

A Comparative MCDM Analysis of Airline Service Ratings of Low Cost Airlines

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Abstract

This study compares the profiles of nine low-cost airlines based on five airline service quality scores. All criteria, including the baggage delivery score, are benefit-oriented. Criterion weights are derived using PSI, LODECI, CRISUS, and a hybrid rule based on their normalized direct product. Rankings are compared using RADAR-2, TOPSIS, and VIKOR. Ranking consistency is measured via Spearman's ρ and Kendall's τ -b. While RADAR-2, using the hybrid weights, places Eurowings, Norwegian, and EasyJet in the top three spots, TOPSIS and VIKOR reverse the top two positions. VIKOR identifies Eurowings and Norwegian as a compromise set rather than selecting a single winner. Four airlines share a RADAR-2 score of 0.0579 because distinct raw profiles map onto the same relative relationship plateau. Weight simulations demonstrate that the leader and the entire ranking can change while the plateau equality persists. The findings describe the recorded score matrix and the aggregation rules; they do not demonstrate actual performance equality, external model validity, or the overall superiority of any method.

1. Introduction

Low-cost airline business models differ in their development trajectories and business practices (Francis et al., 2006). The implications of these differences for passenger perceptions have also been examined in studies comparing low-cost and full-service airlines (O'Connell & Williams, 2005). The stages at which services are delivered are also relevant to the assessment of airline service quality. Chen and Chang (2005) distinguish between ground services and in-flight services as separate areas of evaluation. The present study focuses on five service indicators representing specific airline touchpoints. Comparing these indicators requires a clear definition of what each measures and which direction of change represents better performance.

Although passenger satisfaction and service quality are related, a criterion-level quality rating is not a direct measure of passenger satisfaction. Research on passenger loyalty and future behavioral intentions places this relationship within a broader service context (Forgas et al., 2010; Park et al., 2006). The present analysis, however, relies on recorded airline service ratings rather than passenger-level survey responses. Its findings should therefore be interpreted within the scope and measurement properties of the selected indicators.

Distinguishing among different sources of service quality evidence is essential to this interpretive framework. SERVQUAL measures expectations and perceived performance (Parasuraman et al., 1988) and has been used with weighted scores in airline service evaluations (Pakdil & Aydin, 2007). In contrast, the star ratings of Skytrax are based on

professional audits of the quality and are a different source of evidence from customer reviews (Skytrax, n.d.-a). Therefore, expectation and perception measures, customer reviews, and professional quality ratings must not be considered synonymous.

Multi-Criteria Decision-Making (MCDM) methods offer a systematic framework for evaluating and comparing alternatives using multiple criteria (Zavadskas et al., 2014). However, their results depend on measurement properties, directions of criteria, weights and aggregation rules. In this study, weights are acquired by the decision matrix properties with the help of the PSI, LODECI and CRISUS methods (Maniya & Bhatt, 2010; Pala, 2024; Adalar & Işık, 2025). These coefficients are measures of variability and differences in the recorded data. They are not direct estimates of passengers' preferences or of causal effects of service indicators on satisfaction.

Different weighting approaches to the same dataset allow to explore changes in the priority of criteria and their implications for the rankings. Furthermore, the use of several ranking methods permits the comparison of the effect of different aggregation rules. This design is developed based on comparative studies of MCDM methods (Triantaphyllou, 2000; Tzeng & Huang, 2011; Zavadskas et al., 2014). But combining methods does not necessarily improve the validity of the measurements or show superiority of the model. The study compares the individual objective weighting methods with a defined hybrid approach.

The research design combines four approaches of weighting with three methods of ranking. The weights for PSI,

LODECI and CRISUS are calculated separately, while the hybrid weights are obtained by multiplying the corresponding coefficients from the three methods element by element and normalizing the resulting products. For each weighting procedure, the same nine airline alternatives are ranked by using three MCDM methods, namely RADAR-2, TOPSIS and VIKOR. Rank correlations are used to assess agreement between methods, and sensitivity analyzes are used to assess the effect of changes in weights and parameters.

The main ranking method was RADAR-2 and the results were compared with the results of TOPSIS and VIKOR as the reference methods. In RADAR-2, relative relationships and ranking indices are generated using distance and range transformations (Komatina, 2025). The method's power of discrimination between alternatives is empirically examined based on its outputs, rather than assumed a priori. In this view, ranking agreement is a property of the data and the modeling decisions, not an independent measure of reliability or validity.

The decision matrix includes quality ratings of nine airline profiles against five airline service indicators from Skytrax. All five criteria are considered as benefit criteria because higher scores indicate better service quality (Skytrax, n.d.-a). This distinction is especially relevant for criterion C5. One of Skytrax's (Skytrax, n.d.-b) airline service assessment items is "Baggage delivery times," but the variable in this study is a quality rating of baggage delivery, not an operational time duration of minutes. Thus, the criterion direction is defined by an increase in the quality score, not by a decrease in the underlying delivery time.

The study provides a common comparative framework in which to examine criterion priorities, ranking agreement and differences preserved or lost through ranking procedures. The selected indicators are linked to certain touchpoints of the airline service and not to the whole passenger journey. Thus, the analysis identifies the effect of weighting and ranking choices on the relative positions in the recorded decision matrix. The scope of the findings is limited by the quality rating scale, indicators selected and aggregation rules. The results themselves should not be used as evidence of passenger satisfaction, overall airline quality, or causal benefits of service interventions.

