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PERFORMANCE EVALUATION IN AIRLINE INDUSTRY WITH CRITIC AND MEREC BASED MAUT AND PSI METHODS

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Abstract:
Due to the developments in the airline industry, competition among airline companies is surging day by day. It is very essential for airline companies to review their performance in order to sustain their activities. In this study, the five-year performance of Pegasus between 2016 and 2020 was analyzed. Accordingly, the criteria of "number of seats", "number of aircraft", "load factor", "average daily use of aircraft", "number of passengers carried" and "number of landings" were chosen. In the study, Pegasus' performance over the years was evaluated using the most up-to-date multi-criteria decision-making methods such as CRITIC, MEREC, MAUT and PSI. With the CRITIC and MEREC methods, the weights of the evaluation criteria were obtained, and the performance of Pegasus by years was listed with the MAUT and PSI methods. The results showed that the criterion with the highest weight on Pegasus' performance was the "number of aircraft", and the criterion with the lowest degree of importance was the "number of seats" criterion. In the ranking made by MAUT and PSI methods, Pegasus' best performance was in 2019, while the lowest performance was in 2020.

Key words:
CRITIC, MEREC, MAUT, PSI, Airline performance

1 INTRODUCTION

After the deregulation in the United States in 1978 and globalization, major changes have occurred in the airline industry. Since then, new business models have emerged, freer markets have been established, and airlines have expanded their current networks and started flights to new destinations. Thus, the competition in the airline industry has increased and it has become almost a necessity for players in the industry to respond quickly to their rivals' moves in order to stay in the game. Nowadays, airlines need to use their capacity and resources more

effectively and efficiently to survive and achieve competitive advantage. At this point, it has become important for airlines to evaluate their efficiency and performance (Bakir et al., 2020.

The civil aviation industry has suffered a lot of damage due to the Covid-19 pandemic. The devastating impact of the pandemic is more obvious when comparing the data in 2019 and 2020. In 2020, compared to 2019, the number of global passengers decreased by 60%, the number of seats offered by airlines by 50%, and the number of employees by 4.8 million (ICAO, 2021. The pandemic has negatively affected Turkey, like rest of the world, but the decrease in passenger numbers has been less compared to Europe due to the fact that the domestic market in Turkey is relatively resilient. In 2020, the number of domestic passengers in Turkey decreased by 50%, while the number of international passengers decreased by 70%, and the total decrease in the number of passengers was 61% (Pegasus, 2020.

Pegasus Airlines changed its business model to a "low-cost network carrier" business model in 2005. Pegasus has successfully implemented its low-cost business model and quickly increased the number of passengers. Based on the Official Airline Guide (OAG) data, Pegasus was the fastest growing airline in terms of passenger numbers among the 25 largest airlines in Europe in 2011, 2012 and 2013 (Pegasus, 2020).

In the study, the performance of Pegasus Airlines is analyzed between the years 2016 and 2020. The aims of this study are as follows:

•Determining the criteria and their weights by examining the literature and taking into account expert opinions in order to be able to analyze the performance of Pegasus,

•Applying "Multi-Criteria Decision Making" methods to analyze Pegasus' performance over the years,

•Comparing the performance of Pegasus between the years 2016 and 2020.

The study firstly deals with the literature review. In the method section, MEREC, MAUT, and PSI methods are explained and then the results are interpreted, and, finally, conclusion is given.

Multi-criteria decision-making methods are often used to measure the performance of airlines. Examples of these studies are given below:

