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GLOBAL AIRLINE ALLIANCES BEFORE AND DURING THE COVID-19 CRISIS: EXPLORING THE CRITICAL SUCCESS FACTORS THROUGH CRITIC-CoCoSo METHODS

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Abstract

This study aims to reveal the critical success factors that provide global airline alliances success by making a comparative analysis of the performances of global airline alliances for the period before and during the pandemic. To do this, the performance data of 35 airlines that are members of Star Alliance, SkyTeam, and Oneworld alliances were analyzed for the years between 2017 and 2020 by using CRITIC-CoCoSo methods. The study benefits 7 criteria including 3 financial and 4 operational. The results reveal that the operating result and the load factor are among the critical success factors for global airline alliances when considering all years analyzed. In addition, SkyTeam alliance is in the first place during the pandemic period, while it is in the last place after Oneworld and Star Alliance in the general ranking. The study is expected to contribute to the airline management literature, executives of global airline alliances and member airlines by exploring the critical success factors that global airline alliances must have to overcome negative effects of crisis periods and to be sustainable.

Keywords: Covid-19 Pandemic, Crisis Management, Global Airline Alliances, Performance Evaluation, MCDM, CoCoSo

JEL Codes: L10, M10, P47

COVID-19 KRİZİ ÖNCESİ VE SIRASINDA KÜRESEL HAVAYOLU İTTİFAKLARI: CRITIC-CoCoSo YÖNTEMLERİ ARACILIĞIYLA KRİTİK BAŞARI FAKTÖRLERİNİN BELİRLENMESİ

Öz

Bu araştırmanın amacı küresel havayolu ittifaklarının pandemi öncesi ve pandemi sürecindeki performanslarının karşılaştırmalı olarak analizinin yapılması yoluyla küresel havayolu ittifaklarını başarıya ulaştıran kritik başarı faktörlerini ortaya çıkarmaktır. Bu amaç doğrultusunda Star Alliance, SkyTeam ve Oneworld ittifaklarına üye 35 havayolunun 2017-2020 yıllarına ait performans verilerinin, 3 finansal ve 4 operasyonel olmak üzere toplam 7 kriter üzerinden, çok kriterli karar verme yöntemlerinden (ÇKKV) CRITIC-CoCoSo yöntemleri aracılığıyla analizi gerçekleştirilmiştir. Çalışma tüm yıllar bazında küresel havayolu ittifakları için faaliyet karı ve doluluk oranının kritik başarı faktörleri arasında yer aldığını ortaya koymaktadır. Ayrıca pandemi sürecinde SkyTeam ittifakının performans sıralamasında ilk sırada yer aldığı tespit edilirken genel sıralamada ise SkyTeam'in Oneworld ve Star Alliance'ın ardından son sırada olduğu görülmüştür. Çalışmanın küresel havayolu ittifaklarının kriz dönemlerinin olumsuz etkilerinin üstesinden gelebilmesi ve sürdürülebilir olması için sahip olması gereken kritik başarı faktörlerini ortaya koyarak literatüre ve küresel havayolu ittifakı ve üye havayolları yöneticilerine katkı sağlaması beklenmektedir.

Anahtar Kelimeler: Covid-19 Pandemisi, Kriz Yönetimi, Küresel Havayolu İttifakları, Performans Değerlendirmesi, ÇKKV, CoCoSo

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INTRODUCTION

Deregulation movements in the aviation industry, which started in the United States in 1978 and gradually showed its effect in Europe after 1986, caused a change in the business strategies of the airline companies operating in the sector (Seo, 2020). The facilitation of access to international airports and intercontinental routes, along with deregulation movements and "open skies" agreements, brought a fierce competition environment in the commercial air transport industry (Min and Joo, 2016). In this period, although there were applications for merger and acquisition strategies among airlines, the difficulties encountered in the implementation of merger and acquisition strategies as a result of the limitations brought by international law and the local legislation of the countries caused the airlines to seek new competitive strategies (Chutiphongdech, 2017). As a result of these quests, the emergence of strategic alliances established by airlines that came together to increase their market share on a global scale and to gain sustainable competitive advantage has resulted in the evolution of competition between airlines into the competition between alliances in recent years (Ireland, Hitt, and Vaidyanath, 2002; Morrish and Hamilton, 2002).

Although more than 500 bilateral airline alliances have emerged within the scope of agreements between the two airlines since 1986, "Global Excellence" established in 1989 by Delta Airlines, Singapore Airlines, and Swissair has the distinction of being the first multilateral airline alliance (Kottas, 2018). Although new international airline alliances were formed in the following period, many of them dissolved within a few years of their establishment (Kyrylenko, Riazanovska, and Novak 2019). There are three major global airline alliances, namely Star Alliance, SkyTeam, and Oneworld, which are active today and have a great impact on the global airline market (Douglas and Tan, 2017). According to traffic data for 2018, the three major global airline alliances, Star Alliance (21.9%), SkyTeam (18.8%), and Oneworld (15.4%) account for approximately 56.1% of the total revenue passenger kilometers (RPK) of the international airline passenger market (IATA, 2019; Peng and Lu, 2022).

It is stated that the sustainability of the alliances has begun to be questioned and approximately one-third of the airlines that are members of global airline alliances are not satisfied since they cannot benefit equally from the alliances (Chang and Chiu, 2016; Kyrylenko et al., 2019). On the other hand, in the face of unforeseen events as in the examples of the September 11 attacks and the 2008 economic crisis that greatly affected the world and thus the aviation industry, airlines tended to show solidarity and collaborative approaches (Migdadi, 2022).

