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PERFORMANCE MEASUREMENT IN AIRLINES WITH INTEGRATED CRITIC-MAVT METHOD

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Abstract
Airline transportation has a great importance in promoting economic growth, trade, and tourism through the fast and efficient services it offers globally. Airlines have to provide this service in the face of fluctuating fuel prices, volatile demand and intense competition. These volatile and challenging external conditions require airlines to constantly monitor their own and their competitors' performance. This study analyzes the operational and financial performance of global airline companies using multi-criteria decision-making (MCDM) methods. In this context, the criteria determined by CRITIC method are weighted and the airlines are ranked by MAVT method. The criteria consist of operational parameters such as Available Seat-Miles, Revenue Passenger-Miles and financial parameters such as Operating Profit Margin, Yield, Market Value, Return on Assets, Total Debt to Total Capitalization ratio. The analysis covers 12 major international airlines with large and extensive flight networks. According to the findings, the criterion with the highest weight is market value on average, while the criterion with the lowest weight is return on assets. Market value is the criterion with the highest weight in all years, but the relative weights of other criteria vary over the years. Overall, the results reveal that North American airlines exhibited the strongest performance during the 2019–2023 period. The study is expected to provide valuable insights for decision-makers and policy-makers in areas such as investment and employment strategies.
Keywords: Airlines, CRITIC, MAVT, Performance, MCDM.

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HAVAYOLU İŞLETMELERİNDE BÜTÜNLEŞİK CRITIC-MAVT YÖNTEMLERİ İLE PERFORMANS ÖLÇÜMÜ

Öz

Havayolu taşımacılığı küresel anlamda sunduğu hızlı ulaşım hizmeti ile ekonomik büyüme, ticaret ve turizmin gelişmesinde büyük öneme sahiptir. Bu hizmeti veren havayolu işletmeleri dalgalı yakıt fiyatları, değişken talep, yoğun rekabet karşısında bu hizmeti vermek durumunda kalmaktadır. Bu değişken ve zorlayıcı dış koşullar havayolu işletmelerinin kendilerinin ve rakiplerinin performansını sürekli takip etmeyi gerektirmektedir. Bu çalışmada havayolu işletmelerinin operasyonel ve finansal performansları çok kriterli karar verme yöntemleri ile analiz edilmiştir. Bu kapsamda CRITIC yöntemi ile belirlenen kriterler ağırlıklandırılmış, MAVT yöntemi ile de havayolu işletmeleri sıralanmıştır. Kriterler Arz Edilen Koltuk-Mil, Ücretli Yolcu-Mil gibi operasyonel parametreler ile Faaliyet Kar Marjı, Birim Gelir, Piyasa Değeri, Aktif Karlılığı, Toplam Borcun Toplam Sermayeye oranı gibi finansal parametrelerden oluşmaktadır. Havayolu işletmeleri ise dünya çapında faaliyet gösteren büyük ve geniş uçuş ağına sahip 12 havayolu işletmesidir. Elde edilen bulgulara göre en büyük ağırlığa sahip kriterin ortalama olarak piyasa değeri olduğu, en düşük ağırlığa sahip kriterin ise aktif karlılığı olduğu ortaya çıkmıştır. Piyasa değeri tüm yıllarda en yüksek ağırlığa sahip kriterdir ancak diğer kriterlerin göreli ağırlıkları yıllar içerisinde farklılık göstermektedir. Araştırma sonucunda Kuzey Amerika menşeili havayolu işletmelerinin 2019-2023 dönemi için en iyi performansı gösteren havayolu işletmeleri olduğu ortaya çıkmıştır. Araştırmanın karar verici ve politika yapıcılara yatırım, istihdam gibi alanlarda katkı sağlaması beklenmektedir.

Anahtar Kelimeler: Havayolu, CRITIC, MAVT, Performans, ÇKKV.

INTRODUCTION

Airline transportation is a critical industry for global economic growth and trade development. Airline businesses have a major economic impact around the world as they provide fast transportation, increase the integration of international trade and support the tourism industry (Yaşar, 2024). However, airlines operating in the industry operate in an environment characterized by high operational costs, fluctuating fuel prices, volatile demand conditions and intense competition (Cento, 2009, p. 13). This situation necessitates airlines to continuously evaluate their financial and operational performance and guide their strategic decisions based on data (Pineda et al., 2018).

Performance analysis of airline businesses is of great importance in understanding their efficiency, profitability and competitive advantages (Nasir et al., 2017; Lee, 2019). While operational performance is determined by factors such as fleet management, passenger capacity, flight efficiency and service quality, financial performance is evaluated through indicators such as profitability ratios, debt management, market capitalization and financial sustainability (Teker et al., 2016; Bakır et al., 2020). Recent studies show that changes in the financial structure of airlines are directly related to their operational efficiency (Kao et al., 2022, Nyugen et al., 2022). However, the economic fluctuations and crises experienced in the industry require a more detailed examination of the effects on the performance indicators of the enterprises.

In this study, the operational and financial performances of airlines between 2019 and 2023 will be evaluated using multi-criteria decision making (MCDM) methods. In particular, in line with the criteria determined by CRITIC (The CRiteria Importance Through Intercriteria Correlation) and MAVT (Multi-Attribute Value Theory) methods, the performances of the enterprises will be compared and their changes over time will be analyzed. The main objective of the research is to determine how the operational and financial indicators of airline companies interact and to reveal the industrial trends.

The scope of the study includes 12 airlines operating on an international scale and performance indicators such as ASM (Available Seat Miles), RPM (Revenue Passenger Miles), OPM (Operating Profit Margin), ROA (Return on Assets), TD/TC (Total Debt/Total

Capitalization), MV (Market Value) and YIELD (Unit Revenue) will be considered in the analysis process. The results of the study will contribute to developing strategic recommendations for airlines to improve their financial and operational efficiency.

