8 (1): 56-65 (2024)

Journal of Aviation

https://dergipark.org.tr/en/pub/jav

e-ISSN 2587-1676

Assessment of Service Quality in Aviation Using the CRITIC-Supported TOPSIS Method: A Case Study of Central Airports in Asia

Sevim Yılmaz [1*], İlinay Güllü [2], Ayşe Susuz[3] and Eda Çınaroğlu[4]

[1*] Erciyes University, Aviation Management Graduate Student, Kayseri, Türkiye (svmylmzzzz@gmail.com)
[2] Erciyes University, Aviation Management Graduate Student, Kayseri, Türkiye (ilinaygll@gmail.com)
[3]Erciyes University, Aviation Management Graduate Student, Kayseri, Türkiye (ayse._susuz58@outlook.com)
[4]Erciyes University, Aviation Management Department, Kayseri, Türkiye (ecinaroglu@erciyes.edu.tr)

Article Info

Received: 05 September 2023
Revised: 18 January 2024
Accepted: 08 February 2024
Published Online: 26 February 2024

Keywords:
Aviation
Asian airports
Airport service quality
CRITIC
TOPSIS

Corresponding Author: *Sevim Yılmaz*

RESEARCH ARTICLE

https://doi.org/10.30518/jav.1353524

Abstract

In this study, the service quality performance of 14 central airports that are members of SKYTRAX in the Asian continent are analyzed. The data of 2022 are taken as basis in the analysis process. The aim of the study is to evaluate the service quality of the airports included in the analysis. In order to compare the service quality performances of the selected airports, The Criteria Importance Trough Intercriteria Correlation (CRITIC) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) methods from Multi-Criteria Decision-Making Methods (MCDM) are used. The data of the airports included in the analysis are obtained through SKYTRAX. While the importance degrees of the criteria of the alternatives are calculated by the CRITIC method, the ranking of the alternatives is obtained by the TOPSIS method. The criteria used in the analysis are security screening, arrival, departure, terminal comfort, terminal facilities, food and beverage services. According to the findings of the CRITIC method; it is concluded that the most important criterion is departure and the least important criterion is terminal comfort. According to the results of the TOPSIS method; Singapore Changi Airport ranks first in terms of service quality performance. Seoul Incheon and Tokyo Haneda airports follow this airport in the ranking. Mumbai Chhatrapati Airport takes the last place.

1. Introduction

Service quality is the whole of the positive impressions that companies leave on their customers as a result of the services they provide. Customers are cognitively affected by the service performance offered by companies. In this case, the service offered is reflected to the customers as an experience. Customers want to be completely satisfied with their experience. Today, companies that prioritize service quality and customer-oriented activities should integrate the idea of "everything starts with the customer" to all units of the organization. Companies acting with this idea should reconsider their operating processes in line with the feedback they receive from their customers. Service quality is also directly proportional to the performance and sensitivity of the company personnel while performing their duties. In the research conducted by Parasuraman and his colleagues, one of the pioneers of service quality, he emphasized that service is directly proportional to the consistency of behavior of the personnel, and therefore the businesses that produce the service have to guarantee uniform service quality. For this reason, it is of great importance that employees are experts in their fields, their attitudes towards customers and the ability to respond quickly and accurately to customers' requests. Service quality is ensured by both the performance of the employees and the adequacy level of the equipment and facilities allocated by the companies (Çekin, 2020, 26-27; Parasuraman et al. 1985, 42). At the same time, service quality can be improved by good management of the process. The desired level of service offered is proportional to the management skills of the company (Grönroos, 1984, 42).

The perception of the globalized world has brought some developments in the transportation sector, as in many other sectors. So much so that the sector needed more speed and security in line with these developments. Air transport is one of the most effective ways to respond to these needs in the sector. The liberalization process of air transport began in the United States in 1978. It has been inevitable for the sector to struggle with many problems in order to ensure its developmental activities along with this process. For this reason, competition among airline companies has increased and businesses operating in the sector have been greatly affected by global economic, social and political events (Özbek and Ghouchi, 2021, 584). Although air transport has a structure that is rapidly affected by economic crises, sudden changing weather conditions and political elements, it continues to develop with a rapid acceleration every day. The expected mobility in the aviation sector specifically affects the

development of sectors such as industry and international trade, which are connected to the sector together with the sector itself (Dalak et al. 2018, 2).

Airports are one of the most basic elements of the transportation process in the aviation industry, and these are the buildings required for the service needed in the realization of flights and passenger transfers. At the same time, it covers the areas that meet the special needs of the process from the take-off to the point where the aircraft will put wheels (Demir and Taşer, 2020, 69). Airports play an effective role in the revival of economic activity in the countries and regions where they are located and provide an increase in income levels. This income increase is directly proportional to the satisfaction of the passengers. The recent increase in commercial relations in the aviation industry has led to the development of a new understanding of competition in the market. The management unit at the airports has to focus on passenger-oriented studies in the service provided in order to have a greater say in this market (Kayapınar, 2015, 1). The service process at the airports starts with the arrival of the passengers at the airports, and then the other stages of the process begin when the passengers arriving at the airport pass through the security control without separating domestic or international lines. The earlier the passengers enter the airports, the greater the opportunity to benefit from the services in the building. Thus, the satisfaction of the passengers turns into positive with the behaviors of the terminal employees and this process continues with the ticket and baggage transactions. At this point, the service performance offered by the ground handling company also affects the overall service quality of the airport. While the next step for domestic passengers is the boarding halls, the next step for international passengers is passport control. The quality of the tax-exempt shopping points that international passengers can benefit from also increases the service quality of the airport. Airports service process ends with the boarding of the passengers (Tuncer and Gavcar, 2014, 188-189).

The aim of this study is to analyze the service quality performances of central airports in the Asian continent. When the studies measuring the service quality performance in the aviation sector are evaluated; it is observed that they mostly have based their samples on airlines. There are a limited number of studies dealing with the service quality performance of airports. In these studies, the airports are not classified as central or regional in measuring service quality performance. With these aspects, it is thought that this study fills the research gap in analyzing service quality in central Asian airports. Also, the most important criteria in service quality assessment of airports are researched in this analysis. The policy recommendations that will be generated concerning this topic are expected to benefit airports that are ranked low in terms of service quality. These can be mentioned as the main contributions of this study to the literature.

