Volume 24 • Number 4 • October 2024

Cilt 24 • Sayı 4 • Ekim 2024

Contents

A Robust Portfolio Construction Using the Bootstrap Method to Extract Multidimensional Uncertainty Sets: An Application on BIST100 Stocks
Salih ÇAM - Süleyman KILIÇ ..... *499-516* — *Article Type: Research Article*

Are Electric Vehicles Discharging Tax Revenues? The Türkiye Case
Doğan BAKIRTAŞ - Metin NAZLIOĞLU - Hasan YAZAR ..... *517-530* — *Article Type: Research Article*

Analysis of the Financial Performance of Airline Companies in Star Alliance Using Lopcow-Topsis Methods
İbrahim YAVUZ ..... *531-562* — *Article Type: Research Article*

Workplace Conflict Effect on Innovative Behavior: The Roles of Engagement and Proactive Personality
Çetin YELGİN - Aslı GEYLAN ..... *563-576* — *Article Type: Research Article*

The Classification of Success Performance of Entrepreneurial and Innovative Universities with Artificial Intelligence Methods
Berhan ÇOBAN ..... *577-592* — *Article Type: Research Article*

Assessment of Hospital Managers' Sustainable Leadership Levels
Ahmet Y. YEŞILDAĞ - Burak SAYAR - Zubeyir DALGIÇ ..... *593-606* — *Article Type: Research Article*

Psychometric Properties of the Turkish Version of the Entrepreneurs' Social Identity Scale
Murat AVCI - Kadir ARDIÇ ..... *607-620* — *Article Type: Research Article*

Determinants of Exchange Rate Jumps in Türkiye
Erkan AĞASLAN - Savaş GAYAKER - Erol BULUT ..... *621-638* — *Article Type: Research Article*

The Effect of Corporate Governance Capacity on Herd Behavior
Esra ÖZKAHVECİ - Fatih KONAK - Sabiha KILIÇ ..... *639-650* — *Article Type: Research Article*

Inquiring Children's Security within the Framework of Human Security: A Theoretical Assessment
Zerrin Ayşe ÖZTÜRK ..... *651-660* — *Article Type: Research Article*

The Spatial Linkages Between International Migration And Security: The Empirical Findings From Türkiye Hosting Most Refugee In The World
Osman TABAK - Merve ZORLU - Necmettin ÇELİK - A. Ayşen KAYA ..... *661-674* — *Article Type: Research Article*

Bitcoin Price Bubbles and The Factors Driving Bitcoin Price Formation
Murat AKKAYA ..... *675-686* — *Article Type: Research Article*

Collaborative Supply Chain Management in the Sharing Economy: An Empirical Research
Çağlar AKTEPE - Ayla ÖZHAN DEDEOĞLU ..... *687-714* — *Article Type: Research Article*

EGE AKADEMİK BAKIŞ / *EGE ACADEMIC REVIEW*

Cilt 24 • Sayı 4 • Ekim 2024
SS. 531/562
Doi: 10.21121/eab.20240404
Başvuru Tarihi: 27.02.2024 • Kabul Tarihi: 28.07.2024

Article Type: *Research Article*

ANALYSIS OF THE FINANCIAL PERFORMANCE OF AIRLINE COMPANIES IN STAR ALLIANCE USING LOPCOW-TOPSIS METHODS

İbrahim YAVUZ[1]

ABSTRACT

This study aims to comparatively evaluate the financial performance of the airlines included in Star Alliance for the period 2018-2022 (pre-COVID-19, COVID-19 and post-COVID-19 periods). For the performance evaluation, 5 criteria and a total of 9 financial performance ratios were used. The LOPCOW method was used to determine the criterion weights of the calculated financial performance ratios and the TOPSIS method was used to determine the performance rankings. According to the results of the LOPCOW analysis, the most important criterion was determined as net profit/total assets (PR3) for 2018, net profit/total equity (PR2) for 2019 and 2021, short-term debt/total assets (FSR3) for 2020 and net profit/net sales (PR1) for 2022. The criterion with the lowest importance weight was net balance sheet position/equity (CA) for 2018, 2019, and 2021, net sales/ current assets (AT) for 2020, and short-term debt/total assets (FSR3) for 2022. According to the TOPSIS performance evaluation results, the best-performing airline was Shenzhen Airlines in 2018, 2019 and 2020, Thai Airways International in 2021, and Aegean in 2022. The airlines that ranked last in the performance ranking were Croatia Airlines in 2018, Asian Airlines in 2019, Thai Airways International in 2020, Air Canada in 2021, and Air China in 2022.

Keywords: Star Alliance Airlines, Financial Performance, Multi-Criteria Decision Making Techniques, LOPCOW, TOPSIS.

JEL Classification Codes: Z3, Z31, M4, M41

Referencing Style: APA 7

INTRODUCTION

Air transportation has an important place in the transportation sector as it is fast, reliable, safe, and economical (General Directorate of Civil Aviation, 2014). In recent years, there have been many developments that have increased the importance of airline companies in both transportation and global commercial activities. The trade liberalization between countries, business model renewal, starting open markets, and expansion of the air transport networks have made the sector more competitive (Bakır et al., 2020). The increasing demand for air transportation has also raised issues, such as how to provide the most appropriate service to customers, and the adequacy of the level of performance and competitiveness (Belton & Stewart, 2002).

One of the important developments affecting the aviation industry is COVID-19. After COVID-19, the aviation sector has gone through a recovery process. The number of passengers carried by air increased by approximately 47%, and Revenue Passenger Kilometres (RPK) by approximately 70% in 2022 compared to 2021 due to the rapid recovery of most international routes. Annual passenger revenues of airlines grew by 50% in 2022 compared to the previous year. With the strong recovery in airline passenger demand, passenger numbers in 2022 are estimated to have reached approximately 74% of the pre-pandemic number, and passenger revenues are estimated to have reached 68% of the revenue level in 2019 (Directorate General of Civil Aviation, 2022).

It has been stated that the total air traffic in 2022, based on paid passenger-km, increased by 64.4% compared to 2021, with the air traffic in 2022 at 68.5% of pre-pandemic (2019) levels. It was reported that in 2022, the international traffic increased by 152.7% compared to 2021 and reached 62.2% of pre-pandemic levels, while the domestic traffic increased by 10.9% compared to the previous year and reached 79.6% of the pre-pandemic levels. EUROCONTROL published a report containing the forecasts of the organizations regarding the elimination of the negative effects of COVID-19 on the aviation sector and the return to the pre-COVID-19 growth figures. According to the report, the European aviation sector was estimated to reach 92% of its 2019 level in 2023. These forecasts were based on the impact of the war in Ukraine, the pressure on energy prices, and the COVID-19 recovery.

[1] Kütahya Dumlupınar Üniversitesi Simav Meslek Yüksekokulu, Finans-Bankacılık ve Sigortacılık Bölümü, ibrahim.yavuz@dpu.edu.tr

According to the optimistic expectation, the recovery of the aviation sector was expected to continue until 2023 according to the optimistic forecast, until 2025 according to the baseline forecast, and until 2028 according to the pessimistic forecast (Directorate General of Civil Aviation, 2022).

Turkiye has recovered faster than other countries as a result of the support provided to the sector and the right steps taken during the COVID-19 process. According to EUROCONTROL's analysis for 2022, Turkiye ranked 6th among the countries with the highest number of takeoffs/landings in Europe with 948 thousand flights. Turkish Airlines ranked 3rd among the airlines with the highest number of flights with an average of 1,245 daily flights. Istanbul Airport, the meeting point of the world, was the busiest airport in Europe with an average of 1,156 daily flights (General Directorate of Civil Aviation, 2022).

Considering the above-mentioned data on the sector, it is believed that the impact of the aviation sector on the growth of national economies will also be significant. Potential and existing investors, shareholders, and lenders, who are among a wide range of stakeholders, make various performance measurements to evaluate the performance of airline companies. When measuring financial performance, multi-criteria decision-making techniques are utilized in financial measurements with multiple criteria and alternatives.

The purpose of this study is to examine the financial performance of airline companies listed on https://www.staralliance.com/en/ in the pre-COVID-19, COVID-19 and post-COVID-19 periods. In the research, the years 2018 and 2019 were selected as the pre-COVID-19 period, 2020 as the COVID-19 period, and 2021 and 2022 as the post-COVID-19 period, considering that the impact of the pandemic would decrease on the financial performance of Star Alliance airline companies. In the study, firstly, the literature review is given, then the methodology, research universe, financial performance ratios to be used in the research, and the methods used in the research are mentioned. The LOgarithmic Percentage Change-driven Objective Weighting method (the LOPCOW method) was used to determine the criteria (importance) weights of the calculated financial performance ratios, and the Technique for Order Preferences by Similarity to an Ideal Solution (the TOPSIS method) was used to determine the performance rankings.

LITERATURE REVIEW

When the literature is examined, it is seen that many studies have been conducted on the performance evaluation of enterprises using multi-criteria decision-making techniques. Considering the purpose and scope of the study, the literature review section includes studies on the evaluation of the financial performance of airline companies using multi-criteria decision-making techniques. Some studies using the LOPCOW method, which is the criteria weighting method used in this research, are also included.

Chang and Yeh (2001) analyzed the performance of 5 domestic airlines in Taiwan with the main criteria of cost, efficiency, service quality, price, and 11 sub-criteria. The Simple Additive Weighting (SAW), Weighted Product (WP), and TOPSIS methods were used in the analysis and the best-performing airline was found to be Eastern Airlines.

Wanke, Barros, and Chen (2015) analyzed the financial performance of 35 airlines operating in Asia for the years 2006-2012 using the TOPSIS method. The criteria used in the study were operating cost, total assets, revenues, depreciation, salaries, fixed assets, and Earnings Before Interest, Taxes, Depreciation, and Amortization (EBITDA). It was found that cost structure, ownership type, market position, and the distance program offered have significant impacts on the efficiency levels of airline operations.

Avcı and Çınaroğlu (2018), analyzed the financial performance of five airlines operating in Europe (Turkish Airlines, Lufthansa, EasyJet, Air France-KLM, and Rynair) using the Analytical Hierarchy Process (AHP) and TOPSIS methods. Current ratio, financial leverage ratio, asset turnover ratio, return on assets, equity multiplier, cash ratio, equity turnover ratio, and return on equity were used as criteria. It was determined that Ryanair had the best financial performance and Lufthansa had the worst financial performance.

Dağlı (2021) calculated the financial ratios using the financial data of the seven airline companies in the top ten in Europe for the second quarter of 2019, the fourth quarter of 2019 and the second quarter of 2020, and performed a financial performance analysis using the TOPSIS method. The performance ranking in the second quarter of 2019 was Pegasus Airlines, International Airlines Group, Aeroflot Airlines, Norwegian Airlines, Air France-KLM Group, Turkish Airlines and Lufthansa, respectively. The financial performance ranking in the fourth quarter

of 2019 was as follows: Air France-KLM Group, Lufthansa, Aeroflot Airlines, Turkish Airlines, International Airlines Group, Pegasus Airlines and Norwegian Airlines. The financial performance ranking in the second quarter of 2020 was determined as Norwegian Airlines, Pegasus Airlines, Turkish Airlines, Aeroflot Airlines, Air France-KLM Group, International Airlines Group and Lufthansa.

Teker, Teker and Polat (2022), analyzed the financial performance of the top 11 airlines in the world for the period 2019-2020-2021 (Covid period) using the TOPSIS method. In the study, airlines are grouped as US Airlines, European Airlines and Chinese Airlines. The result of the analysis shows that the COVID period significantly affects the profitability and operational efficiency of airline companies. As a result of the study, it was observed that China-based airlines managed the COVID period better than US and European airlines.

Bektaş (2022) analyzed the performance of the Turkish insurance sector for the period 2002-2021 using the Method based on the Removal Effects of Criteria (MEREC), LOPCOW, COCOSO, and Evaluation based on the Distance from Average Solution (EDAS) method. According to the results of the study, the most important criteria were found as total claims paid, total equity, and total assets, respectively. With COCOSO and EDAS methods, it was found that the best performance was in 2020.

Ecer and Pamucar (2022) analyzed the performance of nine banks operating in Turkey and published sustainability reports by using LOPCOW and DOmbi Bonferroni (DOBI) methods. In the study, banks were analyzed in terms of three main dimensions of sustainability and seventeen criteria created from these dimensions. It was determined that average return on equity, electricity consumption, number of branches and number of employees are the four most important criteria for sustainability and Garanti BBVA had the best sustainability performance.

Bektaş (2023) analyzed Akbank's sustainability performance for the period 2009-2021 with the LOPCOW and Combined Compromise Solution (COCOSO) methods. The most important criterion in the economic category was return on equity. The most important criterion in the social category was the total number of ATMs. The most important criterion in the environmental category was Scope 1 emissions. According to the COCOSO analysis, the best sustainability performance was achieved in 2018, 2017, and 2014, respectively.

Sürmeli Sarıgül, Ünlü, and Yaşar (2023) analyzed the financial performance of 6 airlines operating in Europe for the years 2019-2021 based on 8 financial criteria. The Criteria Importance Through Intercriteria Correlation (CRITIC) method was used to determine the weight levels of the criteria, and Multi-Attribute Utility Theory (MAUT) and Measurement of Alternatives and Ranking according to Compromise Solution (MARCOS) methods were used to obtain the financial performance ranking. The most important criterion is asset turnover ratio in 2019. The most important criterion is the financial leverage ratio in 2020 and 2021. It was determined that the airline with the best financial performance was Air France in 2019, 2020, and 2021 according to the MAUT method, but Pegasus Airlines in 2019, and EasyJet in 2020 and 2021 according to the MARCOS method.