Within this framework, the study addresses the following research questions:

1. How do objective weighting methods and their hybrid combination affect criterion priorities and airline rankings?
2. How do RADAR-2 rankings compare with TOPSIS and VIKOR under the different weighting approaches?
3. How sensitive are the rankings to changes in the weights of the criteria?

Section 2 reviews related literature. Data, directions of the criteria, weighting rules, ranking methods and protocol of sensitivity are given in section 3. The criterion weights, the airline scores, the transformation mathematical analysis, the rank correlations, the benchmark comparisons and the sensitivity results are given in Section 4. Implications for research, limitations, future research and managerial implications are discussed in separate sub-sections of Section 5.

2. Literature Review

Research on airline service quality has linked service evaluations with passengers' behavioral intentions and loyalty. Park et al. (2006) studied the relationships between service quality and other variables, and passengers' future behavioral intentions. Forgas et al. (2010) investigated the relationships between satisfaction, trust and airline loyalty. SERVQUAL offers a measurement model to compare expected and perceived service (Parasuraman et al., 1988). Pakdil and Aydın (2007) estimated weighted SERVQUAL scores for airline services, with factor loadings as weights. This method of expectation and perception measures differs from the direct aggregation of published audit ratings.

The scope of service quality also varies by airline business model and the service stage studied. The work of O'Connell and Williams (2005) examined the perception of passengers of low-cost and full-service airlines and An and Noh (2009) looked at the relationship between in-flight service quality and loyalty. Chen and Chang (2005) studied separately the ground and in-flight service stages. Gilbert and Wong (2003) studied airline passengers' expectations. These studies cover different service settings and passenger populations, highlighting the need to define the scope of the indicators and the service context represented in the present analysis. However, this literature does not establish that five airline service indicators are sufficient to measure overall airline quality.

Multi-Criteria Decision-Making (MCDM) methods enable alternatives to be compared across multiple attributes by specifying explicit weighting and aggregation rules. In the airline service quality literature, Chen (2016) combined DEMATEL and ANP to evaluate service improvement criteria. Perçin (2018) integrated fuzzy DEMATEL, ANP, and VIKOR for airline evaluation. Although such integrated approaches can address different analytical questions, agreement among methods should not, by itself, be regarded as evidence of measurement validity.

MCDM applications also differ in their data, decision-makers, and aggregation rules. Liou and Tzeng (2007) used a fuzzy integral and factor analysis within a non-additive model, whereas Tsaur et al. (2002) applied a fuzzy MCDM approach. This diversity implies that constructs measured and numerical transformations used in the calculations need to be separately assessed when comparing results. Thus, the interpretation of methodological comparisons is contingent upon the resulting rankings as well as the underlying choices of measurement and modeling.

This study considers five Skytrax airline service quality dimensions: check-in service options, check-in staff service, boarding efficiency, staff assistance on arrival, and baggage delivery time. The contribution is to compare the criterion priorities obtained from objective weighting methods and the results of RADAR-2, TOPSIS and VIKOR in terms of ranking agreement, sensitivity to weights and preservation of the differences between the alternatives. The indicators are not meant to be new measures and the study does not empirically test improvements in competitiveness or passenger satisfaction.

Figure 1 outlines the evaluation framework which is built from a decision matrix consisting of nine airlines and five benefit criteria. Separate weights are calculated using PSI, LODECI, and CRISUS. A fourth weighting approach is constructed by multiplying the corresponding coefficients element by element and normalizing the resulting products. RADAR-2, TOPSIS, and VIKOR are then applied under each weighting approach using the same criterion directions. The resulting outputs are evaluated through rank correlations, an

analysis of how numerical transformations affect differences among alternatives, and sensitivity tests.

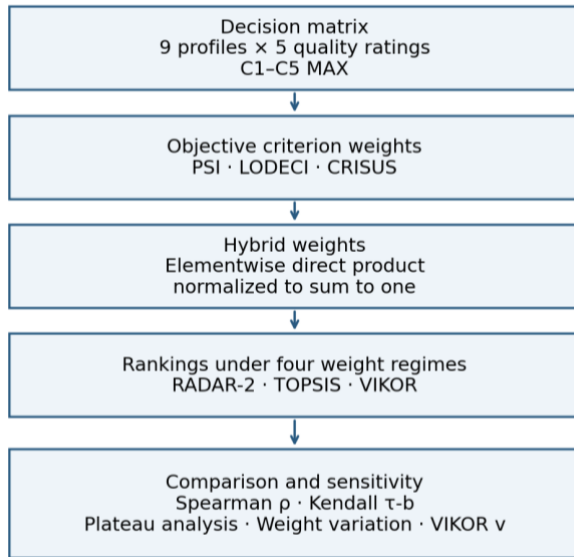


Figure 1. Evaluation procedure of this study

2.1. Multi-criteria decision-making applications of airline service quality

Airline MCDM applications use different ways to represent criterion dependence and combine performance. Liou and Tzeng (2007) use factor analysis and a fuzzy integral. Chen (2016) applies DEMATEL and ANP, while Perçin (2018) combines fuzzy DEMATEL, ANP, and VIKOR. Table 1 summarizes selected airline applications and distinguishes their methods.