Aydoğan (2011) examined the performance of four airlines operating in Turkey using AHP and TOPSIS methods. According to the AHP analysis, it was found that the most effective criterion on the performance of airlines is risk, and the least effective criterion is professional satisfaction. According to the TOPSIS analysis, "airline 4" was the company with the best performance. Kiracı and Bakır (2019) examined the performance of 13 airlines by using CRITICAL and EDAS methods between the years 2005 and 2012. According to the result of the study, it was revealed that the effects of the financial market crisis were felt most in 2010. Badi and Abdulshahed (2019) analyzed the performance of four airlines operating in Libya using FUCOM and AHP methods. According to the AHP analysis, the criterion that is most effective in the performance of airlines is reliability, while the criterion that is least effective is determined as services. Ozdagoglu et al., 2020) evaluated the performance of airlines operating from Isparta Süleyman Demirel Airport using BWM and MAIRCA methods. The weights of 4 criteria were determined by the BWM method, and the performance of 7 airlines was ranked by the MAIRCA method. Then, in order to test the compatibility of the results, calculations were made by the MABAC method. According to the analysis, the most important criterion was determined as "number of passengers", while the airline with the best performance was determined as "Alternative 4". According to Bakir et al., 2020) examined the performance of 11 airlines operating in developing countries using the PIPRECIA and MAIRCA methods. According to the result of the PIPRECIA analysis, the criterion with the most effective on the airline's operating performance was operational expenses, while the criterion with the least weight was the available seat kilometers. According to the MAIRCA analysis, the airline with the best performance was Air China, while the company with the worst performance was

determined as Garuda Indonesia. Ustaömer et al., 2021) analyzed the effect of the Covid-19 pandemic on the performance of Turkish Airlines with Data Envelopment Analysis. Four input and two output variables were used in the study. According to the results of the analysis, the performance of Turkish Airlines has decreased significantly compared to before the pandemic.

Multi-criteria decision-making methods have been applied in every industry. Examples of various studies in which multi-criteria decision-making methods used in this study are as follows:

Ozdagoglu et al., 2022) evaluated the logistic performance of 160 countries in the World Bank's 2018 report by using seven different multi-criteria decision-making methods based on six criteria. In the evaluation, they used the methods of MAUT, TOPSIS, MOORA, MAIRCA, MABAC, WSM, WPM. Işık and Koşaroğlu (2020) evaluated the performance of five oil companies listed on the Istanbul Stock Exchange between the years 2010 and 2019 using Standard Deviation (SD) and MAUT methods. According to the Standard Deviation analysis, the criterion with the most weight on the performance of oil companies was found to be Tobin's, while the criterion with the least weight was found to be the beta coefficient. According to the MAUT analysis, the oil company with the best performance is Turkish Oil Refineries, however, the company with the worst performance is Turcas Petrol. Gül and Fırat (2021) identified priority areas for network rehabilitation at drinking water distribution sites using Entropy, TOPSIS and MAUT methods. According to the entropy analysis, the criterion with the most weight is the amount of leakage detected, while the criterion with the least weight is determined as operating pressure. According to the results of TOPSIS and MAUT analyses, the region with the highest priority for rehabilitation was identified as Tandogan, while the region with the least priority was identified as Saray. Acuner and Kaygın (2021) analyzed the tourism performance of Turkey between the years 2005 and 2019 using the CRITICAL and MABAC methods. Seven criteria were used in the study. According to the result of the CRITICAL analysis, it was found that the most influential criterion on tourism performance is the number of visitors living in Turkey and traveling abroad, and the least influential criterion is the number of visitors. According to the result of the MABAC analysis, while the year 2019 is the best year for tourism performance, the year 2016 is the worst. Keleş (2020) evaluated the performance of Turkish Airlines between the years 2016 and 2020 by using the CRITIC and MABAC methods together. The weights of the evaluation criteria were obtained by the CRITICAL method and the performance ranking of Turkish Airlines was done by the MABAC method. According to the analysis performed by the CRITICAL method, the criterion with the highest weight is the "number of aircraft" criterion. According to the ranking, while the best year of Turkish Airlines' performance is 2019, the worst year of performance is 2016.

There are only a few studies using the MEREC method in the literature. Toslak et al., 2022) analyzed the performance of Ekol Logistics 4.0 operating in the logistics sector according to the financial data of Fortune 500 Turkey website for the years 2010-2020. While the best performance is in 2020, the worst performance is in 2010. In the study, the MEREC method was used with the WEDBA method. Goswami et al., 2021) evaluated the best renewable energy source out of five alternatives for India using the MEREC and PIV methods. According to the results of the analysis, the best renewable energy source for India was determined to be a hydroelectric power station, while the worst option was determined to be a biomass power plant. Hadi and Abdullah (2022), using the methods of MEREC and TOPSIS, determined the most suitable hospital location for the city of Baghdad where Covid patients will be treated. According to the results of the analysis, the R7 region was determined as the best alternative among the eight alternatives. Khorshidi and Hassani (2013) used AHP, TOPSIS and PSI methods in the selection of the most suitable material required for the aluminium composition. By comparing the TOPSIS and PSI results, they concluded that the PSI method could be used instead of the TOPSIS method. Akyüz and Aka (2015) analyzed the performance of three

