industries. The proposed framework consists of two MCDM techniques. First, the Simple Additive Weighting (SAW) method was applied to convert the subjective evaluations of some criteria to the crisp values. Second, the simultaneous evaluation of criteria and alternatives (SECA) technique was implemented to identify the criteria weights and determine the preference ratings of the decision alternatives. In this perspective, the proposed methodological framework was applied to evaluate dairy products suppliers in Turkey. The identified evaluation criteria are price, reliability, delivery performance, product quality, payment ease, packaging quality, warranty period, product variety, production capacity, and financial situation. According to the analysis results, it has been observed that the criterion of financial situation is the most influential factor, and the A4 option is the best alternatives.

Key words: Tourism and Hospitality, Multi-Criteria Decision-Making (MCDM), Simultaneous Evaluation of Criteria and Alternatives (SECA), Simple Additive Weighting (SAW), Supplier Selection

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1. INTRODUCTION

Tourism and hospitality, called the smokeless industry, is the most crucial industry of a country and serves regional and national development (Lan et al., 2021; Bhattarai & Adhikari, 2021; Akash & Aram 2021). It has many valuable contributions to a country's economy and its prestige. Service quality of the current industry has been the most vital issue for customer satisfaction and sustainability every time. Quality is entirely dependent on well-organized tourism supply chains. Significantly, food and beverage suppliers are the determinative factors for service quality, as there are no good things than tasty treats for tourism industry customers. In the existing literature, although several studies dealt with supplier selection in the tourism industry, the number of studies dealing with this issue by applying decision-making tools is exceptionally scarce. The available papers existing in the literature are presented in Table 1 by summarising

Table 1. The related previous papers and implemented approaches

Authors	The subject of the papers	Technique
Şimşek et al. (2015)	SS of a hotel company	TOPSIS & MOORA
Yangınlar, (2018)	SS criteria	Statistical analysis
Gündüz & Güler, (2015)	SS in thermal tourism	AHP
Karaatlı & Davras (2014)	SS in hotel company	AHP
Sarıoğlan (2011)	Accommodation business SS	Statistical analysis
Doğan & Gencan (2015)	Best hotel selection	AHP
Gümüş et al. (2017)	Alanya hotels SS	AHP
Ünal et al. (2019)	SS for hotel companies	BULANIK AHP
Vatansever & Tellioğlu (2020)	Choosing a supplier for a Hotel	T2IF TOPSIS
Hsu C-W (2014)	Low carbon SS for tourism firms	DANP & VIKOR
Önder & Kabadayı (2015)	SS in hotel firms	ANP

As shown in Table 1, the most preferred MCDM approaches in the existing literature are the Analytic Hierarchy Process (AHP) and the Analytic Network Process (ANP) methods to evaluate the suppliers in the tourism industry. Hence, there are severe and surprising gaps in the literature since the used techniques have some drawbacks and limitations. First, these techniques suffer from rank reversal problems, and any change (i.e., the number of attributes and alternatives or the value of attributes) may cause a change in the final results dramatically (Mufazzal & Muzakkir, 2018). Because of that, these approaches have no significant reliability. Also, they require many computations and pairwise comparisons, and it is required to use additional techniques for identifying the consistency (Karthikeyan et al., 2016).

In addition, the simultaneous evaluation of criteria and alternatives (SECA) technique has been applied by several researchers in the literature though it is a very novel multi-criteria decision-making (MCDM) approach. These studies can be summarised as follows. In some studies performed by Keshavarz-Ghorabaee et al. (2018), the technique, called Simultaneous Evaluation of Criteria and Alternatives (SECA), introduced by the same authors, was implemented. It was applied for evaluating the sustainable production systems (Keshavarz-Ghorabaee et al. 2019), the best asymmetric formulation for the traveling salesman problems (Bazrafshan et al. 2021), evaluating the performances of the battery vehicles (Ecer, 2021). Also, Ecer (2020) demonstrated the implementations and algorithm of the SECA technique.

When the literature is evaluated in general, the SECA approach is still a very novel MCDM technique, and it was applied in fewer studies in the existing literature. Thus, we preferred to use the SECA approach to handle the evaluation and selection of the dairy products suppliers in Turkey, and it is aimed to solve this decision-making problem encountered in the field of the tourism industry by applying an MCDM framework based on this approach.