Methods developed in other domains also inform comparative decision analysis. Büyüközkan and Çifçi (2011), for example, study sustainable supplier selection with incomplete information. Such studies provide methodological context, but are not evidence about airline passenger satisfaction and are not included among the airline applications in Table 1.

Table 1. Selected MCDM applications in airline service quality

Study	Application	Focus	Methods
Tsaur et al. (2002)	Airline quality	Evaluation	Fuzzy MCDM
Liou & Tzeng (2007)	Airline quality	Evaluation	Factor analysis; fuzzy integral
Chen (2016)	Airline criteria	Improvement priorities	DEMATEL; ANP
Perçin (2018)	Airline quality	Evaluation	Fuzzy DEMATEL; ANP; VIKOR

Multi-Criteria Decision-Making (MCDM) methods produce relative comparisons among alternatives based on specified criteria and weights. These methods complement passenger surveys and statistical analyses but do not replace them. Published airline evaluation studies illustrate the use of different aggregation approaches (Tsaur et al., 2002; Liou & Tzeng, 2007; Perçin, 2018).

The interpretation of weights depends on their data source and calculation method. Whereas Pakdil and Aydın (2007) used weights derived from factor analysis within

SERVQUAL, the present study derives weights directly from the quality rating matrix. Objective weights should therefore be interpreted as coefficients generated by specified computational rules, rather than as direct expressions of the importance passengers assign to each criterion.

The comparative design enables us to investigate the influence of weighting rules on rankings and the extent to which numerical transformations result in the same output score for different input profiles. The rank correlations are used to measure the agreement between the methods. The number of distinct output scores is used to measure the distinguishability of the alternatives. However, neither of these indicators alone is sufficient to establish the validity of a measure of service quality.

Thus, the study considers interpretation of source data, computational reproducibility and conceptual validity of measurement as distinct dimensions of evaluation. The comparison is done for all weighting methods and the outputs of RADAR-2 are also compared with the results obtained from TOPSIS and VIKOR methods based on the same decision matrix.

2.2. Background on objective weighting methods

PSI, LODECI, and CRISUS derive weights from different properties of normalized data. PSI: The Preference Selection Index (Maniya & Bhatt, 2010; Obeidat et al., 2025). LODECI: The LOGarithmic DEcomposition of Criteria Importance (Pala, 2024; Nhan & Hang, 2026). CRISUS: CRiterion Importance based on the SUM of Squares (Adalar & Işık, 2025). Their original application contexts do not, by themselves, establish their validity for airline evaluation. Table 2 summarizes the relevant foundational sources and a transportation application in which PSI is combined with other methods.

In this study, all three weighting procedures are applied to the same airline decision matrix. A hybrid approach is also evaluated by multiplying the corresponding weights element by element and then normalizing the resulting products. Differences among the approaches are examined empirically, without assuming that combining methods captures uncertainty or provides a more accurate measure.

The four weighting approaches are used to examine how criterion priorities affect airline rankings. Individual and hybrid results are presented together to make the effects of the combination rule explicit. Rank correlations, comparisons with reference methods, and sensitivity tests enable agreement among methods and their ability to distinguish among alternatives to be assessed within the scope of the dataset.

Table 2. Foundational objective weighting studies and a transport application

Study and domain	Method and role
Maniya & Bhatt (2010) Material selection	PSI; normalization and dispersion
Pala (2024) EU social progress	LODECI; logarithmic criterion divergence
Adalar & Işık (2025) Corporate sustainability	CRISUS; sums of squares and dispersion
Ulutaş et al. (2021) Transport company selection	Fuzzy PSI-PIPRECIA-CoCoSo combination

2.3. Background on RADAR-2

RADAR-2 is a version of the Distance and Range-Based Ranking method. It is used within Multi-Criteria Decision-Making (MCDM). The method transforms criterion values

into relative relationships. It combines these relationships using criterion weights. It then calculates a relative ranking index (Komatina, 2025).

Transformation rules determine how much of the differences among alternatives is preserved in the final scores. Aggregation rules also affect this outcome. Ranking consistency should therefore be examined. The number of distinct output scores should also be assessed. These indicators reveal ranking agreement. They also indicate the extent to which alternatives remain distinguishable.

The present application uses PSI, LODECI, and CRISUS weights. Hybrid weights are constructed using an explicitly defined rule. RADAR-2 results are compared with TOPSIS and VIKOR results. This comparison examines the effects of weighting choices. The effects of normalization choices are also evaluated. Combining methods is not assumed to provide greater accuracy.

RADAR-2 is evaluated within a comparative framework. Its ability to distinguish among alternatives is examined empirically. The findings are limited to the decision matrix used. The tested weighting approaches further define their scope.

Table 3. Selected sources on RADAR and RADAR-2

Source	Variant and scope
Komatina (2025)	RADAR-2 formulation and an automotive equipment application
Komatina et al. (2026)	RADAR and RADAR II characteristics, including the constant relative-relationship branch

Komatina (2025) presents RADAR II as a modification of RADAR using range-based differences; this study denotes that variant as RADAR-2. Komatina et al. (2026) examine both variants and show the constant branch of their relative-relationship function. The present study applies the RADAR-2 formulation and examines how that established property affects the recorded airline profiles.