different production lines of an enterprise operating in the glass manufacturing sector in an eight-month period using the PSI method. Akbulut (2020) examined the performance of the top ten deposit banks in Turkey for 2018 by using Gray Entropy, PSI and ARAS methods. The most important criterion for deposit banks is determined as the age of bank. On the basis of performance, the most successful bank was determined to be Ziraat Bank. Tuş and Adalı (2018) conducted a personnel selection for a textile company in Denizli using the CRITICAL, PSI and CODAS methods. According to the analysis, A4 was determined as the best personnel candidate among the candidates.

2 METHODS AND METHODOLOGY

In the study, CRITIC, MAUT, MEREC and PSI methods are used. Below, the application steps of these methods are explained and accompanied by equations:

2.1 The CRITIC Method

CRITICAL (The Criterion Importance Through Intercriteria Correlation) is one of the objective methods used to determine criterion weights. The CRITIC method process is as follows (Işık, 2019).

The first step of the CRITIC method is the decision matrix. The decision matrix is shown in Equation 1.

$i: alternative; i = 1,2,3, \dots, m$

$m: total\ number\ of\ alternatives$

$j: criterion; j = 1,2,3, \dots, n$

$n: otal\ number\ of\ criterion$

$x_{ij}: performance\ value\ of\ alternative\ i\ for\ criterion\ j$

$$\begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix} \quad (1)$$

The second step is the normalization process. The implementation of the normalization process for the utility criteria is shown in Equation 2.

$r_{ij}: normalized\ value\ of\ alternative\ i\ for\ criterion\ j$

$$r_{ij} = \frac{x_{ij} - min\{x_j\}}{max\{x_j\} - min\{x_j\}} \quad (2)$$

The implementation of the normalization process for the cost criteria is shown in Equation 3.

$$r_{ij} = \frac{max\{x_j\} - x_{ij}}{max\{x_j\} - min\{x_j\}} \quad (3)$$

The normalized decision matrix is shown as in Equation 4.

$$\begin{bmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ \dots & \dots & \dots & \dots \\ r_{m1} & r_{m2} & \dots & r_{mn} \end{bmatrix} \quad (4)$$

Then the correlation coefficients are obtained.

$k: kriter; k = 1,2,3, \dots, n$

$t_{jk}: correlation\ value\ between\ criterion\ j\ and\ k$

The matrix of correlation coefficients is given in Equation 5.

$$\begin{bmatrix} t_{11} & t_{12} & \dots & x_{1n} \\ t_{21} & t_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ t_{n1} & t_{n2} & \dots & t_{nn} \end{bmatrix} \quad (5)$$

Then the standard deviations are calculated.

$\sigma_j: standard\ deviation\ of\ criterion\ j$

After that, the non-normalized weights of each criterion are calculated with the help of Equality 6.

$c_j: weight\ of\ criterion\ j\ before\ normalization$

$$c_j = \sigma_j \sum_{k=1}^{n} (1 - t_{jk}) \quad (6)$$

In the last step, the weights of the criteria are normalized so that their sum is 1. In Equation 7, it is shown that the weights of the criteria are found.

$w_j: weight\ of\ criterion\ j$

$$w_j = \frac{c_j}{\sum_{j=1}^{n} c_j} \quad (7)$$

2.2 The MAUT Method

MAUT (Multi Attribute Utility Theory) is one of the methods used to evaluate alternatives. The MAUT method is described below (Zhu et al., 2017, 429-430).

The MAUT method also starts with the decision matrix given earlier in Equality 1, like the CRITIC method.