This study consisted of 5 parts. In the 2nd part, literature research on the subject is presented. In the 3rd part, data and method are included. Analysis and findings are given in the 4th section, and conclusions and recommendations are given in the 5th section.

2. Literature Review

In the literature review section, studies on service quality in aviation, studies conducted with the CRITIC method and studies carried out with the TOPSIS method are presented under separate headings.

2.1. Studies on Service Quality in Aviation

Fodness and Murray (2007) conducted a survey, taking into account the comments made by passengers about the aviation service quality of 65 airports. They combined qualitative and quantitative approaches in their studies. The methods used quantitatively are exploratory factor analysis and confirmatory factor analysis. As a result, they concluded that the development of service quality in aviation is parallel in academic studies, and the more this subject is included in the literature, the more the sector will develop.

Tsai et al. (2011) measured the aviation service quality of Taiwan International Airport in their study. The study used AHP, VIKOR and IPA multi-criteria techniques. In order to apply the criterion rating method, 12 criteria were included in the analysis. As a result, the three most important criteria for passengers are "on-time departure of flights" (11.85%), "inner direction line layout" (10.27%) and "accuracy of the flight information board" (10.06%).

In Pekkaya and Akıllı's study (2013), they measured how much 8 airlines operating in Türkiye care about the service quality of their passengers. Five dimensions of the SERVPERF/SERVQUAL scale were used in the study. These dimensions were safety, competence, physical environment, empathy and enthusiasm. A questionnaire was applied to 410 passengers using these five dimensions. The perceived and expected service quality was compared with the difference analysis using the survey results. With the analysis, it was concluded that the service quality was perceived as lower than expected in terms of the enthusiastic dimension, which is one of the dimensions of the SERVPERF/SERVQUAL scale. Other dimensions were perceived higher than expected.

The study by Pabedinskaite and Aksrinaite (2014) discussed the problems related to improving the airport service provided to airlines. The authors have conducted research using the SERVQUAL method to measure airport service quality. As a result, it is found out that the most important criterion for airlines is the quality of the aircraft and the least important criterion is the landing and parking service.

Hatipoğlu and Işık (2015) measured the service quality within the scope of domestic routes in airline transportation. In order to measure the service quality of AnadoluJet Airlines, a questionnaire was applied within the scope of SERVQUAL measurement model. As a result of the survey, it was determined that AnadoluJet's service quality is close to meeting expectations.

Bezarre and Gomes (2016) in their study, aimed to create a service model for airport service quality (ASQ) and test the equivalence of the model between passenger groups. For these purposes, the author applied a comprehensive survey to passengers at Guarulhos International airport in Brazil. He preferred the Confirmatory Factor Analysis method using the data obtained from the survey. As a result, it is concluded that the six-factor model created in the study was meaningful for the airport service quality (ASQ) perceived by passengers.

Pandey, M. M. (2016) aimed to evaluate the service quality performance of the two busiest airports operating in Thailand and to produce improvements by prioritizing the differing consumer needs throughout the process. The author used Fuzzy Multi-Criteria Decision-Making Analysis to measure service quality, and Improvement Performance Analysis to identify improvements. In his analysis, he used many criteria that refer to airports' accessibility, security, arrival services, facilities, and timing of services offered at airports. He concluded that the average service quality score of

Suvarnabhumi Airport was higher than the average service quality score of Don Mueang Airport.

In the study of Belbag and Belbag (2018), a survey was conducted using SERVQUAL measurement model to determine the service quality of existing local airlines in Türkiye. The survey results were evaluated with Type-2 fuzzy multi-criteria decision-making method. As a result of the study, the company with the highest service quality was determined as AnadoluJet.

Öztürk and Onurlubaş (2019) evaluated the service quality in air passenger transportation with AHP and TOPSIS methods in their study. The sample of the study consisted of the 3 most used airline companies (A, B and C) in Samsun, Türkiye. In addition to the five dimensions of service quality, in-flight comfort, aircraft employees, operations performed in extraordinary situations, service convenience and reliability, 15 service characteristics were also included in the study. The study showed that onboard comfort was the most important criterion and the highest service performance belonged to A airline company.

Prentice et al. (2019) conducted a research on the service quality provided to passengers departing from one of Australia's international airports in 2018. The study used a survey as the analysis method. As a result, if the service quality offered is at the desired level, passengers traveling from that airport have concluded that they will include it in their flight routes once again.

In a study by Altınkurt and Merdivenci (2020), the service quality offered by airlines to their customers traveling for business purposes was evaluated using AHP-based EDAS methods, one of the MCDM methods. In the study, they considered 11 airline companies that were members of SKYTRAX. As a result of the analysis, it was determined that the most important criterion among the service quality criteria is in-flight comfort. Ana Air ranked first in the ranking of airline companies in terms of service quality.

Shen and Yahya's study (2021), it was aimed to examine the service quality of low-cost airlines operating in Southeast Asia and to examine the effect of price on passenger loyalty through the passenger satisfaction link. The researchers applied the AIRQUAL model for the first time in low-cost airlines in Southeast Asia, unlike the literature. At the same time, they obtained a dataset by surveying 200 passengers to measure the satisfaction level of the passengers. As a result, they observed that there was a relationship between customer satisfaction with loyalty and price. In this case, they came to the conclusion that customer satisfaction was a vital factor for the survival of low-cost airlines in the aviation market where there was such intense competition.

Chonsalasin et al. (2021), in their study, aimed to measure the service quality of airports in Thailand. For this purpose, a questionnaire including seven dimensions of service quality was applied to 1037 passengers on domestic flights. These dimensions were: airport access, airport environment, security service, functionality of wayfinding signs, ticket offices, airport threats and airport arrival service. The researchers empirically analyzed the data set they obtained through Confirmatory Factor Analysis (CFA). They concluded that the most important of the seven dimensions included in the analysis was the security dimension.

