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Dr. Öğr. Üyesi Mustafa Kısa

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IV**

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PERFORMANCE EVALUATION OF AIRLINE COMPANIES FROM CONSUMERS' PERSPECTIVE: MCDM APPROACH

Sümeyye ÇETİNKAYA¹ , Hüseyin EKİZLER²

INTRODUCTION

Air transportation has been in a great development after the World War II, very rapid technological and structural changes occurred in a short period of time and it has become a transportation sector. Passenger and cargo transportation have made significant progress, especially through the speed it provides in transportation (Devlet Planlama Teşkilatı, 2001).

Airway transportation sector includes airline management, airport management, air navigation and air traffic control services, location and catering services, training, maintenance, related sub and superstructures and other aviation activities coordination and supervision according to international rules (T.C. Başbakanlık Devlet Planlama Teşkilatı, Hava Yolu Ulaştırması Alt Komisyon Raporu, 1995).

According to Sivil Havacılık Genel Müdürlüğü Annual Report, published in 2017, there are 13 active airline companies

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in Turkey and nine of these have aircraft fleets. Turkish Airlines ranks first in the list of Turkey's 500 major service exporters in 2017, where Sun Express ranks as second, Pegasus as third, Atlasjet as 10th, and Onur Air as 16th. Stating that airline companies have an important role in the service export of Turkey. Total export quantities are as follows (Türkiye İhracatçıları Meclisi (TİM) Annual Report, 2018):

- Turkish Airlines \$8,049,606,630
- Sun Express \$ 959,591,716
- Pegasus \$903,982,342
- Atlasjet \$ 403,952,967
- Onur Air \$ 288,648,000

Transportation, as well as time benefit, is valued to the extent that it allows for favorable and economic displacement. Activities requiring transportation; production, consumption, trade, defense, social life and services (tourism, financial, educational, sportive, religious services, etc.) occur in every point of life, every moment. The ever-growing transport has been an essential factor in economic and socio-cultural development. Nowadays, it is one of the fundamental tools that become an indispensable part of daily life (Gerede, 2015; Kaya, 2012).

Airline product is realized in a service process with untouchable features, not just a seat that has physical properties and carries passengers between two points (Dempsey, Gesell & Crandall, 1997). The airline companies should design their service offerings (including all their components and products) in a way that meets the wishes and needs of the customers. Otherwise, the perceived quality of service, and accordingly, demand and income are negatively affected. For this reason, it is necessary to know what the airline product components are and what they mean for customers (Gerede, 2015).

Since the 1980s, customer satisfaction has been one of the main issues that companies have been discussing in developed countries. It is stated that customer satisfaction, which leads to an increase in the company's profitability, increase in market share and an increase in the company's growth rate, depends mainly on the loyalty of the company (Eroğlu, 2005). Consequently, customer satisfaction in profit-making enterprises has become one of the most important targets for companies. Customers' comments about firms are easy to reach each other with the development of internet technology and social media, also those positive/negative comments affect customer preferences. In this respect, it is inevitable for the airline companies, who want to reach more customers and enlarge themselves, to make intercorporate arrangements considering the customer satisfaction.

According to a report released by TİM, five aviation service providers was in the list of Turkey's top 10 services exporters in 2016, indicating the aviation sector in Turkey is a big power in economic terms. Since civil aviation undertakes the duty of human transportation, it is possible to say that customer requests and suggestions have the highest and even the first important issue for the companies. Nevertheless, international flights have an important place in terms of country promotion.

In this study, we aimed to evaluate this great power from the eyes of the customers and to make a positive contribution to aviation sector. Achieving this aim to collect the necessary data, a survey is created consisting of two sections. In the first section, we asked randomly selected passengers to evaluate the given criteria, where they were determined according to literature and in second section we asked them to evaluate the selected airline companies according to the same criteria by using the preference scale. The criteria that determine the satisfaction of the passengers and their impact levels, here

named weights, is calculated with AHP method. Considering the weights of criteria, this time using the VIKOR and TOPSIS methods we ranked the airline companies in terms of their performances.