As in previous global-scale crises, it is predicted that the Covid-19 pandemic, which emerged in Wuhan, China in 2019 and spread all over the world, cause airlines to show a cooperative tendency to their

survival. Some studies in the literature reveal that airlines recover after such crises through strategic collaborations (Franke and John, 2011; Graham and Vowles, 2006). As an important example of this, some global airline alliance members, are seeking to recover as soon as possible by getting rid of the negative effects of the post-pandemic, in addition to their cooperation with member airlines of their alliances, their cooperation with airlines that are not members of any alliance or a rival alliance member can be shown (Lufthansa Consulting, 2021). Although there are many studies in the literature examining the performance of airlines individually, there are not enough studies that discuss the performances of global airline alliances (Min & Joo, 2016). Notwithstanding that it has been determined that the data analyzed in the current studies belong to the period before the Covid-19 pandemic, only the study by Tanrıverdi (2022) in which the effect of the Covid-19 pandemic on strategic airline alliances has been reached. To fill this gap in the literature, this study aims to reveal the performances of strategic alliances by comparing the three major global airline alliances for the period before and during the Covid-19 pandemic. In addition, based on the performances of global airline alliances during the pandemic period, the study also aims to make inferences about the future of alliances for potential crises by exploring which critical factors they are affected by. To do this, the study employs CRITIC and CoCoSo methods, which are multi-criteria decision-making methods. While the CRITIC method was used in the study since it is used more frequently than other objective weighting methods and it allows to include negative values in the evaluation, the reason why CoCoSo was used as a relatively new method compared to other ranking methods is that it can give more robust and accurate results due to the combination of simple additive weighting (SAW), weighted aggregated sum product assessment (WASPAS) and multiplicative exponential weighting (MEW) (Torkayesh et al., 2021). This study differs from the related literature in that it reveals the performances of global airline alliances and critical factors that can make global airline alliances successful in a crisis time and makes a significant contribution to the literature in this direction. The study is also expected to contribute to executives of global airline alliances and their member airlines in terms of crisis management.

The study consists of five sections, namely the introduction section where the purpose and motivation of the research are explained, the literature section on the strategic airline alliances, the methodology section where the data and methods used in the study are explained, the findings section where the findings obtained as a result of the analyzes are presented, the conclusion and recommendations section which includes general inferences, research limitations and suggestions for future studies.

LITERATURE REVIEW

In the first part of this section, global airline alliances are introduced and their advantages and disadvantages are listed. In addition, the second part includes studies investigating the performance of global airline alliances in the literature.

An Overview of Global Airline Alliances

The deregulation, privatization, and globalization movements in the aviation industry paved the way for the emergence of new strategies that started with the merger and acquisition attempts of the airlines and continued with the establishment of strategic alliances (Oum, Park, Kim, and Yu, 2004). Joining global airline alliances following legal restrictions in merger and acquisition practices has gained popularity as a strong business strategy preferred by airlines adopting a competitive differentiation strategy against low-cost airlines and aiming to expand their market share on a global scale (Iatrou and Alamdari, 2005; Wang, 2014). Global airline alliances are defined as cooperation agreements between two or more airlines, which include operational partnerships and allow the member parties to preserve their business identities, increase competitiveness, and accordingly business performance (Morrish and Hamilton, 2002). Chang and Chiu (2016), stated that there are six types of strategic alliances that are commonly preferred among airlines, and sort these alliance types as sharing ground facility and operations agreements, code-sharing agreements, collaborative shipping agreements, coordination of flight schedules agreements, joint technology development agreements and joint marketing, promotion and advertising agreements.

Today, Star Alliance, which was founded in 1997 with 26 current member airlines (Star Alliance, 2022), Oneworld, which was founded in 1999 with 14 current member airlines (Oneworld, 2022), and SkyTeam, which was founded in 2000 with 18 current member airlines (SkyTeam, 2022), three major global airline alliances, with 58 member airlines in total, make up more than half of the global airline market (Peng and Lu, 2022). Alongside the three major successful airline alliances, there are numerous past failed airline alliance attempts (Kyrylenko et al., 2019). Novak, Symonenko, and Litvinenko (2009) list the reasons for the failure of airline alliances as the inconsistency between the needs and goals and the size of the airline alliance, wrong choices were made in the selection of the airlines that are members of the alliance, the ongoing international competition between the member airlines within the alliance, and the extreme difficulties of controlling alliances which formed with the participation of many airlines.

One of the biggest advantages of strategic alliances for airlines is that it facilitates airlines' goals of growth and gaining access to global markets by sharing the service network among the alliance members (Peng and Lu, 2022). Strategic alliances established between airlines make it possible to overcome the

restrictions imposed by legal regulations and allow airlines to access airports in foreign countries within the alliance, thanks to the cooperation between alliance member airlines at the point of market access (Wan, Zou, and Dresner, 2009). In addition, global airline alliances provide benefits to member airlines in terms of reducing environmental uncertainty, sharing information (Ireland et al., 2002), benefiting from the advantages of scope and economies of scale, and thus both reducing unit costs and increasing traffic density and therefore profitability (Weber and Dinwoodie, 2000). In addition to its contributions to airlines, strategic alliances provide various advantages for passengers such as access to more flexible and alternative flight schedules, shorter travel times due to operational and schedule-based improvements, and common frequent flyer programs (Wang, 2014).

Along with the advantages that global airline alliances provide to airlines, they also bring some disadvantages. Airlines cooperating in the same alliance, on the other hand, continue to compete with each other (Kopeć and Wolanin, 2019). Klophaus and Lordan (2018), pointing out that the parties have access to information of strategic importance about each other, state that the parties can use the information they have while they are members of the alliance to gain a competitive advantage after leaving the alliance. Another negative situation created by the alliances is that the members of the alliance cannot benefit from the opportunities offered by the alliance equally. As a matter of fact, Kyrylenko et al. (2019), states that small-scale airlines in the alliance provide more benefits than large airlines. On the other hand, the risk of global airline alliances creating monopoly markets stands out as one of the biggest dangers posed by alliances for non-member airlines (Annaç Göv, 2020). It is predicted that the monopoly markets that will be formed with the increase in the number of global airline alliances will lead to a decrease in the total number of airlines (Greenberg, 1990; Morrish and Hamilton, 2002).