The rest of the paper is organized as follows. In section 2, the basic algorithm of the proposed framework is introduced, and implementation of the proposed model is demonstrated to solve the selection of dairy product suppliers in the tourism & hospitality industry in section 3. In section 4, a comprehensive sensitivity analysis was performed to test the validation of the proposed model. In section 5, the obtained overall results are discussed by considering the outputs and findings of the study. Also, recommendations to the following studies are indicated in this section.

2. THE PROPOSED MCDM FRAMEWORK

In this section, the proposed MCDM framework is demonstrated in detail. The basic algorithm of the model is presented in Figure 1 schematically.

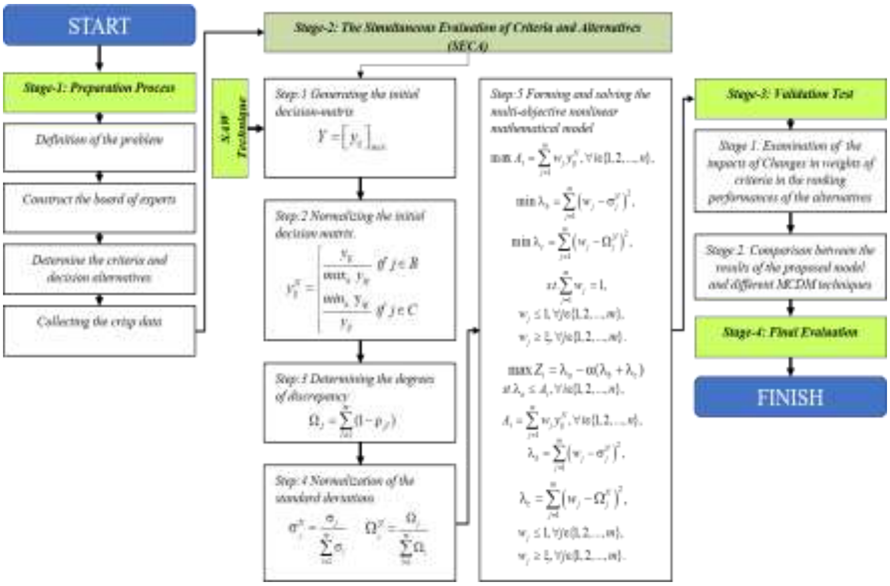

Fig. 1. The procedure of the proposed MCDM framework

As given in Figure 1, the decision-making problem is first identified, and decision alternatives and the selection criteria are determined. Secondly, the criteria weights and the preference ratings of the options are determined simultaneously by applying the SECA technique. Finally, a comprehensive sensitivity analysis is performed to test the validation and robustness of the proposed model.

Simultaneous Evaluation of Criteria and Alternatives (SECA) technique

The SECA introduced by Keshavarz-Ghorabaee et al. (2018) is a novel MCDM technique (Ecer, 2021; Keshavarz-Ghorabaee et al., 2018). When this approach is compared to other traditional and popular MCDM frameworks, its most significant difference is that this technique can simultaneously identify the weights of the selection criteria and the preference ratings of the decision alternatives (Keshavarz-Ghorabaee et al. 2018; Ecer, 2020; Bazrafshan et al. 2021). According to the procedure of the SECA technique (Keshavarz-Ghorabaee et al.2018, Keshavarz-Ghorabaee, 2018), two types of reference points such as within-criteria and between-criterion are identified. The first reference point (i.e., within-criterion) is based on standard deviation, and the second (i.e., between-criterion) is identified based on correlation measure (Keshavarz-Ghorabaee et al.2019). The deviations of within-criterion and between-criterion are determined, respectively. Thus, a multi-purpose nonlinear model formed the basis on these expressions is mathematically

formulated in a manner that consists of three aim functions (Ecer, 2020). It aims to maximize the relative importance scores of the alternatives and minimize the deviations of within-criterion and between-criterion. Thus, as a result of the optimization of the mathematical model, both the performance score of the alternatives and the relative significance of the criteria are synchronically identified Keshavarz-Ghorabaee et al.2018; Ecer, 2021) advantages and suitable and applicable structure of this approach have effective for selecting it as a methodological for the current paper.
The basic algorithm of the SECA technique is presented as follows (Keshavarz-Ghorabaee et al. 2018; Ecer, 2020; Ecer, 2021; Bazrafshan et al. 2021).