Using equations 2 and 3, normalization in the MAUT method is performed. After that, the weighted normalized performance values are calculated by means of Equality 8. At this stage, the weight values obtained from the CRITIC method are integrated with the MAUT method.

$n_{ij}: normalized\ value\ of\ alternative\ i\ for\ criterion\ j$

$$n_{ij} = w_j . r_{ij};\ for\ \forall i, j \quad (8)$$

At the final stage of the MAUT method, the overall weighted benefit values of the alternatives are calculated using Equality 9.

$U_i: utility\ value\ of\ alternative\ i$

$$U_i = \sum_{j=1}^{n} n_{ij} \quad (9)$$

2.3 The MEREC Method

One of the up-to-date methods, the MEREC (Method based on the Removal Effects of Criteria) method, is one of the objective methods for determining criterion weights, such as the CRITIC method. The method is described below (Keshavarz-Ghorabaee et al., 2021, 7-9.

In the first step of the MEREC method, the decision matrix is formed. The initial decision matrix is the same as Equality 1, which is presented in the descriptions of the CRITIC method.

The initial decision matrix values for utility criteria are normalized using Equality 10.

$$v_{ij}: normalized\ value\ of\ alternative\ i\ for\ criterion\ j$$

$$v_{ij} = \frac{\min_j x_{ij}}{x_{ij}} \tag{10}$$

For cost-oriented criteria, the initial decision matrix values are normalized using Equality 11.

$$v_{ij} = \frac{x_{ij}}{\max_j x_{ij}} \tag{11}$$

The overall performance values of the alternatives are calculated using Equality 12.

$$S_i: overall\ performance\ value\ of\ alternative\ i$$

$$S_i = \ln\left(1 + \frac{\sum_{j=1}^{n}|\ln(v_{ij})|}{n}\right) \tag{12}$$

Then transactions are made to eliminate the effect of each criterion. For this purpose, the performance values that take into account the effect of the eliminated criterion are calculated by Equality 13.

$$S'_{ij}: overall\ performance\ value\ of\ alternative\ i\ concerning\ the\ removal\ of\ criterion\ j$$

$$S'_{ij} = \ln\left(1 + \frac{\sum_{j=1,j\neq k}^{n}|\ln(v_{ij})|}{n}\right) \tag{13}$$

The sums of absolute differences in relation to the values obtained in Equations 12 and 13 are found using Equation 14.

$$E_j: summation\ of\ absolute\ deviations\ for\ criterion\ j$$

$$E_j = \sum_{i=1}^{m}\left|S'_{ij} - S_i\right| \tag{14}$$

At the final stage of the MEREC method, criterion weights are calculated using Equality 15.

$$w_j: weight\ of\ criterion\ j$$

$$w_j = \frac{E_j}{\sum_{j=1}^{n} E_j} \tag{15}$$

2.4 The PSI Method

PSI (Preference Selection Index) is one of the methods that determines the weights of criteria and evaluates alternatives together. The method is described below (Tuş and Adalı, 2018, 248-249.

The PSI method also starts with a decision matrix. The decision matrix is shown in Equation 1.

Normalized values for utility criteria in the second stage are found with the help of Equality 16.

$$x_{ij}^{*}: normalized\ value\ of\ alternative\ i\ for\ criterion\ j$$

$$x_{ij}^{*} = \frac{x_{ij}}{\max_{j} x_{ij}} \tag{16}$$

For cost-oriented criteria, normalized values are calculated using Equality 17.

$$x_{ij}^{*} = \frac{\min_{j} x_{ij}}{x_{ij}} \tag{17}$$

At the next stage, the average normalized value for each criterion is found by Equality 18.

$$\overline{x_{j}^{*}}: average\ normalized\ value\ for\ criterion\ j$$

$$\overline{x_{j}^{*}} = \frac{\sum_{i=1}^{m} x_{ij}^{*}}{m} \tag{18}$$

The preference variability for each criterion is calculated using Equality 19.

$$PV_{j}: preference\ variability\ for\ criterion\ j$$

$$PV_{j} = \sum_{i=1}^{m} \left(x_{ij}^{*} - \overline{x_{j}^{*}}\right)^{2} \tag{19}$$