Performance Studies on Global Airline Alliances

When the studies in the literature are examined, it can be said that the studies focus on airline performance rather than global airline alliances and there are limited empirical studies on the performance analysis of global airline alliances. Some of these studies are exemplified below.

Kuzminykh and Zufan (2014) discussed the impact of airline alliances on business performance in their study, in which they used the panel data analysis method. Their finding shows that membership in a strategic airline alliance has significant importance on airline turnover and total assets. Min and Joo (2016) performed a competitive performance analysis of strategic airline alliances. They used the DEA method to analyze the effect on the performance of being a member of strategic airline alliances. Their findings were limited to individual airlines' performance for the selected period, not the strategic alliances' performance.

Douglas and Tan (2017) performed the profitability analysis of global airline alliances in their studies using the difference-in-difference method. Their study has found no evidence of airline alliances' positive effect on the economic performances of their member airlines. Payan-Sánchez, Pérez-Valls, and Plaza-Úbeda (2019) examined the contribution of global airline alliances to the environmental performance of airlines by employing ANOVA analysis. Their findings show that airline alliances hurt airlines' environmental performance while they have a positive impact on their economic and operational performance. Thendu (2020) analyzed the impact of global airline alliances on the performance of airlines using a literature-based analysis method. The findings of the paper show that being a member of strategic alliances creates various operational advantages for the airlines while this does not always increase airlines' performance. Kiracı and Bakır (2020) performed the performance analysis of Star Alliance member airlines using CRITIC and CODAS methods. Their study focuses on airlines individually rather than examining global airline alliances as a whole. Their findings show that financial indicators have a greater impact on the airlines' performance than operational indicators. Asker (2021), analyzed the financial performance of global airline alliances before the Covid-19 pandemic by using the data envelopment technique. The result of the study shows the change in strategic cooperation level between the member airlines of the strategic alliances for the period which the study aims to analyze. Peng and Lu (2022), examined the effects of cooperation between global airline alliances in Asian airports by using the Herfindahl-Hirschman Index (HHI) and Entropy Index (EI) methods. The study focuses on ten selected Asian airports and the performance of the strategic alliance member airlines which use these selected airports for the data which belongs to 2018.

As seen above, the studies examining the performances of global airline alliances and member airlines discussed the period before the Covid-19 pandemic crisis. However, Tanriverdi (2022) is the only study encountered in the literature which examines the impact of the Covid-19 pandemic on the sustainability of global airline alliances through Twitter data. At this point, it is important and original that it allows the comparative analysis of the performance of the global airline alliances during the Covid-19 pandemic process with the performance data of the year 2020 within the scope of the current study. In addition, as seen above most of the studies focus on airlines individually while this paper focuses on strategic airline alliances' performance as a whole. From this perspective, it is expected that the study will contribute to the literature, especially in terms of presenting the critical success factors for the alliance, which is relatively more successful than the others by better managing the pandemic period. In addition, it is predicted that this study differs from previous studies in that it focuses on strategic airline alliances rather than airlines individually and will contribute to the literature in this sense too.

METHODOLOGY

Within the scope of the study, global airline alliances are discussed as one of the strategic airline alliances. In this context, the performance data of 35 airlines (17 Star Alliance members, 9 SkyTeam Alliance members, and 9 Oneworld Alliance members) are analyzed comparatively and comprehensively for the four years between 2017 and 2020 by using multi-criteria decision-making methods. The CRITIC method (Diakoulaki et al., 1995) is used to determine the importance levels of the performance criteria used in the study, and the CoCoSo method (Yazdani et al., 2018) is used to rank the airlines and thus their alliances according to their performance.

In this study, in which the performance analysis of airlines that are members of strategic airline alliances, CRITIC and CoCoSo methods from MCDM methods were used. There are two main reasons why the CRITIC method is preferred as one of the objective-based methods in the weighting of the criteria in the study. The first one is that while mathematical operations should be performed after enumerating the results obtained by referring to the opinions of the decision-makers in subjective methods, it can be used in situations where direct numerical data can be accessed and reliable subjective weighting cannot be done (Wang and Lee, 2009). Secondly, in the preference of the CRITIC method as one of the objective-based methods, it comes to the fore as a model developed for weighting the criteria, especially in the performance analysis of enterprises. When the relevant literature is examined, it has been determined that the CRITIC method is applied as a preferred method, especially in the performance analysis of enterprises. The CRITIC method was used by Diakoulaki et. al. (1995), who developed the method, to weigh the criteria in a study in which the performance of 8 companies in the Greek pharmaceutical market was analyzed. Hsu et al. (2015), in their study on the sustainable performance analysis of high-tech businesses in Taiwan, Kiracı and Bakır (2018), in their study on the analyze the performance data of 13 airline companies before and after the global economic crisis between 2005 and 2012, also Kiracı and Bakır (2020), in their studies where they carried out the performance analysis of Star Alliance member airlines and Aydın (2020), used the CRITIC method to weight the criteria in their studies where they carried out the performance analysis of public banks in Turkey.