LITERATURE REVIEW

In this part of the study, VIKOR and TOPSIS methods were compared and more favorable and unfavorable aspects of the methods are compared.

Tzeng, Lin and Opricovic (2005) discussed the use of alternative fuels to be used in public transportation with VIKOR and TOPSIS methods in their study. TOPSIS and VIKOR methods are compared and applied for the determination of the best fuel mode. The researchers applied AHP method in the determination of the weight of the evaluation criteria. Gaudenzi and Borghesi (2006) manage the risk in the supply chain with AHP method, they aimed to create a model to determine the risk in the supply chain with using AHP method. Their model was successful to create awareness of supply chain risk factors. In the study of Li and Qin-Sheng (2006) with the aim of selecting the best tendering offer that took place in the production companies, it was determined by TOPSIS method considering the 12 indicators which are the best bid of the four companies that are tender for some electronic products. Benitez, Martin and Roman (2007) studied on the service quality of three hotels. They used fuzzy numbers to measure the service quality and used the TOPSIS method to rank the service performance of the hotels. They concluded that this method is useful for comparing the relative service quality performance. Yazdani and Payam (2015) used three methods Ashby, VIKOR and TOPSIS in the selection of the electrostatic actuators of microelectromechanical systems. They made a comparative study for material selection and for had a conformity between three methods.

MCDM studies are widely studied and applied in many areas in Turkey as the rest of the countries. TOPSIS method used by Yurdakul and İ (2003) for the performance measurement of Turkish automotive companies. With the TOPSIS method, the ratios calculated and interpreted could be expressed mathematically with a single point and companies can be ranked among themselves according to their success. The method presented in the study has brought a useful approach in determining the degree of success and ranking of success by comparing the firms of the same size with each other according to the same criteria. Ersöz and Kabak (2010) made a literature research of MCDM in defense industry applications. As a result of their study, it has been seen that Goal Programming (GP) and AHP, which is known as the oldest method, are used in this field. However, in recent years in Turkey and in the world since the superior properties of the Analytical Network Process (ANP) was used to replace the AHP. Kaya, Çetin and Kuruüzüm (2011) used the VIKOR method to analyze the life quality of the European Union and candidate countries. Three different analyzes were performed with VIKOR method for 2003, 2005 and 2007. The common area with the European Union (EU) countries and EU candidate countries (Norway, Croatia, Macedonia and Turkey) were evaluated in terms of quality of life indicators. Ertuğrul and Özil (2014) made a comparative study with TOPSIS and VIKOR methods for air conditioning selection. In the application, TOPSIS and VIKOR were used in the selection of air conditioners and the results were compared and evaluated. When choosing the air conditioner: product, price and technical preferences are presented according to preference suggestions. The subjective criteria of the consumer were used in determining the weight criteria. While the decision matrix was formed, direct numerical data which were applicable in both methods were obtained. As

a result of the study, while the results found in TOPSIS method can be reliable, the results of the VIKOR method were found to be unreliable when compared with the TOPSIS method due to the lack of acceptable advantages and acceptable stability conditions. The reason of the failure meeting the conditions of the VIKOR method was explained as the preference order based on Q_i values. In the study of Ekizler (2020), performance of Woven, Clothing and Leather Industry companies listed on Borsa İstanbul was evaluated with TOPSIS and VIKOR methods. The researcher used a time series data, instead of cross-sectional data, and consider the selected six financial indicators of 19 companies between 2011 and 2018.

