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Air Cargo Carrier Selection: The Case of Turkey

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Abstract

In this study, 5 companies operating in Turkey and carrying out the most air cargo shipments in 2021 (Turkish Cargo, MNG Airlines and Transportation, ACT Air Cargo, ULS Airlines Cargo Transportation and Sunexpress Cargo Transportation.) were investigated The aim is to evaluate and analyze them according to different criteria. These are 12 different criteria: Breadth of the network, the productivity of employees, adequacy of equipments, flexibility, undamaged delivery, image, cost, customer information systems, handling customer requests and complaints, special cargo handling capabilities, flight frequency, and punctuality. In the research design, using the Multi Criteria Decision Making (MCDM) method, the opinions of 9 different experienced and active experts in the sector were used to evaluate the relevant criteria. A scale of 1 to 5 was used in the evaluation of the companies, with a value of 5 representing the maximum benefit for this criterion. As a result of the research, it was found that the most significant criteria in selecting air cargo companies are undamaged delivery, costs, and on-time delivery. In addition, (1) image, (2) flexibility, and (3) special cargo handling capabilities are among the results of the research, which are the least significant criteria. Another important result of this research is that Turkish Cargo is ranked first and MNG Airlines and Transportation is ranked second.

1. Introduction

Logistics is one of the most important factors that enable a country to compete on the global stage. (Demirbilek et al., 2018). Logistics is one of the basic requirement for international trade (Gani, 2017; Klaus, 2009). However, it is not enough to meet these requirements alone. At this point, air transportation, which provides fast and reliable transportation services, is of great importance (Akoğlu & Fidan, 2020). Indeed, it is well known that air transportation is the mode of transportation which offers the greatest time advantage in freight transportation (Alshurideh et al., 2019).

Air transportation consists several activities that also serve service production (Öztürk & Onurlubaş, 2019). Agencies, carriers, insurance companies, and customs agents that provide the service in question work are inseparable elements of a whole (Doğan, 2003). Looking at these activities from a holistic perspective, it is clear that the airline industry is critically important at the national and international levels (Niosi & Zhegu, 2005). For example, the fact that air cargo traffic in the world will change between 0 and 70 million tons between 2004 and 2022 is the most important indicator of this situation. Another significant indicator relates to the Turkish air cargo sector. In fact, the Turkish air cargo industry has grown ten times faster than the world average. In addition, 145 companies operating in the Turkish air cargo sector received 15 new licenses.

The airport with the most license applications is Atatürk Airport (AHL). Esenboğa Airport (Ankara) and Adnan Menderes Airport (İzmir) are also among the airports with the most license applications. Thus, the breadth of Turkey's air cargo network is an indisputable fact. Especially the data from the last ten years are crucial at this point. Information on the above data are shown in Figure 2.

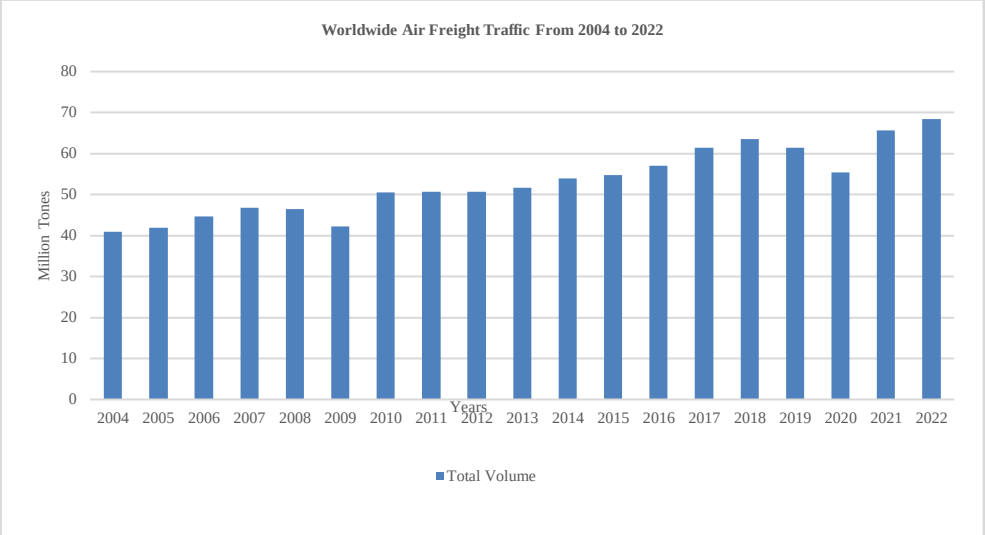

Figure 1. Worldwide freight traffic between 2004 and 2022 (Statisca, 2023)