In the second stage of the study, the CoCoSo method, which is a relatively new method, was applied to rank the airline companies and related global airline alliances according to the performance data based on the criteria weighted in the first stage. In the CoCoSo method, the alternatives are first evaluated with the help of three different equations and then the final ranking is reached by integrating the equations. When the relevant literature was scanned, some studies were found in which the CoCoSo method was used to rank the alternatives. Ecer et al. (2019), in their study on sustainability assessment of OPEC countries, Ulutas et

al. (2020), in their study on location selection for logistics centers, Ecer and Pamucar (2020), in their study on sustainable supplier selection, Lai et al. (2020), in their cloud service producer selection study, Torkayesh et al. (2021), in their comparative assessment of social sustainability performance study, Popovic (2021), in his study on the selection of personnel to be recruited, and Deveci et al. (2021), in their studies to determine the priority of vehicle transit as a solution to traffic congestion, and Ecer and Aycin (2022), in their study where they measured the innovation performance of G7 countries, applied the CoCoSo method to ranking the alternatives.

In the study, alliance performances through airlines are evaluated on 3 financial and 4 operational criteria as can be seen in Table 1. While net profit, total income, and operating result criteria are used as financial criteria, revenue passenger kilometer (RPK), available seat kilometer (ASK), load factor (LF), and passenger number (PAX) are used as operational criteria. The reason why these criteria are selected is that these criteria are the most important in terms of the sustainability of an airline company, and global airline alliances are formed by airline companies. Operational data on alliance members were gathered from the annual sector analysis reports of Airline Business magazines published by Flight Global and the annual reports of airlines. Thomson Reuters Data Stream database, annual sector analysis reports of Airline Business magazines, and airlines' annual reports were used for reaching financial data.

Table 1: Performance Criteria and Definitions

Performance Criteria	Criteria Type	Definitions
Total Revenue (TR)	Max	The whole revenue received by airlines.
Net Profit (NP)	Max	The sum of airlines' net profits.
Operating Result (OR)	Max	The difference, whether positive or negative, between an airline company's operating income and operating expenses.
Revenue Passenger Kilometer (RPK)	Max	The value is calculated by multiplying the flight distance for a fee by the number of passengers.
Available Passenger Kilometer (ASK)	Max	The value is calculated by multiplying the flight distance for a fee by the number of seats.
Load Factor (LD)	Max	It is the proportion between revenue passenger-km and available seat km.
Total Passenger (PAX)	Max	The total number of passengers transported by airlines during a period.

The proposed research model of the study is as in Figure 1. As can be seen from Figure 1, after the criteria and alternatives are determined, data collection was carried out for each alternative. In the next step, the CRITIC method is used to determine the criterion weights. Then, the weights calculated by the CRITIC method are transferred to the CoCoSo method, and the performances of the member airlines are investigated separately for each alliance and each year. In the last stage, global airline alliances are compared through the averages of the member airlines' performances. In the next section, the CRITIC and CoCoSo methods used in this study are explained in detail.

Figure 1: Proposed research model

CRITIC Method

Determination of criterion weights (importance levels) in multi-criteria decision-making methods (MCDM) is one of the main problems of studies. In determining the criteria weights, subjective approaches in which the opinions of decision-makers or experts participating in the decision process are included or objective approaches in which the criteria weights are determined based on the decision matrix alone are used (Žižović, Miljković and Marinković, 2020). Although there are many different objective weighting methods in the literature, one of the frequently used methods is the CRITIC (Criteria Impartance Through Intercriteria Correlation) method developed by Diakoulaki et al. (1995). In the CRITIC method, criterion weights are obtained from the contrasts in the structure of the decision problem and the density of these contrasts (Diakoulaki et al., 1995).

The following stages are followed in the application of the CRITIC method, respectively (Çakır and Perçin, 2013; Kiracı and Bakır, 2018):

Step 1: Construction of the decision matrix

While employing the CRITIC method, in the first step, as in other MCDM methods, a decision matrix is created, which includes the criteria and alternatives related to the decision problem (Equation 1).

$$X = [X_{ij}] = \begin{bmatrix} x_{11} & x_{12} & \dots & x_{1n} \\ x_{21} & x_{22} & \dots & x_{2n} \\ \dots & \dots & \dots & \dots \\ x_{m1} & x_{m2} & \dots & x_{mn} \end{bmatrix} \quad i = 1, \dots, m; \quad j = 1, \dots, n \qquad (1)$$

As seen in Equation (1), in X_{ij} expression, " i " alternative represents " j " criteria, while there are " n " criteria and " m " alternatives in the decision matrix (Alinezhad and Khalili, 2019).

Step 2: Normalization of the decision matrix

At this stage, the criteria values in the decision matrix are converted into common units as a result of the normalization process by using Equations (2-3) (Madić and Radovanović, 2015).

$$r_{ij} = \frac{x_{ij} - x_j^{min}}{x_j^{max} - x_j^{min}} \quad i = 1, \dots, m; \quad j = 1, \dots, n \quad for\ benefit\ criterion \qquad (2)$$

$$r_{ij} = \frac{x_j^{max} - x_{ij}}{x_j^{max} - x_j^{min}} \quad i = 1, \dots, m; \quad j = 1, \dots, n \quad for\ cost\ criterion \qquad (3)$$

In Equation (2-3), "x_j^{max}", is the highest value for the j criterion, and "x_j^{min}", is the lowest value for the j criterion.

Step 3: Calculation of correlation coefficients

To measure the relationship between the criteria values, the $R = (\rho_{jk})_{mxm}$ a matrix consisting of linear correlation coefficients ρ_{jk} is created with the help of the formula in Equation (4) (Çakır & Perçin, 2013).

$$\rho_{jk} = \frac{\sum_{i=1}^{m}(r_{ij} - \bar{r}_j)(r_{ik} - \bar{r}_k)}{\sqrt{\sum_{i=1}^{m}(r_{ij} - \bar{r}_j)^2 \sum_{i=1}^{m}(r_{ik} - \bar{r}_k)^2}} \quad j,k = 1,\dots,n \qquad (4)$$

In Equation (4), ρ_{jk} refers to the correlation coefficient between "j." and "k." criteria values (Alinezhad and Khalili, 2019).