The reminder of the paper is structured as follows. First, a literature review on the subject is conducted and performance analysis studies on airlines are discussed in this section. Then, in the Methodology section 2, the data set and the methods used are explained and then the findings are interpreted. Finally, the study is completed with conclusion, discussion and recommendations.

1. LITERATURE REVIEW

Performance measurement of airline businesses has been addressed in a wide range of perspectives, from traditional financial indicators to operational and sustainability-based measures. Performance assessments cover not only financial profitability but also operational efficiency, customer satisfaction and sustainability criteria.

The information content of non-financial performance measures in the airline sector reveals that the industry requires an assessment based on operational indicators in addition to traditional financial measures (Liedtka, 2002, p. 1105). Studies examining the impact of operational performance on financial results show that traditional performance measures need to be expanded (Schefczyk, 1993). Research analyzing the efficiency and productivity of airlines emphasizes the need to adopt various approaches to performance analysis by elaborating both the conceptual framework and measurement methods (Yu, 2016).

The use of performance measurement techniques in airline businesses has been widely examined and it has been stated that financial and operational indicators should be considered in a balanced manner (Francis et al., 2005, p. 208). In particular, sustainability-oriented performance evaluations are among the important factors affecting the long-term success of airlines (Alemayehu and vom Brocke, 2010). Methods such as network DEA, which combine operational and financial analysis, provide an important framework for performance evaluation (Zhang et al., 2021).

Multi-criteria decision-making models that include airline financial, operational and environmental sustainability measurements suggest the adoption of a holistic approach in performance evaluations (Tanrıverdi et al., 2023). Analyses of passenger expectations and satisfaction reveal that big data sources such as online reviews are increasingly used in performance evaluations (Dike et al., 2024). Moreover, the relationship between sustainable corporate reputation and financial performance has emerged as an important factor in understanding the long-term competitive advantage of airlines (Batrancea et al., 2022). In this context, instead of focusing only on financial indicators when measuring the performance of airlines, a holistic approach should be adopted that also takes into account criteria such as operational efficiency, customer satisfaction and sustainability.

There are many studies in the literature on operational and performance analysis of airlines. Some of these studies focus only on operational performance (Kiracı and Yaşar, 2020; Bakır et al., 2020), while others focus only on financial performance. In some prominent studies, both operational and financial performance analyses have been conducted (Yaşar and Gerede, 2023). In addition to multi-criteria decision-making methods and econometric analyses, forecasting methods such as regression are also preferred in these studies. Some of the related studies are given in the rest of the section.

Davila and Venkatachalam (2004) examine the role of non-financial performance metrics in influencing CEO compensation within the airline industry. The research indicates that industry-specific non-financial indicators, such as passenger occupancy rate, positively correlate with CEO cash compensation. The relationship remains significant even when accounting for conventional financial performance indicators, including return on assets (ROA) and stock returns. The findings indicate that non-financial measures offer supplementary insights into the CEO's actions beyond financial metrics, thus holding positive significance in compensation contracts. This study investigates the influence of CEO power and financial performance volatility on the correlation between non-financial performance measures and cash compensation.

Bhadra (2009) performed a performance analysis of US-based airlines. Data envelopment analysis was employed to assess intertemporal and peer group efficiency among airlines. The findings for the United States from 1985 to 2006 indicate a convergence in airline performance over time. The intertemporal inefficiency of airlines reached its peak earlier and converged subsequently. Additionally, Tobit specifications indicate that demand intensity plays a lesser role in influencing the intertemporal inefficiency of airlines, while its impact is more pronounced in relation to peer group inefficiency.

Mahesh and Prasad (2012) examined the performance of Indian Airlines following the consolidation of the airline industry in 2007-08. This study aims to assess the financial performance efficiency of Indian Airlines in the post-merger period, focusing specifically on profitability, leverage, liquidity, and capital market standards. A paired sample t-test was performed to determine significant differences in financial performance metrics two years prior to and two years following the merger activity. The merger of airlines in India does not significantly impact post-merger financial performance. This study's findings indicate that the surviving company's return on equity, net profit margin, interest coverage ratio, earnings per share, and dividends per share show no improvement following mergers and acquisitions.

Min and Joo (2016) examined the influence of strategic alliances on the comparative performance of airlines by assessing the efficiency of these alliances among global carriers. Yaşar et al. (2018) assessed the operational performance of airlines on a route-specific basis. The analysis included the 16 largest city-pair markets based on passenger volume among international routes originating from Turkey between 2015 and 2017. The analysis utilized the number of passengers carried and occupancy rate as output variables, while the number of seats offered and the number of flights operated on the relevant line served as input variables. The DEA and Malmquist TFP methods were employed to distinguish between efficient and inefficient lines. Kiraci and Yaşar (2020) examined the factors influencing operational performance among major airlines globally. The study's results indicate that passenger numbers, load factors, flight operations, aircraft utilization rates, and cargo volumes substantially influence airlines' operational performance.

Bakır et al. (2020) utilized a multi-criteria decision-making (MCDM) model to evaluate the operational performance of airlines in emerging economies. This study advocates for a hybrid multi-criteria decision-making model that amalgamates the PIPRECIA (PIvot Pairwise RElative Criteria Importance Assessment) and MAIRCA (MultiAttributive Ideal-Real Comparative Analysis) methodologies. The suggested model applies the PIPRECIA approach to determine criteria weights and utilizes the MAIRCA method for ranking alternatives. This paper provides a practical case analysis of the operational performance of 11 airlines in emerging economies to demonstrate the applicability of the suggested methodology. Furthermore, after the installation, a sensitivity analysis was conducted to validate the application's resilience, which was subsequently affirmed. The study highlighted operating expenses as the principal performance metric.

Özdağoğlu et al. (2022) performed an examination of Pegasus's performance spanning five years, from 2016 to 2020. To attain this goal, the chosen criteria comprise “number of seats,” "number of aircraft," "load factor," "average daily aircraft utilization," "number of passengers transported," and "number of landings." The research assessed Pegasus's performance over time using modern multi-criteria decision-making techniques, such as CRITIC, MEREC, MAUT, and PSI.