Previous methodological applications do not establish that a ranking method will preserve all distinctions in every dataset. This study therefore supplements ranking agreement with a transformation-level analysis and comparisons with TOPSIS and VIKOR. Agreement across methods is treated as descriptive evidence rather than external validation.

3. Materials and Methods

Objective criterion weights are calculated separately using PSI, LODECI, and CRISUS. The hybrid weight vector is constructed by multiplying the corresponding weights element by element and then normalizing the resulting products. Nine airlines are ranked using RADAR-2, TOPSIS, and VIKOR under each of the four weighting approaches. Rank correlations accounting for ties are used to assess agreement among methods. Local and global sensitivity analyzes are conducted to explore the robustness of the results to changes in weights.

The decision matrix contains five service criterion values for nine airline profiles. These values were taken directly from Skytrax pages and recorded as star ratings. Half-star values were retained as reported. They were not calculated by averaging. The data were compiled on 25 May 2025. This date refers to data collection rather than the original production of the ratings. The nine airlines were selected from low-cost carriers with complete data for all five criteria examined on the Skytrax website. This allowed the comparison to be conducted

without imputing missing values. However, data completeness does not establish sample representativeness. The available documentation does not confirm that the selected profiles cover the entire Skytrax low-cost airline category. The findings are therefore limited to the nine listed alternatives. They should not be generalized to all low-cost airlines.

Table 4 defines the indicators and criterion directions. Table 5 presents the decision matrix used in the analysis. No missing values were imputed. Star ratings were not converted into minutes. Source page captures and the cabin or fare selections used in the original compilation are unavailable. Half-star values were taken directly from the Skytrax pages. They were not calculated by averaging and were analyzed as recorded.

The Skytrax methodology page describes the quality scale and professional audit framework (Skytrax, n.d.-a). The airline assessment pages identify baggage delivery times as an airline service assessment item (Skytrax, n.d.-b). These sources support the interpretation of the rating direction. They do not independently verify each cell in the matrix.

C5 is defined as a quality rating for the baggage delivery service. A higher star rating represents better service quality. C5 is therefore treated as a benefit criterion and maximized alongside C1-C4. This coding does not imply that longer actual baggage delivery times are preferred. In the present analysis, C5 values are retained as star ratings. The analysis relies on data recorded as professional audit ratings rather than passenger survey responses. Limitations concerning data provenance are discussed in Section 5.2.

Table 4. Information on Criteria

Criteria	Code	Direction
Check-in service options	C1	max
Check-in staff service	C2	max
Boarding efficiency	C3	max
Staff assistance on arrival	C4	max
Baggage-delivery rating	C5	max

Table 5. Decision Matrix Considered Within the Scope of the Study

	C1	C2	C3	C4	C5
	max	max	max	max	max
AJet	3.0000	2.5000	3.0000	2.5000	3.0000
Corendon Airlines	3.0000	3.0000	3.0000	3.0000	3.0000
Easyjet	4.0000	4.0000	4.0000	3.5000	3.5000
Eurowings	4.5000	4.0000	4.0000	3.5000	4.5000
Norwegian	4.5000	4.0000	4.0000	4.0000	4.0000
Pegasus Airlines	4.0000	3.0000	3.0000	3.0000	3.0000
Sunexpress	3.0000	3.0000	3.0000	2.0000	3.0000
Wizz Air	3.0000	3.0000	3.0000	2.0000	3.0000
Vueling Airlines	3.5000	3.5000	3.5000	3.0000	3.5000

Note: C1-C5 are recorded service-quality star ratings and are all benefit criteria. They are not measured durations. Historical source captures and extraction-context records are unavailable.

3.1. PSI Method

The PSI procedure derives criterion coefficients from dispersion in normalized values (Maniya & Bhatt, 2010). All five criteria are benefit-oriented in this application.

Step 1: The Decision Matrix (H) is created using Equation (1).

$$H = [h_{ij}]. \quad (1)$$

h_{ij} is the recorded performance of alternative i on criterion j .

Step 2: The values in the decision matrix are normalised according to the direction of the criteria using Equation (2).

$$h_{ij}^* = \begin{cases} \frac{h_{ij}}{\max_j h_j}, & j \in C_B \\ \frac{\min_j h_j}{h_{ij}}, & j \in C_C \end{cases} \quad (2)$$

Here, $C_B = \{j \in C : j \text{ benefit-oriented criterion}\}$, $C_C = \{j \in C : j \text{ cost-oriented criterion}\}$ are the sets of criteria, and $C = C_B \cup C_C$, $C_B \cap C_C = \emptyset$.

Step 3: The average of the normalised values for each criterion is calculated using Equation (3):

$$\bar{h}_j = \frac{1}{m} \sum_{i=1}^m h_{ij}^* \quad (3)$$

Here, m is the number of alternatives.

Step 4: The preference variance for each criterion is calculated using Equation (4):

$$TV_j = \sum_{i=1}^m (h_{ij}^* - \bar{h}_j)^2 \quad (4)$$

Step 5: The preference deviations of the criteria are calculated using Equation (5):

$$\delta_j = 1 - TV_j \quad (5)$$

Step 6: The weight of each criterion according to *PSI* is determined using the following Equation (6):

$$w_j^{PSI} = \frac{\delta_j}{\sum_{j=1}^n \delta_j} \quad (6)$$

3.2. LODECI Method

LODECI was formulated by Pala (2024). It computes criterion divergence and applies a logarithmic transformation before normalizing the resulting coefficients. The procedure below follows Pala (2024).