Related with airlines, Feng and Wang (2000) conducted TOPSIS method in their study of the performance of five Taiwanese airline companies by using 22 variables as financial and transportation indicators and concluded that financial indicators were more effective in performance evaluation. Tsaur, Chang and Yen (2002) have measured the quality of airline services. They applied AHP to obtain the criteria weight and used TOPSIS to rank the airline companies. There were 15 criteria for making comparison between three airline companies in their study. They emphasized the importance of the customer's perspective in service quality. Lioua and Tzeng (2007) measured the airlines service quality using AHP. They have gathered the factors that affecting the service quality on customers' perceptions in two categories as the common factors and the relative factors. And they ultimately determine the total 12 criteria to rank among six airlines. They also emphasized the importance of customers' perspective in the service quality. Sun (2010) evaluated the performance using Fuzzy AHP and fuzzy TOPSIS Method. In this study, AHP method is used for the evaluation of preference weights. Then TOPSIS method is used to improve the gap between real values and pursued

levels to find out the best alternative. Torlak, Şevkli, Sanal and Zaim (2011) made a comparative evaluation in the Turkish domestic airline company with using fuzzy TOPSIS Method. According to their research they conclude that in the domestic airline industry Turkish Airlines retained its leading role and Turkish Airlines is the most competitive company. Pegasus is the second company for the competition, it is the runner-up company. Onur Air and Atlas Jet needs to improvement and they have not been good enough in terms of competition. Canöz (2017) conducted a research with the aim of evaluating the service concept of airline companies.

METHODOLOGY

Multi-criteria decision making methods helps the decision makers by providing appropriate tools when uncertainty and complexity exist (Hahn, 2003). MCDM methods is attracting the researchers for finding the optimal solution (Triantaphyllou, 2000), in the case of conflicting criteria. MCDM is kind of a sequence process proposing direction of action among the alternatives by considering a number of metric and nonmetric criteria in uncertain and volatile environment. Problems may become more complex with conflicting criteria and a greater number of alternatives. MCDM is essential tool for analyzing real-world problems, since they can judge different alternatives on several criteria for the possible selection or ranking of the best alternatives (Raju and Kumar, 2010).

Among MCDM methods, VIKOR is helpful tool considering compromises, and TOPSIS is widely used for various applications due to the reliability of the method. Moreover, these two methods are not complex

In this study, VIKOR and TOPSIS are used for finding the best alternative (the best airline company that is chosen by passengers) and AHP method is used to weight criteria that are necessary for VIKOR and TOPSIS.

Analytical Hierarchy Process (AHP)

Analytical Hierarchy Process provides models in a hierarchical structure expressing the associations of decision makers' complex problems (Kuruüzüm and Atsan, 2001), to reflect the tendency of the decision maker's thoughts and to determine the level of influence the function between criteria and alternatives (Henson, Culoba and Mendoza, 2002). AHP is also one of the most popular MCDM methods since it provides the numerical weights from the verbal comparisons (Vaidya and Kumar, 2006).

In the first step of AHP, decision hierarchy is constructed from the beginning with the goal of the decision. Goal, criteria, sub-criteria, alternatives are determined by going from top to bottom in the problem (Saaty, 2008). The formation of a hierarchical structure, the first stage of decision making problems, implies the division of the problem into various levels.

In the second step, relative significance is determined by pairwise comparisons between elements at each level, considering the scale of absolute number proposed by Saaty (2008). The intensity of the importance is coded from 1 to 9 (1=equal importance and 9=extreme importance) in the preference scale. The main objective at this stage is to determine the relative importance of the elements and to determine the effect of these importance on the main objective. Therefore, in the established hierarchy, the effects of the elements at one level of the hierarchy on the higher level are tried to be determined and the effect of the elements at the lowest level on the main target is determined (Arıkan, 2008).

Depending on the number of criteria, denoted by n , totally $n(n-1)/2$ comparisons are required, by taking into consideration that diagonal elements are equal to 1 and the other elements represent the comparisons (Vaidya and Kumar, 2006).

In the third and last step, consistency index (CI) and consistency ratio (CR) are calculated for validity of calculations. If CR is less than 0.1 then the weightings is considered as consistent. Otherwise, they need to be reconsidered.

As a consequence, the AHP begins with determining the hierarchy and advances with ordinal ranking further into comparisons from ranking. By making comparisons among the numbers, the reciprocal structure is determined. Thus, from paired comparisons AHP get behavioral judgements of properties (inconsistency, intransitivity). And then, AHP shows that a derived scale should approximate the original scale ensuring the high consistency (Saaty and Vargas, 2012).