Gülcemal and İzci (2024) conducted a financial performance analysis of the Turkish Participation Banking sector for the period January 2021-October 2022 using LOPCOW and Multi-Objective Optimization on the basis of Simple Ratio Analysis (MOOSRA) methods. In the study, the performance of participation banks was evaluated on 6 criteria using total sector data. These criteria are dividends received, loans, return on equity, return on assets, foreign resources/total equity, and operating expenses/average total assets. The most important criterion is the foreign resources/total equity criterion. The sector's best performance period was October 2022 and the worst performance period was January 2021.

Apart from the studies summarized above, there are other studies on analyzing the financial performance of airline companies using multi-criteria decision-making techniques: Kurt and Kablan (2022), Bae, Gupta and Mau (2021), Ellibeş and Candan (2021), Köse (2021), Perçin and Aldalou (2018), Pestana Barros and Wanke (2015), Ömürbek and Kınay (2012), Torlak, Sevkli, Sanal & Zaim (2011), Wang (2008), Feng and Wang (2000).

RESEARCH METHODOLOGY

The research is designed in three stages. In the first stage, the financial ratios given in Table 2 were calculated from the financial statements of the airline companies for the relevant years. In the 2nd stage, the criteria (importance) weights of the financial ratios obtained by the LOPCOW method, which is an objective criteria weighting method, were obtained. In the 3rd stage, in order to determine the performance rankings of airline companies, the criterion weights obtained by the LOPCOW method were used in the TOPSIS method, which is a performance ranking method.

RESEARCH POPULATION AND VARIABLES TO BE USED IN THE RESEARCH

In this study, 26 airline companies listed on https://www.staralliance.com/en/ were selected as the main population for the period 2018-2022. The following criteria were taken into consideration when determining the research population:

1. While calculating the financial performance ratios, the consolidated financial statements of the group, if any, including the airline companies were taken into consideration.

2. Airline companies that made financial reporting for the period January 1-December 31 were included in the research population. Accordingly, ANA, Air New Zealand, EGYPTAIR, Ethiopian Airlines, Scandinavian Airlines, Singapore Airlines, and South African Airways were excluded from the research population.

3. Air India and LOT Polish Airlines were not included in the research population since their annual financial reports were not available on the official website.

4. Avianca's annual financial reports for the years 2018-2022, which is the research period, were not included in the research population as they were not fully available on the official website of Avianca.

5. Since Austrian Airlines, Swiss International Airlines and Brussels Airlines are part of Lufthansa Group, the financial performance ratio was calculated by using the annual reports of Lufthansa Group.

According to the information given above, the research population is as shown in Table 1 below:

Table 1: Research Population

	Code	Airline Operation	Country of Operation
1	ACAN	Air Canada	Canada
2	ACHN	Air China	China
3	AEA	Aegean	Greece
4	ASAIR	Asiana Airlines	South Korea
5	COPAIR	Copa Airlines	Panama
6	CROAIR	Croatia Airlines	Croatia
7	EVA	EVA Air	Taiwan
8	LUF	Lufthansa	Germany
9	SHEAIR	Shenzhen Airlines	China
10	TAP	TAP Air Portugal	Portugal
11	THAIR	Thai Airways International	Thailand
12	TUAIR	Turkish Airlines	Turkiye
13	UNAIR	United Airlines	USA

The annual financial statement data for the years 2018 and 2022 were used in the study. The data were obtained from the official websites of the airline companies. Considering the research in the literature, the financial ratios that reflect the general performance results of airline companies were selected. Table 2 lists the financial ratios used in the study. If the annual activity report of the relevant airline is in a currency other than "euro", the financial statement data are converted into "euro/currency of the relevant country" at the end of the year and the financial ratios are calculated. The financial ratios/criteria to be used in the study, calculation method, target criteria, and symbol of the financial ratios/criteria are given in Table 2.

In column 3 of Table 2, the targets to be achieved in terms of the financial ratios are shown. Thus, the maximum asset turnover, profitability ratios, liquidity ratios, and capital adequacy ratios may positively affect both business performance and investor decisions in favor of the business. The minimization of short-term debt/total assets and total debt/total assets, which are among the financial structure ratios, can be welcomed positively. While creating ideal solutions in the application stage of the TOPSIS method to be used in this study, which aspect (benefit factor/cost factor) is important for decision-makers in terms of the contribution of the relevant ratios to performance was taken into account. In addition, in the application stage of the TOPSIS method, the importance weights for each criterion were calculated by using the LOPCOW method.

Table 2: Financial Ratios Used in the Study

Criteria	Calculation Format	Target	Symbol
Asset Turnover	Net sales/current assets	Maximum (benefit)	AT
Financial Structure Ratios	Current Assets/Total Assets	Maximum (benefit)	FSR1
	Total debt/total assets	Minimum (cost)	FSR2
	Short-term debt/total assets	Minimum (cost)	FSR3
Profitability ratios	Net profit/net sales	Maximum (benefit)	PR1
	Net profit/total equity	Maximum (benefit)	PR2
	Net profit/total assets	Maximum (benefit)	PR3
Liquidity ratio (Current Ratio)	Current assets/short-term debt	Maximum (benefit)	CR
Capital Adequacy	Net Balance Sheet Position/ equity	Maximum (benefit)	CA

METHODS USED IN THE RESEARCH

In this section of the study, two multi-criteria decision-making methods are described, namely the objective criteria weighting method, LOPCOW, and performance ranking method, TOPSIS.

The LOPCOW Method

The LOPCOW method is one of the multi-criteria decision-making techniques and was introduced to the literature by Ecer and Pamucar (2022). In this method, there is no limit to the number of criteria included in the decision matrix created in the first step. The LOPCOW method proposes a solution according to whether the criteria are benefit or cost-oriented. In case there is a dimension difference (data gap) in the data, the method eliminates this problem by taking the percentage of the standard deviation of the mean square values of the series. The LOPCOW method is not affected by negative values. The method consists of four steps (Ecer and Pamucar, 2022; Bektas, 2022).

Step 1: Creating the Decision Matrix

In the first step, the internal decision matrix (IDM) given in Equation (1) is constructed to identify and solve the decision problem. In Equation (1), m is the number of alternatives and n is the number of criteria. The decision matrix is created with the help of Equation (1).

$$IDM = \begin{bmatrix} x_{11} & \cdots & x_{1j} & \cdots & x_{1n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mj} & \cdots & x_{mn} \end{bmatrix} \quad (1)$$

Step 2: Creating the Normalized Decision Matrix

Each criterion is subjected to the normalization process with the linear normalization technique (max-min), taking into account the cost and benefit characteristics of the internal decision matrix elements in the decision matrix. The normalization process is performed as in Equation (2) and Equation (3). If the criterion is cost-oriented (if it is desired to be minimum), it is calculated by Equation (2), and if the criterion is benefit-oriented (if it is desired to be maximum), it is calculated by Equation (3).

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

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

Step 3: Creating the PVij Matrix of Percentage Values for Each Criteria

The percentage value of each criterion is calculated as the mean square value as a percentage of the standard deviations of each criterion. Here, the difference (gap) due to the size of the data is eliminated. Percentile values are calculated as in equation (4):

$$PV_{ij} = \left| ln\left(\frac{\sqrt{\frac{\sum_{i=1}^{m} r_{ij}}{m}}}{\sigma} \right) * 100 \right| \quad (4)$$

Step 4: Calculation of Objective Weights (Wj)

The objective importance weight for each criterion is calculated by Equation (5).

$$w_j = \frac{PV_{ij}}{\sum_{i=1}^{n} PV_{ij}} \quad (5)$$

TOPSIS Method

The TOPSIS method was introduced to the literature by Hwang and Yoon (1981) and is one of the multi-criteria decision-making techniques that enables the selection of the alternative that is closest to the positive ideal solution (optimal solution, decision point) and the alternative that is farthest from the negative ideal solution. The positive ideal solution ensures that the benefit/maximum criteria are maximized and the cost/minimum criteria are minimized. The negative ideal solution minimizes the benefit/maximization criteria and maximizes the cost/minimization criteria. The TOPSIS method consists of six steps (Hwang and Yoon, 1981; Wang and Elhag, 2006; Tzeng and Huang, 2011; Behzadian et. al., 2012; Zhu et. al., 2012; Işık, 2019).

Step 1: In the decision matrix, the rows contain the decision points (decision units, decision alternatives) whose performance is to be compared up to "m1, m2, ..., mn" and the columns contain the decision criteria (evaluation factors) to be used in decision making. The size of the decision matrix (evaluation matrix) is $m*n$.

$$X\begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ . & & & . \\ . & & & . \\ . & & & . \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix} \quad (6)$$

Step 2: The decision matrix is normalized using equation (7) below:

$$r_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}, \; i = 1,2,3,\dots,m \text{, and } j = 1,2,3,\dots,n \quad (7)$$

Step 3: Normalized decision matrix: A weighted normalized decision matrix is obtained by multiplying the weight values of the decision units obtained by the LOPCOW method. Weighted normalized values ( ) are calculated with the help of equation (8):

$$v_{ij} = w_j * r_{ij}, \; i = 1,2,3,\dots,m \text{ and } j = 1,2,3,\dots,n \quad (8)$$

In the above equation, $w_j \sum_{i=1}^{n} w_j = 1$ denotes the weight of criterion *i*.

Step 4: Positive ideal solutions and negative ideal solutions are calculated with the help of equation (9) and equation (10) below:

$$A^+ = \left\{v_1^+, v_2^+, \dots, v_j^+, \dots, v_n^+\right\} = \left\{\left(\max_i v_{ij} \,\middle|\, j \in J_1\right), \left(\min_i v_{ij} \,\middle|\, j \in J_2,\ i = 1,2,\dots,m\right)\right\} \quad (9)$$

$$A^+ = \left\{v_1^+, v_2^+, \dots, v_j^+, \dots, v_n^+\right\} = \left\{\left(\max_i v_{ij} \,\middle|\, j \in J_1\right), \left(\min_i v_{ij} \,\middle|\, j \in J_2,\ i = 1,2,\dots,m\right)\right\} \quad (10)$$

Here, J_1 is the benefit criterion set, while J_2 is the cost criterion set.

Step 5: Based on the Euclidean distance approach, the distances of each alternative to the positive ideal (D_i^+) and negative ideal (D_i^-) solution points are calculated with the help of equation (11) and equation (12) below:

$$D_i^+ = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^+)^2}, \; i = 1,2,3,\dots,m \quad (11)$$

$$D_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2}, \; i = 1,2,3,\dots,m \quad (12)$$

Step 6: The relative closeness coefficient of each alternative to the ideal solution, C_i is calculated by the equation below:

$$D_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2}, \; i = 1,2,3,\dots,m \quad (13)$$

$0 < C_i \leq 1$ being in Equation (13), C_i the coefficient taking the value of 1 shows that the relevant alternative is at the positive ideal solution point, and taking the value of 0 shows that the relevant alternative is at the negative ideal solution point. At this stage, the C_i values are compared with each other, and the alternatives are ranked in descending order. The alternative with the highest C_i value is evaluated as the highest-performing alternative compared to the other alternatives.

FINDINGS

LOPCOW and TOPSIS methods were applied respectively for the relevant years and the results obtained are shown below in summary tables. More detailed analysis results are given in the Appendix.

LOPCOW Analysis Results

The LOPCOW criteria (importance) weights of the criteria for each year were calculated by applying the stages of the LOPCOW weighting method respectively, and the results are summarized in Table 3.

The most important criteria are net profit/total assets (PR3) for 2018, net profit/total equity (PR2) for 2019 and 2021, short-term debt/total assets (FSR3) for 2020 and net profit/net sales (PR1) for 2022. The criteria with the lowest importance weight are net balance sheet position/equity for 2018, 2019, and 2021 (CA), net sales/current assets for 2020 (AT), and short-term debt/total assets for 2022 (FSR3).