Step 1: Creation of the Decision Matrix

$$H = [h_{ij}], i = 1, \dots, m; j = 1, \dots, n. \quad (7)$$

Step 2: The normalised matrix elements h_{ij}^* are calculated according to the criterion type as follows:

$$h_{ij}^* = \begin{cases} \frac{h_{ij}}{h_j^{\max}}, & j \in C_B \\ \frac{h_j^{\min}}{h_{ij}}, & j \in C_C \end{cases} \quad (8)$$

Step 3: For each normalised element, the divergence value DV_{ij} is calculated as the maximum absolute difference between the normalised values of the other alternatives on the same criterion:

$$DV_{ij} = \max_{r=1, r \neq i}^m |h_{ij}^* - h_{rj}^*| \quad (9)$$

Step 4: The Logarithmic Decomposition Value (LDV) for each criterion is obtained using Equation (10).

$$LDV_j = \ln \left(1 + \frac{\sum_{i=1}^m DV_{ij}}{m} \right) \quad (10)$$

Step 5: The importance levels of the criteria w_j^{LODECI} are obtained using Equation (11).

$$w_j^{LODECI} = \frac{LDV_j}{\sum_{j=1}^n LDV_j} \quad (11)$$

3.3. CRISUS Method

CRISUS determines objective criterion weights through two normalization stages, sums of squares, and standard deviation (Adalar & Işık, 2025). Adalar and Işık (2025) relate their procedure to variance-based weighting and information entropy. Rao and Patel (2010) provide a variance-based objective component in material selection, while Shannon (1948) provides the information-theoretic foundation of entropy rather than a CRISUS or airline weighting procedure. The CRISUS calculation is applied here to the same benefit directions as the other weighting methods.

Step 1: The initial performance matrix H , containing alternatives $A_1, A_2, \dots, A_m$ based on criteria $C_1, C_2, \dots, C_n$, is created as in Equation (12).

$$H = \begin{bmatrix} h_{11} & \dots & h_{1n} \\ \vdots & \ddots & \vdots \\ h_{m1} & \dots & h_{mn} \end{bmatrix} \quad (12)$$

Step 2: Euclidean vector normalization is applied to the initial matrix using the benefit branch of Equation (13) for all five criteria. The first normalized matrix is denoted by $\tilde{H}$.

$$\tilde{h}_{ij} = \begin{cases} \frac{h_{ij}}{\sqrt{\sum_{i=1}^m h_{ij}^2}}, & j \in C_B \\ 1 - \frac{h_{ij}}{\sqrt{\sum_{i=1}^m h_{ij}^2}}, & j \in C_C \end{cases} \quad (13)$$

Step 3: The second normalised matrix $Y = (y_{ij})$ is created by transforming all elements of the matrix normalised in Step 2 into the $[0,1]$ range using Equation (14).

$$y_{ij} = \frac{\tilde{h}_{ij}}{\sum_{i=1}^m \tilde{h}_{ij}} \quad (14)$$

Step 4: The values $(\rho_j, j = 1, 2, \dots, n)$, representing the sum of the squares of each criterion in the matrix created in the second normalisation, are found using Equation (15):

$$\rho_j = y_{1j}^2 + \dots + y_{mj}^2. \quad (15)$$

Step 5: For each criterion, the population standard deviation of the first normalized matrix is computed as $\sigma_j = \sqrt{[(1/m)\sum_i (\tilde{h}_{ij} - \mu_j)^2]}$, where $\mu_j = (1/m)\sum_i \tilde{h}_{ij}$ and $m = 9$. The second normalized matrix is used for ρ_j ; the first is used for σ_j .

Step 6: The weight coefficients w_j of the criteria are found using Equation (16).

$$w_j^{CRISUS} = \frac{\rho_j \sigma_j}{\sum_{j=1}^n \rho_j \sigma_j} \quad (16)$$

The hybrid rule multiplies the corresponding PSI, LODECI, and CRISUS weights and normalizes the products to sum to one, as shown in Equation (17). This rule is selected to examine joint emphasis across the three weighting procedures. It penalizes a criterion assigned a small coefficient by any component and can amplify their differences; it is not an arithmetic average or a normalized geometric mean. All component weights are positive in this dataset. Separate approaches and sensitivity results are reported so that the consequences of the rule remain visible. The product rule is not claimed to be an optimal or independently validated fusion method.

$$w_j^{HYBRID} = \frac{w_j^{PSI} \cdot w_j^{LODECI} \cdot w_j^{CRISUS}}{\sum_{j=1}^n (w_j^{PSI} \cdot w_j^{LODECI} \cdot w_j^{CRISUS})} \quad (17)$$

3.4. RADAR-2 Method

RADAR ranks alternatives using criterion values, their ranges, and criterion weights. The original method was introduced by Komatina (2024); the RADAR-2 variant uses range-based differences (Komatina, 2025). This study applies RADAR-2, with higher normalized loss indicating a worse rated position. Alternative indices are $i = 1, \dots, I$ and criterion indices are $j = 1, \dots, J$, with $I = 9$ and $J = 5$. The following equations specify the implemented variant.