The formulation of AHP step by step as follows (Saaty and Vargas, 2012; Saaty, 1980);

Step 1: Determine purpose, alternatives and criteria.

Step 2: Make pairwise comparisons between criteria to determine the relative importance weights. In other words, determine the which element is more important by using the preference scale. The comparison matrix that created by the comparison between criteria matrix is $n \times n$ size.

$$A = \begin{pmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{nn} \end{pmatrix}$$

The matrix $A = (a_{ij})$, $a_{ij} = w_i / w_j$, $i, j = 1, 2, \dots, n$ has positive entries and satisfies the reciprocal property; $a_{ij} = 1 / a_{ji}$ and $a_{ii} = 1$

Step 3: From pairwise comparisons calculate the priority vector.

$$w_i = \frac{\sum_{j=1}^n a_{ij} w_j}{n}$$

Step 4: Calculate overall priority vectors. According to priority vectors, each vector multiplied by the initial comparison matrix and find the overall priority matrix.

Step 5: Calculate the Consistency Ratio.

$$CR = CI / RI$$

The consistency index measures the inconsistency in the pairwise comparisons with the formula;

$$CI = \lambda_{max} - n / (n-1)$$

where λ_{max} is the principal eigenvalue of A and n is the number of criteria.

The random index (RI) is calculated randomly for every n size matrix. If the consistency ratio (CR) is significantly small (to be about 10% or less), i.e. takes value less than 0.1 then it is called good. But if it is greater than 0.1 then it would be reconsidered.

TOPSIS Method

TOPSIS (Technique for Order Preference by Similarity to an Ideal Solution) method is presented first by Chen and Hwang's (1992) study, referring to Hwang and Yoon (1981). The basis of the method is the distances in which best alternative is supposed to have the farthest distance from the negative ideal solution and the closest distance to the positive ideal solution (Opricovic and Tzeng, 2004). Here, positive ideal solution maximizes the benefit criteria and minimizes the cost criteria (Wang and Elhag, 2005). The steps of the TOPSIS method are as follows:

Step 1: Normalized decision matrix calculation.

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{i=1}^m a_{ij}^2}} \quad i = 1, 2, \dots, n; j = 1, 2, \dots, m$$

Step 2: Weighted normalized decision matrix calculation.

$$v = \begin{bmatrix} w_1 r_{11} & \cdots & w_n r_{1n} \\ \vdots & \ddots & \vdots \\ w_1 r_{m1} & \cdots & w_n r_{mn} \end{bmatrix}$$

where w_i is the weight of the i^{th} attribute, and sum of all w_i is equal to 1.

Step 3: Determination of the positive ideal and negative ideal solutions.

$$A^* = \{(\max_j v_{ij} \mid i \in I^+), (\min_{ij} v_{ij} \mid i \in I^+)\} = \{v_1^*, v_2^*, v_3^*, \dots, v_n^*\}$$

$$A^- = \{(\max_j v_{ij} \mid i \in I^-), (\min_{ij} v_{ij} \mid i \in I^-)\} = \{v_1^-, v_2^-, v_3^-, \dots, v_n^-\}$$

where I^+ represents the benefit, and I^- represents the cost criteria.

Step 4: Using Euclidean distance, calculate the separation matrix.

Each alternative's separation measure from the ideal solution is calculated as:

$$D_j^* = \sqrt{\sum_{i=1}^n (v_{ij} - v_i^*)^2}$$

Each alternative's separation measure from the negative ideal solution is calculated as:

$$D_j^- = \sqrt{\sum_{i=1}^n (v_{ij} - v_i^-)^2}$$

Step 5: Calculate relative closeness to the ideal solution by using separation measures.

The relative closeness of the alternative a_j with respect to A^* is defined as:

$$C_i^* = \frac{D_j^-}{D_i^* + D_j^-}$$

Step 6: Preference order ranking. Rank the alternatives in descending order of C_i^* .