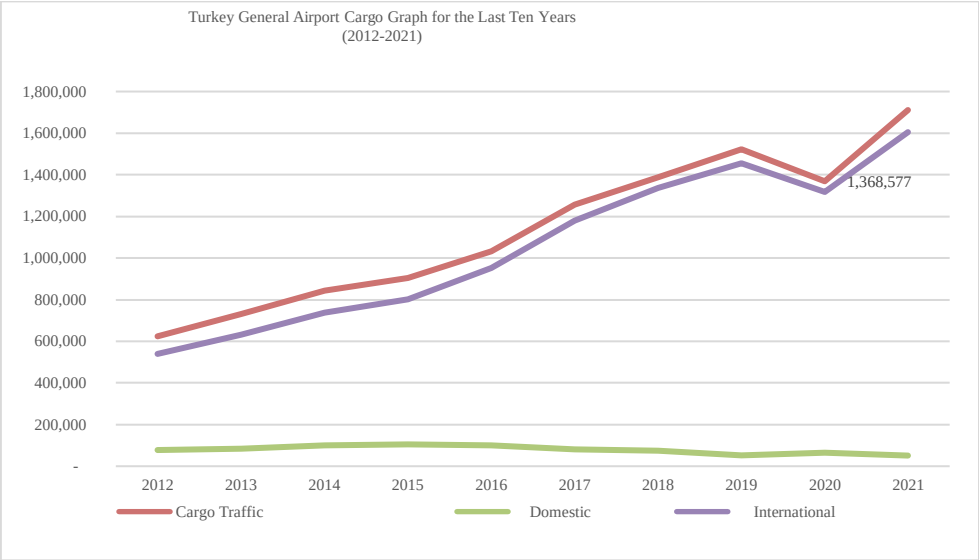

Figure 2. Ten years of air freight transport data in Turkey (DHMİ, 2022)

After the publication of the Civil Aviation Law in Turkey, the process of harmonization with the European Union came to the fore and the modernized airports started their operations. Within this process, reciprocal aviation agreements were signed with 159 countries. In the agreements concluded with these countries, the flight points and the number of flights are opened for cargo traffic. According to the 2011 data, 27 of the 346 aircraft are cargo aircraft. This number increased to 489 in 2015, and the number of airports increased to 60 in 2015 (Demirbilek et al., 2018). When cargo traffic data is analyzed, it is known that the total cargo traffic (1,368,577 tons) in 2020 decreased by 10.10% compared to 2019. When analyzing the cargo traffic in 2021 compared to 2020, it is found that there is an increase of 12.40% in cargo traffic (1,711,151 tons). On the other hand, domestic freight traffic, which decreased in 2020 (22.27%), exceeds the 2019 level by 61.90% in 2021. Similarly, international freight traffic, which decreased by 9.56% in 2021, exceeded the 2019 level by 10.17% in 2021.

In analyzing the estimated cargo and freight traffic at Turkish airports for 2022-2024, a total of 4,298,340 tons of cargo, mail and baggage traffic is predicted for domestic and international routes. In addition, 1,805,881 tons of cargo traffic is expected (DHMI, 2022). The most important result of this statistical data is the increase in the desire of companies that want to receive logistics services from a single source to take an active role in air cargo transportation (UTKİAD, 2023). In this case, it can be seen that the selection of the air carrier by the airlines operating in Turkey is of crucial importance. In order to address this importance, the relevant literature was reviewed and the weighting of the criteria for airline preference and evaluation of the companies in this sector was determined.

When examining the relevant literature, it has been found that there are studies such as Akoğlu & Fidan, 2020; Demirbilek et al., 2018; Niosi & Zhegu, 2005; Öztürk & Onurlubaş, 2019 which include different types of criteria. However, answering the question of which of these criteria is more important will be useful to both the relevant literature and practitioners. According to this purpose, an assessment was made by considering many criteria and companies collectively and 3 different multi criteria decision making methods were used together in this study.

2. Theorictical Review

The literature contains numerous studies on the selection of transportation companies in different sectors (Brooks 1990).