Step 1: Creation of the Decision Matrix

In this step, the decision matrix was created from the observation data obtained by evaluating I alternatives according to J criteria.

$$[M_{ij}]_{IXJ} \quad (18)$$

Step 2: Normalized Loss Matrix (α)

The matrix α expresses each alternative's distance from the benefit ideal relative to the observed criterion range.

$$[\alpha_{ij}]_{IXJ} \quad (19)$$

Let $a_j = \min_i M_{ij}$, $b_j = \max_i M_{ij}$, and $R_j = b_j - a_j$. All ranges are positive in the recorded matrix. Equation (20) defines normalized loss; its benefit branch applies to C1–C5. Input checks reject zero-range criteria before range division, so an undefined normalization is not silently evaluated.

$$\alpha_{ij} = (b_j - M_{ij})/R_j \text{ (benefit)} \quad (20)$$

$$\alpha_{ij} = (M_{ij} - a_j)/R_j \text{ (cost)}.$$

Step 3: Complementary Matrix (β)

The complementary matrix β is defined from α and has values between zero and one.

$$[\beta_{ij}]_{IXJ} \quad (21)$$

Equation (22) applies to both benefit and cost criteria after their normalized losses have been defined.

$$\beta_{ij} = 1 - \alpha_{ij}. \quad (22)$$

For every alternative i and criterion j , the following identity holds:

$$\alpha_{ij} + \beta_{ij} = 1. \quad (23)$$

Step 4: Calculation of the Gap (Difference) Matrix (E)

In this step, the gap matrix $[E_{ij}]_{IXJ}$ was created by calculating the absolute difference between the α_{ij} and β_{ij} values for each alternative and criterion pair.

$$E_{ij} = |\alpha_{ij} - \beta_{ij}| \quad (24)$$

Step 5: Relative Relationship Matrix

In this step, the relative relationship matrix $[RR_{ij}]_{IXJ}$ containing the relative relationship values for each alternative and criterion was created.

$$RR_{ij} = \frac{\alpha_{ij}}{\beta_{ij} + E_{ij}} \quad (25)$$

Step 6: Weighted Relative Relationship Matrix

In this step, the relative relationship value of each alternative in the relevant criterion was multiplied by the weight of that criterion to create the weighted relative relationship matrix.

$$WRR_{ij} = RR_{ij} * \omega_j \quad (26)$$

Here:

RR_{ij} is the relative-relationship value of alternative i on criterion j .

ω_j is the weight of criterion j .

Step 7: Calculation of the Total Ranking Index (RI) Let $L_i = \sum_j WRR_{ij}$ denote the aggregate loss.

$$RI_i = \min_k L_k / L_i. \quad (27)$$

Alternatives are ranked by decreasing RI. All aggregate losses are positive in this application, so the leading alternative has $RI = 1$. The index expresses relative position in the matrix; it is not a percentage of service quality. An all-ideal alternative producing zero aggregate loss would require an explicit convention for the otherwise undefined normalization.

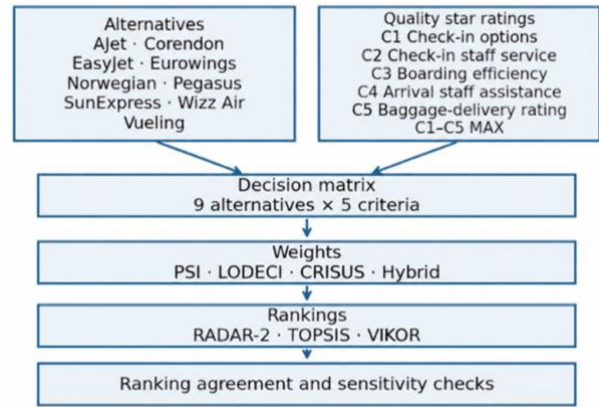


Figure 2. Alternatives, indicators, and comparison procedures

3.5. Benchmarking and Rank Agreement

TOPSIS uses Euclidean vector normalization and the same criterion weights as RADAR-2. Its positive ideal maximizes C1–C5, and its negative ideal minimizes all five. The closeness coefficient is ranked in descending order. VIKOR uses benefit-oriented range losses, weighted total loss S , and maximum weighted loss R ; Q is ranked in ascending order with $v = 0.5$ (Opricovic & Tzeng, 2004). For every criterion, $t_j^+ = \max_k t_{kj}$ and $t_j^- = \min_k t_{kj}$. The negative-ideal distance is $D_i^- = \sqrt{[\sum_j (t_{ij} - t_j^-)^2]}$.

$$z_{ij} = x_{ij} / \sqrt{(\sum_k x_{kj}^2)} \quad t_{ij} = w_j z_{ij}$$

$$D_i^+ = \sqrt{[\sum_j (t_{ij} - t_j^+)^2]}$$

$$G_i = D_i^- / (D_i^+ + D_i^-)$$

$$S_i = \sum_j w_j \alpha_{ij} \quad R_i = \max_j (w_j \alpha_{ij})$$

$$Q_i = v S_i^+ + (1 - v) R_i^+$$

Here $S_i^+ = (S_i - \min_k S_k) / (\max_k S_k - \min_k S_k)$, and $R_i^+ = (R_i - \min_k R_k) / (\max_k R_k - \min_k R_k)$. Both denominators are positive in the reported calculations. The implementation checks these denominators; a constant aggregate contributes zero normalized separation rather than generating a division-by-zero result.