Table 3: LOPCOW Criteria (Importance) Weights (Wj)) Calculated for Criteria by Year

	2018	2018	2019	2019	2020	2020	2021	2021	2022	2022
Criteria	Wj	Rank	Wj	Rank	Wj	Rank	Wj	Rank	Wj	Rank
CR	0,0651	7	0,0857	8	0,0919	6	0,1110	5	0,0928	8
PR1	0,0457	8	0,1036	7	0,1543	2	0,0909	7	0,1399	1
PR2	0,1744	2	0,1692	1	0,1253	5	0,2089	1	0,1144	4
PR3	0,1926	1	0,1395	2	0,1349	4	0,1335	3	0,1101	6
AT	0,0888	6	0,1201	4	0,0372	9	0,0764	8	0,1216	2
CA	0,0376	9	0,0333	9	0,0709	8	0,0012	9	0,1151	3
FSR1	0,0942	5	0,1086	6	0,0852	7	0,1075	6	0,1005	7
FSR2	0,1430	4	0,1160	5	0,1379	3	0,1557	2	0,1130	5
FSR3	0,1585	3	0,1239	3	0,1624	1	0,1149	4	0,0926	9

Table 4: Relative Proximity Coefficients to the Ideal Solution and Performance Rankings-TOPSIS Analysis Results

Business Code	2018 ROCS	2018 Rank	2019 ROCS	2019 Rank	2020 ROCS	2020 Rank	2021 ROCS	2021 ROCS	2022 ROCS	2022 Rank
ACAN	0,5646	9	0,6288	2	0,6388	8	0,2268	13	0,5704	11
ACHN	0,6585	5	0,5455	8	0,7326	5	0,6126	10	0,2964	13
AEA	0,7414	2	0,6276	3	0,6355	9	0,6597	6	**0,7918**	**1**
ASAIR	0,2502	12	0,1489	13	0,7513	4	0,6221	9	0,7299	8
COPAIR	0,6062	8	0,6169	5	0,7060	7	0,6681	4	0,7821	3
CROAIR	0,2479	13	0,3478	10	0,6053	10	0,5700	11	0,5551	12
EVA	0,6423	7	0,5155	9	0,7927	2	0,6733	3	0,7317	6
LUF	0,6825	4	0,5510	7	0,5759	12	0,6283	8	0,7314	7
SHEAIR	**0,7632**	**1**	**0,7394**	**1**	**0,8039**	**1**	0,6890	2	0,7004	9
TAP	0,3077	10	0,2775	11	0,5938	11	0,5036	12	0,7600	4
THAIR	0,2561	11	0,1513	12	0,3270	13	**0,8075**	**1**	0,6507	10
TUAIR	0,6436	6	0,5585	6	0,7622	3	0,6655	5	0,7831	2
UNAIR	0,7014	3	0,6244	4	0,7212	6	0,6427	7	0,7478	5

TOPSIS Performance Ranking Results

The stages of the TOPSIS method were applied in order and the relative closeness coefficients to the ideal solution (ROCS) were calculated for each alternative and the performance rankings of the alternatives in line with these calculations are summarized in Table 4.

According to the data in Table 4, in the period covering the years 2018-2022, the position of the airline companies in the performance ranking varies over the years. The evaluations regarding the performance of airlines for the pre-COVID-19, COVID-19, and post-COVID-19 periods are summarized below:

1. The best-performing airline was Shenzhen Airlines in 2018, 2019, and 2020, Thai Airways International in 2021, and Aegean in 2022.
2. The last airline in the performance ranking was Croatia Airlines in 2018, Asiana Airlines in 2019, Thai Airways International in 2020, Air Canada in 2021, and Air China in 2022.
3. The airline companies whose performance ranking increased in 2020, which was selected as the COVID-19 period, compared to 2019, which was selected as the pre-COVID-19 period are Air China, Asiana Airlines, TAP Airlines, and Turkish Airlines.
4. The airlines whose performance ranking decreased in 2020, the COVID-19 period, compared to 2019, the pre-COVID-19 period, were Air Canada, Aegean, Copa Airlines, Croatia Airlines, Lufthansa and United Airlines.

5. In 2021 and 2022, the post-COVID-19 period, Aegean, Copa Airlines, and Lufthansa were the airlines whose performance ranking increased in both years compared to 2020, while Air China, Croatia Airlines, EVA, and Shenzhen Airlines were the airlines whose performance ranking decreased in both years.

6. Turkish Airlines ranked 6th in 2018 and 2019, 3rd in 2020, 5th in 2021 and 2nd in 2022 in the performance ranking.

CONCLUSION

The airline sector, which is one of the components of the transportation sector that brings together many different sectors of the national and international economy, is of great importance for the development of commercial and tourism activities, ensuring economic growth and sustainability. In fact, the volume of transactions related to both passenger transportation and the transportation of commercial goods and services from one place to another by air is increasing day by day. This situation has also created a great competitive environment for domestic and international transportation. As a result of competition, information users, such as customers, current and potential investors, and shareholders, conduct performance measurements to evaluate the performance of airline companies for use in future decisions. One of the social phenomena that made information users important for performance measurement was COVID-19. Closures around the world due to the pandemic negatively affected the airline industry. Based on this, it was thought that it would be important to measure the financial performance of airline companies before, during, and after COVID-19, and the study was designed accordingly.

The aim of the study is to measure the financial performance of 13 out of 26 airlines (Lufthansa Group includes Austrian Airlines, Swiss International Airlines, and Brussels Airlines) in the Star Alliance, which includes the best airlines, and smaller and regional member airlines operating worldwide, for the years 2018-2022. In the calculation of financial performance, 9 criteria were selected: Net sales/ current assets, current assets/total assets, net profit/net sales, net profit/total equity, net profit/total assets, current assets/short-term debt, net balance sheet position/equity, total debt/total assets, and short-term debt/total assets. While the first 7 of these criteria are benefit (maximum) oriented, the last 2 are cost (minimum) oriented.

After calculating the financial ratios of the airline companies for the period January 1- December 31, 2018-2022, the analysis process started. The LOPCOW method was used to determine the importance weights of the criteria and the TOPSIS method was used to determine the performance ranking.

The results of the LOPCOW method analysis determined net profit/total assets (PR3) for 2018, net profit/total equity (PR2) for 2019 and 2021, short-term debt/total assets (FSR3) for 2020, and net profit/net sales (PR1) for 2022. The criterion with the lowest importance weight was net balance sheet position/equity (CA) for 2018, 2019, and 2021, net sales/ current assets (AT) for 2020, and short-term debt/total assets (FSR3) for 2022. These results show that while profitability ratios were the criteria with the highest criterion weight in 2018 and 2019, short-term debt/total assets (PR3), which is one of the financial structure ratios, was the most important criterion in the COVID-19 period, and profitability ratios were again the most important criteria in the following years.

According to the TOPSIS method analysis results, the top-performing airlines were Shenzhen Airlines in 2018, 2019, and 2020, Thai Airways International in 2021, and Aegean in 2022. The worst-performing airlines were Croatia Airlines in 2018, Asian Airlines in 2019, Thai Airways International in 2020, Air Canada in 2021, and Air China in 2022. In 2020, the COVID-19 period, the performance ranking of some airlines increased and some decreased compared to 2019. Air China, Asiana Airlines, TAP Airlines, and Turkish Airlines improved their performance ranking, while Air Canada, Aegean, Copa Airlines, Croatia Airlines, Lufthansa, and United Airlines decreased their performance ranking. In 2021 and 2022, Aegean, Copa Airlines, and Lufthansa were the airlines whose performance ranking increased in both years compared to 2020, while Air China, Croatia Airlines, EVA and Shenzhen Airlines were the airlines whose performance ranking decreased in both years. The performance ranking of Turkish Airlines operating in Turkey was 6 in 2018 and 2019, 3 in 2020, 5 in 2021, and 2 in 2022.

The results obtained in the research show that the financial performance of Star Alliance airline companies was generally negatively affected during the COVID-19 period, but the COVID-19 effect gradually decreased in 2021 and 2022. In Dağlı's (2021) study, it was determined that the performances of 7 airline companies in Europe before and during COVID-19 differed. In addition, this study also provides evidence for the results of Kurt and

Kablan's (2022) study, which is also mentioned in the literature review. Similarly, Teker, Teker, and Polat's (2022) study shows that the COVID period significantly affects the profitability and operational efficiency of airlines.

This study, which analyzes the financial performance of airline companies operating worldwide and participating in the Star Alliance, is thought to make important contributions to the airline industry in terms of the results obtained. When the literature is examined, although there are many financial performance analysis studies on airline companies, this study is unique because it analyzes the financial performance of airline companies in Star Alliance and it is thought to contribute to the literature.

REFERENCES

Avcı, T., & Çınaroğlu, E. (2018). AHP Temelli TOPSIS Yaklaşımı İle Havayolu İşletmelerinin Finansal Performans Değerlemesi. Cumhuriyet Üniversitesi İktisadi ve İdari Bilimler Dergisi, 19(1), 316-335.

Bae, K., Gupta, A., & Mau, R. (2021). Comparative Analysis of Airline Financial and Operational Performances: A fuzzy AHP and TOPSIS Integrated Approach. Decision Science Letters, 10(3), 361-374. http://dx.doi.org/10.5267/j.dsl.2021.2.002.

Bakır, M., Akan, Ş., Kiracı, 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.

Behzadian, M., Otaghsara, S. K., Yazdani, M., & Ignatius, J. (2012). A State-of the-Art Survey of TOPSIS Applications. Expert Systems with Applications, 39(17), 13051-13069, https://doi.org/10.1016/j.eswa.2012.05.056.

Bektaş, S. (2023). Özel Sermayeli Bir Mevduat Bankasının Sürdürülebilirlik Performansının Hibrit ÇKKV Modeliyle Değerlendirilmesi: 2009-2021 Dönemi Akbank Örneği. İzmir İktisat Dergisi, 38(4), 884-907, https://dx.doi.org/10.24988/ije.1216968.

Bektaş, S. (2022). Türk Sigorta Sektörünün 2002-2021 Dönemi için MEREC, LOPCOW, COCOSO, EDAS ÇKKV Yöntemleri ile Performansının Değerlendirilmesi. BDDK Bankacılık ve Finansal Piyasalar Dergisi, 16 (2), 247-283, https://dx.doi.org/10.46520/bddkdergisi.1178359.

Belton, V., & Stewart, T. (2002). Multiple Criteria Decision Analysis: An Integrated Approach. Springer Science & Business Media.

Chang, Y. H., & Yeh, C. H. (2001). Evaluating Airline Competitiveness Using Multi Attribute Decision Making. Omega, 29(5), 405-415.

Dağlı, D. (2021). Havayolu İşletmelerinin Covid-19 Öncesi ve Covid-19 Sürecindeki Finansal Performanslarının TOPSIS Yöntemi ile Değerlendirilmesi. İşletme Araştırmaları Dergisi, 13 (3), 2242-2255, https://doi.org/10.20491/isarder.2021.1259.

Ecer, F. ve Pamucar, D. (2022). A Novel LOPCOW-DOBI Multi Criteria Sustainability Performance Assessment Methodology: An Application in Developing Country Banking Sector. Omega, 112,112690, 1-17, 10.1016/j.omega.2022.102690.

Ellibes, E., & Candan, G. (2021). Financial Performance Evaluation of Airline Companies with Fuzzy AHP and Grey Relational Analysis Methods. EKOIST Journal of Econometrics and Statistics, 34, 37-56, https://dx.doi.org/10.26650/ekoist.2021.34.917326.

Feng, C. M., & Wang, R. T. (2000). Performance Evaluation for Airlines Including the Consideration of Financial Ratios. Journal of Air Transport Management, 6(3), 133-142, https://econpapers.repec.org/scripts/redir.pf?u=https%3A%2F%2Fdoi.org%2F10.1016%2F52FS0969-6997%252800%252900003-X;h=repec:eee:jaitra:v:6:y:2000:i:3:p:133-142.

Gülcemal, T., & İzci, A. Ç. (2024). Türk Katılım Bankacılığı Sektörünün Performansının LOPCOW-MOOSRA Modeliyle Analizi. Doğuş Üniversitesi Dergisi, 25(1), 115-134.

Hwang, C. L. & Yoon, K. (1981). Multiple Attributes Decision Making Methods and Applications, Berlin: Springer.

Işık, Ö. (2019). Entropi ve TOPSIS Yöntemleriyle Finansal Performans İle Pay Senedi Getirileri Arasındaki İlişkinin İncelenmesi. Kent Akademisi, 12(1), 200–213.

Köse, Y. (2021). Havacılık Sektöründe Spesifik Finansal Oranlar: Türkiye'deki Havayolu Şirketleri Üzerine Analiz ve Değerlendirme. Finansal Araştırmalar ve Çalışmalar Dergisi, 13(25), 623-636, https://doi.org/10.14784/marufacd.976607.

Kurt, G., & Kablan, A. (2022). Covid-19'un, BİST Ulaştırma Endeksinde Faaliyet Gösteren Havayolu İşletmelerinin Finansal Performansı Üzerindeki Etkilerinin, Çok Kriterli Karar Verme Yöntemleri İle Analizi. İşletme Akademisi Dergisi, 3(1), 16-33, https://doi.org/10.26677/TR1010.2022.961.

Ömürbek, Y., & Kınay, Ö. (2013). Havayolu Taşımacılığı Sektöründe TOPSIS Yöntemiyle Finansal Performans Değerlendirmesi. Süleyman Demirel Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 18(3), 343-363.

Perçin, S., & Aldalou, E. (2018). Financial Performance Evaluation of Turkish Airlines Companies Using Integrated Fuzzy AHP Fuzzy TOPSIS Model. Uluslararası İktisadi ve İdari İncelemeler Dergisi, 18. EYİ Özel Sayısı, 583-598, https://doi.org/10.18092/ulikidince.347925.

Pestana Barros, C., & Wanke, P. (2015). An Analysis of African Airlines Efficiency with Two-Stage TOPSIS and Neural Networks. Journal of Air Transport Management, 44-45, 90-102, https://doi.org/10.1016/j.jairtraman.2015.03.002.

Sivil Havacılık Genel Müdürlüğü. (2014). Faaliyet Raporu. Erişim Adresi: https://web.shgm.gov.tr/documents/sivilhavacilik/files/kurumsal/faaliyet/2014.pdf. Erişim Tarihi: 13.02.2024.

Sivil Havacılık Genel Müdürlüğü. (2022). Faaliyet Raporu. Erişim Adresi: https://web.shgm.gov.tr/documents/sivilhavacilik/files/kurumsal/faaliyet/2022-v2.pdf. Erişim: 13.02.2024.

Sümerli Sarıgül, 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, https://doi.org/10.54821/uiecd.1257488.