Yaşar and Gerede (2023) assessed the factors influencing the financial and operational performance of airlines within the framework of competitor pairs. The study's findings demonstrate that the relative market share increase of airlines is positively affected by company maturity, relative size, financial resources, total flight volume, and fleet homogeneity, however it is negatively impacted by resource allocation capability. The research demonstrates that the relative size of airlines, comparable business models, and occupancy rates positively affect RPC, whereas resource allocation capabilities and intra-alliance competition have a detrimental impact.

Sarıgül et al. (2023) aimed to evaluate the financial performance of six European airline businesses from 2019 to 2021 utilizing CRITIC-based MAUT and MARCOS techniques. Eight financial metrics were employed for performance evaluation: current ratio, cash ratio, financial leverage ratio, equity multiplier, asset turnover ratio, equity turnover ratio, return on equity, and return on assets ratio. The outcomes of the CRITIC approach reveal that the asset turnover ratio in 2019 and the financial leverage ratio in both 2019 and 2020 were recognized as the most critical criteria. The application of the MAUT method indicated that Air France exhibited the highest financial performance in the years 2019, 2020, and 2021. The MARCOS method findings indicate that Pegasus Airlines exhibited the highest financial performance in 2019, while EasyJet achieved this distinction in 2020 and 2021.

Yaşar (2023) assessed the performance of airline companies according to their line and business model. The study utilizing the DEA method indicated that Pegasus Airlines exhibited superior performance in line-based comparisons as per the CCR model, while THY demonstrated better performance according to the BCC model in concurrently operated markets.

Asker (2024) examined the impact of the COVID-19 pandemic on the financial performance of traditional and low-cost airlines. This study examines the financial performance of 32 traditional airlines and 14 low-cost airlines across different worldwide areas, utilizing the Merec-based Cobra technique for the periods before and during the pandemic (2018-2021). The Cobra method results demonstrate that Ryanair (FR) displayed the most robust financial performance in 2018 and 2020. The data reveals that low-cost carriers, such as Southwest Airlines (WN), Wizz Air (W6), Allegiant Air Travel (G4), and Ryanair (FR), surpassed numerous conventional airlines before the onset of the COVID-19 epidemic. Throughout the COVID-19 epidemic, low-cost carriers such as Spring Airlines (9C), Air Arabia (G9), Cebu Air (5J), EasyJet (U2), and JetBlue Airways (B6) exhibited inferior performance relative to numerous major airlines.

2. METHODOLOGY

The research evaluated the performance of airline companies operating globally. In this context, CRITIC and MAVT, which are widely used multi-criteria decision-making methods in this field, were used in an integrated manner. CRITIC method was used to obtain the weights of the evaluation criteria and MAVT method was used to rank the companies.

The airline companies included in the study are among the world's leading organizations with large and extensive flight networks and fleets. These airlines stand out as important players in their regions and worldwide. Located in Europe, North America and Asia-Pacific, these major airlines stand out with their passenger transportation, large fleet structures and international cooperation.

Table 1 includes various performance criteria of airlines. The criteria used and their orientations are as follows:

- ASM (Available Seat Miles): Indicates the total seat capacity and flight distance offered by the airline within a certain period of time. It is an important indicator in terms of capacity management and efficiency and shows how effectively the seat capacity supplied is utilized (Gerede, 2015).
- MV (Market Value): Market capitalization shows the financial strength of the company and the perception of investors. The airline's share price multiplied by the total number of shares. It is an important indicator of the company's future growth potential and competitive advantage in the industry and shows the value the market places on the company (Abdi et al., 2020).
- OPM (Operating Profit Margin): Operating profit margin refers to profitability. The ratio of the airline's profit from its operations to total revenue. It is an important indicator of efficiency, cost management and profitability and shows how profitable the company's core operations are (Andoko and Angeline, 2023, s. 61).
- ROA (Return on Assets): Return on assets shows how effectively the company utilizes its assets. It is important in terms of capital efficiency and return on investment and is used to evaluate the investment decisions of airlines (Asatryan and Březinová, 2014).
- RPM (Revenue Passenger Miles): Revenue kilometers per passenger determines load factor and revenue generating capacity. RPM indicates the total distance traveled by fare-paying passengers. It is a critical measure for demand management (Francis et al., 2005).
- YIELD: Indicates the level of revenue per passenger-kilometer that generates revenue in the airline industry. Pricing strategies are an important indicator of demand elasticity and profitability and are used to evaluate the optimization of ticket prices (Donovan, 2005).
- TD/TC (Total Debt/Total Capital): The ratio of total debt to total capital. A low debt ratio indicates that the company's financial risk is low. The airline industry is important for financial risk management due to high fixed costs and large investment requirements. Over-indebted companies are less likely to survive in times of crisis (Chairunisa et al., 2023).

As emphasized in the literature, the relevant criteria are not addressed in only one dimension. For this reason, criteria reflecting both operational and financial performances of airlines are included in the study. The relevant indicators are capacity and cost management, return on investments and market perception.

The decision-making units in the study consist of 12 airlines operating globally. The geographical distribution of airline companies covers North America, South America, Europe, Asia Pacific regions. The airline companies serve with large and wide flight networks worldwide.

Table 1. Criteria and Alternatives Used in the Study

Criteria			**Alternatives**	
Codes	**Direction**	**Criteria Name**	**Codes**	**Firms**
C1	MAX	Available Seat Miles	A1	AIR FRANCE-KLM
			A2	AMERICAN AIRLINES
C2	MAX	Market Value	A3	ANA HOLDINGS
			A4	DELTA AIRLINES
C3	MAX	Operating Profit Margin	A5	DEUTSCHE LUFTHANSA
			A6	IAG SA
C4	MAX	Return on Assets	A7	JAPAN AIRLINES

			A8	LATAM AIRLINES
C5	MAX	Revenue Passenger Miles	A9	QANTAS AIRWAYS
			A10	SINGAPORE AIRLINES
C6	MIN	Total Debt/Total Capital	A11	TURKISH AIRLINES
C7	MAX	Yield	A12	UNITED AIRLINES

After the presentation of alternatives and criteria, information on the methods used for weighting the criteria and ranking the decision-making units will be given.