Law et al. (2022) aimed to investigate the factors affecting service quality and customer satisfaction in the aviation industry. To achieve this goal, they created a dataset from a total of 400 passenger surveys in the public area on the departures and arrivals floors of Wattay International Airport.

Usman et al. (2022) conducted a literature review on the subject of airport service quality using 27 articles from 2000-2020. According to the results of the research, it was observed that there was a theoretical and practical gap in the relevant field, and in addition, it was concluded that focusing on passenger satisfaction would have a positive impact on the service chain.

2.2. Studies Using CRITIC Method

The studies in which the CRITIC method was used in the criterion weighting phase of different MCDM problems are given below.

Table 1. Critic Based Studies

Author	Period	Subject of Study	Methods	Conclusion
Can and Kargı (2019)	2016	Determination of risk levels within the framework of occupational health and safety of the sectors	CRITIC EDAS	The sector that produces processed petroleum products and coke was the sector with the highest risk level in terms of occupational health and safety.
Belbag, E. (2021)	2010-2019	Evaluation of the financial performance of participatory banks	CRITIC EDAS	Among the banks examined, Ziraat Bank's financial performance in 2019 was the best.
Satıcı, S. (2021)	2021	Evaluation of innovation performance of countries	CRITIC WASPAS	The countries with the highest innovation performance were Switzerland, Finland and Sweden.
Erkılıç, C. E. (2021)	2009-2019	Measuring the financial performance of the Hospital Services Unit operating in the health sector	CRITIC TOPSIS	It was concluded that the year with the highest performance was 2009.
Doğan, H. (2022)	2010-2020	Measuring Türkiye's macroeconomic performance	CRITIC ARAS	It was concluded that 2012 was the year in which Türkiye's macroeconomic performance was the best.

Keleş, M. K. (2022)	2016-2020	Evaluated the 5-year financial performance of Turkish Airlines.	CRITIC MABAC	While Turkish Airlines' best performance was 2019, its worst performance was 2016
Ecemiş and Avşar (2023)	2021	It examined the logistics performance index of Türkiye and its co-dominant countries.	CRITIC CODAS	As a result, it was concluded that the logistics performance index positively affects the economic development of countries.
Avşar, İ. İ. (2023)	2002-2022	To determine the level of impact of the Covid-19 epidemic on the aviation industry over the years	CRITIC PROME-THEE	It was concluded that the Covid-19 epidemic negatively affected the Turkish aviation industry. He concluded that 2012 was better than 2020
Güler and Polatgil (2023)	2022	The study conducted research on which of the university hospitals operating in Turkey is the most ideal.	CRITIC TOPSIS	As a result, the study concluded that Erciyes University Hospital is closest to the ideal and Bozok University Hospital is the furthest from the ideal.

2.3. Studies Using TOPSIS Method

The studies that used the TOPSIS method in the process of ranking the alternatives in different MCDM problems are given below.

Table 2. Topsis Based Studies

Author	Period	Subject of Study	Methods	Conclusion
Özden U. H. (2011)	2009	Ranking of the candidate countries in the European Union according to their economic performance	TOPSIS	Luxembourg was found to be the country with the highest economic success, while Greece was found to be the country with the lowest.
Yayar and Baykara (2012)	2005-2011	Examining the effectiveness and efficiency of participatory banks	TOPSIS	The bank with the best efficiency was Albaraka and the bank with the best efficiency was Bank Asya.
Ünlü et al. (2017)	2014	Evaluation of corporate governance and financial performance of BIST companies	CRITIC TOPSIS	It was concluded that there was no difference in financial performance among the 30 companies included in the corporate governance index and not in the BIST.
Çaylak, M. (2019)	2019	Best hotel selection	AHP TOPSIS	Crystal Sunrise Queen Luxury Resort & Spa ranked first.
Derse and Yontar (2020)	2020	Determination of the most suitable renewable energy source	SWARA AHP TOPSIS	It has been concluded that hydroelectric energy was a more suitable renewable energy source in our country compared to others.
Köse, Y. (2021)	2014-2019	The specific financial values of Turkish Airlines and Pegasus Airlines were examined	TOPSIS	Turkish Airlines' data was seen to be in a better situation than Pegasus Airlines' data.
Gütekin and Çarıkçı (2023)	2018-2021	The financial structures of Tav and Fraport companies operating in Turkey and Germany for the years 2018-2021 were examined	ENTROPİ TOPSIS	Tav company financial performance was good in 2018-2020. Fraport was good financial performance in 2021
Ergül and Kondak (2023)	2017-2021	The study aimed to analyze the financial performance of companies operating in the IT sector.	TOPSIS COPRAS	As a result, according to the TOPSIS method, it was concluded that the company with the best financial performance between 2017-2021 was LINK.
Geçer and Avşar (2023)	2021	The study aimed to evaluate the financial performances of 18 companies within the Istanbul Trade Office (ISO) and also operating in Borsa Istanbul.	TOPSIS ARAS	According to the results obtained from the analysis of the study, it was observed that DEVA and KARTN companies were the companies with the best financial performance.

When the studies measuring the service quality performance of airports were examined, very few studies were found that evaluated the performance of airports in the Asian continent. In addition, it has been observed that there is no distinction between central and regional airports in studies on this subject. In studies examining service quality at the airport with MCDM methods, there are few analyzes that weight criteria by using the CRITIC method. This study differs from the literature in terms of these factors.

3. Data and Method

3.1. Data Set

The data of the airports included in the study are obtained via SKYTRAX. SKYTRAX is an organization that established in England in 1989 to make international ratings in the aviation industry. The SKYTRAX certified airport ratings made by this organization are respected by the whole world. These ratings range from 1 to 5 stars. While 5 stars mean excellence for all dimensions of service quality, 1 star indicates that the service quality offered is not at a sufficient level (https://skytraxratings.com). 14 central airports with 4 and 5 stars located in the Asian continent are selected for analysis. The 2022 data of these selected airports are used. While creating the decision matrix the main criteria expressing the service quality are used. While creating these criteria, the criterion sample was differentiated and expanded by taking the food and beverage services criterion in the study of Bakır and Akan (2018) as reference. The initial matrix is created by taking the arithmetic average of the scores given for the sub-headings of these main criteria. The criteria based on the analysis are shown in Table 3 and the alternatives included in the analysis are shown in Table 4.