The deviation of the preference value for each criterion is found by Equality 20.

$$\phi_{j}: deviation\ for\ criterion\ j$$

$$\phi_{j} = \left(1 - PV_{j}\right) \tag{20}$$

The total preference value for each criterion is found using Equality 21.

$$\omega_{j}: overall\ preference\ value\ for\ criterion\ j$$

$$\omega_{j} = \frac{\phi_{j}}{\sum_{j=1}^{n} \phi_{j}} \tag{21}$$

At the final stage of the PSI method, the preference selection index value is calculated for all alternatives with the help of Equality 22.

$$I_{i}: preference\ selection\ index\ of\ alternative\ i$$

$$I_{i} = \sum_{j=1}^{n} x_{ij}^{*} \omega_{j} \tag{22}$$

3 RESULTS AND DISCUSSION

In the study, analyzes are made based on the performance indicators of Pegasus Airlines between the years 2016 and 2020. Performance indicators are given in Table 1. The performance indicators were determined by examining the literature and obtaining the opinions of the academicians who are experienced in the field of aviation management.

Table 1: *Performance Indicators*

Indicator Code	Performance Indicator	Explanation	Unit Of Measurement	Direction
K1	Number of Seats	The number of seats offered for sale by the airline within one year	Million	Max
K2	Number of Aircraft (Shao & Sun, 2016)	The number of aircraft owned or leased by the airline	Number	Max
K3	Load Factor (Barros & Wanke, 2015; Chang & Yeh, 2001)	Revenue passenger km/ Available Seat km *100	Percent	Max
K4	Average daily aircraft utilization	The time from the moment the aircraft door closes at departure of a revenue flight until the moment the aircraft door opens at the arrival gate after its landing	Block hour	Max
K5	Total Number of Passengers (Özdagoğlu et al., 2020; Lozano & Guiterrez, 2014)	The total number of trips	Million Passengers	Max
K6	Number of Landings	The total number of landings within one year	Thousands	Max

The data obtained in relation to these indicators formed the decision matrix. The decision matrix is given in Table 2.

Tab. 2: *Decision Matrix*

Year	K1	K2	K3	K4	K5	K6
2016	30,73	82	78,6	12	24,14	166691
2017	32,88	76	84,6	12,1	27,82	177392
2018	35,06	82	85,5	12,6	29,97	189491
2019	34,72	84	88,6	12,8	30,76	187307
2020	18,45	93	79,7	6,2	14,71	99289

Sources: Pegasus (2016), Pegasus (2017), Pegasus (2018), Pegasus (2019), Pegasus (2020)

In order to find the weights of the performance indicators, the steps of the CRITIC method were applied to the decision matrix. The CRITIC method is an objective decision-making method that allows make transactions on negative values in the decision matrix. The normalized decision matrix is shown in Tab. 3.

Tab. 3: *Normalized Decision Matrix*

Year	K1	K2	K3	K4	K5	K6
2016	0,2296	0,3529	0,0000	0,0000	0,5875	0,3799
2017	0,5072	0,0000	0,6000	0,0882	0,8168	0,4569
2018	0,5699	0,3529	0,6900	0,4013	0,9508	0,6122
2019	1,0000	0,4706	1,0000	1,0000	1,0000	1,0000
2020	0,0000	1,0000	0,1100	0,9625	0,0000	0,0000

In the following stage, the correlation coefficients were calculated and the matrix of correlation coefficients given in Equality 5 was formed. The matrix of correlation coefficients is shown in Tab. 4.

Tab. 4: *Correlation Values*

	K1	K2	K3	K4	K5	K6
K1	1,0000	-0,4600	0,9367	0,1993	0,8818	0,9799
K2	-0,4600	1,0000	-0,3655	0,7424	-0,7577	-0,4665
K3	0,9367	-0,3655	1,0000	0,3282	0,7873	0,8591
K4	0,1993	0,7424	0,3282	1,0000	-0,2489	0,1238
K5	0,8818	-0,7577	0,7873	-0,2489	1,0000	0,9028
K6	0,9799	-0,4665	0,8591	0,1238	0,9028	1,0000

After that, non-normalized weights were found with the help of Equality 6 and the final weights were found with the help of Equality 7. The obtained values are given in Tab. 5.