CRITIC Method

The Criteria Importance Through Intercriteria Correlation (CRITIC) approach, introduced by Diakoulaki, Mavrotas, and Papayannakis in 1995 (Xie et al., 2014), is primarily employed to ascertain the weight of the criteria. The standard deviation of the choice matrix for the evaluation criteria and the correlation coefficient of these criteria are used in the weighting procedure of the CRITIC method (Krishnan et al., 2021). The decision matrix is used to establish the feature weights, and the procedure is predicated on the idea that the features do not contradict each other. Numerous applications have used the CRITIC method, such as the ranking of machining processes (Madic and Radovanovic, 2015), aircraft selection (Kaur et al., 2023), and blockchain evaluation systems (Zafar et al., 2021). Below is a summary of the CRITIC method's application steps (Diakoulaki et al., 1995, p. 765):

The preparation of the decision matrix is a prerequisite for the CRITIC technique. Equation 1 provides the decision matrix:

$$Y = [y_{ij}] = \begin{bmatrix} y_{11} & y_{12} & \cdots & y_{1n} \\ y_{21} & y_{22} & \cdots & y_{2n} \\ \vdots & \vdots & \vdots & \vdots \\ y_{m1} & y_{m2} & \cdots & y_{mn} \end{bmatrix} \tag{1}$$

Equation (2) is used to normalize the decision matrix. The evaluation criteria's cost and benefit aspects are considered.

$$r_{ij} = \frac{y_{ij} - y_j^{min}}{y_j^{max} - y_j^{min}} \tag{2}$$

The correlation coefficient of the pertinent criterion is determined using equation (3), and a matrix R = $(\rho_{jk})_{mxm}$ made up of linear correlation coefficients (ρ_{jk}) is constructed to illustrate the direction and strength of the association between the evaluation criteria.

$$\rho_{jk} = \frac{\sum_{i=1}^{m}(r_{ij} - \bar{r}_j)(r_{ik} - \bar{r}_k)}{\sqrt{\sum_{i=1}^{m}(r_{ij} - \bar{r}_j)^2 \sum_{i=1}^{m}(r_{ik} - \bar{r}_k)^2}} \tag{3}$$

Equation (4) is used to determine the value σj, which gives the standard deviation value of each metric, and Cj, which indicates the amount of information for each parameter.

$$C_j = \sigma_j \sum_{k=1}^{n}(1 - \rho_{jk}) \tag{4}$$

Finally, equation (5) is used to calculate the weight of each evaluation criterion.

$$w_j = C_j / \sum_{k=1}^{n} C_k \tag{5}$$

MAVT Method

Multi-Attribute Value Theory (MAVT) is one of the multi-criteria decisions making (MCDM) methods that enables the evaluation of multiple criteria in the decision-making process. MAVT, which is one of the quantitative decision-making techniques, is especially used for ranking alternatives and determining the best option (Ferretti et al., 2014, 646). Keeney and Raiffa (1993), Raiffa (1969), and Fishburn (1967) have all elaborated on the theoretical ideas of MAVT.

MAVT assumes that each criterion has different degrees of importance and is based on converting the alternatives into an overall value score. The criteria identified in the MAVT method are weighted by expert opinion or some objective weighting methods (CRITIC, Entropy, etc.). Then, with the help of Equation (6), the Value Functions and Total Utility Scores of the alternatives are calculated (Montibeller and Yoshizaki, 2011):

$$V(\alpha) = \sum w_i \, v_i(\alpha_i) \qquad (6)$$

$V(\alpha)$= Total value of alternative "α"

$v_i(\alpha_i) =$ "α" value function reflecting the performance of alternative "α" on criterion "i"

$w_i =$ The importance weight value for each criterion (this value is usually obtained from weighting methods)

4. FINDINGS

The application stages of the CRITIC and MAVT methodologies are discussed in this section of the research, which gives information on those stages. The performance indicators of twelve firms operating in the international airline industry were analyzed over the period of time spanning 2019 to 2023 as part of the research pertaining to the industry. The investigation consisted of a total of seven different operational and financial metrics.

4.1. CRITIC Results

The first step involved implementing the CRITIC method to assign weights to the performance indicators. The weighting process in this study was conducted individually for each year from 2019 to 2023, with the criteria weights for each year obtained from the decision matrix. For the purpose of exemplification and to conserve space, only the weighting process applied to the 2023 data is presented here. The first phase of the CRITIC method involves constructing a decision matrix to represent the evaluation criteria. The decision matrix included 12 airlines within the industry as alternatives and 7 criteria as indicators, structured according to Equation (1). The decision matrix for these enterprises is illustrated in Table 2.