VIKOR Method

VIKOR (VIseKriterijumska Optimizacija I Kompromisno Resenje) is first proposed by Serafim Opricovic to assess the situations which includes conflicting and noncommensurable criteria (Opricovic and Tzeng, 2004), aiming to obtain a solution which is closest to the ideal solution, referring to “compromise solution” (Opricovic, 1998), by evaluating the alternatives with respect to all established criteria. Compromise solutions can be acquired with mutual agreements (Zhang and Wei, 2013). Apart from other MCDM methods, VIKOR considers the maximum group utility and minimum individual regret of competitors. Calculations are quite simple and clear (Ju and Wang, 2013).

Assuming that f_{ij} is the value of i^{th} criterion function for the alternative j . The steps of the VIKOR method are as follows (Opricovic and Tzeng, 2004);

Step 1: Determine the best (f_i^*) and the worst (f_i^-) values of all criterion functions. If the criterion i is a benefit, the best and worst values will be:

$$f_i^* = \max_j f_{ij}, f_i^- = \min_j f_{ij}$$

Step 2: Compute the values S_j and R_j .

$$S_j = \sum_{i=1}^n w_i (f_i^* - f_{ij}) / (f_i^* - f_i^-)$$

$R_j = \max_i [w_i (f_i^* - f_{ij}) / (f_i^* - f_i^-)]$ where w_i are the weights of criteria.

Step 3: Compute the values S_j where $j = 1, 2, \dots, m$ by the relation;

$$Q_j = \frac{v(S_j - S^*)}{S^- - S^*} + \frac{(1-v)(R_j - R^*)}{R^- - R^*} \text{ where,}$$

$$S^- = \min S_j; S^* = \max S_j$$

$$R^- = \min R_j; R^* = \max R_j$$

and v denotes weight of the strategy between individual regret and group utility.

Step 4: Rank the alternatives by sorting Q values in ascending order, and create ranking lists.

Step 5: The compromise solution is achieved for alternative a' that have the minimum Q value, if two conditions, as $C1$ and $C2$, are satisfied:

C1- Acceptable Advantage:

If a'' is the second-best alternative in terms of Q ;

$Q(a'') - Q(a') \geq DQ$ where $DQ=1 / (J-1)$, J is the number of alternatives.

C2- Acceptable Stability in Decision Making:

Alternative a' must also be the best ranked by S or/and R .

FINDINGS

In this section we discuss the survey according to the methods AHP, VIKOR and TOPSIS. In the first section, the results of the survey applied on eight different passengers traveling with different airline companies were used for the AHP method in assessing the weights of criteria. Then, seven different alternatives were compared with the TOPSIS and VIKOR methods according to the results of the survey applied to 52 different passengers and to determine the best alternative. In the comparison with TOPSIS and VIKOR methods, the weights are determined by AHP.

AHP Findings

In this part of the study, AHP method was used to evaluate the criteria weights required for VIKOR and TOPSIS methods. A questionnaire was applied to eight passengers of different professions who were flying by different airways, and CI, was

calculated for each matrix created accordingly.

Seven different criteria were determined for the comparison of the passengers:

- Ticket prices (budget-friendly prices),
- Corporate image and public recognition,
- In-cab comfort and convenience (seat knee distance, entertainment systems, seat comfort, toilet hygiene, cab hygiene),
- In-flight service quality (quality of food and quality of staff behavior),
- Timing (delay frequency, check in time length),
- Number of flight points (having airline company flights at the desired point),
- Reliability (Safety Factor) (passengers feeling safe during the flight).

Table 1: Criteria, Codes and Weights for the Evaluation of Airline Companies

Criterion	Code	Weight
Ticket Prices	C1	0.20
Corporate Image and Public Recognition	C2	0.09
In-cab Comfort and Convenience	C3	0.11
In-flight Service Quality	C4	0.10
Timing	C5	0.15
Number of Flight Points	C6	0.15
Reliability (Safety Factor)	C7	0.19

Each criterion, their codes and weights calculated by AHP are listed in the Table 1. According to the answers given by the passengers in accordance preference scale, the comparison matrix was created. The results obtained from the comparison matrices were calculated with the geometric mean and the

weighted scores of criteria and alternatives for each criterion were calculated separately. The consistency indexes of all weightings were calculated as less than 0.1 which were satisfactory.