She examined the criteria used by shippers in Eastern Canada to evaluate ocean container carriers. Murphy et al., (1997) examined carrier selection using 18 criteria on both the carrier and shipper sides and found that both parties had similar expectations. Ergin,(2011) studied the selection of container carriers in the supply chain using the Fuzzy Analytical Hierarchy Process (AHP) and found that the most important criterion in carrier selection is safety. In their study, Kent & Parker (1999), examined the preferences of shippers, export carriers, and container ship carriers based on 18 criteria and found that damage, loss, and equipment adequacy that can occur in deliveries make significant differences. Wen & Lai (2010) concluded in their study using 8 criteria in air transportation that customers are willing to pay more for high-quality service.

In examining the literature on the criteria that are effective in selecting the carrier that is the subject of the study, similar results to this study were found for the criterion of the adequacy of equipment. A study conducted by Rajkarnikar (2010) emphasized the need for the use of high-quality and up-to-date equipment in handling the loads to be transported, arguing that the safety of the loads to be transported would be compromised if the equipment used to transport the loads was inadequate. Kent & Parker (1999) conducted a survey of transportation companies in their study and found that equipment adequacy is one of the most important criteria for transportation companies.

The relevant literature also contains numerous studies on worker competence. These studies argue that employee competence increases staff productivity and creates a well-functioning organizational climate (Chen et al., 2008). In another similar study, it is emphasized that logistics companies should focus on employee competence and that it is necessary to give importance to staff training in this direction (Punnakitikashem et al., 2013). Another criterion evaluated in this study is network width. Regarding network width, Bottani & Antonio (2006) emphasized that criteria such as service quality and on-time delivery are important for freight forwarders in competition, and argued that the width of the logistics network is also a differentiator.

Regarding the flexibility criterion, the flexibility problem of an airline investing in regional charter flights in Brazil was analyzed using 11 different criteria (Gomes et al., 2014). In another study on the flexibility criterion, Jharkharia & Shankar (2005) divided flexibility into price flexibility and operational flexibility and argued that payment and price flexibility would promote long-term relationships.

When examining the image criterion, one comes across many different studies. When examining the literature on this criterion, it was found that the results of this study are opposite. Example: In a study conducted by Maharani & Wahyuni (2021), a questionnaire was sent to 118 air cargo companies operating in Indonesia. From the results of the survey, the factors that affect customer loyalty are transportation safety, transportation security, and image, respectively. In the study where similar results as in this study were obtained with the criterion of undamaged delivery, the image criterion was mentioned as one of the most important factors, in contrast to our study. Again, in contrast to the results obtained with the image criterion used in our study, another study by Sarıoğlan & Yabacı (2018) argued that consumers who purchase goods or services from mail-order companies consider image during their repurchase behavior and that image reduces the elasticity of demand. In another study by Liou & Chuang (2010), the effect of corporate image and reputation on preference was examined using the Multi-Criteria Decision Making (MCDM) method at an international airport in Taiwan, and it was found that the criterion gave the company an advantage in decision making. Marketing strategies were also considered in these reviews.

Another criterion of this research is timely delivery. Studies conducted according to this criterion are also included in the relevant literature. For example, in a study by Yimga (2017), it was found that an increase in delays in air travel at airports has a negative impact on the probability of choosing a product. The study by Dožić et al., (2018) examined the selection of the appropriate type of aircraft. Suzuki's (1999) study on punctuality concluded that passengers who experience frequent delays are more likely to switch airlines and that undelayed service is important for their market share.

In addition to the studies mentioned above, there are numerous studies on the criteria for handling customer complaints and claims. In the study conducted by Simpson et al., (2002), it was argued that supplier evaluation generally focuses on basic aspects such as price and quality, but that today the importance of communication and customer satisfaction has increased even more. Tan (2002) emphasized the importance of information security and suggested that good suppliers in the aviation industry should be protected and supplier switching should be avoided.

Yaseen et al., (2022) emphasized that service quality affects passenger satisfaction and that there is a positive correlation between passenger satisfaction and service quality. Finally, Suresh (2016) concluded in his study that customer satisfaction is directly proportional to service quality.

Another criterion of this research is cost. In the research conducted by Degraeve et al., (2004), it was found that 19.5% of costs can be saved by evaluating purchasing for companies in terms of airline selection. Seristo (1996), on the other hand, in his survey of 28 managers of 17 European airlines, emphasized that the most important factor in supplier selection is cost. In addition, the relevant literature also includes studies that emphasize that airline pricing policies should be consistent and that stable pricing is important for consumer choice (Taneja, 2017; McIvor et al., 2003).