Table 2. Initial Decision Matrix (2023)

	MAX	MAX	MAX	MAX	MAX	MIN	MAX
	ASM	MV	OPM	ROA	RPM	TD/TC	YIELD
AIR FRANCE-KLM	192.317.491	3.096	5,23	4,32	167.853.486	104,11	5,00
AMERICAN AIRLINES	277.723.000	7.803	7,60	4,13	231.926.000	118,78	21,00
ANA HOLDINGS	53.299.723	1.424.548	7,03	3,61	36.419.167	64,88	10,21
DELTA AIRLINES	272.033.000	22.148	11,00	7,24	232.241.000	64,36	21,00
DEUTSCHE LUFTHANSA	186.772.996	8.590	3,69	5,27	154.888.576	58,96	10,06
IAG SA	200.771.867	7.142	11,99	9,44	171.328.815	83,07	6,00
JAPAN AIRLINES	48.912.945	1.177.883	2,34	1,96	33.107.914	51,92	10,49
LATAM AIRLINES	85.274.046	4.442.617	8,32	8,72	70.832.549	94,06	7,40
QANTAS	72.860.743	8.449	13,63	10,09	60.703.616	99,85	11,00

SINGAPORE AIRLINES	82.662.190	18.848	15,15	5,11	70.605.228	60,51	7,00
TURKISH AIRLINES	145.905.470	307.739	12,62	19,00	120.517.918	47,79	9,14
UNITED AIR	291.333.000	12.965	9,61	5,81	244.435.000	75,88	20,00

According to the values in the Table 2, United Airlines (ASM, RPM, MV), Delta Airlines (OPM, RPM, Yield) and Turkish Airlines (ROA, OPM, Yield, low debt ratio) perform strongly. Among the airlines, United Airlines has the highest capacity, while Japan Airlines has the lowest capacity. American airlines such as American, Delta and United have higher unit revenues than others. OPM is highest for Singapore Airlines. During the second stage of the CRITIC method, the decision matrix is normalized using Equation (2), reflecting the benefit and cost characteristics of the decision alternatives. During the normalization process, the minimum and maximum values for each criterion are determined, followed by the application of the equation using the alternative values. To achieve this, the relevant formula was utilized to obtain the normalized values, derived by dividing the criteria by the sum of the corresponding columns. Table 3 presents the decision matrix that has been normalized.

Table 3. Normalized Decision Matrix (2023)

	MAX	MAX	MAX	MAX	MAX	MIN	MAX
	ASM	**MV**	**OPM**	**ROA**	**RPM**	**TD/TC**	**YIELD**
AIR FRANCE-KLM	0,59	0,00	0,23	0,14	0,64	0,21	0,00
AMERICAN AIRLINES	0,94	0,00	0,41	0,13	0,94	0,00	1,00
ANA HOLDINGS	0,02	0,32	0,37	0,10	0,02	0,76	0,33
DELTA AIRLINES	0,92	0,00	0,68	0,31	0,94	0,77	1,00
DEUTSCHE LUFTHANSA	0,57	0,00	0,11	0,19	0,58	0,84	0,32
IAG SA	0,63	0,00	0,75	0,44	0,65	0,50	0,06
JAPAN AIRLINES	0,00	0,26	0,00	0,00	0,00	0,94	0,34
LATAM AIRLINES	0,15	1,00	0,47	0,40	0,18	0,35	0,15
QANTAS	0,10	0,00	0,88	0,48	0,13	0,27	0,38
SINGAPORE AIRLINES	0,14	0,00	1,00	0,18	0,18	0,82	0,13
TURKISH AIRLINES	0,40	0,07	0,80	1,00	0,41	1,00	0,26
UNITED AIR	1,00	0,00	0,57	0,23	1,00	0,60	0,94

It was identified, in the second phase of the CRITIC method, the direction and intensity of the association between the performance measurement criteria by applying a correlation analysis to the relevant criteria with the assistance of Equation (3). This was done in order to determine the relationship between the criteria. The results of the correlation study that was carried out on the performance measurement criteria are presented in Table 4.

Table 4. Correlation Matrix (2023)

	ASM	MV	OPM	ROA	RPM	TD/TC	YIELD
ASM	1,00	-0,47	0,02	0,00	1,00	-0,29	0,66
MV	-0,47	1,00	-0,22	0,00	-0,47	-0,06	-0,26
OPM	0,02	-0,22	1,00	0,58	0,04	-0,01	0,00
ROA	0,00	0,00	0,58	1,00	0,01	0,18	-0,17
RPM	1,00	-0,47	0,04	0,01	1,00	-0,30	0,63
TD/TC	-0,29	-0,06	-0,01	0,18	-0,30	1,00	-0,13
YIELD	0,66	-0,26	0,00	-0,17	0,63	-0,13	1,00

There is a final phase of the CRITIC approach that involves determining the amount of information that is available as well as the weights that are allocated to the criteria. In the context of this discussion, the initial determination of the information quantity (Cj) is accomplished by applying Equation (4). After then, the value of (Cj) for each criterion is divided by the total value of (Cj) for all of the criteria before the process is complete. After that, the value that was obtained is expressed as the criterion weight value, which is determined with the assistance of Equation (5) by calculation. The (Cj) and (Wj) values for the performance measurement criterion are presented. Table 5 contains these values.

Table 5. Amount of Information and Standard Deviations (2023)

	ASM	MV	OPM	ROA	RPM	TD/TC	YIELD
Std. Dev.	0,37	0,29	0,31	0,26	0,37	0,32	0,36
Cj	1,90	2,19	1,76	1,43	1,89	2,12	1,92

The Table 5 evaluates the discrimination and variability of the criteria. Market Value (MV) and Total Debt/Total Capitalization (TD/TC) are the criteria with the highest amount of information (2.19 and 2.12). ROA has the lowest amount of information (1.43), which may indicate that there is not much variation across firms. To this point in the investigation, the only values that have been established for 2023 are the criterion weight value and the amount of information value to be determined. Table 6 displays the information regarding the weight values of the criteria for the period of 2019-2023.

Table 6. Weight of criteria (2019-2023)

		ASM	MV	OPM	ROA	RPM	TD/TC	YIELD
2019	W_j	0,158958	0,179856	0,108823	0,109410	0,160988	0,137966	0,143997
2020	W_j	0,145423	0,211075	0,149930	0,109812	0,131166	0,096029	0,156564
2021	W_j	0,129086	0,272987	0,123231	0,092359	0,122174	0,122632	0,137530
2022	W_j	0,134909	0,168281	0,100631	0,101089	0,137810	0,192190	0,165090
2023	W_j	0,143799	0,166168	0,133211	0,107971	0,143153	0,160605	0,145094

When the changes between 2019 and 2023 are analyzed, Market Value (MV) has the highest weight in 2021 (0.272987). Investor interest may have made this criterion more important due to the uncertainty in financial markets after the pandemic. The weight of ROA has decreased over time (0.1094 → 0.1079). How companies manage their assets may have become less decisive than in the past. TD/TC (Debt/Total Capital) increased to 0.192 in 2022, but declined to 0.1606 in 2023. This may indicate that companies' debt management has become more stable compared to previous years. MV (Market Value), TD/TC (Total Debt/Total Capitalization) and ASM (Available Seat Miles) have the highest weights. Market capitalization and debt ratios of airlines stand out as important variables that determine financial performance and investor expectations.