Step 1. Generating the initial decision-matrix: Let suppose that n denotes the number of alternatives (i = 1,2,...,n) and m represents the number of the criteria (j = 1,2,...,m). The initial decision matrix is constructed as given in equation 1. Each matrix element [Y] should provide the condition of y_{ij}>0.

$$Y = \begin{bmatrix} y_{11} & x_{12} \cdots & y_{1m} \\ y_{21} & y_{22} \cdots & y_{2m} \\ \cdots & \cdots \quad \cdots & \cdots \\ y_{n1} & y_{n2} \cdots & y_{nm} \end{bmatrix}$$
(1)

Step 2. Normalizing the initial decision matrix: The elements of the initial decision matrix given in equation 1 are normalized with the help of equation 2 (Bazrafshan et al. 2021) by considering the characters of the criteria (i.e., benefit or cost criteria).

$$y_{ij}^{N} = \begin{cases} \dfrac{y_{ij}}{max_k \ y_{kj}} & if \ j \in B \\ \dfrac{min_k \ y_{kj}}{y_{ij}} & if \ j \in C \end{cases} \qquad (2)$$

Where; *B* denotes the benefit criteria, and *C* symbolizes the cost criteria.

Step 3. Determining the degrees of discrepancy: In this step, the degrees of the discrepancy between j^{th} criterion and others are computed using equation 3 (Ecer, 2020).

$$\Omega_j = \sum_{l=1}^{m}(1-\rho_{jl}) \qquad (3)$$

While ρ_{jl} is the correlation between j^{th} and l^{th} column of the normalized matrix, Ω_j denotes the degrees of discrepancy.

Step 4. Normalization of the standard deviations(σ_j) and correlation coefficients: The normalized values of standard deviation and correlation coefficient for each column of the normalized decision matrix are computed. For this purpose, Eqs. 4 and 5 are used, respectively.

$$\sigma_j^N = \frac{\sigma_j}{\sum_{l=1}^{m} \sigma_l} \quad (4)$$

$$\Omega_j^N = \frac{\Omega_j}{\sum_{l=1}^{m} \Omega_l} \quad (5)$$

Where; σ_j^N is normalized standard deviation value, Ω_j^N denotes the normalized correlation coefficient.

Step 5. Forming and solving the multi-objective nonlinear mathematical model: In this step, the mathematical model consisting of expressions between 6th and 11th is formulated.

$$\max A_i = \sum_{j=1}^{m} w_j y_{ij}^N, \forall i \varepsilon \{1, 2, ..., n\}, \quad (6)$$

$$\min \lambda_b = \sum_{j=1}^{m} \left(w_j - \sigma_j^N \right)^2, \quad (7)$$

$$\min \lambda_c = \sum_{j=1}^{m} \left(w_j - \Omega_j^N \right)^2, \quad (8)$$

$$s.t. \sum_{j=1}^{m} w_j = 1, \quad (9)$$

$$w_j \leq 1, \forall j \varepsilon \{1, 2, ..., m\}, \quad (10)$$

$$w_j \geq \xi, \forall j \varepsilon \{1, 2, ..., m\}. \quad (11)$$

Then, this model is optimized by converting the model consisting of equations from 12th to 17th, and the criteria weights and preference ratings of the decision alternatives are determined. ξ, parameter existing in the model denotes the value provided to remain between ξ, and 1 for criteria; Also, it is recommended that this value should be identified as 0.001 (Ecer, 2020).

$$\max Z_i = \lambda_a - \alpha(\lambda_b + \lambda_c) \quad (12)$$

$$st. \lambda_a \leq A_i, \forall i \varepsilon \{1, 2, ..., n\}, \quad (13)$$

$$A_i = \sum_{j=1}^{m} w_j y_{ij}^N, \forall i \varepsilon \{1, 2, ..., n\},$$

$$\lambda_b = \sum_{j=1}^{m} \left(w_j - \sigma_j^N \right)^2, \tag{14}$$

$$\lambda_c = \sum_{j=1}^{m} \left(w_j - \Omega_j^N \right)^2, \tag{15}$$

$$\sum_{j=1}^{m} w_j = 1, \tag{16}$$

$$w_j \leq 1, \forall j \varepsilon \{1, 2, ..., m\}, w_j \geq \xi, \forall j \varepsilon \{1, 2, ..., m\}. \tag{17}$$

α coefficient given in equation 12 denotes the value that is effective for taking closer scores to the reference points for criteria weights as providing the condition $\alpha \geq 0$. As well as it can take a score between 0 and 1, it is possible to identify a value over 1 for that (Ecer, 2020; Bazrafshan et al., 2021; Ecer, 2021).