Tab. 5: *Weight Values Before and After Normalization*

Parameter	K1	K2	K3	K4	K5	K6
c_j	0,9300	2,2811	1,0239	1,8214	1,4005	0,9453
w_j	0,1107	0,2715	0,1219	0,2168	0,1667	0,1125

As can be seen from Tab. 5, the criterion with the most weight is K2 (number of aircraft) with a value of 0.2715. The second place is taken by K4 (average daily aircraft utilization) with a score of 0.2168 and the third place is taken by K5 (number of passengers) with a value of 0.1667. The criterion of the lowest weight is K1 (number of seats) with a value of 0.1107.

After the weights are found, rankings are performed by the MAUT. The weighted normalized performance values are shown in Tab. 6.

Tab. 6: *Weighted Normalized Decision Matrix (with CRITIC Weights)*

Year	K1	K2	K3	K4	K5	K6
2016	0,0847	0,1403	0,0000	0,1098	0,0627	0,0858
2017	0,0996	0,0000	0,0849	0,1117	0,0871	0,0994
2018	0,1146	0,1403	0,0977	0,1212	0,1014	0,1149
2019	0,1122	0,1870	0,1415	0,1250	0,1067	0,1121
2020	0,0000	0,3974	0,0156	0,0000	0,0000	0,0000

Finally, the general benefit values for the years through Equality 9 are calculated. The overall benefit values and the ranking results obtained accordingly are in Tab. 7.

Tab. 7: *General Utility Values and Ranking (with CRITIC Weights)*

Year	U_i	Ranking
2016	0,4833	3
2017	0,4827	4
2018	0,6899	2
2019	0,7845	1
2020	0,4130	5

According to the Tab. 7, the year 2019 is the best-performing year with a score of 0.7845, followed by 2018 with a score of 0.6899, 2016 with a score of 0.4833 and 2017 with a score of 0.4827, respectively. The year 2020 is the worst-performing year with a score of 0.4130.

After implementing these methods, the MEREC method was used to determine the effect of criterion weights. The normalized values calculated by means of equality 10 and 11 are shown in Tab. 8.

Tab. 8: *Normalized Decision Matrix according to MEREC Method*

Year	K1	K2	K3	K4	K5	K6
2016	0,6004	0,9268	1,0000	0,5167	0,6094	0,5956
2017	0,5611	1,0000	0,9291	0,5124	0,5288	0,5597
2018	0,5262	0,9268	0,9193	0,4921	0,4908	0,5240
2019	0,5314	0,9048	0,8871	0,4844	0,4782	0,5301
2020	1,0000	0,8172	0,9862	1,0000	1,0000	1,0000

According to the MEREC method, in the next step, the overall performance values are found using Equality 12 and the values are given in Tab. 9.

Tab. 9: *General Performance Values according to the MEREC Method*

Year	General Performance Value
2016	0,3197
2017	0,3527
2018	0,3908
2019	0,3998
2020	0,0353

After these calculations, the performance values considering the effect of the eliminated criterion are calculated with Equality 13 and the values are shown in Tab. 10.

Tab. 10: *S'_{ij} Values*

Year	K1	K2	K3	K4	K5	K6
2016	0,2559	0,3104	0,3197	0,2363	0,2578	0,2549
2017	0,2826	0,3527	0,3441	0,2712	0,2751	0,2823
2018	0,3157	0,3822	0,3813	0,3075	0,3072	0,3152
2019	0,3266	0,3886	0,3864	0,3154	0,3138	0,3263
2020	0,0353	0,0023	0,0331	0,0353	0,0353	0,0353

Then, the sums of absolute differences related to the values obtained in Equations 12 and 13 are found using Equation 14, and finally, the criterion weights of the MEREC method are obtained using Equation 15. The values are shown in Tab. 11.

Tab. 11: *E_j, w_j Values*

Year	E_j	w_j
2016	0,2822	0,2164
2017	0,0621	0,0476
2018	0,0339	0,0260
2019	0,3327	0,2550
2020	0,3091	0,2370

Transactions in the MAUT method were repeated with the weights obtained from the MEREC method in order to see the effect of the criterion weights on the decision.