4.2. MAVT Results

In this section, the decision matrix that was utilized in the computations of the CRITIC technique is utilized to rank the options by evaluating the performance of airlines in accordance with the MAVT approach. Table 7 contains the initial choice matrix that is provided in this context.

Table 7. Initial Decision Matrix for MAVT (2023)

Weights	**0,1438**	**0,1662**	**0,1332**	**0,1080**	**0,1432**	**0,1606**	**0,1451**
Alternatives\ /Criteria	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
AIR FRANCE-KLM	192.317.491	3.096	5,23	4,32	167.853.486	104,11	5,00
AMERICAN AIRLINES	277.723.000	7.803	7,60	4,13	231.926.000	118,78	21,00
ANA HOLDINGS	53.299.723	1.424.548	7,03	3,61	36.419.167	64,88	10,21
DELTA AIRLINES	272.033.000	22.148	11,00	7,24	232.241.000	64,36	21,00
DEUTSCHE LUFTHANSA	186.772.996	8.591	3,69	5,27	154.888.576	58,96	10,06
IAG SA	200.771.867	7.142	11,99	9,44	171.328.815	83,07	6,00
JAPAN AIRLINES	48.912.945	1.177.883	2,34	1,96	33.107.914	51,92	10,49
LATAM AIRLINES	85.274.046	4.442.617	8,32	8,72	70.832.549	94,06	7,40
QANTAS	72.860.743	8.450	13,63	10,09	60.703.616	99,85	11,00
SINGAPORE AIRLINES	82.662.190	18.848	15,15	5,11	70.605.228	60,51	7,00
TURKISH AIRLINES	145.905.470	307.740	12,62	19,00	120.517.918	47,79	9,14
UNITED AIR	291.333.000	12.965	9,61	5,81	244.435.000	75,88	20,00

Following the initial decision matrix in Table 7, Table 8 presents the ranking results of airline companies for 2019-2023 using MAVT.

Table 8. Ranking of Alternatives (2023)

Alternatives	**2019**	**2020**	**2021**	**2022**	**2023**
AIR FRANCE-KLM	5	10	4	4	5
AMERICAN AIRLINES	1	1	1	1	2
ANA HOLDINGS	11	5	9	12	11
DELTA AIRLINES	3	2	2	3	3
DEUTSCHE LUFTHANSA	4	8	5	6	6
IAG SA	6	7	7	5	4
JAPAN AIRLINES	12	9	11	9	12
LATAM AIRLINES	9	12	8	8	8
QANTAS	10	6	10	11	10
SINGAPORE AIRLINES	8	4	12	10	9
TURKISH AIRLINES	7	11	6	7	7
UNITED AIR	2	3	3	2	1

The data presented in the table indicates that American Airlines and United Airlines are the airlines that have the highest levels of stability and success. The year 2023 saw American Airlines fall from its previous position of first place, which it held between the years 2019 and 2022. United Airlines, on the other hand, went from standing in second place in 2019 to being in first place in 2023. The fact that the company has been able to sustain its performance while simultaneously increasing its competitiveness is demonstrated by this. Delta Airlines has also maintained a position within the industry that is robust, as seen by the fact that it has constantly ranked among the top three since 2019. From sixth place in 2019 to fourth place in 2023, IAG

SA, which is a conglomerate that includes brands such as British Airways and Iberia, has managed to climb up the rankings. A similar pattern may be seen in the fact that Air France-KLM maintains its position as the fifth best airline in 2023, having risen from fifth place in 2019. On the other hand, Deutsche Lufthansa has demonstrated a performance that is generally consistent, falling from fourth to sixth position with their performance.

On the other side, airlines that are based in the Asia-Pacific area, such as ANA Holdings, Japan Airlines, Qantas Airways, and Singapore Airlines, are typically positioned in the center of the ranking or at the bottom of the ranking. Turkish Airlines, on the other hand, maintained its position as the seventh best airline in 2023, maintaining its position as the seventh best airline in 2019, suggesting that it has not undergone a significant shift in performance. According to these findings, airlines located in North America, particularly United, American, and Delta, are at the top of the list, while airlines based in Europe are constantly positioned in the center of the ranking, and airlines based in Asia-Pacific are frequently at the bottom of the ranking. It is essential to have this table because it offers valuable insight into the ways in which factors such as fleet management, operational efficiency, regional economic dynamics, and post-pandemic recovery procedures influence the ranks of airlines.

5. CONCLUSION, DISCUSSION AND FUTURE STUDIES

This study uses CRITIC and MAVT methods to evaluate the performance of 12 firms operating in the international airline industry between 2019 and 2023. According to the results of the analysis, American-based airlines (United Airlines, American Airlines and Delta Airlines) in particular have generally shown high performance. European-based airlines generally ranked in the middle, while Asia-Pacific-based airlines ranked at the bottom of the rankings. The weights of financial and operational criteria have varied over the years, with the weights of market capitalization and debt-to-total capitalization ratio showing significant fluctuations over time.