The literature search on the customer information systems criterion, which is another criterion of the study, found studies that reached similar conclusions to our study. For example, Kannan et al., (2011) identified information systems as the least important criterion in selecting container transportation companies for Indian shippers in their study. Similarly, Kent & Parker (1999) in their study found that cargo tracking is neither very important nor very unimportant and that cargo tracking can be done by employees.

The criterion of carrying special cargo cannot be met by most of the freight forwarding companies operating in this sector due to the lack of equipment, and companies that can meet these conditions are sought by the freight forwarders who want to carry special cargo, especially in the air cargo sector (Şeker & Korkmaz, 2021). Since this situation is only applicable in certain business sectors, it may be last in the list of carrier selection criteria in general. In the doctoral thesis of Ergin (2011), the criterion of special transportation was discussed in different industries and the criterion of special

transportation was in the last place in the order of importance, similar to our work in all industries.

For the criterion of undamaged delivery, there are some studies conducted in the literature under the heading of safety.

Ho et al., (2017) concluded in their study that safety during the transportation is one of the most important criteria that international transportation companies in Taiwan value when selecting a transportation company.

3. Materials and Methods

The authors used 3 different methods of multicriteria decision-making (MCDM) in this study. The SWARA method was used to weigh the identified criteria, and the CODAS and Gray Relational Analysis methods were used to evaluate the companies. The following sections describe the respective methods and application steps.

3.1. SWARA (Step-Wise Weight Assessment Ratio Analysis) Method

The SWARA method, introduced to the literature by Keršuliene et al., (2010), is a subjective method based on pairwise comparisons used to weight the criteria among MCDM methods. Among the most important advantages of this method is the fact that the number of pairwise comparisons between criteria is less and there is no need to use a (1-9) scale (Yücenur & İpekçi, 2021). The method starts with the decision maker (DM) ranking the relevant criteria from important to unimportant and then determining the relative importance of the criteria. In this context DM is asked how much criteria j is more important than criteria $(j+1)$ and this value is defined as the comparative priority value (s_j). The values in this comparison are assigned between 0 and 1 and in multiples of 5 (e.g., the first criterion is 5% more important than the other criterion). After this stage, the k_j coefficient values are calculated according to Equation (1). The k_j value of the criterion that the decision maker considers most important is defined as 1 (Ayçin, 2019).

$$\mathbf{k_j} = \begin{cases} 1, & j = 1 \\ s_j + 1, & j > 1 \end{cases}, j = 1,2,\dots,n \quad (1)$$

After calculating the k_j coefficients, the q_j values (corrected weight) are obtained using equation (2) (Bircan, 2020).

$$\mathbf{q_j} = \begin{cases} 1, & j = 1 \\ \frac{q_{j-1}}{s_j}, & j > 1 \end{cases}, j = 1,2,\dots,n \quad (2)$$

In the final stage of the method, the criterion weights (w_j) have been calculated using equation (3) (Ayçin, 2019). In the case of more than one DM, the final weighting values can be calculated by taking the geometric means of the weighting values calculated for each criterion separately (Elmas & Özkan, 2021).

$$\mathbf{w_j} = \frac{q_j}{\sum_{j=1}^{n} q_j} \quad (3)$$

3.2. CODAS (Combinative Distance-Based Assessment) Method

CODAS is a method introduced to the literature in 2016 by Ghorabaee et al. (2016) based on the assumption that the alternative furthest from the negative ideal is the most appropriate. In this method, the evaluations have been made in the context of Euclidean distance. In addition, the taxicab distance is also included in the calculations, according to the difference of the Euclidean distance values to a specified parameter (τ) (Aytekin, 2022). In this context, the CODAS method basically evaluates the decision-making units (DMU) in the $l^2 -$ norm indifference space (Kabak & Çınar, 2020). It is recommended to use a threshold parameter in the range of 0.01-0.05 (Ghorabaee et al., 2016). Generally, this value is considered to be 0.02 (Kabak & Çınar, 2020). Depending on the threshold parameter used, a relative evaluation matrix is formed using the threshold function (Ψ), which includes Euclidean and Taxicab distance measures, and DMUs are ranked from highest to lowest according to the values obtained (Aytekin, 2022). The method consists of 7 steps. These are;

Step 1: Create the decision matrix (X): The initial matrix is created as shown in equation (4).

$$\boldsymbol{X} = [x_{ij}]_{nxm} \quad (4)$$

Step 2: Normalization of the decision matrix: These calculations are performed according to equation (5), depending on whether the relevant criteria are benefit-oriented (J^+) or cost-oriented (J^-).