Table 3. Criteria based on the analysis

	Criteria
Security Screening	Crt.1
Arrival	Crt.2
Departure	Crt.3
Terminal Comfort	Crt.4
Terminal Facilities	Crt.5
Food and Beverage Service	Crt.6

This work consisted of two stages. In the first stage, the CRITIC method is used to determine the importance levels of the criteria used in the analysis. In the second stage of the study, the weight values obtained by the CRITIC method are integrated into the TOPSIS method and a ranking is handled among the alternatives. Analysis is carried out to evaluate the service quality performances of 14 airports in the central airports segment in SKYTRAX.

Table 4. Airports included in the analysis

	Alternatives (Airports)
Alt.1	Beijing Daxing *
Alt.2	Delhi Indira Gandhi *
Alt.3	Fukuoka*
Alt.4	Guangzhou Baiyun*
Alt.5	Taiwan Taoyuan*
Alt.6	Mumbai Chhatrapati Shivaji Maharaj*
Alt.7	Tokyo Narita*
Alt.8	Haikou Meilan**
Alt.9	Hong Kong**
Alt.10	Seoul Incheon**
Alt.11	Shanghai Hongqiao**
Alt.12	Shenzhen Bao'an**
Alt.13	Singapore Changi**
Alt.14	Tokyo Haneda**

Note: Airports marked with (*) denote 4-star airports, and airports marked (**) denote 5-star airports.

3.1.1. CRITIC Method

The CRITIC method, which is one of the criteria weighting methods, was developed by Diakoulaki et al. in 1995. The characteristics of the alternatives included in the analyzes are not parallel to each other. The criteria used in the evaluation process of alternatives have different weight values due to these different characteristics. Therefore, one of the most basic steps in the decision process is the weighting of the criteria. If the weighting is done by experts, it is called subjective weighting, and if it is carried out in accordance with the numerical values of the criteria, it is called objective weighting. CRITIC, which is one of the objective weighting methods, is used by many researchers due to its objective evaluation advantage. This method consists of 5 steps. These steps are detailed below (Diakoulaki et al., 1995, 765; Sakarya and İlkdoğan, 2022, 430-432):

Step 1: While applying the CRITIC method, in the first step, a decision matrix containing m decision alternatives and n criteria is created as in Equation (1).

$$x = [x_{ij}] = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \end{bmatrix} \quad (1)$$

Step 2: In this step, the decision matrix is normalized with the help of Equation (2) and Equation (3). Equation (2) is used for benefit criteria, while Equation (3) is used for cost criteria.

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

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

Step 3: In this step of the method, the correlation coefficient between the criteria is calculated. By using the r_ij values obtained as a result of the normalization step, the correlation value between the j and k criteria is calculated by means of Equation (4).

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

Step 4: In this step, the total amount of information is obtained through Equation (5). Equation (6) is used to reach the standard deviation value in this equation.

$$c_j = \sigma_j \sum_{k=1}^{n}(1 - p_{jk}) \qquad (5)$$

$$\sigma_j = \frac{\sqrt{\sum_{i=1}^{m}(r_{ij} - \bar{r}_j)^2}}{m} \qquad (6)$$

Step 5: In the last step of the method, criterion weights are calculated by Equation (7).

$$w_j = \frac{c_j}{\sum_{k=1}^{n} c_k}, j, k = 1,2, \dots, n \qquad (7)$$

3.1.2. TOPSIS Method

The TOPSIS method allows the selection of the best alternative among the alternatives and is one of the methods used by researchers in decision-making problems that pose an important problem in many areas. This method was developed by Yoon and Hwang in 1981. The main goal of the TOPSIS method is to determine the alternative that is closest to the positive ideal solution and farthest from the negative ideal solution (Öztel et al. 2018, 12). The method is preferred in the decision-making process in many different areas for reasons such as not having complex algorithms and mathematical expressions, being easy to interpret, and the convenience of the application stages (Avcı and Çınaroğlu, 2018, 325). The advantages of this method are utilized in areas such as financial applications, human resources management, supply chain management, production systems, marketing applications (Organ and Kaçaroğlu, 2020, 32). The ranking of alternatives by TOPSIS method can be expressed in the following 6 steps:

Step 1: While applying the TOPSIS method, firstly, the decision matrix is created as shown in Equation (1).

Step 2: In this step, the standard decision matrix is obtained by using Equation (8).

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{k=1}^{m} a_{k_j}^2}} \qquad (8)$$

Step 3: In this step, the standard decision matrix and the criterion weights are multiplied to form the V_{ij} matrix, which is represented by Equation (9).

$$V_{ij} = \begin{bmatrix} w_1 r_{11} & w_2 r_{12} \cdots w_n r_{1n} \\ w_1 r_{11} & w_2 r_{22} \cdots w_n r_{2n} \\ \vdots & \vdots \\ w_1 r_{m1} & w_2 r_{m2} \ \dots \ w_n r_{mn} \end{bmatrix} \qquad (9)$$

Step 4: After the V_{ij} matrix is created, positive and negative ideal solution values are determined in this step. Ideal solution values are represented by the symbols $A^*$and A^-. A^* denotes the positive ideal solution, while A^-denotes the negative ideal solution. A^* values are obtained by Equation (10), and A^-values are obtained by Equation (11).

$$A^* = \left\{\left(\max_i v_{ij} | j \epsilon J\right), \left(\min_i v_{ij} | j \epsilon J'\right)\right\} \qquad (10)$$

$$A^- = \left\{\left(\min_i v_{ij} | j \epsilon J\right), \left(\max_i v_{ij} | j \epsilon J'\right)\right\} \qquad (11)$$

While J in Equation (10) and Equation (11) refers to the set of benefit-oriented criteria, J' refers to the set of cost-oriented criteria.