The findings of this study reveal that airline companies' financial and operational performance exhibit regional differences and the weights of some criteria have changed over time. Comparing the findings with the literature will enable the results to be evaluated in a broader context. First of all, the evaluation in terms of the weights of the criteria shows that the ASK and RPK criteria were also used in the study by Bakır et al. (2020). However, in the related study, it was determined that the weights of these factors were lower. In our study, the fact that MV has the highest weight in 2021 (0.272987) can be attributed to the uncertainty created by the pandemic in financial markets and investors' sensitivity to stock value. This has also been mentioned in studies such as Krišto et al. (2014) and Bassanini and Reviglio (2011), who emphasize that the financial soundness of companies becomes a priority criterion for investors in times of crisis. In general, the findings of our study are consistent with the existing literature, which shows that the importance of financial indicators in airline performance evaluations may vary over the years and that regional factors are determinant.

Especially Asia-Pacific based airlines need to develop strategies to increase their operational efficiency and create flexible business models that can adapt to global demand changes faster. Companies with high debt-to-equity ratios should develop long-term sustainable growth strategies and adopt investor-friendly policies to increase market capitalization. Considering regional differences, incentive mechanisms can be developed to increase competition in the airline industry and enhance the resilience of companies in times of crisis.

In this study, only certain operational and financial indicators were used. In future research, additional variables such as customer satisfaction, service quality and sustainability criteria can be included in the model. Furthermore, time series analysis or panel data methods can be applied to further examine the impact of regional economic factors on airline performance. This research is limited to the period 2019-2023 and includes only a select number of financial and operational indicators. Exogenous variables such as macroeconomic factors, fuel prices and the effects of global economic crises are not included in the model. Moreover, the long-term effects of the pandemic on the industry could not be fully assessed.

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REFERENCES

Abdi, Y., Li, X., & Càmara-Turull, X. (2020). Impact of sustainability on firm value and financial performance in the air transport industry. Sustainability, 12(23), 9957.

Alemayehu, W., & vom Brocke, J. (2010, September). Sustainability performance measurement–the case of Ethiopian airlines. In International Conference on Business Process Management (pp. 467-478). Berlin, Heidelberg: Springer Berlin Heidelberg.

Andoko, A., & Angeline, A. (2023). The Influence Of Debt To Equity Ratio, Operating Profit Margin Ratio And Operating Expense Toward Entity Income Tax Of Infrastructure, Utility And Transportation Companies Listed On The Indonesia Stock Exchange. International Journal of Sociıal, Policy and Law, 4(1), 58-68. https://doi.org/10.8888/ijospl.v4i1.115

Asatryan, R., & Březinová, O. (2014). Corporate social responsibility and financial performance in the airline industry in central and eastern Europe. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis, 62(4), 633-639.

Asker, V. (2024). Financial Performance Analysis Using the Merec-Based Cobra Method: An Application to Traditional and Low-Cost Airlines. Gospodarka Narodowa. The Polish Journal of Economics, 318(2), 35-52.

Bakir, M., Akan, Ş., Kiraci, K., Karabasevic, D., Stanujkic, D., & Popovic, G. (2020). Multiple-criteria approach of the operational performance evaluation in the airline industry: Evidence from the emerging markets. Romanian Journal of Economic Forecasting, 23(2), 149-172.

Bassanini, F., & Reviglio, E. (2011). Financial stability, fiscal consolidation and long-term investment after the crisis. OECD Journal: Financial Market Trends, 1, 1-45.

Batrancea, L. M., Nichita, A., & Cocis, A. D. (2022). Financial performance and sustainable corporate reputation: Empirical evidence from the airline business. Sustainability, 14(20), 13567.

Bhadra, D. (2009). Race to the bottom or swimming upstream: performance analysis of US airlines. Journal of Air Transport Management, 15(5), 227-235.

Cento, A. (2009). The airline industry: challenges in the 21st century, Verlag-Heidelberg, Heidelberg. doi:10.1007/978-3-7908-2088-1.

Chairunisa, S. S., Digdowiseiso, K., & Karyatun, S. (2023). The Effect of Total Assets Turnover, Debt to Assets Ratio, Cash Ratio and Current Ratio on Financial Performance of Companies The Hotel, Restaurant and Tourism Subsector in IDX for The Period 2016-2020. Jurnal Syntax Admiration, 4(3), 548-558.

Davila, A., Venkatachalam, M. (2004). The Relevance of Non-financial Performance Measures for CEO Compensation: Evidence from the Airline Industry. Rev Acc Stud 9, 443–464. https://doi.org/10.1007/s11142-004-7792-8

Diakoulaki, D., Mavrotas, G., & Papayannakis, L. (1995). Determining objective weights in multiple criteria problems: The critic method. Computers & Operations Research, 22(7), 763-770.

Dike, S. E., Davis, Z., Abrahams, A., Anjomshoae, A., & Ractham, P. (2024). Evaluation of passengers' expectations and satisfaction in the airline industry: an empirical performance analysis of online reviews. Benchmarking: An International Journal, 31(2), 611-639.

Donovan, A. W. (2005). Yield Management in the Airline Industry. Journal of Aviation/Aerospace Education & Research, 14(3). DOI: https://doi.org/10.58940/2329-258X.1522

Ferretti, V., Bottero, M., & Mondini, G. (2014). Decision making and cultural heritage: An application of the Multi-Attribute Value Theory for the reuse of historical buildings. Journal of cultural heritage, 15(6), 644-655.

Fishburn, P. C. (1967). Methods of Estimating Additive Utilities, Manage. Sci. 13 435–453.

Francis, G., Humphreys, I., & Fry, J. (2005). The nature and prevalence of the use of performance measurement techniques by airlines. Journal of Air Transport Management, 11(4), 207-217.

Gerede, E. (2015), "Havayolu İşletmeciliğine İlişkin Temel Kavramlar", in: Havayolu Taşımacılığı ve Ekonomik Düzenlemeler Teori ve Türkiye Uygulaması, 1-46.

Kao, F. C., Ting, I. W. K., Chou, H. C., & Liu, Y. S. (2022). Exploring the influence of corporate social responsibility on efficiency: An extended dynamic data envelopment analysis of the global airline industry. Sustainability, 14(19), 12712.