APPLYING THE PROPOSED MODEL TO THE SUPPLIER SELECTION PROBLEM

In this section, the proposed model was applied to solve the selection problem of dairy product suppliers in Turkey's tourism & hospitality industry. Before the implementation steps, information about the preparation process is presented in the following section.

Problem description

The current paper is derived from a real-life decision-making problem. Top managers of a tourism and hospitality firm that is one of the most significant tourism companies in Turkey requested help to solve decision-making problems on selecting their suppliers to our research team, and they requested a meeting to discuss these problems. By attending the first meeting, we tried to collect information about their problems and the company. According to our first sight, the company followed the entirely traditional and ancestral ways to evaluate and select the suppliers. They could not select the right and appropriate suppliers, as there were no sufficiently reliable and honest companies trying to do the work right. Consequently, they continued to lose money, and their material flows were not satisfactory concerning productivity, effectivity, and costs. By keeping this pre-information about the company in mind, we decided to collaborate with them to solve this decision-making problem permanently and carry out a research process. First, as seen in Table 2, we constructed a board of experts consisting of five highly experienced members and have extensive knowledge of the tourism and hospitality industry to obtain more reliable and reasonable results. We organized many round table meetings with them in addition to many face-to-face interviews with each expert. In this meeting, we requested each expert to prepare a list to identify the selection criteria. Next, we collected these lists and prepared the final criteria list by eliminating the repetitive criteria. At the end of the process, the final criteria set has been identified to use in the research process by providing the complete consensus of the board members, as presented in Table 3.

Table 2. Information and details of the experts

No	Experience	Graduate	Duty
DM1	24	Tourism management	General manager
DM2	26	Finance	Business owner
DM3	28	Travel management	Purchasing manager
DM4	32	Business	supply chain manager
DM5	30	Tourism hotel management	General manager

Table 3. The selection criteria and decision alternatives

Code	Criteria	Code	Criteria	Code	Alternatives
C1	Price	C6	Packaging quality	A_1	SekSüt
C2	Reliability	C7	Warranty period	A_2	Ülker İçim
C3	Delivery performance	C8	Product variety	A_3	Sütaş
C4	Product quality	C9	Production capacity	A_4	Torku
C5	Ease of payment	C10	Financial situation	A_5	Pınar

Definitions about the identified selection criteria are presented in Table 4.

Table 4. The final selection criteria & alternatives, and definitions

Codes	Criteria	Definition
C1	Price	The price of service & products presented by suppliers
C2	Reliability	the ability of a firm to supply an acceptable product at the required time consistently
C3	Delivery performance	The level that measures how much an organization's supply of goods and services has met the standards expected by its customers.
C4	Product quality	It refers to how well a product satisfies customer needs, serves its purpose, and meets industry standards.
C5	Ease of payment	The ease of transactions helps companies to make payments.
C6	Packaging quality	It refers to well-packaging for preserving the product quality
C7	Warranty period	It guarantees the quality of services and products presented by suppliers
C8	Product variety	The number and range of brands or products offered by a supplier
C9	Production capacity	It refers to maximum production or output, which can be produced in business with the help of available resources.
C10	Financial situation	It means the company's financial position and represents to balance or unbalance its financial structure.

Evaluation of the suppliers with the help of the proposed model

After the criteria and decision alternatives are identified, the proposed model is applied by following the SECA technique's implementation steps. For this purpose, the initial decision matrix is constructed as presented in Table 5. The subjective data related to the existing subjective criteria were transformed to the crisp data by using the Simple Additive Weighting (SAW) technique (Ömürbek et al., 2016), other crisp and objective data collected from the reports, catalogues, technical data published by the dairy products manufacturers identified as the decision alternatives in the current study.