Step 5: After determining the positive and negative ideal solution values, the distances of each alternative from the positive and negative ideal solution points are determined. Distances are calculated by Equation (12) and Equation (13).

$$S_i^* = \sqrt{\sum_{j=1}^{n}\left(V_{ij} - V_j^*\right)} \qquad (12)$$

$$S_i^- = \sqrt{\sum_{j=1}^{n}\left(V_{ij} - V_j^-\right)} \qquad (13)$$

Step 6: After determining the distances of the alternatives from the positive and negative ideal solution, the closeness values to the ideal solution are symbolized with $C_i^*$and calculated as in Equation (14). It takes values in the range $0 \leq C_i^* \leq 1$. Alternative ordering is also obtained by sorting the C_i^*values in descending order.

$$C_i^* = \frac{S_i^-}{S_i^- - S_i^*} \qquad (14)$$

4. Analyzes and Results

The analysis process is consisted of two basic steps. The first step is to determine the criteria weights with the CRITIC method and the second step is included ranking the central airports in the Asian continent in terms of service quality with the TOPSIS method.

4.1. Determining the Weights of the Criteria with the CRITIC Method

In the analysis, the importance levels of the criteria are calculated with the CRITIC method in 5 steps:

Step 1: In this step, the decision matrix is created in line with the data obtained from SKYTRAX. The decision matrix is shown in Table 5.

Table 5. Decision Matrix

	Crt.1	Crt.2	Crt.3	Crt.4	Crt.5	Crt.6
Alt.1	3.6	3.8	3.91	3.77	2.75	3.61
Alt.2	3.7	3.83	3.8	3.31	3.61	3.72
Alt.3	4.1	4	3.66	3.95	3.66	3.44
Alt.4	3.6	3.83	3.83	3.27	3.03	3.22
Alt.5	3.9	4.58	3.5	4	4.15	3.88
Alt.6	3.2	3.41	2.9	2.72	2.68	3.11
Alt.7	4.2	4.5	4.16	4.45	4.36	4.27
Alt.8	4.3	4.33	4.6	4.18	4	4.11
Alt.9	4	4.75	4.16	4.5	4.42	4.72
Alt.10	4.1	4.75	4.83	4.36	4.58	4.5
Alt.11	4.1	4.5	4.6	4.4	3.77	4.16
Alt.12	4.25	4.41	4.35	4.36	3.9	4
Alt.13	4.4	4.83	4.66	4.59	4.76	4.5
Alt.14	4.5	4.66	4.5	4.5	4.29	4.16

Step 2: Equation (2) and (3) formulas are used in the normalization of decision matrices. Equation (2) is used for benefit criteria and Equation (3) for cost criteria. Equation (2) is used because the criteria used in the study are beneficial. The normalized decision matrix is included in Table 6.

Table 6. Normalized Decision Matrix

	Crt.1	Crt.2	Crt.3	Crt.4	Crt.5	Crt.6
Alt.1	0.31	0.27	0.52	0.56	0.03	0.31
Alt.2	0.38	0.30	0.47	0.32	0.45	0.38
Alt.3	0.69	0.42	0.39	0.66	0.47	0.20
Alt.4	0.31	0.30	0.48	0.29	0.17	0.07
Alt5	0.54	0.82	0.31	0.68	0.71	0.48
Alt.6	0.00	0.00	0.00	0.00	0.00	0.00
Alt.7	0.77	0.77	0.65	0.93	0.81	0.72
Alt.8	0.85	0.65	0.88	0.78	0.63	0.62
Alt.9	0.62	0.94	0.65	0.95	0.84	1.00
Alt.10	0.69	0.94	1.00	0.88	0.91	0.86
Alt.11	0.69	0.77	0.88	0.90	0.52	0.65
Alt.12	0.81	0.70	0.75	0.88	0.59	0.55
Alt.13	0.92	1.00	0.91	1.00	1.00	0.86
Alt.14	1.00	0.88	0.83	0.95	0.77	0.65

Step 3: The correlation coefficients between the criteria used in this step are calculated using Equation (4). The binary correlation matrix is presented in Table 7.

Table 7. Bilateral Correlation Matrix

	Crt.1	Crt.2	Crt.3	Crt.4	Crt.5	Crt.6
Crt.1	1	0.82	0.80	0.90	0.82	0.72
Crt.2	0.82	1	0.76	0.92	0.94	0.92
Crt.3	0.80	0.76	1	0.81	0.68	0.78
Crt.4	0.90	0.92	0.81	1	0.84	0.88
Crt.5	0.82	0.94	0.68	0.84	1	0.89
Crt.6	0.72	0.92	0.78	0.88	0.89	1

Step 4: In this step, the total amount of information for the criteria is calculated.

Table 8. (1-P_{jk}) Matrix

	Crt.1	Crt.2	Crt.3	Crt.4	Crt.5	Crt.6
Crt.1	0	0.18	0.20	0.10	0.18	0.28
Crt.2	0.18	0	0.24	0.08	0.06	0.08
Crt.3	0.20	0.24	0	0.19	0.32	0.22
Crt.4	0.10	0.08	0.19	0	0.16	0.12
Crt.5	0.18	0.06	0.32	0.16	0	0.11
Crt.6	0.28	0.08	0.22	0.12	0.11	0

Step 5: The c_j values are applied to the Equation (7) formula and the criterion weights (w_j) are reached.

Table 9. Criterion Weight

	Crt.1	Crt.2	Crt.3	Crt.4	Crt.5	Crt.6
w_j	0.172	0.134	0.219	0.131	0.176	0.166
Ranking	3	5	***1***	***6***	2	4

The criteria weights and rankings reached as a result of the application of the CRITIC method are given in Table 9. According to the results, it is determined that the most important criterion determining the service quality at airports is "departure". The second and third ranked criteria are "terminal facilities" and "security screening" criteria. It is seen that the last criterion in the ranking is "terminal comfort".

4.2. Ranking of Alternatives with TOPSIS Method

The TOPSIS method is used to rank the alternatives in the analysis and the analysis is carried out in 6 steps. The criteria weights based on this method are obtained from the CRITIC method, which is an objective weight determination technique.