TOPSIS Findings

Initial step of both VIKOR’ and TOPSIS’ decision matrix created according to the customers’ evaluations in Table 2.

Table 2: TOPSIS Solution Steps

Airline Company	C1	C2	C3	C4	C5	C6	C7
<i>Decision Matrix</i>							
A1	3.02	4.77	4.62	4.50	3.63	308	4.75
A2	3.04	2.98	2.88	2.90	3.02	7	3.12
A3	2.94	2.15	2.52	2.60	2.87	72	2.81
A4	3	2.96	2.85	2.92	2.94	73	2.98
A5	3.23	3.62	2.81	2.60	2.98	110	3.23
<i>Step 1: Normalized Decision Matrix</i>							
A1	0.44	0.63	0.64	0.63	0.52	0.90	0.62
A2	0.45	0.39	0.40	0.41	0.44	0.02	0.40
A3	0.43	0.28	0.35	0.37	0.41	0.21	0.36
A4	0.44	0.39	0.40	0.41	0.42	0.21	0.39
A5	0.47	0.47	0.39	0.37	0.43	0.32	0.42
<i>Step 2: Weighted Normalized Decision Matrix</i>							
Weight	0.20	0.09	0.11	0.10	0.15	0.15	0.19
A1	0.089	0.056	0.070	0.063	0.079	0.135	0.117
A2	0.089	0.035	0.044	0.041	0.065	0.003	0.077
A3	0.086	0.025	0.038	0.037	0.062	0.032	0.069
A4	0.088	0.035	0.043	0.041	0.064	0.032	0.073
A5	0.095	0.043	0.043	0.037	0.064	0.048	0.080
A⁺	0.095	0.056	0.070	0.063	0.079	0.135	0.117
A⁻	0.086	0.025	0.038	0.037	0.062	0.003	0.069

<i>Step 3a: Positive Ideal Solutions</i>							
A1	0.00004	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
A2	0.00003	0.00045	0.00070	0.00050	0.00017	0.01735	0.00161
A3	0.00007	0.00096	0.00103	0.00071	0.00027	0.01066	0.00228
A4	0.00005	0.00046	0.00073	0.00049	0.00022	0.01057	0.00190
A5	0.00000	0.00018	0.00076	0.00071	0.00020	0.00751	0.00140
<i>Step 3b: Negative Ideal Solutions</i>							
A1	0.00001	0.00096	0.00103	0.00071	0.00027	0.01735	0.00228
A2	0.00001	0.00010	0.00003	0.00002	0.00001	0.00000	0.00006
A3	0.00000	0.00000	0.00000	0.00000	0.00000	0.00081	0.00000
A4	0.00000	0.00009	0.00003	0.00002	0.00000	0.00083	0.00002
A5	0.00007	0.00030	0.00002	0.00000	0.00001	0.00203	0.00011

Five airline companies located their bases in Turkey were selected as the alternatives to be ranked by the customers. These mentioned companies were coded as A1 (Turkish Airlines), A2 (Onur Air), A3 (Sun Express), A4 (Atlasjet) and A5 (Pegasus). Evaluation is acceptable for six criteria since they are subjective issues and passengers' thoughts are essential for these criteria (ticket prices, corporate image and public recognition, in-cab comfort and convenience, in-flight service quality, timing, reliability (safety factor)). For these criteria passengers' thoughts are essential because the aim of the research is evaluating airline companies from consumers' perspective.

One criterion that is number of flight points (C6) has not evaluated by passengers since it is objective issue and exists in airline companies' websites.

Step 4-5: Calculation of the separation measures and closeness to ideal solution.