$$\boldsymbol{f_{ij}} = \begin{cases} \frac{x_{ij}}{\max_i x_{ij}}, j \in J^+ \\ \frac{\min_i x_{ij}}{x_{ij}}, j \in J^- \end{cases} \quad (5)$$

Step 3: Weighting the normalized decision matrix: In this step, the criteria weights (w_j) as given in equation (6) are used to calculate the elements (r_{ij}) that form the normalized decision matrix. Note that w_j takes values in the range of 0-1 ($0 < w_j < 1$).

$$\boldsymbol{r_{ij}} = w_j * f_{ij} \quad (6)$$

Step 4: Calculation of the negative ideal solution values (ns_j): The corresponding calculations are performed using equation (7).

$$\boldsymbol{ns_j} = \min_i x_{ij} \quad (7)$$

Step 5: Calculation of the distances of the DMUs from the negative ideal solution: In this step, the Euclidean distance of each DMU is calculated using equation (8) and the Taxicab distance is calculated using equation (9).

$$\boldsymbol{E_i} = \sqrt{\sum_{j=1}^{n} (r_{ij} - ns_j)^2} \quad (8)$$

$$\boldsymbol{T_i} = \sum_{j=1}^{n} |r_{ij} - ns_j| \quad (9)$$

Step 6: Construction of the relative evaluation matrix (G): Equation (10) and Equation (11) are used.

$$\boldsymbol{G} = [h_{ik}]_{mxn} \quad (10)$$

$$\boldsymbol{h_{ik}} = (E_i - E_k) + (\Psi(E_i - E_k) * (T_i - T_k)), \quad k \in \{1, \dots, m\} \quad (11)$$

Ψ expressed in equation (11), is determined by equation (12).

$$\Psi(x) = \begin{cases} 1, & |x| \geq \tau \\ 0, & |x| < \tau \end{cases} \quad (12)$$

Step 7: Calculation of DMU scores (H_i): In this step, the scores of the relevant DMUs are calculated using Equation (13), the relevant values are ranked from the highest to lowest,

and the DMU in the first rank is determined as the most suitable alternative.

$$H_i = \sum_{k=1}^{m} h_{ik} \quad (13)$$

3.3. Gray Relational Analysis (GRA) Method

The GRA method is a ranking and classification procedure based on *the Gray System Theory* that can be applied to both quantitative and linguistic variables. The method defines the degree of influence (gray relationship degree) between factors *(Wen, 2004; Yıldırım, 2014; Üstünışık, 2007*). It is a method in which a reference set with ideal values for the criteria in the decision matrix is created and the gray relationship degrees of the DMUs with these values are determined *(Aytekin, 2022).* The method consists of 6 steps. These are;

Step 1: Create the initial decision matrix (X): This matrix (mxn), where the number of alternatives (DMU) is m and the number of criteria is n, is shown in equation (14). $x_i(j)$ defines alternative i's $v$alue according to the criteria j.

$$\boldsymbol{X} = \begin{bmatrix} x_1(1) & x_1(2) & \dots & x_1(n) \\ x_2(1) & x_2(2) & \dots & x_2(n) \\ \dots & \dots & \dots & \dots \\ x_m(1) & x_m(2) & \dots & x_m(n) \end{bmatrix}$$

$$\boldsymbol{i} = 1,2,\dots,m;\ j = 1,2,\dots,n \quad (14)$$

Step 2: Creating the reference set: The reference set ($x_0 = (x_0(j))$ is created by determining the ideal values for each criterion included in the decision problem. The reference set depends on the decision matrix depending on the structure of the problem (for the benefit-oriented criteria, the relevant criterion is the highest in the matrix; for the cost-oriented criteria, the lowest value in the matrix is taken) or the ideal values can be determined independently of the decision matrix.