Step 4: Calculation of C_j values

At this stage, after calculating the standard deviation (σ_j) for each value criterion, C_j value, which represents the total information found in the "j." value criterion, is calculated with the help of the formula in Equation (5) (Alinezhad and Khalili, 2019; Çakır and Perçin, 2013).

$$c_j = \sigma_j \sum_{k=1}^{n}(1 - \rho_{jk}) \quad j = 1,\dots,n \qquad (5)$$

When the results obtained from Equation (5) are considered, it can be deduced that the criteria with higher C_j value express more information and therefore the specific criterion has relatively higher importance for the multi-criteria decision-making method (Diakoulaki et al., 1995; Madić and Radovanović, 2015).

Step 5: Calculation of Criteria Weights

In the last step of the CRITIC method, with the help of the unit values obtained as a result of the normalization of the C_j values obtained by Equation (5) by using Equation (6), "j." criterion weights (w_j) expressing the weight coefficient for the criterion are calculated (Diakoulaki et al., 1995).

$$w_j = c_j / \sum_{k=1}^{n} c_k \quad j = 1, \dots, n \tag{6}$$

The importance levels of the criteria are determined by ordering the w_j values obtained as a result of the weighting process performed with the help of Equation (6) from the biggest to the smallest.

CoCoSo Method

The use of the CoCoSo (Combined Compromise Solution) method developed by Yazdani et al. (2018) has been gaining popularity in recent years. In the application of the CoCoSo method, the priorities of the alternatives are first evaluated with three different equations, and then the priorities are integrated to reach the general rankings (Gençkaya, Gündoğdu, and Aytekin, 2021). The CoCoSo method consists of the stages of creating the decision matrix, normalizing the decision matrix, generating the gray relational and multiplicative comparison values, making the relative evaluations of the alternatives, and creating the integrated scores of the alternatives (Gençkaya et al., 2021; Yazdani et al., 2018). Since the creation of the decision matrix in the first step and the normalization of the decision matrix in the second step are similar to other MCDM methods, and the related equivalences are under the title of CRITIC method, they are not mentioned in this section.

Step 3: Generating the gray relational and multiplicative comparison values

After the creation and normalization of the decision matrix, S_i values based on the gray relational approach are calculated using Equation (7) in this step (Yazdani et al., 2018).

$$S_i = \sum_{j=1}^{n} w_j z_{ij} \tag{7}$$

With the help of Equation (8), P_i values are calculated based on WPM (Weighted Product Model), which is also used in the WASPAS (Weighted Aggregated Sum Product Assessment) method (Yazdani et al., 2018).

$$P_i = \sum_{j=1}^{n} (z_{ij})^{w_j} \tag{8}$$

Step 4: Making the relative evaluations of alternatives

Relative evaluation scores of the alternatives are calculated with the help of Equations (9-11) containing the different effect levels of the S_i and P_i values. (Gençkaya et al., 2021).

$$k_{ia} = \frac{P_i + S_i}{\sum_{i=1}^{m}(P + S_i)} \quad (9)$$

$$k_{ib} = \frac{S_i}{min_i\, S_i} + \frac{P_i}{min_i\, P_i} \quad (10)$$

$$k_{ic} = \frac{\lambda S_i + (1-\lambda)P_i}{\lambda(max_i S_i) + (1-\lambda)(max_i P_i)} \qquad 0 \le \lambda \le 1 \quad (11)$$

Yazdani et al. (2018), who developed the CoCoSo method, state that the λ value in Equation (11) is generally taken as λ =0.5 by the decision-makers. On the other hand, if different values are selected for λ in the range of 0-1, the effect levels of S_i and P_i values may vary (Gençkaya et al., 2021).

Step 5: Creation of integrated scores of alternatives

The results obtained as a result of applying Equation (9-11) are integrated through Equation (12).

$$k_i = (k_{ia}.k_{ib}.k_{ic})^{\frac{1}{3}} + \frac{1}{3}(k_{ia} + k_{ib} + k_{ic}) \quad (12)$$

The solution to the problem is completed by ordering the alternatives from the biggest to the smallest according to the $k_i$values obtained after applying Equation (12).

APPLICATION AND RESULTS

This section presents criteria weights calculated via the CRITIC method and comparative performance results of global airline alliances achieved via CoCoSo.

Determination of Criteria Weights

In the first step of this stage, the financial and operational data collected for each alliance member airline were transferred to the decision matrices, an example of which is included in Appendix 1 and created separately for each alliance on an annual basis. As seen in Table 1 and Appendix 1, all of the criteria in the decision matrix are benefit criteria in terms of benefit-cost. These criteria are wished by the airlines to increase since higher values of the relevant criteria will bring the performance of the airlines to a better place. Thus, these criteria are accepted and used as benefit criteria in this study. After the decision matrix was created, the normalized decision matrices, the example of which is included in Appendix 2, were obtained with the help of Equation 2. After this stage, Pearson correlation coefficients for the criteria were determined through Equation 4 and standard deviations of the criteria were determined using Equation 5. In the last step, criterion weights were calculated using Equation 6. At this point, it is worth noting that there is a direct proportionality between the criteria weights and the importance level of the criteria. As the criterion weight increases, the importance of the criterion increases, and as the criterion weight decreases, the importance level of the criterion also decreases.

The criteria weights obtained by years for each global airline alliance using the CRITIC method are given in Appendix 3. Accordingly, while operating result and load factor were the most important criteria for Star Alliance in 2017, 2018, and 2019, net profit and the operating result were in first place in 2020. Considering the criteria weights according to the years obtained for the SkyTeam alliance performance evaluation, it is seen that the criteria that are important for the SkyTeam alliance are exactly the same as those of the Star Alliance. Finally, it seems that there is a different situation for Oneworld. While the load factor ranked first among the important criteria in 2017, this criterion is followed by operating result. In 2018, it is seen that RPK and ASK, among the operational criteria, share the first place with equal importance. While load factor and net profit were in the first two places, respectively, in 2019, net profit and operating result took the first two places in 2020 after Covid-19.