Table 3: Separation Measures and Relative Closeness

Airline Company	D_j^*	D_j^-	C_i
A1	0.006	0.150	0.961
A2	0.144	0.015	0.093
A3	0.126	0.028	0.184
A4	0.120	0.032	0.208
A5	0.104	0.050	0.327

Step 6: Rank the alternatives in terms of preference order.

Table 4: Preference Order Ranking

Rank	Airline Company	C_i
1	A1	0.803
2	A5	0.327
3	A4	0.208
4	A3	0.184
5	A2	0.094

As a result of TOPSIS method, we conclude that A1 is the most successful and preferred company from consumers' perspective. We can say that A1 is the leader in terms of the performance in the perspective of customers. A5, following A1, doesn't differ much with other companies. A4 and A3 have close value. It is seeming that A2 needs to develop itself and needs more recognition in customers' perspectives.

VIKOR Findings

One of the main aims of the study is making a comparative research and having more reliable conclusions. Hence, two methods of the MCDM are selected and applied to solutions of survey. According to the first method -TOPSIS- application we conclude that A1 has the most successful performance according to passengers. Now, we applied the VIKOR method to same decision matrix in Table 2. The calculation steps of the VIKOR are as follows:

Step 1: Determine the best f_i^* and the worst f_i^- values of all criterion functions, $i = 1, 2, \dots, n$

Table 5: VIKOR Solution Steps

Weights	0.20	0.09	0.11	0.10	0.15	0.15	0.19
Airline Company	C1	C2	C3	C4	C5	C6	C7
A1	3.02	4.77	4.62	4.50	3.63	308	4.75
A2	3.04	2.98	2.88	2.90	3.02	7	3.12
A3	2.94	2.15	2.52	2.60	2.87	72	2.81
A4	3	2.96	2.85	2.92	2.94	73	2.98
A5	3.23	3.62	2.81	2.60	2.98	110	3.23
f_i^*	3.23	4.77	4.62	4.50	3.63	308	4.75
f_i^-	2.94	2.15	2.52	2.60	2.87	7	2.81
$f_i^* - f_i^-$	0.29	2.62	2.10	1.90	0.76	301	1.94

Step 2 and 3: Compute the values S_j and R_j and Q_j for $\nu = 0.5$

Table 6: S_j and R_j and Q_j Values

Airline Company	S_j	R_j	Q_j
A1	0.14	0.14	0.00
A2	0.80	0.16	0.54
A3	0.96	0.20	1.00
A4	0.82	0.17	0.68
A5	0.61	0.15	0.32

Step 4: Rank the alternatives, sorting by Q values in increasing order.

Table 7: Ranking List

Rank	Airline Company	Q_j
1	A1	0.00
2	A5	0.32
3	A2	0.54
4	A4	0.68
5	A3	1.00

Step 5: Propose as a compromise solution.

C1: Acceptable Advantage

The difference of second and first best in terms of Q, should be greater than $DQ = 1/(5-1)$

$Q(A5) - Q(A1) \geq DQ \rightarrow 0.32 \geq 0.25$ acceptable advantage is provided.

C2: Acceptable Stability in Decision Making

Table 8: Acceptable Stability

S_j	R_j	Q_j
A1	A1	A1
A5	A5	A5
A2	A2	A2
A4	A4	A4
A3	A3	A3

As stated in Table 8, acceptable stability condition is satisfied since the A1 is the best in terms of all three parameters S_j , R_j and Q_j .

A1 is found to be the best alternative for VIKOR method as well as TOPSIS method.

CONCLUSION

The concept of time is very important for today and it is possible to say that the role of airline transportation in saving time is great. It is inevitable to prefer airlines for less time spending and comfortable travel. Examining the SHGM Annual Report (2017), the aviation sector is developing day by day and growing rapidly.