For VIKOR, let $A(1), A(2), \dots$ denote alternatives ordered by increasing Q . Acceptable advantage requires $Q(A(2)) - Q(A(1)) \geq DQ$, where $DQ = 1/(9 - 1) = 0.125$. Stability requires $A(1)$ to lead S or R . If both conditions hold, $A(1)$ is the single compromise solution. If advantage fails, the compromise set includes alternatives satisfying $Q(A(k)) - Q(A(1)) < DQ$; if stability alone fails, the first two alternatives form the compromise set (Opricovic & Tzeng, 2004). Rank agreement is measured by Spearman correlation of average ranks (Spearman, 1961) and Kendall τ -b, which accounts for ties (Kendall, 1945). Scores rounded to 12 decimal places determine equality; tables display four decimals. The correlations describe agreement among the same nine alternatives and are not inferential tests of passenger satisfaction.

Sensitivity is assessed using ten local weight perturbations, multiplying each hybrid weight separately by 0.8 or 1.2 and renormalizing the vector; VIKOR v values of 0.25, 0.50, and 0.75; and 10,000 Dirichlet (1,1,1,1,1) weight vectors generated using NumPy PCG64 with seed 20260930. C1-C5 remain benefit criteria throughout. Simulation frequencies describe this selected weight space and are not probabilities of true airline performance. Full-ranking retention requires the entire average-rank vector, including ties, to match the hybrid baseline.

4. Results and Discussion

4.1 Objective Criterion Weights

Table 6. Criterion Weights

Weights	C1	C2	C3	C4	C5
PSI	0.197885	0.200524	0.209601	0.182369	0.209621
LODECI	0.197186	0.202594	0.161062	0.241972	0.197186
CRISUS	0.203695	0.189175	0.161209	0.264197	0.181724
Hybrid	0.197492	0.190958	0.135225	0.289685	0.186640

PSI assigns its largest weight to C5 (0.209621), narrowly exceeding C3 (0.209601). LODECI and CRISUS prioritize C4 (0.241972 and 0.264197), and the normalized-product hybrid assigns C4 a weight of 0.289685. C3 has the lowest hybrid weight (0.135225). These objective coefficients summarize properties of the recorded matrix; they do not estimate how strongly each criterion affects passenger satisfaction.

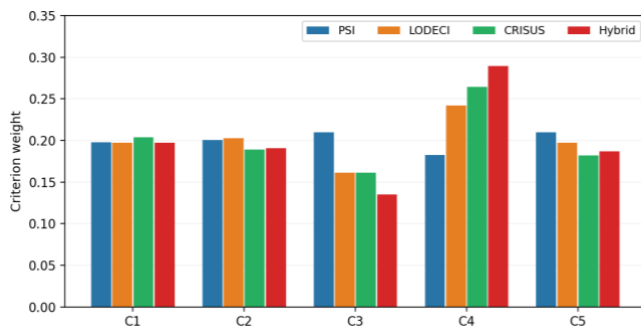


Figure 3. Criterion Weights

4.2. RADAR-2 Scores and Rankings

Table 7. RADAR-2 scores under four weighting approaches

Airline	PSI	LODECI	CRISUS	Hybrid	Hybrid rank
AJet	0.0365	0.0484	0.0528	0.0579	7.5
Corendon Airlines	0.0365	0.0484	0.0528	0.0579	7.5
EasyJet	0.1169	0.1555	0.1747	0.1866	3
Eurowings	1.0000	1.0000	1.0000	1.0000	1
Norwegian	0.5220	0.7363	0.8723	0.9313	2
Pegasus Airlines	0.0420	0.0557	0.0611	0.0667	4
SunExpress	0.0365	0.0484	0.0528	0.0579	7.5
Wizz Air	0.0365	0.0484	0.0528	0.0579	7.5
Vueling Airlines	0.0421	0.0560	0.0605	0.0664	5

Hybrid RADAR-2 ranks Eurowings first (1.0000), Norwegian second (0.9313), and EasyJet third (0.1866), followed by Pegasus Airlines (0.0667) and Vueling Airlines (0.0664). AJet, Corendon Airlines, SunExpress, and Wizz Air share 0.0579 and occupy positions 6-9, reported as average rank 7.5. Eurowings, Norwegian, and EasyJet retain the first three positions under all four weighting approaches. PSI and LODECI place Vueling ahead of Pegasus, while CRISUS and Hybrid reverse those two positions.

The scores are relative indices within the recorded five-criterion matrix. A score of 1 identifies the leading alternative under the selected aggregation rule. It does not indicate perfect service quality or complete passenger satisfaction. Equal final scores require examination of the original and transformed profiles.