Table 5. The initial decision matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
A_1	6.25	7.50	7.16	8.16	7.33	8.33	7	69	2	89900000
A_2	7.90	7.00	7.16	7.50	6.83	7.83	6	78	5	99800000
A_3	6.25	7.30	6.66	7.50	6.83	7.50	6	49	2	92000000
A_4	5.75	8.50	8.00	8.50	8.66	8.16	6	73	5	102000000
A_5	6.40	9.00	8.16	8.66	7.66	8.66	5	98	3	34700000

The decision matrix given in Table 5 has been normalized using equation 2. In the current paper, only criterion C1 is the cost criterion, and remainders are the benefit criteria. The normalized matrix is presented in Table 6.

Table 6. The normalized decision matrix

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
A_1	0.920	0.833	0.877	0.942	0.846	0.962	1.000	0.704	0.400	0.881
A_2	0.728	0.778	0.877	0.866	0.789	0.904	0.857	0.796	1.000	0.978
A_3	0.920	0.811	0.816	0.866	0.789	0.866	0.857	0.500	0.400	0.902
A_4	1.000	0.944	0.980	0.982	1.000	0.942	0.857	0.745	1.000	1.000
A_5	0.898	1.000	1.000	1.000	0.885	1.000	0.714	1.000	0.600	0.340

Next, by computing the correlation coefficient, degrees of discrepancy are determined with the help of Eq. 3 based on these values. After the standard deviations are calculated, these values are normalized with the help of Eqs. 4 and 5, and the results are given in Table 7.

Table 7. The σ_j^N and the (Ω_j^N) values

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
σ_j	0.100	0.094	0.077	0.063	0.087	0.052	0.101	0.180	0.303	0.273
σ_j^N	0.075	0.071	0.058	0.047	0.066	0.039	0.076	0.135	0.228	0.205
Ω_j	7.036	5.649	5.113	5.034	4.883	5.918	10.965	6.851	7.858	11.247
Ω_j^N	0.100	0.080	0.072	0.071	0.069	0.084	0.155	0.097	0.111	0.159

In the last step, the model has been formed and solved with the help of LINGO 18.0 software. In the model, it has been taken as $\zeta=0.001$ and $\alpha=4$. The obtained criteria weights and the performance scores of the alternatives are given in Table 8.

Table 8. The criteria weights and performance score of options

	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10
W_j	0.0965	0.0776	0.0676	0.0647	0.0680	0.0667	0.1211	0.0992	0.1472	0.1914
Rank	5	6	8	10	7	9	3	4	2	1
	A1	**A2**	**A3**	**A4**	**A5**					
Score	0.814	0.877	0.759	0.947	0.763					
Rank	3	2	5	1	4					

When the criteria weights given in Table 8 are evaluated, the most significant criterion is the C10 financial situation with a score of 0.1914. remain criteria have been ranked as C9>C7>C8>C1>C2>C5>C3>C6>C4. Besides, the A4 Ülker İçim has been determined as the most suitable option, and remainders are ranked as A2>A1>A5>A3.

THE VALIDATION TEST

Here, we performed a comprehensive sensitivity analysis consisting of two phases to test the validity and applicability of the proposed model.

a) ***Examination of the modification of*** α ***coefficient:*** In this section, the criteria weights and performance score of alternatives were re-calculated by changing the α coefficient. For this purpose, we formed 14 different scenarios. As a result of optimizing the mathematical models formed for each coefficient, the criteria weights in Figure 2 and ranking the criteria for different values of α in Table 9 are given. When the obtained results are evaluated, the coefficient values of $\alpha \geq 0.5$, C10 has remained in the same rank.