Star Alliance. https://www.staralliance.com/en/

Teker, D., Teker, S., Polat, E., (2022). Performance of airlines: Topsis analysis. PressAcademia Procedia (PAP), 15, 149-150, https://doi.org/10.17261/Pressacademia.2022.1602.

Tzeng, G. H. & Huang, J. J. (2011). Multiple Attribute Desicion Making Methods and Applications. New York: Chapman and Hall/CRC, https://doi.org/10.1201/b11032.

Torlak, G., Sevkli, M., Sanal, M., & Zaim, S. (2011). Analyzing Business Competition by Using Fuzzy TOPSIS Method: An Example of Turkish Domestic Airline İndustry. Expert Systems with Applications, 38(4), 3396-3406 https://doi.org/10.1016/j.eswa.2010.08.125.

Wang, Y. M., & Elhag, T. M. (2006). Fuzzy TOPSIS Method Based on Alpha Level Sets With An Application to Bridge Risk Assessment. Expert Systems with Applications, 31(2), 309-319, http://dx.doi.org/10.1016/j.eswa.2005.09.040.

Wang, Y. J. (2008). Applying FMCDM to Evaluate Financial Performance of Domestic Airlines in Taiwan. Expert Systems with Applications, 34(3), 1837-1845, http://dx.doi.org/10.1016/j.eswa.2007.02.029.

Wanke, P., Pestana Barros, C., & Chen, Z. (2015). An Analysis of Asian Airlines Efficiency with Two-Stage TOPSIS and MCMC Generalized Linear Mixed Models. International Journal of Production Economics, 169, 110–126. DOI: 10.1016/j.ijpe.2015.07.028.

Zhu, X., Wang, F., Liang, C., Li, J., & Sun, X. (2012). Quality Credit Evaluation Based on TOPSIS: Evidence From Air-Conditioning Market In China. Procedia Computer Science, 9, 1256-1262, https://doi.org/10.1016/j.procs.2012.04.137.

APPENDIX 1: 2018 LOPCOW Analysis Results

Decision Matrix									
Target Criteria	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Min**	**Min**
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	1,23573	0,00924	0,04141	0,00870	0,94103	4,75998	0,32823	0,78992	0,26561
ACHN	0,48605	0,05831	0,08174	0,03371	5,93789	2,42450	0,09737	0,58754	0,09737
AEA	1,28046	0,05720	0,24441	0,09356	1,63580	2,61232	0,64859	0,61720	0,50653
ASAIR	0,44925	-0,02727	-0,17916	-0,02391	4,74574	7,49285	0,18479	0,86654	0,41133
COPAIR	1,01616	0,03290	0,04786	0,02155	2,51640	2,22051	0,26034	0,54965	0,25620
CROAIR	0,44584	-0,05058	-0,26527	-0,09401	7,68986	2,82211	0,24170	0,64559	0,54213
EVA	1,24742	0,04010	0,10289	0,02991	2,36731	3,43974	0,31508	0,70928	0,25259
LUF	0,65705	0,06034	0,22595	0,05660	0,93801	3,99175	0,27881	0,74948	0,42433
SHEAIR	2,39793	0,56357	0,14713	0,07736	0,38876	1,90182	0,35311	0,47419	0,14726
TAP	1,13472	-0,01846	-0,55407	-0,02636	2,07482	21,02108	0,68813	0,95243	0,60643
THAIR	0,55729	-0,05904	-0,56555	-0,04305	3,95506	13,13633	0,18438	0,92388	0,33086
TUAIR	0,86921	0,06436	0,12930	0,03708	0,57623	3,48664	0,21733	0,71319	0,25004
UNAIR	0,54385	0,05159	0,21402	0,04758	5,74610	4,49794	0,16050	0,77768	0,29511
Max	2,39793	0,56357	0,24441	0,09356	7,68986	21,02108	0,68813	0,95243	0,60643
Min	0,44584	-0,05904	-0,56555	-0,09401	0,38876	1,90182	0,09737	0,47419	0,09737
Normalization of Criteria									
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	0,40464	0,10967	0,74936	0,54758	0,07564	0,14949	0,39078	0,33982	0,66951
ACHN	0,02060	0,18848	0,79916	0,68094	0,76004	0,02734	0,00000	0,76298	1,00000
AEA	0,42756	0,18669	1,00000	1,00000	0,17080	0,03716	0,93307	0,70097	0,19625
ASAIR	0,00175	0,05103	0,47704	0,37372	0,59676	0,29243	0,14797	0,17959	0,38326
COPAIR	0,29216	0,14767	0,75733	0,61611	0,29141	0,01667	0,27586	0,84220	0,68800
CROAIR	0,00000	0,01358	0,37074	0,00000	1,00000	0,04813	0,24431	0,64159	0,12632
EVA	0,41063	0,15923	0,82527	0,66066	0,27099	0,08044	0,36853	0,50842	0,69510
LUF	0,10820	0,19175	0,97720	0,80297	0,07523	0,10931	0,30712	0,42436	0,35772
SHEAIR	1,00000	1,00000	0,87989	0,91364	0,00000	0,00000	0,43290	1,00000	0,90201
TAP	0,35290	0,06517	0,01418	0,36068	0,23093	1,00000	1,00000	0,00000	0,00000
THAIR	0,05710	0,00000	0,00000	0,27168	0,48846	0,58760	0,14728	0,05971	0,54134
TUAIR	0,21688	0,19819	0,85788	0,69890	0,02568	0,08289	0,20306	0,50025	0,70011
UNAIR	0,05021	0,17769	0,96247	0,75487	0,73377	0,13579	0,10685	0,36541	0,61156

Square Matrix										
Criteria / Alternative	CR	PR1	PR2	PR3	AT	CA	FSR1	FSR2	FSR3	
ACAN	0,16373	0,01203	0,56155	0,29984	0,00572	0,02235	0,15271	0,11547	0,44824	
ACHN	0,00042	0,03552	0,63866	0,46368	0,57766	0,00075	0,00000	0,58213	1,00000	
AEA	0,18280	0,03485	1,00000	1,00000	0,02917	0,00138	0,87061	0,49135	0,03852	
ASAIR	0,00000	0,00260	0,22757	0,13967	0,35612	0,08551	0,02190	0,03225	0,14689	
COPAIR	0,08536	0,02181	0,57355	0,37959	0,08492	0,00028	0,07610	0,70931	0,47335	
CROAIR	0,00000	0,00018	0,13745	0,00000	1,00000	0,00232	0,05969	0,41164	0,01596	
EVA	0,16862	0,02535	0,68107	0,43648	0,07344	0,00647	0,13581	0,25849	0,48316	
LUF	0,01171	0,03677	0,95492	0,64475	0,00566	0,01195	0,09432	0,18008	0,12796	
SHEAIR	1,00000	1,00000	0,77421	0,83473	0,00000	0,00000	0,18740	1,00000	0,81363	
TAP	0,12454	0,00425	0,00020	0,13009	0,05333	1,00000	1,00000	0,00000	0,00000	
THAIR	0,00326	0,00000	0,00000	0,07381	0,23859	0,34528	0,02169	0,00356	0,29305	
TUAIR	0,04704	0,03928	0,73595	0,48847	0,00066	0,00687	0,04123	0,25025	0,49015	
UNAIR	0,00252	0,03157	0,92636	0,56983	0,53842	0,01844	0,01142	0,13352	0,37400	
Total	1,79000	1,24422	7,21148	5,46093	2,96370	1,50159	2,67287	4,16807	4,70490	
m	13	13	13	13	13	13	13	13	13	
total/m	0,13769	0,09571	0,55473	0,42007	0,22798	0,11551	0,20561	0,32062	0,36192	
Square Root(total/m)	0,37107	0,30937	0,74480	0,64813	0,47747	0,33986	0,45344	0,56623	0,60159	
Standard Deviation (Standardization of Criteria)	0,27847	0,25292	0,34503	0,27715	0,32277	0,28790	0,29930	0,30145	0,29904	
Square Root(total/m)/Standard Deviation (Standardization of Criteria)	1,33254	1,22319	2,15865	2,33853	1,47928	1,18051	1,51499	1,87840	2,01172	
pwij	28,70855	20,14642	76,94844	84,95207	39,15549	16,59443	41,54096	63,04179	69,89925	440,98741
wj	0,06510	0,04568	0,17449	0,19264	0,08879	0,03763	0,09420	0,14296	0,15851	1
Rank	7	8	2	1	6	9	5	4	3	

APPENDIX 2: 2018 TOPSIS Analysis Results

Target Criteria	Max	Max	Max	Max	Max	Max	Max	Min	Min
Weight Values	0,06510	0,04568	0,17449	0,19264	0,08879	0,03763	0,09420	0,14296	0,15851
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	1,23573	0,00924	0,04141	0,00870	0,94103	4,75998	0,32823	0,78992	0,26561
ACHN	0,48605	0,05831	0,08174	0,03371	5,93789	2,42450	0,09737	0,58754	0,09737
AEA	1,28046	0,05720	0,24441	0,09356	1,63580	2,61232	0,64859	0,61720	0,50653
ASAIR	0,44925	-0,02727	-0,17916	-0,02391	4,74574	7,49285	0,18479	0,86654	0,41133
COPAIR	1,01616	0,03290	0,04786	0,02155	2,51640	2,22051	0,26034	0,54965	0,25620
CROAIR	0,44584	-0,05058	-0,26527	-0,09401	7,68986	2,82211	0,24170	0,64559	0,54213
EVA	1,24742	0,04010	0,10289	0,02991	2,36731	3,43974	0,31508	0,70928	0,25259
LUF	0,65705	0,06034	0,22595	0,05660	0,93801	3,99175	0,27881	0,74948	0,42433
SHEAIR	2,39793	0,56357	0,14713	0,07736	0,38876	1,90182	0,35311	0,47419	0,14726
TAP	1,13472	-0,01846	-0,55407	-0,02636	2,07482	21,02108	0,68813	0,95243	0,60643
THAIR	0,55729	-0,05904	-0,56555	-0,04305	3,95506	13,13633	0,18438	0,92388	0,33086
TUAIR	0,86921	0,06436	0,12930	0,03708	0,57623	3,48664	0,21733	0,71319	0,25004
UNAIR	0,54385	0,05159	0,21402	0,04758	5,74610	4,49794	0,16050	0,77768	0,29511
Normalization of Criteria									
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	0,31672	0,01575	0,04258	0,04578	0,06886	0,17015	0,26109	0,29891	0,20034
ACHN	0,12457	0,09933	0,08406	0,17742	0,43452	0,08667	0,07746	0,22233	0,07345
AEA	0,32818	0,09743	0,25135	0,49235	0,11970	0,09338	0,51592	0,23355	0,38206
ASAIR	0,11514	-0,08747	-0,28977	-0,53794	0,70513	0,10844	0,21148	0,31082	0,47376
COPAIR	0,26044	0,05604	0,04922	0,11342	0,18415	0,07937	0,20709	0,20799	0,19324
CROAIR	0,11427	-0,08616	-0,27280	-0,49472	0,56273	0,10088	0,19226	0,24430	0,40891
EVA	0,31971	0,06831	0,10581	0,15740	0,17324	0,12296	0,25063	0,26840	0,19052
LUF	0,16840	0,10279	0,23236	0,29786	0,06864	0,14269	0,22177	0,28361	0,32006
SHEAIR	0,61458	0,96000	0,15131	0,40711	0,02845	0,06798	0,28088	0,17944	0,11107
TAP	0,29083	-0,03145	-0,56980	-0,13870	0,15183	0,75142	0,54737	0,36041	0,45741
THAIR	0,14283	-0,10056	-0,58161	-0,22655	0,28942	0,46957	0,14667	0,34960	0,24955
TUAIR	0,22278	0,10963	0,13297	0,19515	0,04217	0,12463	0,17288	0,26988	0,18859
UNAIR	0,13939	0,08789	0,22010	0,25039	0,42049	0,16078	0,12767	0,29428	0,22260
Multiplication of Normalized Matrices by Weight Values									

Criteria / Alternative	CR	PR1	PR2	PR3	AT	CA	FSR1	FSR2	FSR3
ACAN	0,02062	0,00072	0,00743	0,00882	0,00611	0,00640	0,02459	0,04273	0,03176
ACHN	0,00811	0,00454	0,01467	0,03418	0,03858	0,00326	0,00730	0,03178	0,01164
AEA	0,02136	0,00445	0,04386	0,09485	0,01063	0,00351	0,04860	0,03339	0,06056
ASAIR	0,00750	-0,00400	-0,05056	-0,10363	0,06261	0,00408	0,01992	0,04443	0,07509
COPAIR	0,01695	0,00256	0,00859	0,02185	0,01635	0,00299	0,01951	0,02973	0,03063
CROAIR	0,00744	-0,00394	-0,04760	-0,09530	0,04996	0,00380	0,01811	0,03492	0,06481
EVA	0,02081	0,00312	0,01846	0,03032	0,01538	0,00463	0,02361	0,03837	0,03020
LUF	0,01096	0,00470	0,04055	0,05738	0,00609	0,00537	0,02089	0,04054	0,05073
SHEAIR	0,04001	0,04386	0,02640	0,07843	0,00253	0,00256	0,02646	0,02565	0,01761
TAP	0,01893	-0,00144	-0,09943	-0,02672	0,01348	0,02828	0,05156	0,05152	0,07250
THAIR	0,00930	-0,00459	-0,10149	-0,04364	0,02570	0,01767	0,01382	0,04998	0,03956
TUAIR	0,01450	0,00501	0,02320	0,03759	0,00374	0,00469	0,01629	0,03858	0,02989
UNAIR	0,00907	0,00402	0,03841	0,04824	0,03734	0,00605	0,01203	0,04207	0,03528
Positive ideal solutions and negative ideal solutions									
A+	0,04001	0,04386	0,04386	0,09485	0,06261	0,02828	0,05156	0,02565	0,01164
A-	0,00744	-0,00459	-0,10149	-0,10363	0,00253	0,00256	0,00730	0,05152	0,07509