Performance Evaluation of Global Airline Alliances

At the stage of evaluating the airline performances, the airlines were ranked by revealing their performances within the alliance they are a member of, via the CoCoSo method. To do this, first, the decision matrices, which are included as an example in Appendix 1, were created, and then the values of the criteria were normalized. An example decision matrix created as a result of normalization is given in Appendix 4. In the second step, the normalized matrix values were converted to S_i and P_i values using Equation 7 and Equation 8. In the next step, with the help of Equation 9, Equation 10, and Equation 11, k_{ia}, k_{ib} and k_{ic}

values were found, respectively. Finally, the performance scores of the airlines (k_i) within each alliance were obtained by combining these three values with Equation 12.

Performance rankings by years obtained for airlines within each global airline alliance using the CoCoSo method are given in Appendix 5, Appendix 6, and Appendix 7. In addition, Appendix 8 presents the annual global airline alliance performances obtained by averaging the performance score of member airlines within each alliance. Accordingly, Star Alliance, which has the most members, ranked last among the three alliances in 2017 and 2020 and ranked second in 2018 and 2019. While the SkyTeam alliance completed 2020 as a leader during the Covid-19 period, it ranked second in 2017 and third in 2018 and 2019. Oneworld, on the other hand, held first place between 2017-2019, while it fell to second place after Covid-19. When considering overall scores and especially rankings of global airline alliances comparatively, it is seen that the Oneworld alliance is the number one among three alliances. Star Alliance and SkyTeam Alliance also take place as second and third, respectively. The Spearman test was subjected to ranking results obtained for years analyzed to test the consistency. When considering Spearman rank coefficients correlation, values of three global airline alliance as follow: Star Alliance: 0.000; SkyTeam: -0.316; Oneworld: 0.775. There is a very low correlation between the ranking results of global airline alliances by year, excluding Oneworld. Accordingly, it can be said that Oneworld has had a stable course over the years and has not experienced a serious shake-up during the Covid pandemic. However, Star Alliance and especially SkyTeam have experienced a serious fluctuation in terms of performance. It should be noted here that this fluctuation is due to the negative situation experienced by member airlines in terms of operating results and load factors. Performance ranking results of global airline alliances differing by years can be seen as a normal condition since strategies or responses of each global airline alliance member against some crises or to strategic actions of their rivals can differ. In another word, these results are reflections of ways followed by member airlines.

CONCLUSION AND RECOMMENDATIONS

This study comparatively analyzes the performances of three global airline alliances during and before the Covid-19 pandemic crisis for the years 2017-2020 by determining the performances of member airlines through the proposed CRITIC-CoCoSo methodology. To this end, global airline alliances were subjected to a four-year comparative examination in line with 3 financial and 4 operational criteria. While the CRITIC method was used to determine the importance of financial and operational criteria, the CoCoSo method was used to reveal airline performances within each alliance and thus, alliance performances by years. The results concluded in the study are listed and discussed with the results of similar studies in the literature below.

The first remarkable conclusion of the study is that operating result and load factor are critical factors in the success or failure of alliances, based on all years. In this respect, considering the number of members and overall ranking of the Star Alliance, although Star Alliance has almost twice in terms of member numbers against to the Oneworld alliance, it ranks second behind Oneworld. It can be explained that the performances of the Star Alliance members are lower than the Oneworld alliance members for the relevant years in line with these two criteria. Accordingly, Min and Joo (2016) similarly reveal that SkyTeam and Oneworld alliances are smaller than Star Alliance in terms of number of members, however, they tend to perform better than Star Alliance. Min and Joo (2016) state that the reason caused this is that with the increase in the size of the alliance, the organizational and technical harmony and assimilation among the members are delayed and this reflects negatively on the alliance's performance. At this point, Asker (2021), which examined the efficiencies of global airline alliances for the period between 2016 and 2019, argued that the decrease in the efficiency values of the Star Alliance in 2019 was due to the fact that the Star Alliance members provided flight services on a larger scale than the members of other alliances, rather than the number of members in the alliance. From this point of view, it can be stated that airlines that tend to enter into alliances should be careful in choosing the alliance that will allow them to be more compatible and achieve better performance. In addition, they need to consider the opportunities offered by three alternative alliances by taking into account the crisis periods. On the other hand, it is possible to say that the members of the Oneworld alliance rank first in the overall ranking and the success they have achieved in the relevant years is due to the load factor and operating result. It can be stated that American Airlines and British Airways, which are among the founders of the Oneworld alliance, pioneered the success of the Oneworld alliance through the successful strategies they followed during the Covid-19 crisis. On the other hand, Kiracı and Bakır (2020), who conducted a case study on the performances of Star Alliance member airlines between 2015 and 2017, unlike our study, revealed the critical success factors for airlines as financial structure ratios, and the liquidity ratios. According to another remarkable conclusion of this study, when the important criteria for each alliance in 2020 are examined in order to better understand the Covid-19 pandemic crisis period, it is seen that there is a consensus among the alliances in terms of the criteria. Net profit and operating result came to the fore as critical success factors for airlines and thus alliances for the period during the Covid-19 pandemic crisis. When the first times of the Covid-19 crisis are considered, it is normal to say net profit and operating result are important since airlines needed cash to sustain their existence.