Tab. 12 shows the weighted normalized performance values found with the help of Equality 8.

Tab. 12: *Weighted Normalized Decision Matrix (with MEREC Weights)*

Year	K1	K2	K3	K4	K5	K6
2016	0,1600	0,0168	0,0000	0,2241	0,1392	0,1629
2017	0,1880	0,0000	0,0156	0,2280	0,1935	0,1888
2018	0,2164	0,0168	0,0179	0,2473	0,2253	0,2180
2019	0,2119	0,0224	0,0260	0,2550	0,2370	0,2128
2020	0,0000	0,0476	0,0029	0,0000	0,0000	0,0000

Finally, the general benefit values for the years through Equality 9 are calculated. The overall benefit values and the ranking results obtained accordingly are in Tab. 13.

Tab. 13: *General Utility Values and Ranking (with MEREC Weights)*

Year	U_i	Ranking
2016	0,7030	4
2017	0,8139	3
2018	0,9417	2
2019	0,9651	1
2020	0,0505	5

According to the Tab. 13, the year 2019 is the best-performing year for Pegasus Airlines with a score of 0.9651 according to the results of the MAUT method. It is followed by 2018 with a score of 0.9417, 2017 with a score of 0.8139 and 2016 with a score of 0.7030, respectively. The year 2020 is the worst-performing year with a score of 0.0505.

After that, calculations are made with PSI method, and the results are compared. The PSI method also starts with a decision matrix. The decision matrix is given in Tab. 2. According to the PSI method, the normalized values are calculated with Equality 16 and 17. The average normalized value for each criterion is found by Equality 18. The preference variability for each criterion is calculated using Equality 19. The deviation of the preference value for each criterion is found by using Equality 20, and the total preference value for each criterion is also found by using Equality 21. The values are shown in Tab. 14.

Tab. 14: *$x_{ij}^*, \overline{x_j^*}, PV_j, \phi_j, \omega_j$ Values*

	K1	K2	K3	K4	K5	K6
2016	0,8765	0,8817	0,8871	0,9375	0,7848	0,8797
2017	0,9378	0,8172	0,9549	0,9453	0,9044	0,9362
2018	1,0000	0,8817	0,9650	0,9844	0,9743	1,0000
2019	0,9903	0,9032	1,0000	1,0000	1,0000	0,9885
2020	0,5262	1,0000	0,8995	0,4844	0,4782	0,5240
$\overline{x_j^*}$	0,8662	0,8968	0,9413	0,8703	0,8283	0,8657
PV_j	0,1541	0,0175	0,0089	0,1889	0,1810	0,1550
ϕ_j	0,8459	0,9825	0,9911	0,8111	0,8190	0,8450
ω_j	0,1598	0,1856	0,1872	0,1532	0,1547	0,1596

At the final stage of the PSI method, the preference selection index value for each year is calculated with the help of Equality 22. The preference selection index values and the ranking results found according to these values are given in Tab. 15.

Tab. 15: *Preference Selection Index Values and Ranking*

Year	I_i	Ranking
2016	0,8751	4
2017	0,9143	3
2018	0,9651	2
2019	0,9787	1
2020	0,6698	5

According to the Tab. 15, the year 2019 is the best-performing year for Pegasus Airlines with a score of 0.9787 according to the results of the PSI method. It is followed by 2018 with a score of 0.9651, 2017 with a score of 0.9143 and 2016 with a score of 0.8751, respectively. The year 2020 is the worst-performing year with a score of 0.6698.

4 CONCLUSION

As a result of liberalization in 1978 and globalization, airlines have grown considerably and competition in the airline industry has intensified. It is necessary for airlines to use their capacity and resources more effectively and efficiently in order to continue their activities. The performance of airlines that use their resources effectively and efficiently will also increase. The civil aviation sector has suffered significant losses due to the Covid-19 pandemic all over the world. Türkiye has been less affected by the pandemic, especially compared to Europe, due to the fact that the domestic market is relatively more resistant.