Kaur, G., Dhara, A., Majumder, A., Sandhu, B. S., Puhan, A., & Adhikari, M. S. (2023). A CRITIC-TOPSIS MCDM technique under the neutrosophic environment with application on aircraft selection. Contemporary Mathematics, 1180-1203.

Keeney, R. L., & Raiffa, H. (1993). Decisions with multiple objectives: preferences and value trade-offs. Cambridge university press.

Kiracı, K., & Yaşar, M. (2020). The Determinants of Airline Operational Performance: An Empirical Study on Major World Airlines. Sosyoekonomi, 28(43), 107-117. https://doi.org/10.17233/sosyoekonomi.2020.01.06

Krishnan, A. R., Kasim, M. M., Hamid, R., & Ghazali, M. F. (2021). A modified CRITIC method to estimate the objective weights of decision criteria. Symmetry, 13(6), 973.

Krišto, J., Stojanović, A., & Pavković, A. (2014). Impact of institutional investors on financial market stability: lessons from financial crisis. International Journal of Diplomacy and Economy 1, 2(1-2), 102-117.

Lee, J. (2019). Effects of operational performance on financial performance. Management Science Letters, 9(1), 25-32.

Liedtka, S. L. (2002). The information content of nonfinancial performance measures in the airline industry. Journal of Business Finance & Accounting, 29(7-8), 1105-1121.

Madic, M., & Radovanovic, M. (2015). Ranking of some most commonly used non-traditional machining processes using ROV and CRITIC methods. UPB Scientific Bulletin, Series D, 77(2), 193–204.

Mahesh, R., & Prasad, D. (2012). Post-merger and acquisition financial performance analysis: A case study of select Indian airline companies. International journal of engineering and management sciences, 3(3), 362-369.

Min, H., & Joo, S. J. (2016). A comparative performance analysis of airline strategic alliances using data envelopment analysis. Journal of Air Transport Management, 52, 99-110.

Montibeller, G., Yoshizaki, H. (2011). A Framework for Locating Logistic Facilities with Multi-Criteria Decision Analysis. In: Takahashi, R.H.C., Deb, K., Wanner, E.F., Greco, S. (eds) Evolutionary Multi-Criterion Optimization. EMO 2011. Lecture Notes in Computer Science, vol 6576. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-19893-9_35

Nasir, A. M., Ahmed, A., & Barkat, W. (2017). Operational performance and financial performance of Malaysia Airlines. Paradigms, 11(1), 34.

Nguyen, M. A. T., Yu, M. M., & Lirn, T. C. (2022). Revenue efficiency across airline business models: A bootstrap non-convex meta-frontier approach. Transport Policy, 117, 108-117.

Özdağoğlu, A., Ustaömer, T. C., & Keleş, M. K. (2022). Performance Evaluation in Airline Industry with Critic and Merec Based Maut and Psi Methods. Transport & Logistics, 22(52).

Pineda, P. J. G., Liou, J. J., Hsu, C. C., & Chuang, Y. C. (2018). An integrated MCDM model for improving airline operational and financial performance. Journal of Air Transport Management, 68, 103-117.

Raiffa, H. (1969). Preference for multi-attributed alternatives, RM-5868-DOT/RC, The RAND Corporation, Santa Monica, CA.

Sarıgül, S. S., Ünlü, M., & Yaşar, E. (2023). Financial performance analysis of airlines operating in Europe: CRITIC based MAUT and MARCOS methods. International Journal of Business and Economic Studies, 5(2), 76-97.

Schefczyk, M. (1993). Operational performance of airlines: an extension of traditional measurement paradigms. Strategic management journal, 14(4), 301-317.

Tanrıverdi, G., Merkert, R., Karamaşa, Ç., & Asker, V. (2023). Using multi-criteria performance measurement models to evaluate the financial, operational and environmental sustainability of airlines. Journal of Air Transport Management, 112, 102456.

Teker, S., Teker, D., & Güner, A. (2016). Financial performance of top 20 airlines. Procedía-Social and behavioral sciences, 235, 603-610.

Xie, Y., & Li Z. J., Xu, Z. (2014). Evaluation on spontaneous combustion trend of sulfide ores based on the method of CRITIC and TOPSIS testing method. Journal of Safety and Environment, 14(1), 122–125.

Yasar, M., Asker, V., & Ozdemir, E. (2018). Havayolu şehir çifti pazarlarinda veri zarflama analizi ve malmquist toplam faktör verimliliği endeksi yöntemleriyle etkinlik ölçümü. PressAcademia Procedia, 7(1), 228-232. https://doi.org/10.17261/Pressacademia.2018.886

Yaşar, M. (2023). Havayolu Işletmelerinde Hat Bazli Operasyonel Performansin Iş Modeli Temelinde Değerlendirilmesi. Malatya Turgut Özal Üniversitesi İşletme ve Yönetim Bilimleri Dergisi, 4(2), 88-106.

Yaşar, M. (2024). Investigating the Air Travel-Tourism Relationship Using Granger Causality Analysis: The Case of Turkish Destinations. Studies in Business and Economics, 19(1), 301-316.

Yaşar, M., & Gerede, E. (2023). Examination of the factors determining the operational and financial performance of airlines: The case of the Turkish international airline market. Journal of Entrepreneurship, Management & Innovation, 19(4), 111-145.

Yu, C. (2016). Airline productivity and efficiency: concept, measurement, and applications. In Airline Efficiency (pp. 11-53). Emerald Group Publishing Limited.

Zafar, S., Alamgir, Z., & Rehman, M. H. (2021). An effective blockchain evaluation system based on entropy-CRITIC weight method and MCDM techniques. Peer-to-Peer Networking and Applications, 14(5), 3110-3123.

Zhang, Q., Koutmos, D., Chen, K., & Zhu, J. (2021). Using operational and stock analytics to measure airline performance: A network DEA approach. Decision Sciences, 52(3), 720-748.