This study, which comparatively analyzes the global airline alliances, one of the strategic airline alliances, during and before the Covid-19 pandemic crisis, has some limitations. The first limitation of the study is related to the sample. Within the scope of the study, 17 out of 26 Star Alliance members, 9 out of

18 SkyTeam Alliance members, and 9 out of 14 Oneworld Alliance members were able to reach. Since the sample of the study does not include all alliance members, it is not possible to generalize the results of this study. However, the results of the study still provide a view of the global airline alliances within the scope of the relevant years. Future studies may achieve a more comprehensive and valid analysis by reaching more or all airlines in the sample. Another limitation is the criteria. In the study, 4 operational and 3 financial criteria were used. Future studies may increase the number of financial and operational criteria for a more detailed analysis or perform a multidimensional analysis by including different performance dimensions. The third limitation of the study is related to the method used in the study. Other studies can be integrated with different classical or fuzzy multi-criteria decision-making methods using rough, fuzzy, or interval numbers. It is expected this study to contribute managers working for airlines within alliances and airlines which tend to attend an alliance.

AUTHOR STATEMENT

Researchers have jointly contributed to the article. Researchers have not declared any conflict of interest.

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APPENDIXES

Appendix 1: Example of decision matrix (Star Alliance-2019)

	Net Profit	Total Revenue	Operating Result	RPK (thousand)	ASK (thousand)	LD (%)	PAX (thousand)
Criteria Type	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**
Aegean Airlines	86960	1449141	-1218555	15768	18596	85	14900
Air Canada	1170000	14473000	1248000	151428	181518	83	51500
Air China	911366	19330956	-16307660	233178	287788	81	115000
Air New Zealand	175542	3761144	-3351547	38572	46029	84	17700
ANA Holdings	1015231	18863681	-15839003	89721	127438	70	52300
Austrian Airlines	220000	2356000	170000	2305	28510	81	14700
Eva Airways	130639	5946471	-5326961	48683	59673	82	12800
Jetblue Airways	569000	8094000	-6456000	86269	102720	84	42700
Juneyao Airlines	994000	167490000	1265000	34769,44	40799,47	85	22018
Lufthansa Airlines	2014000	25828000	1964000	168085	204202	82	71300
SAS	683100	5140000	1280000	39375	52371	75	29761
Singapore Airlines	499632	11946094	-10397798	140999	171211	82	35800
Swiss Airlines	628000	5381000	583000	53120	63325	84	21600
Thai Airways	-397735	5954246	-6905898	67166	84559	79	19400
Turkish Airlines	778093	13062676	-11992304	153186	187696	82	74300
United Continental	3009000	43259000	4301000	385130	458563	84	162400
Virgin Atlantic	370000	3880000	730000	39602	48832	81	5700

Appendix 2. Example of normalized decision matrix (Star Alliance-2019)

	Net Profit	Total Revenue	Operating Result	RPK	ASK	LD	PAX
Criteria Type	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**
Aegean Airlines	0,142	0,000	0,732	0,035	0,000	0,973	0,059
Air Canada	0,460	0,078	0,852	0,390	0,370	0,878	0,292
Air China	0,384	0,108	0,000	0,603	0,612	0,716	0,698
Air New Zealand	0,168	0,014	0,629	0,095	0,062	0,905	0,077
ANA Holdings	0,415	0,105	0,023	0,228	0,247	0,000	0,297
Austrian Airlines	0,181	0,005	0,800	0,000	0,023	0,703	0,057
Eva Airways	0,155	0,027	0,533	0,121	0,093	0,757	0,045
Jetblue Airways	0,284	0,040	0,478	0,219	0,191	0,919	0,236
Juneyao Airlines	0,409	1,000	0,853	0,085	0,050	1,000	0,104
Lufthansa Airlines	0,708	0,147	0,887	0,433	0,422	0,804	0,419
SAS	0,317	0,022	0,853	0,097	0,077	0,324	0,154
Singapore Airlines	0,263	0,063	0,287	0,362	0,347	0,811	0,192
Swiss Airlines	0,301	0,024	0,820	0,133	0,102	0,912	0,101
Thai Airways	0,000	0,027	0,456	0,169	0,150	0,608	0,087
Turkish Airlines	0,345	0,070	0,209	0,394	0,384	0,757	0,438
United Continental	1,000	0,252	1,000	1,000	1,000	0,919	1,000
Virgin Atlantic	0,225	0,015	0,827	0,097	0,069	0,723	0,000

Appendix 3: Criteria weights (for all alliances and all years)

	Year	Net Profit	Total Revenue	Operating Result	RPK	ASK	LD	PAX
Star Alliance	2017	0,104	0,089	0,285	0,105	0,106	0,208	0,103
	2018	0,125	0,068	0,308	0,073	0,074	0,275	0,076
	2019	0,092	0,162	0,233	0,108	0,114	0,173	0,118
	2020	0,208	0,139	0,208	0,115	0,109	0,116	0,104
SkyTeam Alliance	2017	0,109	0,095	0,354	0,095	0,097	0,138	0,113
	2018	0,109	0,093	0,358	0,097	0,100	0,129	0,115
	2019	0,105	0,096	0,324	0,137	0,101	0,126	0,112
	2020	0,188	0,122	0,200	0,120	0,115	0,135	0,120
Oneworld Alliance	2017	0,149	0,112	0,200	0,102	0,109	0,222	0,105
	2018	0,120	0,178	0,156	0,181	0,181	0,014	0,170
	2019	0,220	0,089	0,199	0,085	0,086	0,227	0,094
	2020	0,200	0,138	0,166	0,122	0,123	0,126	0,125

Appendix 4: Example of normalized decision matrix (Star Alliance-2019)