Step 3: Normalization of (X): Different equations are used depending on whether the relevant criteria are benefit or cost oriented. Equation (15) is used for the benefit-oriented and equation (16) for the cost-oriented criteria. In addition, if the values in the matrix contribute positively to the purpose according to the determined optimal value ($x_{ob}(j)$, equation (17) is used.

$$\boldsymbol{x_i^*} = \frac{x_i(j) - min_j x_i(j)}{max_j x_i(j) - min_j x_i(j)} \quad (15)$$

$$\boldsymbol{x_i^*} = \frac{max_j x_i(j) - x_i(j)}{max_j x_i(j) - min_j x_i(j)} \quad (16)$$

$$\boldsymbol{x_i^*} = \frac{|x_i(j) - x_{ob}(j)|}{max_j x_i(j) - x_{ob}(j)} \quad (17)$$

The normalized decision matrix (X^*) is shown in equation (18).

$$\boldsymbol{X^*} = \begin{bmatrix} x_1^*(1) & x_1^*(2) & \dots & x_1^*(n) \\ x_2^*(1) & x_2^*(2) & \dots & x_2^*(n) \\ \dots & \dots & \dots & \dots \\ x_m^*(1) & x_m^*(2) & \dots & x_m^*(n) \end{bmatrix} \quad (18)$$

Step 4: Determine the distances ($\triangle_{oi}$) of the DMUs from the reference values: In this step, the absolute value matrix is created. The absolute value of the difference between x_0 and x_i^* ($\triangle_{oi}$ (j)) is used to create this matrix. The $\triangle_{oi}$ matrix is formed using the obtained values. These calculations are performed using equation (19) and the corresponding matrix is formed as in equation (20).

$$\triangle_{oi}(j) = |x_o(j)^* - x_i^*(j)| \quad i = 1,2,\dots,m;\ j = 1,2,\dots,n \quad (19)$$

$$\triangle_{oi} = \begin{bmatrix} \triangle_{o1}(1) & \triangle_{o1}(2) & \dots & \triangle_{o1}(n) \\ \triangle_{o2}(1) & \triangle_{o2}(2) & \dots & \triangle_{o2}(n) \\ \dots & \dots & \dots & \dots \\ \triangle_{om}(1) & \triangle_{om}(2) & \dots & \triangle_{om}(n) \end{bmatrix} \quad (20)$$

Step 5: Create the gray relational coefficient matrix: $\triangle_{max}$ in equation (21) represents the largest change in value in the matrix and is calculated as $max_i max_j \triangle_{oi}$ (j). $\triangle_{min}$ represents the smallest change in value in the matrix and $min_i min_j \triangle_{oi}$ (j) is calculated as $\triangle_{oi}$ (j), $\triangle_i$, represents the j. value in the difference data series ζ is defined as a discriminant coefficient and takes a value in the range of [0,1]. This coefficient normally has the value 0.5.

$$\gamma_{oi}(j) = \frac{\triangle_{min} + \zeta \triangle_{max}}{\triangle_{oi}(j) + \zeta \triangle_{max}} \quad (21)$$

Step 6: Calculation of gray relationship degrees (Γ_{oi}): At this stage, the weight values (w_i) of the criteria are important. If the criteria weights are equal, the gray relationship degree (Γ_{oi}) is calculated according to equation (22), if they are different, according to equation (23). Each alternative is ranked according to these values and the first alternative is evaluated as the most suitable alternative (Demir et al., 2021; Aytekin, 2022).

$$\Gamma_{oi} = \frac{1}{n} \sum_{j=1}^{n} \gamma_{oi}(j) \quad \text{ve} \quad i = 1,2,\dots m \quad (22)$$

$$\Gamma_{oi} = \sum_{j=1}^{n} \left[w_i(j) * \gamma_{oi}(j) \right] \quad \text{ve} \quad i = 1,2,\dots m \quad (23)$$

3.4. Findings

The aim of this study is to evaluate and analyze the 5 companies (Turkish Cargo, MNG Airlines and Transportation, ACT Air Cargo, ULS Airlines Cargo Transportation and Sunexpress Cargo Transportation) operating in Turkey, which handled the most air cargo in 2021, in line with 12 different criteria determined by the authors as a result of the literature research.These citeria are; Scale of network (C1); Adequacy of Employees (C2); Adequacy of Equipments (C3); Flexibility (C4); Undamaged Delivery (C5); Image (C6); Costs (C7); Customer Information Systems (C8); Approach to Customer Requests and Complaints (C9); Special Cargo Handling Capabilities (C10); Flight Frequency (C11) and On-Time Delivery (C12). To determine the weighting of these criteria, the opinions of 9 experts (DM) who know the air freight sector and have been and are actively involved in the relevant topic were obtained.

It should be noted that there is no limitation on the number of decision makers in MCDM methods (Dehdasht et al., 2017). A scale (1-5) was used in the evaluation of the companies, and the opinions of 8 experts experienced in this field were obtained. The value of 5 on each scale is scaled to represent the maximum usefulness for that criterion. For example, 5 means "very affordable" for the cost criterion and "very adequate" for the adequacy of the equipment. Consistent with this information, the weighting values determined by the SWARA method for each DM and the resulting final criteria weighting values are shown in Table 1 and Table 2, respectively.