Distance of each alternative to the positive ideal and negative ideal solution points and performance ranking

Alternative	Di+	Di-	Ci	Rank
ACAN	0,12672	0,16429	0,56455	9
ACHN	0,10147	0,19566	0,65849	5
AEA	**0,08762**	**0,25121**	**0,74141**	**2**
ASAIR	0,24004	0,08010	0,25019	12
COPAIR	0,11399	0,17549	0,60622	8
CROAIR	0,22947	0,07565	0,24794	13
EVA	0,10447	0,18760	0,64232	7
LUF	0,10100	0,21706	0,68245	4
SHEAIR	**0,07424**	**0,23927**	**0,76320**	**1**
TAP	0,21117	0,09386	0,30770	10
THAIR	0,21878	0,07533	0,25613	11
TUAIR	0,10785	0,19476	0,64361	6
UNAIR	**0,09095**	**0,21361**	**0,70138**	**3**

APPENDIX 3: 2019 LOPCOW Analysis Results

Decision Matrix									
Target Criteria	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Min**	**Min**
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	0,96669	0,07715	0,33545	0,05317	2,54537	6,30886	0,27076	0,84149	0,28009
ACHN	0,31828	0,05180	0,07168	0,02469	5,65099	2,90346	0,08435	0,65558	0,26503
AEA	1,41084	0,06001	0,23913	0,05890	1,82939	4,06025	0,53652	0,75370	0,38028
ASAIR	0,34239	-0,11741	-0,90047	-0,06057	4,46308	14,86689	0,11558	0,93274	0,33757
COPAIR	1,23737	0,09123	0,12766	0,05669	2,19322	2,25198	0,28330	0,55595	0,22895
CROAIR	0,40924	-0,04824	-0,34275	-0,06217	7,88247	5,51313	0,16349	0,81861	0,39950
EVA	0,93642	0,02677	0,06209	0,01362	2,34813	4,55903	0,21670	0,78066	0,23141
LUF	0,70593	0,03418	0,12139	0,02918	3,22765	4,15942	0,26454	0,75958	0,37474
SHEAIR	2,09171	0,42268	0,15018	0,07778	0,53185	1,93085	0,34598	0,48209	0,16541
TAP	1,06892	-0,02931	-0,71086	-0,01856	1,75901	38,30027	0,35997	0,97389	0,33678
THAIR	0,58713	-0,06665	-1,02131	-0,04682	3,63950	21,81468	0,19299	0,95416	0,32870
TUAIR	0,80015	0,06038	0,11094	0,03088	2,65069	3,60022	0,19295	0,72224	0,24114
UNAIR	0,54795	0,06960	0,26201	0,05724	5,28322	4,57753	0,15565	0,78154	0,28406
Max	2,09171	0,42268	0,33545	0,07778	7,88247	38,30027	0,53652	0,97389	0,39950
Min	0,31828	-0,11741	-1,02131	-0,06217	0,53185	1,93085	0,08435	0,48209	0,16541
Normalization of Criteria									
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	0,36563	0,36025	1,00000	0,82418	0,27392	0,12038	0,41225	0,26921	0,51011
ACHN	0,00000	0,31330	0,80559	0,62065	0,69642	0,02674	0,00000	0,64723	0,57445
AEA	0,61607	0,32851	0,92901	0,86510	0,17652	0,05855	1,00000	0,44772	0,08210
ASAIR	0,01360	0,00000	0,08907	0,01144	0,53482	0,35568	0,06907	0,08368	0,26454
COPAIR	0,51826	0,38632	0,84684	0,84929	0,22602	0,00883	0,43999	0,84983	0,72855
CROAIR	0,05129	0,12808	0,50013	0,00000	1,00000	0,09850	0,17502	0,31573	0,00000
EVA	0,34856	0,26696	0,79852	0,54155	0,24709	0,07226	0,29270	0,39292	0,71803
LUF	0,21859	0,28069	0,84223	0,65278	0,36674	0,06128	0,39850	0,43577	0,10578
SHEAIR	1,00000	1,00000	0,86344	1,00000	0,00000	0,00000	0,57862	1,00000	1,00000
TAP	0,42327	0,16313	0,22882	0,31161	0,16695	1,00000	0,60954	0,00000	0,26796
THAIR	0,15160	0,09398	0,00000	0,10970	0,42277	0,54672	0,24026	0,04012	0,30243

TUAIR	0,27172	0,32920	0,83453	0,66492	0,28825	0,04590	0,24018	0,51170	0,67647	
UNAIR	0,12951	0,34627	0,94587	0,85323	0,64639	0,07277	0,15768	0,39111	0,49314	
Square Matrix										
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**	
ACAN	0,13368	0,12978	1,00000	0,67927	0,07503	0,01449	0,16995	0,07247	0,26021	
ACHN	0,00000	0,09816	0,64897	0,38521	0,48501	0,00072	0,00000	0,41891	0,32999	
AEA	0,37954	0,10792	0,86305	0,74839	0,03116	0,00343	1,00000	0,20045	0,00674	
ASAIR	0,00018	0,00000	0,00793	0,00013	0,28603	0,12651	0,00477	0,00700	0,06998	
COPAIR	0,26859	0,14924	0,71714	0,72129	0,05108	0,00008	0,19359	0,72221	0,53078	
CROAIR	0,00263	0,01640	0,25013	0,00000	1,00000	0,00970	0,03063	0,09969	0,00000	
EVA	0,12149	0,07127	0,63763	0,29328	0,06105	0,00522	0,08567	0,15438	0,51557	
LUF	0,04778	0,07878	0,70935	0,42612	0,13450	0,00375	0,15880	0,18989	0,01119	
SHEAIR	1,00000	1,00000	0,74553	1,00000	0,00000	0,00000	0,33480	1,00000	1,00000	
TAP	0,17916	0,02661	0,05236	0,09710	0,02787	1,00000	0,37154	0,00000	0,07180	
THAIR	0,02298	0,00883	0,00000	0,01203	0,17874	0,29890	0,05773	0,00161	0,09147	
TUAIR	0,07383	0,10838	0,69643	0,44212	0,08309	0,00211	0,05768	0,26183	0,45761	
UNAIR	0,01677	0,11991	0,89466	0,72801	0,41782	0,00530	0,02486	0,15297	0,24319	
Total	2,24665	1,91527	7,22320	5,53295	2,83139	1,47021	2,49003	3,28142	3,58853	
m	13	13	13	13	13	13	13	13	13	
total/m	0,17282	0,14733	0,55563	0,42561	0,21780	0,11309	0,19154	0,25242	0,27604	
Square Root(total/m)	0,41572	0,38383	0,74541	0,65239	0,46669	0,33629	0,43765	0,50241	0,52540	
Standard Deviation (Standardization of Criteria)	0,28114	0,23919	0,34427	0,34505	0,26970	0,28894	0,26654	0,29591	0,29841	
Square Root(total/m)/Standard Deviation (Standardization of Criteria)	1,47868	1,60472	2,16520	1,89070	1,73042	1,16390	1,64195	1,69783	1,76064	
pwij	39,11530	47,29499	77,25107	63,69463	54,83645	15,17741	49,58867	52,93529	56,56764	456,46144
wj	0,08569	0,10361	0,16924	0,13954	0,12013	0,03325	0,10864	0,11597	0,12393	1,00000
Rank	8	7	1	2	4	9	6	5	3	

APPENDIX 4: 2019 TOPSIS Analysis Results

Target Criteria	Max	Max	Max	Max	Max	Max	Max	Min	Min
Weight Values	0,08569	0,10361	0,16924	0,13954	0,12013	0,03325	0,10864	0,11597	0,12393
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	0,96669	0,07715	0,33545	0,05317	2,54537	6,30886	0,27076	0,84149	0,28009
ACHN	0,31828	0,05180	0,07168	0,02469	5,65099	2,90346	0,08435	0,65558	0,26503
AEA	1,41084	0,06001	0,23913	0,05890	1,82939	4,06025	0,53652	0,75370	0,38028
ASAIR	0,34239	-0,11741	-0,90047	-0,06057	4,46308	14,86689	0,11558	0,93274	0,33757
COPAIR	1,23737	0,09123	0,12766	0,05669	2,19322	2,25198	0,28330	0,55595	0,22895
CROAIR	0,40924	-0,04824	-0,34275	-0,06217	7,88247	5,51313	0,16349	0,81861	0,39950
EVA	0,93642	0,02677	0,06209	0,01362	2,34813	4,55903	0,21670	0,78066	0,23141
LUF	0,70593	0,03418	0,12139	0,02918	3,22765	4,15942	0,26454	0,75958	0,37474
SHEAIR	2,09171	0,42268	0,15018	0,07778	0,53185	1,93085	0,34598	0,48209	0,16541
TAP	1,06892	-0,02931	-0,71086	-0,01856	1,75901	38,30027	0,35997	0,97389	0,33678
THAIR	0,58713	-0,06665	-1,02131	-0,04682	3,63950	21,81468	0,19299	0,95416	0,32870
TUAIR	0,80015	0,06038	0,11094	0,03088	2,65069	3,60022	0,19295	0,72224	0,24114
UNAIR	0,54795	0,06960	0,26201	0,05724	5,28322	4,57753	0,15565	0,78154	0,28406
Normalization of Criteria									
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	0,26790	0,16052	0,20083	0,29956	0,18176	0,13043	0,27728	0,29816	0,25559
ACHN	0,08820	0,10777	0,04292	0,13910	0,40352	0,06003	0,08638	0,23229	0,24184
AEA	0,39099	0,12485	0,14317	0,33182	0,13063	0,08394	0,54943	0,26705	0,34702
ASAIR	0,09489	-0,24429	-0,53910	-0,34124	0,31870	0,30735	0,11836	0,33049	0,30804
COPAIR	0,34292	0,18982	0,07643	0,31936	0,15661	0,04656	0,29012	0,19698	0,20892
CROAIR	0,11341	-0,10037	-0,20520	-0,35025	0,56287	0,11398	0,16743	0,29005	0,36455
EVA	0,25951	0,05569	0,03717	0,07673	0,16767	0,09425	0,22192	0,27660	0,21117
LUF	0,19564	0,07112	0,07268	0,16442	0,23048	0,08599	0,27091	0,26914	0,34196
SHEAIR	0,57968	0,87942	0,08991	0,43819	0,03798	0,03992	0,35431	0,17082	0,15094
TAP	0,29623	-0,06099	-0,42558	-0,10457	0,12561	0,79181	0,36863	0,34507	0,30731
THAIR	0,16271	-0,13868	-0,61145	-0,26376	0,25989	0,45099	0,19764	0,33808	0,29995
TUAIR	0,22175	0,12564	0,06642	0,17400	0,18928	0,07443	0,19760	0,25591	0,22005
UNAIR	0,15186	0,14482	0,15686	0,32247	0,37726	0,09463	0,15940	0,27692	0,25921

Multiplication of Normalized Matrices by Weight Values									
Criteria / Alternative	CR	PR1	PR2	PR3	AT	CA	FSR1	FSR2	FSR3
ACAN	0,02296	0,01663	0,03399	0,04180	0,02184	0,00434	0,03012	0,03458	0,03167
ACHN	0,00756	0,01117	0,00726	0,01941	0,04848	0,00200	0,00938	0,02694	0,02997
AEA	0,03350	0,01294	0,02423	0,04630	0,01569	0,00279	0,05969	0,03097	0,04300
ASAIR	0,00813	-0,02531	-0,09124	-0,04762	0,03829	0,01022	0,01286	0,03833	0,03817
COPAIR	0,02939	0,01967	0,01293	0,04456	0,01881	0,00155	0,03152	0,02284	0,02589
CROAIR	0,00972	-0,01040	-0,03473	-0,04887	0,06762	0,00379	0,01819	0,03364	0,04518
EVA	0,02224	0,00577	0,00629	0,01071	0,02014	0,00313	0,02411	0,03208	0,02617
LUF	0,01676	0,00737	0,01230	0,02294	0,02769	0,00286	0,02943	0,03121	0,04238
SHEAIR	0,04967	0,09112	0,01522	0,06114	0,00456	0,00133	0,03849	0,01981	0,01871
TAP	0,02539	-0,00632	-0,07203	-0,01459	0,01509	0,02633	0,04005	0,04002	0,03808
THAIR	0,01394	-0,01437	-0,10348	-0,03681	0,03122	0,01500	0,02147	0,03921	0,03717
TUAIR	0,01900	0,01302	0,01124	0,02428	0,02274	0,00247	0,02147	0,02968	0,02727
UNAIR	0,01301	0,01500	0,02655	0,04500	0,04532	0,00315	0,01732	0,03211	0,03212
Positive ideal solutions and negative ideal solutions									
A+	0,04967	0,09112	0,03399	0,06114	0,06762	0,02633	0,05969	0,01981	0,01871
A-	0,00756	-0,02531	-0,10348	-0,04887	0,00456	0,00133	0,00938	0,04002	0,04518