According to the SHGM Annual Report, since 2003 number of aircrafts of the airline companies in Turkey has increased 219%, the number of seats has increased 253% and domestic and overseas flown point number has reached to 351. In 2017, Istanbul Atatürk Airport hosted a total of 63 million

727 thousand passengers, including 19 million 450 thousand domestic flights and 44 million 277 thousand domestic flights. In 2017, the passenger traffic of Sabiha Gökçen Airport exceeded 31 million. According to the same report, there are 13 license holder airline companies in Turkey, the number of aircraft is 517 units and there are total 97,500 seat capacity. When looking at this report, it is possible to say that there is a rapid acceleration of the airline market and increasing demand in Turkey. This growth also means competition and increasing customer requirements.

This study aims to evaluate the airline companies from the customers' perspective and the criteria are determined by using the literature. A questionnaire was conducted at the Istanbul Airport for people selected from different occupational groups. AHP method was used to determine which criteria more important in customer perspective.

As a result of AHP method, it is concluded that ticket price is the most important criterion for passengers with 20% ratio. Passengers first prefer the budget-friendly firms. The second important criterion is reliability (safety factor) with 19% ratio. Passengers want to feel themselves in safe when they fly. Fear have an important role in preference of customers. Actually, according to ICAO Safety Report 2018, worldwide 4.1 billion passengers preferred airline travelling and there were only 50 fatal accidents on commercial flights in 2017. This means that the fatality rate is 12.2 fatalities per billion passengers. This report shows that, air travel is one of the safest trips, and each aircraft has almost the same level of security as it is complying with the ICAO safety criteria. The third important criteria are timing and number of flight points with 15% ratio. We know that the concept of timing is important for passengers and they do not want to spent more time. In addition, passengers have to choose the airline company which make a flight the point that

passengers willing to fly. So, the multiplicity of flight points becomes important in this case. The fourth one is in-cab comfort and convenience with 11% ratio. The fifth one is in flight services with 10% ratio and the last one is corporate image and public recognition with 9% ratio. According to the passengers, the fact that the corporate image and public recognition gives both the confidence and the think of high quality of service. Hence the last three criteria have close ratios.

The second part of the study is a comparative study. For this part, another survey was applied to passengers in İstanbul Airport. In this survey, comparison is made between five alternatives (Turkish Airlines, Onur Air, SunExpress, Atlasjet and Pegasus) in terms of seven criteria (ticket prices, corporate image and public recognition, in-cab comfort and convenience, in-flight service quality, timing, number of flight points and aircraft and reliability (safety factor) is requested from passengers. 52 number of passengers answered the questionnaire. The TOPSIS and VIKOR methods were applied separately by using the criteria weights obtained by the AHP method and the initial decision matrix was formed. In both methods, the values without any restriction can be evaluated and preserved. The other six criteria except the number of flight points were evaluated according to the survey results. Because the main purpose of the study is to evaluate the criteria from the customer's perspective and the criteria presented require evaluation. Only number of flight destination is an objective criterion and this criterion was taken into consideration directly from their website.

Both of the MCDM methods used in this study had a common ranking result for the best two alternatives. Turkish Airlines was ranked as the best performed company with a significant difference, followed by Pegasus in TOPSIS and VIKOR. Examining the decision matrix, except ticket price criterion, Turkish Airlines was graded with highest scores.

Customers perceived that corporate image, in-cab comfort, service quality, timing, safety factor of Turkish Airlines were better comparing its competitors. Considering the ticket prices Pegasus was scored as best, also for several criteria as image, timing and safety factor Pegasus was following Turkish Airlines in the eyes of the customers. These scores were also similar for the only objective criterion, number of flight points.

Examining the worst performance, the methods gave a distinct output: in TOPSIS Onur Air, whereas in VIKOR Sun Express was listed as the last. This source this difference comes from the calculation logic of two methods. TOPSIS covered all the information of decision matrix to obtain relative closeness, while VIKOR took account the individual regret in final calculations.

This study is important due to the fact that there are few comparative studies with VIKOR and TOPSIS methods together in Turkey. The study was conducted for airline companies and is applicable in many different fields. However, the study has a form that can be improved by expanding the criteria or by creating sub-criteria in hierarchical order. Also, the inclusion of financial indicators in the evaluation of the performance may produce extensive results for future studies.

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