Step 1: In this step, the decision matrix in Table 5 is established.

Step 2: After the decision matrix is created, the Normalized Matrix is obtained with the help of Equation (8) and presented in Table 10.

Table 10. Normalized Decision Matrix

	Crt.1	Crt.2	Crt.3	Crt.4	Crt.5	Crt.6
Alt.1	0.240	0.235	0.253	0.248	0.188	0.242
Alt.2	0.247	0.237	0.245	0.218	0.247	0.249
Alt.3	0.273	0.247	0.236	0.260	0.250	0.231
Alt.4	0.240	0.237	0.247	0.215	0.207	0.216
Alt.5	0.260	0.283	0.226	0.263	0.284	0.260
Alt.6	0.213	0.211	0.187	0.179	0.183	0.209
Alt.7	0.280	0.278	0.269	0.293	0.298	0.286
Alt.8	0.286	0.268	0.297	0.275	0.274	0.276
Alt.9	0.266	0.294	0.269	0.296	0.302	0.317
Alt.10	0.273	0.294	0.312	0.287	0.313	0.302
Alt.11	0.273	0.278	0.297	0.289	0.258	0.279
Alt.12	0.283	0.273	0.281	0.287	0.267	0.268
Alt.13	0.293	0.299	0.301	0.302	0.326	0.302
Alt.14	0.300	0.288	0.291	0.296	0.294	0.279

Step 3: The Weighted Normalized Matrix is obtained with the help of Equation (9) and presented in Table 11.

Table 11. Weighted Normalized Matrix

	Crt.1	Crt.2	Crt.3	Crt.4	Crt.5	Crt.6
wj	0.173	0.135	0.219	0.131	0.176	0.166
Alt.1	0.041	0.032	0.055	0.033	0.033	0.040
Alt.2	0.043	0.032	0.054	0.029	0.043	0.041
Alt.3	0.047	0.033	0.052	0.034	0.044	0.038
Alt.4	0.041	0.032	0.054	0.028	0.037	0.036
Alt.5	0.045	0.038	0.050	0.035	0.050	0.043
Alt.6	0.037	0.028	0.041	0.023	0.032	0.035
Alt.7	0.048	0.037	0.059	0.038	0.053	0.048
Alt.8	0.050	0.036	0.065	0.036	0.048	0.046
Alt.9	0.046	0.040	0.059	0.039	0.053	0.053
Alt.10	0.047	0.040	0.068	0.038	0.055	0.050
Alt.11	0.047	0.037	0.065	0.038	0.045	0.046
Alt.12	0.049	0.037	0.062	0.038	0.047	0.045
Alt.13	0.051	0.040	0.066	0.040	0.057	0.050
Alt.14	0.052	0.039	0.064	0.039	0.052	0.046

Step 4: In this step, positive and negative ideal solution values are determined by Equation (10) and Equation (11) and presented in Table 12.

Table 12. Positive and Negative Ideal Solution Values

	Crt.1	Crt.2	Crt.3	Crt.4	Crt.5	Crt.6
Positive Ideal Solution Value	0.052	0.040	0.068	0.040	0.057	0.053
Negative Ideal Solution Value	0.037	0.028	0.041	0.023	0.032	0.035

Step 5: In this step, the distances of each alternative to the positive and negative ideal solutions are calculated using Equation (12) and Equation (13).

Step 6: The relative closeness values of the alternatives to the ideal solution are obtained by Equation (14) and shown in Table 13. in descending order.

The results obtained with the CRITIC supported TOPSIS method point out that the airport with the highest service quality performance among the central airports in the Asian continent is Singapore Changi Airport. In terms of service quality, Seoul Incheon International Airport and Tokyo Haneda Airport are ranked as the second and the third. The airport with the lowest service quality performance is determined as Mumbai Chhatrapati Shivaji Maharaj International Airport.

Table 13. Relative Closeness Values of Alternatives to the Ideal Solution and Rankings

	S_i^*	S_i^-	C^*	Ranking
Beijing Daxing*	0.034	0.019	0.357	12
Delhi Indira Gandhi*	0.028	0.020	0.415	11
Fukuoka*	0.027	0.023	0.452	10
Guangzhou Baiyun*	0.035	0.016	0.311	13
Taiwan Taoyuan*	0.024	0.027	0.532	9
Mumbai Chhatrapati Shivaji Maharaj*	0.048	0.000	0.000	***14***
Tokyo Narita*	0.013	0.037	0.743	5
Haikou Meilan**	0.013	0.037	0.734	6
Hong Kong**	0.012	0.039	0.767	4
Seoul Incheon**	0.006	0.044	0.880	2
Shanghai Hongqiao**	0.015	0.036	0.706	7
Shenzhen Bao'an**	0.016	0.034	0.686	8
Singapore Changi**	0.004	0.046	0.926	***1***
Tokyo Haneda**	0.010	0.040	0.803	3

Note: Airports marked with (*) denote 4-star airports, and airports marked (**) denote 5-star airports.

5. Conclusion and Suggestions

In today's world where time is very precious, fast and comfortable transportation has become a necessity rather than a request with the globalization and technological developments. For this reason, air transportation is emerging as a preferred transportation alternative every day in line with the benefits it provides to its passengers. Airports, which are the places where aviation services are offered, are also preferred in the same direction and became the doors of regions and countries opening to the world.

In this study, it is aimed to examine the service quality performance of airports based on the increasing importance of aviation in societies. Recently, the concept of service quality has become an important factor for managers in airports used by millions of people, with the spread of service production. Service quality has been an important issue for passengers as well as airport managers. This concept may have different meanings for each passenger, as it is effective in the preferences of passengers regarding their flights. Although there are differences, basically the level of meeting the common expectations and requests of the passengers for the flights to be made constitutes the service quality. As a result, service quality in aviation covers all of the intangible and tangible elements offered to passengers.