In this study, the performance of Pegasus between the years 2016 and 2020 was analyzed by the CRITIC, MEREC, MAUT and PSI methods. The weights of the criteria measuring the performance of Pegasus Airlines were determined using the CRITIC and MEREC methods, and the performance of Pegasus was ranked based on the years using the MAUT and PSI methods.

As a result of the CRITIC and MEREC analyses, it was revealed that the criterion that most affected the performance of Pegasus between the years 2016 and 2020 was the “number of aircraft” criterion. The second and third criteria were “average daily aircraft utilization” and

"number of passengers", respectively. The criterion with the least weight was the number of seats.

The number of aircraft owned or leased by an airline is an important element in competition. The fact that the aircraft in the airline's fleet are modern and comforTab. will make a significant contribution to the airline's business at the point of superiority over its competitors. Another criterion that has a high impact on the performance of Pegasus Airlines was the "average daily aircraft utilization". Aircraft financing is one of important operating expenses. Therefore, airlines should benefit from this valuable resource as much as possible. The third-ranking criterion was the "number of passengers". Increasing the number of passengers increases the market share of airlines. This gives the airline a competitive advantage over other airlines.

According to the MAUT and PSI analyses, while the year 2019 was the best-performing year, the year 2020 was the worst-performing year.

The year 2019 was the best-performing year because Pegasus Airlines increased its performance in almost all criteria in 2019. In 2019 compared to one year ago, Pegasus Airlines managed to increase the number of aircraft (2.4%), load factor (3.6%), average aircraft utilization (1.5%) and number of passengers (2.6%. On the other hand, it decreased the number of seats (0.9%) and the number of landings (1.1%) (Pegasus, 2019.

The Covid-19 pandemic is the main reason why the year 2020 is the worst-performing year. Pegasus had to suspend all domestic and international flights between 30 March and 1 June 2020. In 2020, Pegasus Airlines suffered a lot in terms of the criteria included in the analysis. Pegasus Airlines only managed to increase the number of aircraft by 10% compared to 2019. In terms of other criteria, significant decreases were observed. For example, the number of passengers and the load factor decreased by 52% and 10%, respectively. Other criteria that experienced dramatic decreases due to travel restrictions were average aircraft utilization (-51%), number of seats (-46%) and number of landings (-46%) (Pegasus, 2020).

With the emergence of new variants, the Covid-19 pandemic continued to adversely affect the air transport sector in 2021. Pegasus Airlines has tried to minimize this negative impact with the measures it has taken. In 2021, Pegasus Airlines decreased the number of aircraft by 3% compared to 2020. Although Pegasus Airlines decreased the number of aircraft in 2021, it could not increase its load factor. Its load factor decreased by 2.4 %, compared to 2020. On the other hand, in terms of other criteria, significant increases were observed in 2021. For example, average daily aircraft utilization and and number of seats increased by 52.1% and 41.3%, respectively. Other criteria that experienced dramatic increases were total number of passengers (37%) and number of landings (39.4%) (Pegasus, 2021).

When the first quarter of 2022 is evaluated, it is striking that Pegasus Airlines has recovered quickly. In 2022, Pegasus Airlines' number of aircraft did not change, compared to 2021. In terms of other criteria, significant increases were observed in the first quarter of 2022. Average daily aircraft utilization and number of landings increased by 57% and 33.2%, respectively. Other criteria that experienced dramatic increases were total number of passengers (42.5%), number of seats (33.1%), and load factor (5.3%)., Pegasus, 2022).

The COVID-19 pandemic has adversely affected all airlines, regardless of their business model. The year 2020, when the pandemic emerged, and the year 2021, when new variants dominated, adversely affected airlines all over the world. In this study, when the criteria set forth in Pegasus Airlines are examined, the criteria that an airline should strengthen in order to be affected by the crisis in the least possible way in a crisis period are revealed. Pegasus Airlines managers can prepare crisis plans using the results of this study in order to reduce the impact of future crises.

In further studies, the authors plan to solve the issue from the next point of view:

•The performance of another airline can be analyzed.

•Analyses can be performed with different criteria.

•The performance of more than one airline can be analyzed and compared with other multi-criteria decision-making methods.

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