Table 1. Criteria weights determined on the basis of decision makers according to the SWARA method

Criteria	DM1	DM2	DM3	DM4	DM5	DM6	DM7	DM8	DM9
C1	0.094	0.069	0.092	0.068	0.106	0.071	0.071	0.083	0.078
C2	0.051	0.105	0.060	0.161	0.057	0.075	0.075	0.070	0.095
C3	0.051	0.063	0.066	0.115	0.058	0.072	0.075	0.069	0.094
C4	0.067	0.049	0.050	0.056	0.076	0.068	0.071	0.078	0.090
C5	0.154	0.121	0.114	0.096	0.112	0.112	0.110	0.094	0.111
C6	0.046	0.060	0.055	0.072	0.052	0.061	0.062	0.077	0.061
C7	0.117	0.123	0.112	0.083	0.118	0.102	0.110	0.104	0.100
C8	0.068	0.080	0.080	0.062	0.076	0.087	0.086	0.082	0.070
C9	0.054	0.088	0.076	0.075	0.061	0.100	0.091	0.085	0.071
C10	0.074	0.052	0.097	0.054	0.084	0.067	0.068	0.081	0.055
C11	0.078	0.076	0.088	0.065	0.088	0.083	0.079	0.084	0.064
C12	0.147	0.116	0.111	0.091	0.111	0.101	0.104	0.093	0.110

Table 2. Final weight values calculated according to the SWARA method

Criteria	Final w_j
Undamaged Delivery	0.10845
Costs	0.10578
On-Time Delivery	0.10444
Adequacy of Employees	0.08266
Approach to Customer Requests and Complaints	0.07992
Scale of Network	0.07898
Flight Frequency	0.07778
Customer Information Systems	0.07759
Adequacy of Equipments	0.07463
Special Cargo Handling Capabilities	0.06814
Flexibility	0.06581
Image	0.06182

As shown in Table 1, the most important criteria in selecting air carriers are undamaged delivery, cost and on-time delivery. These three criteria are close to each other and have similarities with the rankings in the literature. The least important criteria in this area are image, flexibility, and special cargo handling capabilities. As a result of the evaluations made by the experts, the average values of the scores obtained by the companies according to the relevant criteria are presented in Table 3. This table also determines the initial matrix (X). The reference value of each criterion was set as 5 in the solution steps for the GRA method. In agreement with the values in Tables 1 and 2, the DVB scores obtained by CODAS and GRA methods in the steps mentioned in Sections 3.2 and 3.3 are presented in Table 4 and Table 5, respectively. According to Tables 4 and 5, it can be observed that the relevant companies are in the same order for both methods. In this context, Turkish Cargo is selected in the first rank according to both the distance from the ideal reference values and by the furthest distance from the negative ideal. The relevant company was followed by MNG Airlines and Transportation.

Table 3. Average score of the companies according to criteria

Weights of Criteria	0.08	0.08	0.07	0.07	0.11	0.06	0.11	0.08	0.08	0.07	0.08	0.10
DMU	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
Turkish Cargo	4.38	4.63	5.00	2.50	4.25	5.00	2.38	4.00	3.75	4.00	4.63	4.50
MNG Airlines and Transportation	3.00	3.38	3.75	3.00	3.63	3.63	3.00	3.75	2.88	3.38	3.13	3.75
ACT Air Cargo	2.50	2.88	3.25	3.00	3.13	1.88	2.63	2.50	2.50	2.63	2.25	3.38
ULS Airlines Cargo Transportation	2.25	3.00	2.88	2.88	2.75	1.75	2.38	2.75	2.13	2.75	2.00	2.88
Sunexpress Cargo Transportation	2.75	4.00	3.88	2.88	3.25	3.63	3.25	2.88	3.00	2.63	3.38	3.75

Table 4. Values and rankings of companies according to the method CODAS

DMU	E_i	T_i	H_i	Ranking
Turkish Cargo	0.11	0.35	1.22	1
MNG Airlines and Transportation	0.06	0.20	0.22	2
ACT Air Cargo	0.02	0.06	-0.70	4
ULS Airlines Cargo Transportation	0.01	0.02	-0.90	5
Sunexpress Cargo Transportation	0.06	0.19	0.16	3