The distance of each alternative to the positive ideal and negative ideal solution points and its performance ranking

Alternative	Di+	Di-	Ci	Rank
ACAN	**0,10235**	**0,17339**	**0,62881**	**2**
ACHN	0,11954	0,14349	0,54553	8
AEA	**0,10322**	**0,17392**	**0,62755**	**3**
ASAIR	0,21640	0,03784	0,14885	13
COPAIR	0,10043	0,16169	0,61686	5
CROAIR	0,17847	0,09516	0,34776	10
EVA	0,12495	0,13292	0,51546	9
LUF	0,11738	0,14401	0,55095	7
SHEAIR	**0,07350**	**0,20852**	**0,73936**	**1**
TAP	0,17603	0,06760	0,27746	11
THAIR	0,21102	0,03761	0,15127	12
TUAIR	0,11459	0,14498	0,55852	6
UNAIR	0,10303	0,17127	0,62440	4

APPENDIX 5: 2020 LOPCOW Analysis Results

Decision Matrix									
Target Criteria	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Min**	**Min**
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	1,21460	-0,79667	-2,70962	-0,16072	0,67270	16,85889	0,29990	0,94068	0,24691
ACHN	0,24487	-0,21413	-0,18880	-0,05568	3,74245	3,39047	0,06949	0,70506	0,28377
AEA	1,01032	-0,54904	-2,93767	-0,15816	0,68928	18,57412	0,41792	0,94616	0,41365
ASAIR	0,45476	-0,12912	-0,46172	-0,03631	1,63241	12,71550	0,17227	0,92136	0,37882
COPAIR	1,49913	-0,75788	-0,47295	-0,15754	0,65690	3,00211	0,31644	0,66690	0,21108
CROAIR	1,67119	-0,65844	-1,65333	-0,48640	0,73871	7,66023	0,44374	0,86946	0,26552
EVA	1,23109	-0,03680	-0,04274	-0,00994	1,59208	4,29910	0,16972	0,76739	0,13786
LUF	0,68490	-0,49489	-4,84859	-0,17032	1,35349	28,46720	0,25428	0,96487	0,37126
SHEAIR	1,14728	0,31043	0,10326	0,05335	0,49904	1,93552	0,34438	0,48333	0,30017
TAP	0,56390	-1,18073	1,06585	-0,24818	0,59856	-4,29464	0,35116	1,23285	0,62273
THAIR	0,06547	-2,95873	1,09727	-0,67618	2,41662	-1,62275	0,09457	1,61624	1,44446
TUAIR	0,64710	-0,12677	-0,14902	-0,03142	1,51499	4,74303	0,16360	0,78916	0,25282
UNAIR	1,16270	-0,46024	-1,19214	-0,11873	1,03750	10,04049	0,24866	0,90040	0,21386
Max	1,67119	0,31043	1,09727	0,05335	3,74245	28,46720	0,44374	1,61624	1,44446
Min	0,06547	-2,95873	-4,84859	-0,67618	0,49904	-4,29464	0,06949	0,48333	0,13786
Normalization of Criteria									
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	0,71565	0,66135	0,35974	0,70656	0,05354	0,64568	0,61566	0,59630	0,91653
ACHN	0,11172	0,83954	0,78370	0,85054	1,00000	0,23458	0,00000	0,80429	0,88833
AEA	0,58843	0,73710	0,32139	0,71007	0,05865	0,69803	0,93102	0,59147	0,78892
ASAIR	0,24244	0,86555	0,73780	0,87710	0,34944	0,51921	0,27465	0,61336	0,81558
COPAIR	0,89284	0,67322	0,73591	0,71092	0,04867	0,22272	0,65986	0,83797	0,94396
CROAIR	1,00000	0,70363	0,53739	0,26014	0,07390	0,36490	1,00000	0,65918	0,90229
EVA	0,72592	0,89379	0,80827	0,91324	0,33700	0,26231	0,26781	0,74926	1,00000
LUF	0,38577	0,75366	0,00000	0,69340	0,26344	1,00000	0,49377	0,57495	0,82136
SHEAIR	0,67372	1,00000	0,83282	1,00000	0,00000	0,19017	0,73452	1,00000	0,87577
TAP	0,31041	0,54387	0,99472	0,58668	0,03068	0,00000	0,75263	0,33841	0,62890
THAIR	0,00000	0,00000	1,00000	0,00000	0,59122	0,08156	0,06702	0,00000	0,00000
TUAIR	0,36223	0,86627	0,79039	0,88380	0,31323	0,27586	0,25147	0,73005	0,91201

UNAIR	0,68333	0,76426	0,61496	0,76412	0,16602	0,43756	0,47874	0,63186	0,94183	
Square Matrix										
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**	
ACAN	0,51215	0,43738	0,12941	0,49922	0,00287	0,41690	0,37904	0,35558	0,84004	
ACHN	0,01248	0,70483	0,61419	0,72342	1,00000	0,05503	0,00000	0,64688	0,78913	
AEA	0,34625	0,54331	0,10329	0,50420	0,00344	0,48725	0,86680	0,34983	0,62239	
ASAIR	0,05878	0,74917	0,54435	0,76930	0,12211	0,26957	0,07543	0,37621	0,66517	
COPAIR	0,79717	0,45322	0,54157	0,50541	0,00237	0,04960	0,43542	0,70219	0,89105	
CROAIR	1,00000	0,49510	0,28879	0,06767	0,00546	0,13315	1,00000	0,43451	0,81413	
EVA	0,52696	0,79885	0,65330	0,83401	0,11357	0,06881	0,07172	0,56140	1,00000	
LUF	0,14882	0,56801	0,00000	0,48080	0,06940	1,00000	0,24381	0,33057	0,67464	
SHEAIR	0,45390	1,00000	0,69360	1,00000	0,00000	0,03616	0,53952	1,00000	0,76698	
TAP	0,09635	0,29579	0,98946	0,34419	0,00094	0,00000	0,56645	0,11452	0,39552	
THAIR	0,00000	0,00000	1,00000	0,00000	0,34955	0,00665	0,00449	0,00000	0,00000	
TUAIR	0,13121	0,75042	0,62472	0,78111	0,09812	0,07610	0,06324	0,53297	0,83177	
UNAIR	0,46694	0,58409	0,37817	0,58387	0,02756	0,19145	0,22919	0,39924	0,88705	
Total	4,55101	7,38018	6,56085	7,09321	1,79538	2,79068	4,47512	5,80391	9,17786	
m	13	13	13	13	13	13	13	13	13	
total/m	0,35008	0,56771	0,50468	0,54563	0,13811	0,21467	0,34424	0,44645	0,70599	
Square Root(total/m)	0,59167	0,75346	0,71041	0,73867	0,37163	0,46332	0,58672	0,66817	0,84023	
Standard Deviation (Standardization of Criteria)	0,30355	0,24561	0,28589	0,27725	0,28356	0,27676	0,31595	0,24549	0,25836	
Square Root(total/m)/Standard Deviation (Standardization of Criteria)	1,94919	3,06767	2,48493	2,66424	1,31057	1,67412	1,85700	2,72184	3,25223	
pwij	66,74143	112,09178	91,02439	97,99189	27,04630	51,52848	61,89604	100,13065	117,93398	726,38493
wj	0,09188	0,15431	0,12531	0,13490	0,03723	0,07094	0,08521	0,13785	0,16236	1
Rank	6	2	5	4	9	8	7	3	1	

APPENDIX 6: 2020 TOPSIS Analysis Results

Target Criteria	Max	Max	Max	Max	Max	Max	Max	Min	Min
Weight Values	0,09188	0,15431	0,12531	0,13490	0,03723	0,07094	0,08521	0,13785	0,16236
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	1,21460	-0,79667	-2,70962	-0,16072	0,67270	16,85889	0,29990	0,94068	0,24691
ACHN	0,24487	-0,21413	-0,18880	-0,05568	3,74245	3,39047	0,06949	0,70506	0,28377
AEA	1,01032	-0,54904	-2,93767	-0,15816	0,68928	18,57412	0,41792	0,94616	0,41365
ASAIR	0,45476	-0,12912	-0,46172	-0,03631	1,63241	12,71550	0,17227	0,92136	0,37882
COPAIR	1,49913	-0,75788	-0,47295	-0,15754	0,65690	3,00211	0,31644	0,66690	0,21108
CROAIR	1,67119	-0,65844	-1,65333	-0,48640	0,73871	7,66023	0,44374	0,86946	0,26552
EVA	1,23109	-0,03680	-0,04274	-0,00994	1,59208	4,29910	0,16972	0,76739	0,13786
LUF	0,68490	-0,49489	-4,84859	-0,17032	1,35349	28,46720	0,25428	0,96487	0,37126
SHEAIR	1,14728	0,31043	0,10326	0,05335	0,49904	1,93552	0,34438	0,48333	0,30017
TAP	0,56390	-1,18073	1,06585	-0,24818	0,59856	-4,29464	0,35116	1,23285	0,62273
THAIR	0,06547	-2,95873	1,09727	-0,67618	2,41662	-1,62275	0,09457	1,61624	1,44446
TUAIR	0,64710	-0,12677	-0,14902	-0,03142	1,51499	4,74303	0,16360	0,78916	0,25282
UNAIR	1,16270	-0,46024	-1,19214	-0,11873	1,03750	10,04049	0,24866	0,90040	0,21386
Normalization of Criteria									
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	0,33435	-0,22333	-0,39743	-0,17109	0,11753	0,39227	0,29564	0,27565	0,13387
ACHN	0,06741	-0,06003	-0,02769	-0,05928	0,65385	0,07889	0,06850	0,20660	0,15385
AEA	0,27811	-0,15391	-0,43088	-0,16836	0,12043	0,43218	0,41198	0,27725	0,22427
ASAIR	0,12518	-0,03620	-0,06772	-0,03865	0,28520	0,29586	0,16982	0,26999	0,20538
COPAIR	0,41267	-0,21245	-0,06937	-0,16770	0,11477	0,06985	0,31194	0,19542	0,11444
CROAIR	0,46003	-0,18458	-0,24250	-0,51776	0,12906	0,17824	0,43743	0,25478	0,14396
EVA	0,33889	-0,01032	-0,00627	-0,01058	0,27815	0,10003	0,16730	0,22487	0,07474
LUF	0,18854	-0,13873	-0,71116	-0,18131	0,23647	0,66237	0,25066	0,28274	0,20129
SHEAIR	0,31582	0,08702	0,01515	0,05679	0,08719	0,04504	0,33949	0,14163	0,16274
TAP	0,15523	-0,33099	0,15633	-0,26418	0,10458	-0,09993	0,34617	0,36126	0,33762
THAIR	0,01802	-0,82941	0,16094	-0,71978	0,42221	-0,03776	0,09322	0,47361	0,78314
TUAIR	0,17813	-0,03554	-0,02186	-0,03345	0,26468	0,11036	0,16127	0,23125	0,13707
UNAIR	0,32006	-0,12902	-0,17486	-0,12639	0,18126	0,23362	0,24512	0,26385	0,11595

Multiplication of Normalized Matrices by Weight Values									
Criteria / Alternative	CR	PR1	PR2	PR3	AT	CA	FSR1	FSR2	FSR3
ACAN	0,03072	-0,03446	-0,04980	-0,02308	0,00438	0,02783	0,02519	0,03800	0,02173
ACHN	0,00619	-0,00926	-0,00347	-0,00800	0,02435	0,00560	0,00584	0,02848	0,02498
AEA	0,02555	-0,02375	-0,05399	-0,02271	0,00448	0,03066	0,03511	0,03822	0,03641
ASAIR	0,01150	-0,00559	-0,00849	-0,00521	0,01062	0,02099	0,01447	0,03722	0,03335
COPAIR	0,03792	-0,03278	-0,00869	-0,02262	0,00427	0,00496	0,02658	0,02694	0,01858
CROAIR	0,04227	-0,02848	-0,03039	-0,06985	0,00481	0,01264	0,03727	0,03512	0,02337
EVA	0,03114	-0,00159	-0,00079	-0,00143	0,01036	0,00710	0,01426	0,03100	0,01213
LUF	0,01732	-0,02141	-0,08912	-0,02446	0,00880	0,04699	0,02136	0,03897	0,03268
SHEAIR	0,02902	0,01343	0,00190	0,00766	0,00325	0,00319	0,02893	0,01952	0,02642
TAP	0,01426	-0,05108	0,01959	-0,03564	0,00389	-0,00709	0,02950	0,04980	0,05482
THAIR	0,00166	-0,12799	0,02017	-0,09710	0,01572	-0,00268	0,00794	0,06529	0,12715
TUAIR	0,01637	-0,00548	-0,00274	-0,00451	0,00986	0,00783	0,01374	0,03188	0,02225
UNAIR	0,02941	-0,01991	-0,02191	-0,01705	0,00675	0,01657	0,02089	0,03637	0,01882
Positive ideal solutions and negative ideal solutions									
A+	0,04227	0,01343	0,02017	0,00766	0,02435	0,04699	0,03727	0,01952	0,01213
A-	0,00166	-0,12799	-0,08912	-0,09710	0,00325	-0,00709	0,00584	0,06529	0,12715