In this research, service quality performances in aviation are compared by using 2022 data of 14 central airports in the Asian continent. In order to achieve this aim, analyzes are made with MCDM methods, using the data obtained from the SKYTRAX website. The CRITIC method is preferred for criterion weighting and the TOPSIS method for ranking the alternatives. In the analysis, a total of 6 criteria expressing the service quality are taken as basis. According to the findings obtained as a result of criterion weighting, it is seen that the most important criterion is departure with a significance coefficient of (0.219), followed by terminal facilities (0.176), security screening (0.172) and food and beverage services (0.166). Bakır and Akan (2018) used the food and beverage services criterion in their study and found the importance level of the criterion to be 0.112. The reasons for the differences in this study may be the difference in the number of criteria, criterion sample and methods used. According to the CRITIC results, it can be said that the least important criterion is terminal comfort (0,131). According to the evaluation made with the CRITIC supported TOPSIS method, it is determined that the airport with the highest service quality is Singapore Changi Airport. According to the ranking obtained as a result of the analysis, Seoul Incheon is the second and Tokyo Haneda is the third. Mumbai Chhatrapati Shivaji Maharaj Airport is the last in ranking.

This study shows that the findings obtained by focusing on central airports in the Asian continent can provide important information to managers. It also provides important clues on issues such as evaluating performance differences between airports and developing new marketing strategies. The most important factors in evaluating the airport service quality are found as departure, terminal facilities and security screening. Managers taking strategic actions based on these findings can increase their airport service quality and contribute their success.

There are some limitations in this study. The data are obtained from passenger reviews on the relevant website on certain dates. On the other hand, this analysis, which includes 14 central airports and 6 criteria, may be insufficient to reflect the concept of service quality, which had a complex structure. It is obvious that the changes that may occur in the importance and scope of the criteria used in the application of the TOPSIS method may bring different results. For this reason, the analyzes can be repeated by increasing the number of airports examined or the number of criteria taken as basis in future studies. In addition, by applying different MCDM methods (ENTROPI, EDAS, CODAS, ARAS, AHP, etc.) to the same data set, the service quality performance results at the airports can be compared with the current study findings.

Ethical approval

Not applicable.

Conflicts of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

References

Altınkurt, T., & Merdivenci, F. (2020). Evaluation of Service Quality in Airline Companies by AHP-Based EDAS Methods. Journal of Aksaray University Faculty of Economics and Administrative Sciences, 12(4), 49-58.

Avcı, T., & Çınaroğlu, E. (2018). Financial Performance Evaluation of Airline Companies by AHP Based TOPSIS Approach. Journal of Economics and Administrative Sciences, 19(1), 316-335.

Avşar, İ. İ. (2023). Evaluation of Turkish Aviation Sector with Multi-Criteria Decision Making Methods: 2002-2022 Period. Bingöl University Journal of Social Sciences Instıtute (26), 153-169.

Bakır, M., & Akan, Ş. (2018). Evaluation of Service Quality in Airports Using Entropy and Topsis Methods: An Application on Europe's Busiest Airports. Electronic Journal of Social Sciences, 17(66), 632-651.

Bayram, E. (2021). Performance Evaluation of Participation Banks in Turkey with Critic Based Edas Method. The Journal of Financial Researches and Studies, 13(24), 55-72.

Belbag, S., & Belbag, A. G. (2018). A Quantitative Study on Examining Perceived Service Quality in Local Airlines. Press Academia Procedia, 7(1), 241-245.

Bezerra, G. C. L., & Gomes, C. F. (2016). Measuring airport service quality: A multidimensional approach. Journal of air transport management, 53, 85-93.

Can, G. F., & Kargı, Ş. (2019). Sectors' Risk Levels Evaluation in Term of Occupational Health and Safety with Critic-Edas Integration. Journal of Industrial Engineering, 30(1), 15-31.

Chonsalasin, D., Jomnonkwao, S., & Ratanavaraha, V. (2021). Measurement model of passengers' expectations of airport service quality. International Journal of Transportation Science and Technology, 10(4), 342-352.

Çaylak, M. (2019). Hotel Selection by Using Topsis Method. Oğuzhan Journal of Social Sciences, 1(2), 65-76.

Çekin, A. (2020). Perceived Service Quality in Airport Food and Beverage Companies: A Survey at Istanbul Airport (Master's thesis). Sakarya Uygulamalı Bilimler Üniversitesi Lisansüstü Eğitim Enstitüsü, Sakarya.

Dalak, S., Günay, F., Beyazgül, M., & Karadeniz, E. (2018). A Research on Using of Financial Analysis Techniques in Airline Companies Operating in Turkey. Journal of Business and Economic Studies, 6 (2), 1-14.

Demir, Ü., & Taşer, A. (2020). The Impacts of Service Innovations at Airports on Service Quality Perception and Passenger Satisfaction. Bilecik Şeyh Edebali University Journal of Social Science, 5(1), 68-87.

Derse, O., & Yontar, E. (2020). Determination of the most Appropriate Renewable Energy Source Byswara-Topsis Method. Journal of Industrial Engineering, 31(3), 389-419.

Diakoulaki, D., Mavrotas, G., & Papayannakis, L. (1995), Determining Objective Weights in Multiple Criteria Problems: The CRITIC Method, Computers & Operations Research, 22(7), 763-770.

Doğan, H. (2022). Evaluation of Turkey's Macroeconomic Performance for 2010-2020 With the CRITIC Based ARAS Method. Akademic Social Studies, 6(19), 189-202.

Ecemiş, O., & Avşar, İ. İ. (2023). Evaluation of the Logistics Efficiency of Türkiye's Leading Trading Partners by Multicriteria Decision Making. Kastamonu Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 25(1), 142-163.

Ergül, N, & Kondak, G. (2023). Analysis of Financial Performance of Companies in The It Sector. İstanbul Journal of Social Sciences, (37).

Erkılıç, C. E. (2021). Evaluating The Financial Performance of Hospital Services Sector by The Critic Based Topsis Method. Pamukkale University Journal of Social Sciences Institute, (46), 63-84.

Fodness, D., & Murray, B. (2007). Passengers' expectations of airport service quality. Journal of Services Marketing, 21(7), 492-506.