Table 5. Gray Relationship Degrees and Rankings of Companies

DMU	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	Γ_{oi}	Ranking
Turkish Cargo	0.69	0.74	1.00	0.33	0.60	1.00	0.33	0.56	0.53	0.54	0.80	0.68	0.63	1
MNG Airlines and Transportation	0.41	0.40	0.46	0.38	0.45	0.54	0.40	0.50	0.40	0.42	0.44	0.46	0.43	2
ACT Air Cargo	0.35	0.33	0.38	0.38	0.38	0.34	0.36	0.33	0.37	0.33	0.35	0.40	0.36	4
ULS Airlines Cargo Transportation	0.33	0.35	0.33	0.37	0.33	0.33	0.33	0.36	0.33	0.35	0.33	0.33	0.33	5
Sunexpress Cargo Transportation	0.38	0.52	0.49	0.37	0.39	0.54	0.43	0.37	0.42	0.33	0.48	0.46	0.42	3

4. Conclusion

Air cargo carriers play a key role in the success of logistics business processes. The study of an important sector at this level by researchers has both theoretical and practical significance. In this sense, 5 air cargo companies operating in Turkey in 2021 were studied and 12 different criteria were identified. The mentioned criteria were identified through relevant literature review and accessibility to the experts. These criteria are; scale of network; adequacy of employees; adequacy of equipments; flexibility; undamaged delivery; image; costs; customer information systems; approach to customer requests and complaints; special cargo handling capabilities; flight frequency and on-time delivery.

The opinions of 9 experts who work in the industry and have experience in their field were obtained for criteria weighting process. These expert opinions on carrier selection were analyzed according to SWARA method and it was found that the most important criteria were (1) undamaged delivery, (2) costs and (3) on-time delivery respectively. These results of the study are also confirmed by the relevant literature. Besides the criteria with the least importance are (1) image, (2) flexibility and (3) special cargo handling capabilities. When the results of the research are analyzed at the company base, it is concluded that Turkish Cargo. ranks first and MNG Airlines and Transportation ranks second. Looking at similar studies in the literature (Durak & Yılmaz, 2016), in their study, using the Analytic Hierarchy Process (AHP) method, they evaluated the choice of airline according to the criteria of price, speed, reliability, flexibility and sociability, and the most important criterion in choosing an airline was price and the second most important criterion was speed. have concluded that these results show similar results with our study. In another study, it was found that the most important criterion among the reasons for preferring airlines was price and fare frequency (Yurttaş, 2007). In another study, it was concluded that price and punctuality are among the three most important criteria for choosing an airline that is carried out in more than one period while the potential demand is known (Liao & Rittscher, 2007). All these studies in the literature show that studies on carrier selection provide similar results as the present study.

In this study authors aimed to make an assessment by considering many criteria and companies collectively and 3 different multi criteria decision making methods were used together. Considering the results of this research and relevant literature from a holistic perspective, it can be concluded that air cargo transportation which is one of the important parts of logistic activities acts according to the relevant criteria. Also, strategic planning of air cargo transportation is based on these. For future studies how importance weights of related criteria have been changed according to different countries.

The limitations of this study are as follows; the air cargo industry has a very large volume as a universe. It is not possible, both in terms of time and cost, to reach this entire stage. For this reason, one of the main limitations of the study is the number of samples available in the air cargo sector. Another important problem of this study is that the personnel working in the air cargo sector do not have information about companies other than the companies whose names are known in this sector. For this reason, another limitation of the study is to reach personnel who are familiar with the less known companies in the air cargo sector. Another limitation of the study is that participants were limited to air cargo sector employees, so general conclusions could not be drawn for the entire air cargo sector.

The final limitation of the study was that participants had to have experience in the air cargo industry, which made it difficult to find participants. A few suggestions emerge from the data that emerge from the research findings. First, air cargo companies should consider the criteria mentioned in the study in order of importance and direct the corresponding business activities in this direction. In other words, it would be beneficial for air cargo companies to align their strategic objectives according to the findings of this research and establish a corresponding action plan. The second point is the contribution to the relevant literature. The studies in the relevant literature show that the criteria in air cargo companies

are limited, so it would be beneficial for future research to develop these criteria and conduct more comprehensive studies. In addition, it is important to consider other criteria that have been established in the international literature on air cargo companies and design future research within this framework.

Ethical approval

The study received ethical approval from the Nisantasi University's Ethics Board (2023/7).

Conflicts of interest

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

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