	Net Profit	Total Revenue	Operating Result	RPK	ASK	LD	PAX
Wj	0,092	0,162	0,233	0,108	0,114	0,173	0,118
Criteria Type	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**	**Max**
Aegean Airlines	0,142	0,000	0,732	0,035	0,000	0,973	0,059
Air Canada	0,460	0,078	0,852	0,390	0,370	0,878	0,292
Air China	0,384	0,108	0,000	0,603	0,612	0,716	0,698
Air New Zealand	0,168	0,014	0,629	0,095	0,062	0,905	0,077
ANA Holdings	0,415	0,105	0,023	0,228	0,247	0,000	0,297
Austrian Airlines	0,181	0,005	0,800	0,000	0,023	0,703	0,057
Eva Airways	0,155	0,027	0,533	0,121	0,093	0,757	0,045
Jetblue Airways	0,284	0,040	0,478	0,219	0,191	0,919	0,236
Juneyao Airlines	0,409	1,000	0,853	0,085	0,050	1,000	0,104
Lufthansa Airlines	0,708	0,147	0,887	0,433	0,422	0,804	0,419
SAS	0,317	0,022	0,853	0,097	0,077	0,324	0,154
Singapore Airlines	0,263	0,063	0,287	0,362	0,347	0,811	0,192
Swiss Airlines	0,301	0,024	0,820	0,133	0,102	0,912	0,101
Thai Airways	0,000	0,027	0,456	0,169	0,150	0,608	0,087
Turkish Airlines	0,345	0,070	0,209	0,394	0,384	0,757	0,438
United Continental	1,000	0,252	1,000	1,000	1,000	0,919	1,000
Virgin Atlantic	0,225	0,015	0,827	0,097	0,069	0,723	0,000

Appendix 6: Star alliance performance Scores

	Score 2017	Rank 2017	Score 2018	Rank 2018	Score 2019	Rank 2019	Score 2020	Rank 2020	Overall Score	Rank
Aegean Airlines	1,241	14	1,530	11	1,392	14	1,157	14	1,330	12
Air Canada	1,764	3	1,960	4	2,087	4	1,281	6	1,773	3
Air China	1,349	8	1,425	15	1,647	7	1,527	1	1,487	7
Air New Zealand	1,322	11	1,642	6	1,544	10	1,221	11	1,432	11
ANA Holdings	1,364	6	1,005	17	0,944	17	1,029	17	1,086	17
Austrian Airlines	1,085	16	1,583	10	1,378	15	1,200	12	1,312	14
Eva Airways	1,173	15	1,476	14	1,437	13	1,191	13	1,319	13
Juneyao Airlines	1,450	5	1,705	5	1,668	6	1,237	9	1,515	6
Lufthansa Airlines	1,945	2	2,033	3	2,258	2	1,251	8	1,872	2
SAS	1,286	12	2,243	2	2,247	3	1,235	10	1,753	5
Singapore Airlines	1,340	10	1,627	8	1,502	11	1,287	5	1,439	10
Swiss Airlines	1,362	7	1,614	9	1,589	9	1,298	4	1,466	8
Thai Airways	1,268	13	1,512	12	1,753	5	1,274	7	1,452	9
Turkish Airlines	1,343	9	1,495	13	1,225	16	1,077	16	1,285	15
United Continental	2,312	1	1,638	7	1,643	8	1,461	2	1,764	4
Jetblue Airways	1,515	4	2,630	1	3,034	1	1,393	3	2,143	1
Virgin Atlantic	0,850	17	1,216	16	1,473	12	1,103	15	1,161	16

Appendix 6: SkyTeam performance scores

	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Overall	Rank
	2017	**2017**	**2018**	**2018**	**2019**	**2019**	**2020**	**2020**	**Score**	
Aeroflot	1,677	5	1,535	1	1,580	5	1,679	2	1,618	3
Air France	2,167	1	1,483	2	1,869	1	1,436	3	1,739	1
Aeromexico	1,424	7	0,940	6	1,037	8	1,208	7	1,152	7
China Airlines	1,128	8	0,736	9	1,055	7	0,946	9	0,966	9
China Eastern Airlines	1,761	3	1,239	5	1,717	4	1,868	1	1,646	2
Delta Airlines	2,041	2	1,374	3	1,746	2	1,185	8	1,586	4
Garuda Indonesia	0,881	9	0,863	8	0,933	9	1,210	6	0,972	8
KLM	1,687	4	1,347	4	1,721	3	1,261	5	1,504	5
Korean Airlines	1,499	6	0,931	7	1,207	6	1,282	4	1,230	6

Appendix 7: Oneworld performance scores

	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Overall	Rank
	2017	**2017**	**2018**	**2018**	**2019**	**2019**	**2020**	**2020**	**Score**	
Alaska Air Group	1,977	4	1,965	5	2,141	3	1,370	4	1,863	4
American Airlines	2,172	2	5,149	1	3,410	1	1,212	7	2,986	1
British Airlines	2,577	1	3,274	2	2,656	2	1,489	2	2,499	2
Cathay Pacific Air	1,588	7	1,744	7	1,597	8	1,094	8	1,506	7
Finnair	0,732	9	0,774	9	0,788	9	1,248	6	0,885	9
Iberia	1,584	8	1,885	6	2,064	5	1,500	1	1,758	6
Japan Airlines	1,677	6	1,703	8	1,632	7	0,964	9	1,494	8
LATAM Airlines	1,985	3	2,026	4	1,941	6	1,376	3	1,832	5
Qantas Airways	1,874	5	2,197	3	2,070	4	1,346	5	1,872	3

Appendix 8: Comparative performance scores of global airline alliances

	Score	Rank	Score	Rank	Score	Rank	Score	Rank	Overall	Rank
	2017	**2017**	**2018**	**2018**	**2019**	**2019**	**2020**	**2020**	**Score**	
Star Alliance	1,410	3	1,667	2	1,695	2	1,248	3	1,505	2
SkyTeam Alliance	1,585	2	1,161	3	1,430	3	1,342	1	1,379	3
Oneworld Alliance	1,796	1	2,302	1	2,033	1	1,289	2	1,855	1