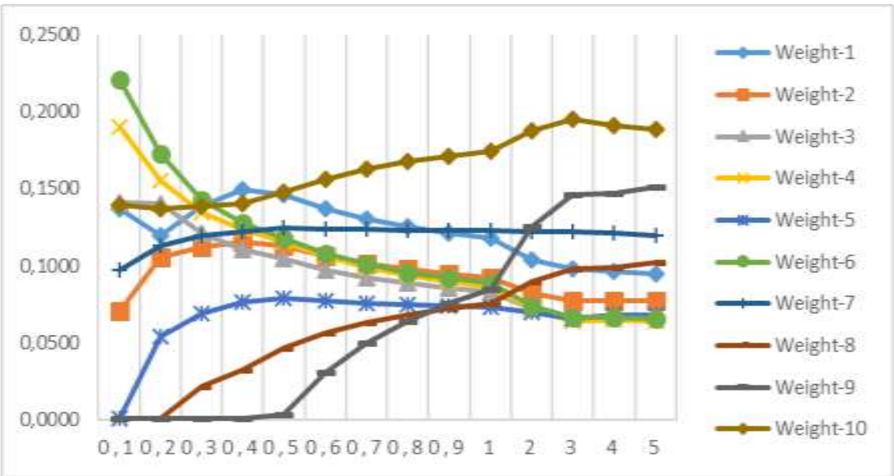

Fig. 2. Changing the criteria weight for α coefficient

Table 9. Ranking the criteria for different values of α

	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1	2	3	4	5
W1	5	5	3	1	2	2	2	2	3	3	4	5	5	5
W2	7	7	7	6	6	5	4	4	4	4	6	6	6	6
W3	3	3	5	7	7	7	7	7	7	8	8	7	8	8
W4	2	2	4	4	5	6	6	6	6	6	9	10	10	10
W5	8	8	8	8	8	8	8	8	9	10	10	9	7	7
W6	1	1	1	3	4	4	5	5	5	5	7	8	9	9
W7	6	6	6	5	3	3	3	3	2	2	3	3	3	3
W8	8	9	9	9	9	9	9	9	10	9	5	4	4	4
W9	8	9	10	10	10	10	10	10	8	7	2	2	2	2
W10	4	4	2	2	1	1	1	1	1	1	1	1	1	1

For the value of the α parameter identified as different, the performance scores of alternatives are given in Table 10.

Table 10. Performance scores of options for the different coefficients of α

	□=0,1	Rank	□=0,2	Rank	□=0,3	Rank	□=0,4	Rank	□=0,5	Rank	□=0,6	Rank	□=0,7	Rank
A1	0,923	2	0,915	2	0,908	2	0,905	2	0,900	2	0,884	2	0,872	2
A2	0,866	3	0,859	3	0,852	3	0,848	3	0,848	3	0,854	3	0,858	3
A3	0,866	3	0,859	3	0,852	3	0,848	3	0,842	4	0,826	4	0,815	4
A4	0,963	1	0,962	1	0,958	1	0,956	1	0,953	1	0,952	1	0,951	1
A5	0,866	3	0,859	3	0,852	3	0,848	3	0,842	4	0,826	4	0,815	4
	□=0,8	**Rank**	**□=0,9**	**Rank**	**□=1**	**Rank**	**□=2**	**Rank**	**□=3**	**Rank**	**□=4**	**Rank**	**□=5**	**Rank**
A1	0,864	2	0,857	3	0,851	3	0,827	3	0,815	3	0,814	3	0,811	3
A2	0,861	3	0,863	2	0,865	2	0,873	2	0,877	2	0,877	2	0,877	2
A3	0,807	4	0,801	4	0,796	4	0,773	4	0,761	4	0,759	5	0,756	5
A4	0,951	1	0,950	1	0,950	1	0,948	1	0,947	1	0,947	1	0,946	1
A5	0,807	4	0,801	4	0,796	4	0,773	4	0,761	4	0,763	4	0,763	4

The ranking results for decision alternatives given in Table 10 are examined; the best option, according to the proposed model results, has remained in the same ranking position. Hence, the proposed model results can be accepted as stable and consistent.

b) Comparison with other MCDM approaches

By considering the initial decision matrix constructed for the SECA technique, different MCDM techniques are implemented, and the ranking results are examined. For this purpose, multiattribute utility theory (MAUT) (Lopes and Almeida, 2015), measurement of alternatives and ranking according to compromise solution (MARCOS)(Stević et al., 2020), the technique for order preference by similarity to ideal solution (TOPSIS) (Venkatesh et al. 2015), multi-attributive border approximation area comparison (MABAC) (Pamučar and Ćirović, 2015), and weighted aggregated sum product assessment (WASPAS) (Zavadskas et al., 2012) techniques are applied. The obtained results are given in Figure 3.