The distance of each alternative to the positive ideal and negative ideal solution points and its success ranking				
Alternative	Di+	Di-	Ci	Rank
ACAN	0,09805	0,17340	0,63880	8
ACHN	0,07461	0,20443	0,73261	5
AEA	0,09843	0,17162	0,63550	9
ASAIR	0,06665	0,20132	0,75127	4
COPAIR	0,07928	0,19034	0,70595	7
CROAIR	0,11068	0,16971	0,60526	10
EVA	**0,05762**	**0,22029**	**0,79268**	**2**
LUF	0,12691	0,17232	0,57588	12
SHEAIR	**0,05609**	**0,22997**	**0,80392**	**1**
TAP	0,11385	0,16644	0,59381	11
THAIR	0,22660	0,11010	0,32700	13
TUAIR	**0,06522**	**0,20906**	**0,76221**	**3**
UNAIR	0,07409	0,19169	0,72122	6

APPENDIX 7: 2021 LOPCOW Analysis Results

Decision Matrix									
Target Criteria	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Min**	**Min**
Criteria / **Alternative**	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	1,45191	-0,56281	-400,22222	-0,11766	0,63663	3401,55556	0,32838	0,99971	0,22617
ACHN	0,33177	-0,23946	-0,28592	-0,06308	2,58588	4,53253	0,10187	0,77937	0,30706
AEA	1,24380	0,00751	0,02373	0,00329	0,95504	7,21041	0,45871	0,86131	0,36880
ASAIR	0,48963	-0,11909	-0,99177	-0,03950	1,69170	25,10603	0,19608	0,96017	0,41709
COPAIR	1,17632	0,02904	0,03374	0,01032	1,21888	3,26941	0,29160	0,69413	0,24789
CROAIR	1,24940	-0,40397	4,16266	-0,20347	1,36031	-20,45855	0,37026	1,04888	0,29635
EVA	1,39764	0,06431	0,07206	0,02053	1,59356	3,50904	0,20037	0,71502	0,14336
LUF	0,91779	-0,13033	-0,48797	-0,05151	1,24757	9,47394	0,31678	0,89445	0,34515
SHEAIR	0,93254	0,32845	0,09659	0,04923	0,68632	1,96198	0,21841	0,49031	0,23419
TAP	0,70976	-1,17789	3,41636	-0,33893	1,09596	-10,07974	0,26255	1,09921	0,37013
THAIR	0,52368	2,55483	-0,77351	0,34185	0,87000	-2,26271	0,15380	1,44195	0,29369
TUAIR	0,72750	0,08435	0,09280	0,02322	1,47998	3,90191	0,18602	0,74372	0,25570
UNAIR	1,19266	-0,07965	-0,39256	-0,02879	1,12824	13,63485	0,32040	0,92666	0,26864
Mak	1,45191	2,55483	4,16266	0,34185	2,58588	3401,55556	0,45871	1,44195	0,41709
Min	0,33177	-1,17789	-400,22222	-0,33893	0,63663	-20,45855	0,10187	0,49031	0,14336
Normalization of Criteria									
Criteria / **Alternative**	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	1,00000	0,16478	0,00000	0,32503	0,00000	1,00000	0,63477	0,46472	0,69747
ACHN	0,00000	0,25141	0,98900	0,40520	1,00000	0,00730	0,00000	0,69625	0,40197
AEA	0,81421	0,31757	0,98976	0,50269	0,16335	0,00809	1,00000	0,61015	0,17642
ASAIR	0,14093	0,28365	0,98725	0,43983	0,54127	0,01332	0,26402	0,50626	0,00000
COPAIR	0,75397	0,32334	0,98979	0,51302	0,29870	0,00693	0,53169	0,78582	0,61813
CROAIR	0,81922	0,20733	1,00000	0,19898	0,37126	0,00000	0,75214	0,41305	0,44108
EVA	0,95155	0,33279	0,98988	0,52802	0,49092	0,00700	0,27603	0,76387	1,00000
LUF	0,52317	0,28064	0,98850	0,42220	0,31342	0,00875	0,60225	0,57533	0,26280
SHEAIR	0,53633	0,40355	0,98995	0,57017	0,02550	0,00655	0,32659	1,00000	0,66818
TAP	0,33745	0,00000	0,99815	0,00000	0,23565	0,00303	0,45029	0,36016	0,17156
THAIR	0,17133	1,00000	0,98779	1,00000	0,11973	0,00532	0,14552	0,00000	0,45081
TUAIR	0,35328	0,33816	0,98994	0,53197	0,43265	0,00712	0,23582	0,73372	0,58959

UNAIR	0,76856	0,29422	0,98874	0,45557	0,25221	0,00996	0,61239	0,54148	0,54232	
Square Matrix										
Kriter / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**	
ACAN	1,00000	0,02715	0,00000	0,10564	0,00000	1,00000	0,40293	0,21596	0,48647	
ACHN	0,00000	0,06320	0,97812	0,16418	1,00000	0,00005	0,00000	0,48476	0,16158	
AEA	0,66294	0,10085	0,97963	0,25270	0,02668	0,00007	1,00000	0,37228	0,03112	
ASAIR	0,01986	0,08046	0,97467	0,19345	0,29297	0,00018	0,06971	0,25630	0,00000	
COPAIR	0,56848	0,10455	0,97968	0,26318	0,08922	0,00005	0,28270	0,61751	0,38208	
CROAIR	0,67112	0,04299	1,00000	0,03959	0,13783	0,00000	0,56571	0,17061	0,19455	
EVA	0,90545	0,11075	0,97987	0,27880	0,24101	0,00005	0,07619	0,58350	1,00000	
LUF	0,27371	0,07876	0,97713	0,17825	0,09823	0,00008	0,36270	0,33100	0,06907	
SHEAIR	0,28765	0,16285	0,97999	0,32509	0,00065	0,00004	0,10666	1,00000	0,44647	
TAP	0,11387	0,00000	0,99631	0,00000	0,05553	0,00001	0,20276	0,12971	0,02943	
THAIR	0,02935	1,00000	0,97574	1,00000	0,01433	0,00003	0,02118	0,00000	0,20323	
TUAIR	0,12481	0,11435	0,97997	0,28299	0,18719	0,00005	0,05561	0,53834	0,34762	
UNAIR	0,59068	0,08657	0,97760	0,20754	0,06361	0,00010	0,37503	0,29320	0,29411	
Total	5,24791	1,97248	11,77872	3,29143	2,20726	1,00070	3,52118	4,99317	3,64573	
m	13	13	13	13	13	13	13	13	13	
total/m	0,40369	0,15173	0,90606	0,25319	0,16979	0,07698	0,27086	0,38409	0,28044	
Square Root(total/m)	0,63536	0,38952	0,95187	0,50318	0,41205	0,27745	0,52044	0,61975	0,52957	
Standard Deviation (Standardization of Criteria)	0,32830	0,22679	0,27481	0,22738	0,26162	0,27544	0,27466	0,24543	0,26735	
Square Root(total/m)/Standard Deviation (Standardization of Criteria)	1,93531	1,71755	3,46379	2,21298	1,57502	1,00728	1,89483	2,52513	1,98081	
pwij	66,02652	54,08967	124,23629	79,43395	45,42691	0,72555	63,91265	92,62935	68,35079	594,83167
wj	0,11100	0,09093	0,20886	0,13354	0,07637	0,00122	0,10745	0,15572	0,11491	1
Rank	5	7	1	3	8	9	6	2	4	

APPENDIX 8: 2021 TOPSIS Analysis Results

Decision Matrix									
Target Criteria	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Min**	**Min**
Weight Value	0,11100	0,09093	0,20886	0,13354	0,07637	0,00122	0,10745	0,15572	0,11491
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	1,45191	-0,56281	-400,22222	-0,11766	0,63663	3401,55556	0,32838	0,99971	0,22617
ACHN	0,33177	-0,23946	-0,28592	-0,06308	2,58588	4,53253	0,10187	0,77937	0,30706
AEA	1,24380	0,00751	0,02373	0,00329	0,95504	7,21041	0,45871	0,86131	0,36880
ASAIR	0,48963	-0,11909	-0,99177	-0,03950	1,69170	25,10603	0,19608	0,96017	0,41709
COPAIR	1,17632	0,02904	0,03374	0,01032	1,21888	3,26941	0,29160	0,69413	0,24789
CROAIR	1,24940	-0,40397	4,16266	-0,20347	1,36031	-20,45855	0,37026	1,04888	0,29635
EVA	1,39764	0,06431	0,07206	0,02053	1,59356	3,50904	0,20037	0,71502	0,14336
LUF	0,91779	-0,13033	-0,48797	-0,05151	1,24757	9,47394	0,31678	0,89445	0,34515
SHEAIR	0,93254	0,32845	0,09659	0,04923	0,68632	1,96198	0,21841	0,49031	0,23419
TAP	0,70976	-1,17789	3,41636	-0,33893	1,09596	-10,07974	0,26255	1,09921	0,37013
THAIR	0,52368	2,55483	-0,77351	0,34185	0,87000	-2,26271	0,15380	1,44195	0,29369
TUAIR	0,72750	0,08435	0,09280	0,02322	1,47998	3,90191	0,18602	0,74372	0,25570
UNAIR	1,19266	-0,07965	-0,39256	-0,02879	1,12824	13,63485	0,32040	0,92666	0,26864
Normalization of Criteria									
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	0,39745	-0,19181	-0,99990	-0,21499	0,12944	0,99993	0,32720	0,30001	0,20999
ACHN	0,09082	-0,08161	-0,00071	-0,11526	0,52576	0,00133	0,10151	0,23389	0,28509
AEA	0,34048	0,00256	0,00006	0,00601	0,19418	0,00212	0,45706	0,25848	0,34242
ASAIR	0,13403	-0,04059	-0,00248	-0,07218	0,34395	0,00738	0,19538	0,28815	0,38725
COPAIR	0,32201	0,01008	0,00605	0,01931	0,24992	0,08315	0,30747	0,21837	0,23541
CROAIR	0,34202	-0,13768	0,01040	-0,37179	0,27658	-0,00601	0,36893	0,31477	0,27515
EVA	0,38260	0,02192	0,00018	0,03752	0,32400	0,00103	0,19965	0,21458	0,13311
LUF	0,25124	-0,04442	-0,00122	-0,09412	0,25366	0,00278	0,31564	0,26843	0,32046
SHEAIR	0,25528	0,11194	0,00024	0,08995	0,13954	0,00058	0,21763	0,14714	0,21744
TAP	0,19429	-0,40144	0,00854	-0,61932	0,22283	-0,00296	0,26161	0,32987	0,34365
THAIR	0,14336	0,87071	-0,00193	0,62465	0,17689	-0,00067	0,15325	0,43273	0,27268
TUAIR	0,19915	0,02875	0,00023	0,04243	0,30091	0,00115	0,18535	0,22319	0,23741
UNAIR	0,32648	-0,02714	-0,00098	-0,05261	0,22939	0,00401	0,31924	0,27809	0,24943

Multiplication of Normalized Matrices by Weight Values									
Criteria / Alternative	CR	PR1	PR2	PR3	AT	CA	FSR1	FSR2	FSR3
ACAN	0,04412	-0,01744	-0,20884	-0,02871	0,00989	0,00122	0,03516	0,04672	0,02413
ACHN	0,01008	-0,00742	-0,00015	-0,01539	0,04015	0,00000	0,01091	0,03642	0,03276
AEA	0,03779	0,00023	0,00001	0,00080	0,01483	0,00000	0,04911	0,04025	0,03935
ASAIR	0,01488	-0,00369	-0,00052	-0,00964	0,02627	0,00001	0,02099	0,04487	0,04450
COPAIR	0,03574	0,00092	0,00126	0,00258	0,01909	0,00010	0,03304	0,03401	0,02705
CROAIR	0,03796	-0,01252	0,00217	-0,04965	0,02112	-0,00001	0,03964	0,04902	0,03162
EVA	0,04247	0,00199	0,00004	0,00501	0,02474	0,00000	0,02145	0,03342	0,01530
LUF	0,02789	-0,00404	-0,00025	-0,01257	0,01937	0,00000	0,03391	0,04180	0,03682
SHEAIR	0,02834	0,01018	0,00005	0,01201	0,01066	0,00000	0,02338	0,02291	0,02499
TAP	0,02157	-0,03650	0,00178	-0,08270	0,01702	0,00000	0,02811	0,05137	0,03949
THAIR	0,01591	0,07918	-0,00040	0,08342	0,01351	0,00000	0,01647	0,06739	0,03133
TUAIR	0,02211	0,00261	0,00005	0,00567	0,02298	0,00000	0,01992	0,03476	0,02728
UNAIR	0,03624	-0,00247	-0,00020	-0,00703	0,01752	0,00000	0,03430	0,04331	0,02866
Positive ideal solutions and negative ideal solutions									
A+	0,04412	0,07918	0,00217	0,08342	0,04015	0,00122	0,04911	0,02291	0,01530
A-	0,01008	-0,03650	-0,20884	-0,08270	0,00989	-0,00001	0,01091	0,06739	0,04450

the distance of each alternative from the positive ideal and negative ideal solution points and its performance ranking				
Alternative	Di+	Di-	Ci	Rank
ACAN	0,26113	0,07661	0,22683	13
ACHN	0,14274	0,22570	0,61258	10
AEA	0,12093	0,23443	0,65970	6
ASAIR	0,13678	0,22520	0,62213	9
COPAIR	0,11702	0,23552	0,66806	4
CROAIR	0,16599	0,22006	0,57003	11
EVA	**0,11500**	**0,23705**	**0,67333**	**3**
LUF	0,13376	0,22612	0,62832	8
SHEAIR	**0,10835**	**0,24007**	**0,68902**	**2**
TAP	0,20943	0,21242	0,50355	12
THAIR	**0,06938**	**0,29099**	**0,80747**	**1**
TUAIR	0,11759	0,23395	0,66549	5
UNAIR	0,12744	0,22920	0,64267	7