Geçer, N., & Afşar, B. (2023). Evaluation of the Financial Performance of ISO Member Companies in The ISO 500 2021 List By Topsis And Aras Methods. Journal of Business and Economics Studies, 11(2), 36-53.

Grönroos, C. (1984). A service quality model and its marketing implications. European Journal of marketing, 18(4), 36-44.

Güler, A., & Polatgil, M. (2023). Ranking of University Hospitals in Term of Services with The Critictopsis Method. Electronic Journal of Social Sciences, 22(88), 1828-1848.

Gültekin, G. and Çarikçi, O. (2023). Financial Performance Evaluation of Airport Operations According to The Business Model with The Entropy Based Topsis Method Mali Analiz/Mali Çözüm Dergisi, 33 (178), 1011-1034.

Hatipoğlu, S., & Işık, E. S. (2015). Measuring The Service Quality in Air Transport: A Case Study Domestic Lines. Kahramanmaraş Sütçü İmam Üniversitesi Sosyal Bilimler Dergisi, 12(2), 293-312.

Kayapınar, S. (2015). Improvement of Airport Service Quality. (Master's Thesis). Anadolu University, Department of Industrial Engineering, Eskişehir.

Keleş, M. K. (2022). Evaluation of Turkish Airlines' Performance by Years with The CRITIC Based MABAC Method. Journal of Applied Sciences of Mehmet Akif Ersoy University, 6(1), 53-67.

Köse, Y. (2021). Aviation Sector Specific Financial Ratios: Analysis and Evaluation on Airline Companies in Turkey. Journal of Financial Researches & Studies/The Journal of Financial Researches and Studies, 13(25), 623-636.

Law, C. C., Zhang, Y., & Gow, J. (2022). Airline service quality,customer satisfaction, and repurchase Intention: Laotian air passengers' perspective. Case Studies on Transport Policy, 10(2), 741-750.

Organ, A., & Kaçaroğlu, M.O. (2020). Evaluation of Private Universities in Turkey with Entropy Weighted TOPSIS Method. Pamukkale Journal of Business and Information Management, 7(1), 28-45.

Özbek, A., & Ghouchi, M. (2021). Performance Evaluation of Airlines Using Financial Ratios. International Journal of Engineering Research and Development, 13(2), 583-599.

Özden, Ü. H. (2011). Topsis Method with the European Union Member States of the Candidate and Mapping of Economic Indicators. Trakya University Journal of Social Science, 13(2), 215-236.

Öztel, A., & Aydın, B., & Köse, M. Said., (2018). Measurement of Corporate Sustainability Performance in Energy Sector by Entropy Based TOPSIS Method: Akenerji Case. Gümüşhane University Journal of Social Sciences Institute, 9 (24), 1-24.

Öztürk, D., & Onurlubaş, E. (2019). Assessment of Service Quality of Airline Industry Using AHP and TOPSIS Methods. Gümüşhane University Journal of Social Sciences Institute, 10, 81-97.

Pabedinskaitė, A., & Akstinaitė, V. (2014). Evaluation of the airport service quality. Procedia-Social and Behavioral Sciences, 110, 398-409.

Pandey, M. M. (2016). Evaluating the service quality of airports in Thailand using fuzzy multi-criteria decision-making method. Journal of Air Transport Management, 57, 241-249.

Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1985). A conceptual model of service quality and its implications for future research. Journal of marketing, 49(4), 41-50.

Pekkaya, M., & Akıllı, F. (2013). Statistical Analysis and Evaluation of Airline Service Quality by Servperf-Servqual Scale. The International Journal of Economic and Social Research, 75-96.

Prentice, C., & Kadan, M. (2019). The role of airport service quality in airport and destination choice. Journal of Retailing and Consumer Services, 47, 40-48.

Sakarya, Ş., & İlkdoğan, S. (2022). Evaluation of Financial Performance of Businesses Operating in The BIST IT Sector Within the Scope of Cash Flow Ratios with The CRITIC-Based TOPSIS Method. Pamukkale University Journal of Business Research, 9(2), 421-445.

Satıcı, S. (2021). Evaluation of the Innovation Performance of Countries with the CRITIC-Based WASPAS Method. Journal of Entrepreneourship and Development, 16(2), 91-104.

Shen, C., & Yahya, Y. (2021). The impact of service quality and price on passengers' loyalty towards low-cost airlines: The Southeast Asia perspective. Journal of Air Transport Management, 91, 101966.

Skytrax Certified Rating. Airport Star Rating Levels Date of access: 21.07.2023. https://skytraxratings.com/explaining-airport-star-ratings-levels

Tsai, W. H., Hsu, W., & Chou, W. C. (2011). A gap analysis model for improving airport service quality. Total Quality Management & Business Excellence, 22(10), 1025-1040.

Tuncer, B., & Gavcar, E. (2014). Determination of Factors Affecting the Quality of Airport Terminal Services. The Journal of Academic Social Science, 6(2), 183-211

Usman, A., Azis, Y., Harsanto, B., & Azis, A. M. (2022). Airport service quality dimension and measurement: a systematic literature review and future research agenda. International Journal of Quality & Reliability Management, 39 (10), 2302-2322.

Ünlü, U., Yalçın, N., & Yağlı, İ. (2017). Corporate Governance and Firm Performance: An Application on Bist 30 Firms with Topsis Method. Dokuz Eylul University the Journal of Graduate School of Social Sciences, 19(1), 63-81.

Yayar, R., & Baykara, H. V. (2012). An Implementation upon Efficiency and Productivity of Participation Banks with TOPSIS Method. Business and Economics Research Journal, 3(4), 21-42.

Cite this article: Yilmaz, S., Gullu, I., Susuz, A., Cinaroglu, E. (2024). Assessment of Service Quality in Aviation Using the CRITIC-Supported TOPSIS Method: A Case Study of Central Airports in Asia. Journal of Aviation, 8(1), 56-65.

This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 International Licence

Copyright © 2024 Journal of Aviation https://javsci.com - http://dergipark.gov.tr/jav