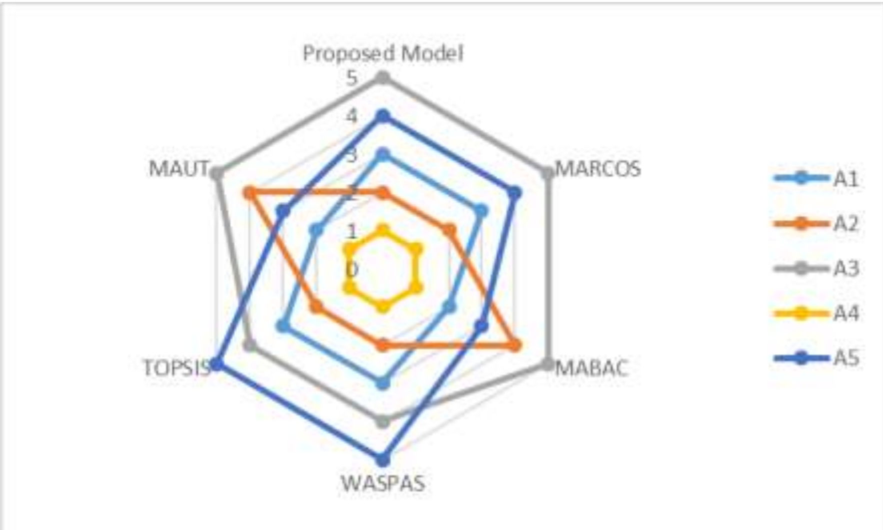

Fig. 3. Comparison with different MCDM techniques

According to the ranking of the alternatives given in Figure 3, the A4 option Ülker İçim is the best alternative for each implemented technique. It has been observed that slight changes cannot change the overall results in the ranking performances of the other alternatives. However, the average correlation coefficient is determined as r= 0.84, which can be accepted very high.

CONCLUSIONS

This study applied an MCDM framework based on the SECA approach to evaluate the dairy products supplier selection problems. The current paper has some valuable contributions and managerial implications. First, a novel criteria set is presented in the current study to fill the existing gap in the literature because there are no criteria set commonly accepted in the literature. In addition, it is unclear how the identified criteria were selected, and there is no evidence about the applied methodological frame for determining these criteria in the previous papers. This paper identifies the criteria set by following a methodological frame. In addition to a detailed literature review, we performed comprehensive fieldwork with highly experienced professionals.

Also, the paper tried to solve a real-life decision-making problem encountered in the tourism & hospitality industry. Besides, the proposed model has an efficient basic algorithm that decision-makers can follow without requiring advanced mathematical knowledge. In addition, the proposed model does not require an additional weighting technique for computing the criteria weights, as it can identify the criteria weights simultaneously. Therefore, it can reach very reasonable and logical results with fewer computations. Furthermore, the sensitivity analysis results show that the model is maximally consistent and stable. Hence, the proposed MCDM approach provides a more reliable decision-making environment.

When the practical results of the current paper are evaluated, the most influential criterion is determined as the financial situation of the suppliers. It means the strong suppliers in terms of financial structure can contribute to the tourism supply chain; also, it is possible to create more strategic solid alliances with these kinds of companies. Because of that, it is the most significant of this criterion. It is entirely understandable.

Besides, C9 product quality is the second-significant selection criterion. In practice, food quality is one of the determinative factors for guests' satisfaction. Eren (2020) indicated that the quality of the food and beverage service is essential for tourists, and its importance increases in all-inclusive hotels having five or over stars. Experts also approve of this view based on their experiences. According to them, guests mostly complain about problems related to food and beverage, and the central part of the complaints encountered in their companies are related to food and beverage. The remaining criteria are ranked as C7>C8>C1>C2>C5>C3>C6>C4.

When we evaluate the ranking results of the proposed model, A4 is the best alternative, as it provides good values for almost all criteria. In addition, this supplier had a robust financial structure when we examined its financial positions and values in the Istanbul stock exchange market (www.borsaistanbul.com).

The current paper provides some managerial implications to the current industry. The identified criteria and their weights can guide decision-makers and practitioners responsible for deciding in the tourism and hospitality industry. Also, dairy product manufacturers can consider these criteria and factors to improve the structure and quality of their products. In addition, the current paper focuses on the dairy products supplier in Turkey, as each supplier may have different characteristics, and it is not possible to compare dairy products producers with other types of suppliers such as meat & meat products suppliers, textile & apparel suppliers and so on. Because of that, presenting a general overview for all kinds of suppliers may not provide practical approaches and solutions to the problems of the current industry.

Although the current paper has many valuable contributions to the literature, it has some limitations. For instance, it deals with Turkey's dairy products suppliers. The current paper can be repeated for different countries and industries that are the supplier of the tourism industry, and the obtained results can be compared. In addition, the scope of the paper can be extended with the different fuzzy sets by the future works to capture and process the existing uncertainties.

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