APPENDIX 9: 2022 LOPCOW Analysis Results

Decision Matrix									
Target Criteria	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Min**	**Min**
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	1,03336	-0,10268	1,09325	-0,05761	1,71298	-18,97556	0,32755	1,05270	0,31698
ACHN	0,24053	-0,80277	-2,09836	-0,15314	2,52965	13,70198	0,07541	0,92702	0,31352
AEA	1,15495	0,07987	0,30675	0,05285	1,65812	5,80397	0,39905	0,82770	0,34551
ASAIR	0,47592	0,00427	0,03707	0,00197	2,18213	18,80168	0,21139	0,94681	0,44417
COPAIR	1,03540	0,11739	0,23326	0,07421	2,39923	3,14344	0,26348	0,68188	0,25447
CROAIR	1,61850	-0,09799	-1,46159	-0,08128	1,69333	17,98265	0,48986	0,94194	0,30022
EVA	1,09151	0,05666	0,08129	0,02448	1,62957	3,32015	0,26516	0,69881	0,24293
LUF	0,86148	0,02414	0,09334	0,01825	2,14815	5,11388	0,35202	0,80445	0,40863
SHEAIR	0,62730	0,12468	0,03508	0,01450	0,50954	2,41842	0,22830	0,58651	0,36394
TAP	0,86557	0,01894	0,15707	0,01109	1,81939	14,16070	0,32183	0,92938	0,37181
THAIR	0,93947	-0,00242	0,00354	-0,00127	1,73680	-2,79027	0,30177	1,35839	0,32121
TUAIR	0,87701	0,15243	0,26144	0,08198	2,30333	3,18900	0,23350	0,68642	0,26624
UNAIR	1,00320	0,01644	0,10765	0,01098	2,24125	9,80757	0,29791	0,89804	0,29696
Mak	1,61850	0,15243	1,09325	0,08198	2,52965	18,80168	0,48986	1,35839	0,44417
Min	0,24053	-0,80277	-2,09836	-0,15314	0,50954	-18,97556	0,07541	0,58651	0,24293
Normalization of Criteria									
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	0,57536	0,73292	1,00000	0,40629	0,59573	0,00000	0,60837	0,39603	0,63204
ACHN	0,00000	0,00000	0,00000	0,00000	1,00000	0,86501	0,00000	0,55886	0,64920
AEA	0,66360	0,92404	0,75357	0,87611	0,56857	0,65594	0,78089	0,68752	0,49024
ASAIR	0,17082	0,84489	0,66907	0,65971	0,82797	1,00000	0,32809	0,53321	0,00000
COPAIR	0,57684	0,96331	0,73055	0,96693	0,93544	0,58551	0,45378	0,87644	0,94263
CROAIR	1,00000	0,73784	0,19951	0,30565	0,58600	0,97832	1,00000	0,53952	0,71532
EVA	0,61756	0,89974	0,68293	0,75546	0,55444	0,59019	0,45783	0,85451	1,00000
LUF	0,45062	0,86569	0,68671	0,72896	0,81115	0,63767	0,66742	0,71764	0,17659
SHEAIR	0,28068	0,97094	0,66845	0,71301	0,00000	0,56632	0,36890	1,00000	0,39866
TAP	0,45359	0,86025	0,70668	0,69850	0,64841	0,87715	0,59457	0,55579	0,35954
THAIR	0,50723	0,83788	0,65857	0,64593	0,60752	0,42844	0,54616	0,00000	0,61100
TUAIR	0,46190	1,00000	0,73938	1,00000	0,88797	0,58672	0,38144	0,87056	0,88415

UNAIR	0,55347	0,85763	0,69119	0,69801	0,85724	0,76192	0,53685	0,59640	0,73151	
Square Matrix										
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**	
ACAN	0,33104	0,53718	1,00000	0,16507	0,35490	0,00000	0,37011	0,15684	0,39948	
ACHN	0,00000	0,00000	0,00000	0,00000	1,00000	0,74824	0,00000	0,31232	0,42147	
AEA	0,44037	0,85385	0,56787	0,76756	0,32328	0,43025	0,60979	0,47269	0,24033	
ASAIR	0,02918	0,71385	0,44766	0,43522	0,68553	1,00000	0,10764	0,28431	0,00000	
COPAIR	0,33275	0,92797	0,53370	0,93496	0,87505	0,34282	0,20592	0,76816	0,88855	
CROAIR	1,00000	0,54441	0,03980	0,09342	0,34340	0,95711	1,00000	0,29108	0,51168	
EVA	0,38139	0,80954	0,46640	0,57072	0,30741	0,34832	0,20961	0,73019	1,00000	
LUF	0,20306	0,74942	0,47157	0,53138	0,65796	0,40662	0,44545	0,51501	0,03119	
SHEAIR	0,07878	0,94273	0,44683	0,50839	0,00000	0,32072	0,13608	1,00000	0,15893	
TAP	0,20575	0,74003	0,49939	0,48791	0,42043	0,76939	0,35351	0,30891	0,12927	
THAIR	0,25728	0,70205	0,43372	0,41722	0,36908	0,18356	0,29829	0,00000	0,37333	
TUAIR	0,21335	1,00000	0,54668	1,00000	0,78849	0,34424	0,14549	0,75787	0,78172	
UNAIR	0,30633	0,73553	0,47774	0,48722	0,73485	0,58052	0,28821	0,35569	0,53510	
Total	3,77927	9,25655	5,93136	6,39907	6,86038	6,43179	4,17012	5,95306	5,47104	
m	13	13	13	13	13	13	13	13	13	
total/m	0,29071	0,71204	0,45626	0,49224	0,52772	0,49475	0,32078	0,45793	0,42085	
Square Root(total/m)	0,53918	0,84383	0,67547	0,70160	0,72644	0,70339	0,56637	0,67670	0,64873	
Standard Deviation (Standardization of Criteria)	0,24407	0,25554	0,25428	0,27396	0,25724	0,26310	0,24013	0,25784	0,29420	
Square Root(total/m)/Standard Deviation (Standardization of Criteria)	2,20909	3,30212	2,65635	2,56096	2,82402	2,67351	2,35861	2,62449	2,20510	
pwij	79,25811	119,45654	97,69548	94,03812	103,81631	98,33905	85,80732	96,48869	79,07711	853,97673
wj	0,09281	0,13988	0,11440	0,11012	0,12157	0,11515	0,10048	0,11299	0,09260	1
Rank	8	1	4	6	2	3	7	5	9	

APPENDIX 10: 2022 TOPSIS Performance Results

Decision Matrix									
Target Criteria	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Min**	**Min**
Weight Values	0,09281	0,13988	0,11440	0,11012	0,12157	0,11515	0,10048	0,11299	0,09260
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	1,03336	-0,10268	1,09325	-0,05761	1,71298	-18,97556	0,32755	1,05270	0,31698
ACHN	0,24053	-0,80277	-2,09836	-0,15314	2,52965	13,70198	0,07541	0,92702	0,31352
AEA	1,15495	0,07987	0,30675	0,05285	1,65812	5,80397	0,39905	0,82770	0,34551
ASAIR	0,47592	0,00427	0,03707	0,00197	2,18213	18,80168	0,21139	0,94681	0,44417
COPAIR	1,03540	0,11739	0,23326	0,07421	2,39923	3,14344	0,26348	0,68188	0,25447
CROAIR	1,61850	-0,09799	-1,46159	-0,08128	1,69333	17,98265	0,48986	0,94194	0,30022
EVA	1,09151	0,05666	0,08129	0,02448	1,62957	3,32015	0,26516	0,69881	0,24293
LUF	0,86148	0,02414	0,09334	0,01825	2,14815	5,11388	0,35202	0,80445	0,40863
SHEAIR	0,62730	0,12468	0,03508	0,01450	0,50954	2,41842	0,22830	0,58651	0,36394
TAP	0,86557	0,01894	0,15707	0,01109	1,81939	14,16070	0,32183	0,92938	0,37181
THAIR	0,93947	-0,00242	0,00354	-0,00127	1,73680	-2,79027	0,30177	1,35839	0,32121
TUAIR	0,87701	0,15243	0,26144	0,08198	2,30333	3,18900	0,23350	0,68642	0,26624
UNAIR	1,00320	0,01644	0,10765	0,01098	2,24125	9,80757	0,29791	0,89804	0,29696
Normalization of Criteria									
Criteria / Alternative	**CR**	**PR1**	**PR2**	**PR3**	**AT**	**CA**	**FSR1**	**FSR2**	**FSR3**
ACAN	0,29692	-0,12035	0,38639	-0,25820	0,24310	-0,47059	0,29770	0,32694	0,26514
ACHN	0,06911	-0,94088	-0,74162	-0,68631	0,35899	0,33980	0,06854	0,28791	0,26225
AEA	0,33186	0,09362	0,10841	0,23685	0,23531	0,14394	0,36269	0,25706	0,28901
ASAIR	0,13675	0,00501	0,01310	0,00883	0,30968	0,46628	0,19213	0,29406	0,37153
COPAIR	0,29751	0,13758	0,08244	0,33256	0,34049	0,07796	0,23947	0,21177	0,21286
CROAIR	0,46505	-0,11484	-0,51657	-0,36425	0,24031	0,44596	0,44523	0,29254	0,25112
EVA	0,31363	0,06641	0,02873	0,10973	0,23126	0,08234	0,24100	0,21703	0,20320
LUF	0,24753	0,02829	0,03299	0,08180	0,30485	0,12682	0,31995	0,24984	0,34180
SHEAIR	0,18025	0,14613	0,01240	0,06500	0,07231	0,05998	0,20750	0,18215	0,30442
TAP	0,24871	0,02220	0,05551	0,04971	0,25820	0,35118	0,29251	0,28864	0,31101
THAIR	0,26994	-0,00284	0,00125	-0,00569	0,24648	-0,06920	0,27427	0,42188	0,26868
TUAIR	0,25200	0,17866	0,09240	0,36740	0,32688	0,07909	0,21222	0,21318	0,22270
UNAIR	0,28826	0,01927	0,03805	0,04919	0,31807	0,24322	0,27077	0,27891	0,24839

Multiplication of Normalized Matrices by Weight Values									
Criteria / Alternative	CR	PR1	PR2	PR3	AT	CA	FSR1	FSR2	FSR3
ACAN	0,02756	-0,01683	0,04420	-0,02843	0,02955	-0,05419	0,02991	0,03694	0,02455
ACHN	0,00641	-0,13161	-0,08484	-0,07558	0,04364	0,03913	0,00689	0,03253	0,02428
AEA	0,03080	0,01310	0,01240	0,02608	0,02861	0,01657	0,03644	0,02904	0,02676
ASAIR	0,01269	0,00070	0,00150	0,00097	0,03765	0,05369	0,01931	0,03322	0,03440
COPAIR	0,02761	0,01925	0,00943	0,03662	0,04139	0,00898	0,02406	0,02393	0,01971
CROAIR	0,04316	-0,01606	-0,05910	-0,04011	0,02921	0,05135	0,04474	0,03305	0,02325
EVA	0,02911	0,00929	0,00329	0,01208	0,02811	0,00948	0,02422	0,02452	0,01882
LUF	0,02297	0,00396	0,00377	0,00901	0,03706	0,01460	0,03215	0,02823	0,03165
SHEAIR	0,01673	0,02044	0,00142	0,00716	0,00879	0,00691	0,02085	0,02058	0,02819
TAP	0,02308	0,00311	0,00635	0,00547	0,03139	0,04044	0,02939	0,03261	0,02880
THAIR	0,02505	-0,00040	0,00014	-0,00063	0,02996	-0,00797	0,02756	0,04767	0,02488
TUAIR	0,02339	0,02499	0,01057	0,04046	0,03974	0,00911	0,02132	0,02409	0,02062
UNAIR	0,02675	0,00270	0,00435	0,00542	0,03867	0,02801	0,02721	0,03151	0,02300
Positive ideal solutions and negative ideal solutions									
A+	0,04316	0,02499	0,04420	0,04046	0,04364	0,05369	0,04474	0,02058	0,01882
A-	0,00641	-0,13161	-0,08484	-0,07558	0,00879	-0,05419	0,00689	0,04767	0,03440

the distance of each alternative from the positive ideal and negative ideal solution points and its performance ranking				
Alternative	Di+	Di-	Ci	Rank
ACAN	0,13819	0,18349	0,57042	11
ACHN	0,24043	0,10127	0,29636	13
AEA	**0,05762**	**0,21910**	**0,79179**	**1**
ASAIR	0,07737	0,20903	0,72985	8
COPAIR	**0,06279**	**0,22541**	**0,78213**	**3**
CROAIR	0,13869	0,17306	0,55512	12
EVA	0,07454	0,20329	0,73171	6
LUF	0,07366	0,20054	0,73135	7
SHEAIR	0,08787	0,20546	0,70044	9
TAP	0,06591	0,20867	0,75995	4
THAIR	0,09827	0,18305	0,65069	10
TUAIR	**0,06395**	**0,23086**	**0,78310**	**2**
UNAIR	0,06864	0,20352	0,74780	5