4.3. Mathematical Explanation of Repeated Scores

The equal lower-tier scores are a deterministic plateau effect. Komatina et al. (2026), (Theorem 5 and Table 1) already show the constant branch of the relative-relationship function. Here its consequences are examined for the airline matrix. Let α be the normalized loss and $\beta = 1 - \alpha$. Equations (24)-(25) imply $RR = \alpha / (1 - \alpha + |2\alpha - 1|)$, which has the following branches:

$$RR(\alpha) = \alpha / (2 - 3\alpha) \quad \text{for } 0 \leq \alpha < 1/2$$

$$RR(\alpha) = 1 \quad \text{for } 1/2 \leq \alpha \leq 1$$

For a benefit criterion, $\alpha \geq 1/2$ corresponds to a value at or below the observed midpoint. The C1-C5 midpoint thresholds are 3.75, 3.25, 3.50, 3.00, and 3.75. The four tied airlines lie at or below every threshold and receive $RR = 1$ on all five criteria. Their transformed profiles are therefore identical, (1,1,1,1,1), although some raw values differ.

Table 8. Transformed RADAR-2 profiles

Airline	RR C1	RR C2	RR C3	RR C4	RR C5
AJet	1.0000	1.0000	1.0000	1.0000	1.0000
Corendon Airlines	1.0000	1.0000	1.0000	1.0000	1.0000
EasyJet	0.3333	0.0000	0.0000	0.2000	1.0000
Eurowings	0.0000	0.0000	0.0000	0.2000	0.0000
Norwegian	0.0000	0.0000	0.0000	0.0000	0.3333
Pegasus Airlines	0.3333	1.0000	1.0000	1.0000	1.0000
SunExpress	1.0000	1.0000	1.0000	1.0000	1.0000
Wizz Air	1.0000	1.0000	1.0000	1.0000	1.0000
Vueling Airlines	1.0000	0.3333	1.0000	1.0000	1.0000

Each of the four airlines has aggregate loss $\sum_j w_j = 1$ under positive weights normalized to sum to one. Their common ranking index is therefore the minimum aggregate loss across the matrix. Under hybrid weights, Eurowings provides the minimum, $0.2w_4 = 0.057937030906$, which is also the tied score. Because the transformed profiles remain identical for all such weights, the tie persists and occupies the lowest group. Only SunExpress and Wizz Air have identical raw profiles. The additional equality involving AJet and Corendon does not establish genuine service-performance parity.

The plateau structure persists after range normalization regardless of the input scale. Within this region, different input values yield the same transformed value. A narrow discrete

scale makes repeated transformed values more frequent. However, the underlying mechanism is the constant branch of the transformation function over a specific interval. A positive affine rescaling of a criterion leaves α unchanged. This value represents the normalized relative position. The plateau structure is therefore preserved. Displaying final scores with more decimal places cannot recover differences already lost during the transformation.

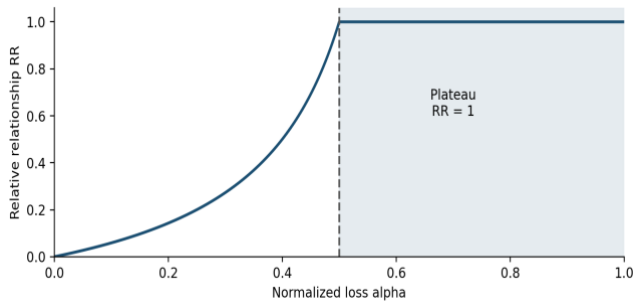


Figure 4. RADAR-2 relative relationship function

4.4 Rank Agreement Across Weighting Approaches

Table 9. Rank agreement across weighting approaches with ties retained

Method	Weights A	Weights B	ρ	τ -b
RADAR2	PSI	LODECI	1.0000	1.0000
RADAR2	PSI	CRISUS	0.9818	0.9333
RADAR2	PSI	Hybrid	0.9818	0.9333
RADAR2	LODECI	CRISUS	0.9818	0.9333
RADAR2	LODECI	Hybrid	0.9818	0.9333
RADAR2	CRISUS	Hybrid	1.0000	1.0000
TOPSIS	PSI	LODECI	1.0000	1.0000
TOPSIS	PSI	CRISUS	1.0000	1.0000
TOPSIS	PSI	Hybrid	1.0000	1.0000
TOPSIS	LODECI	CRISUS	1.0000	1.0000
TOPSIS	LODECI	Hybrid	1.0000	1.0000
TOPSIS	CRISUS	Hybrid	1.0000	1.0000
VIKOR	PSI	LODECI	0.9496	0.8857
VIKOR	PSI	CRISUS	0.9328	0.8286
VIKOR	PSI	Hybrid	0.9328	0.8286
VIKOR	LODECI	CRISUS	0.9832	0.9429
VIKOR	LODECI	Hybrid	0.9832	0.9429
VIKOR	CRISUS	Hybrid	1.0000	1.0000

Agreement across weighting approaches for RADAR-2 ranges from $\rho = 0.9818$ to 1.0000. Tau-b values range from 0.9333 to 1.0000. TOPSIS yields $\rho = 1.0000$ and τ -b = 1.0000 in all pairwise comparisons among the four weighting approaches. For VIKOR, ρ values range from 0.9328 to 1.0000. Tau-b values range from 0.8286 to 1.0000.

These values indicate ranking agreement only within the tested decision matrix. They do not establish predictive

accuracy or measurement validity. Nor do they demonstrate the structural superiority of the methods. The plateau structure of RADAR-2 produces tied rankings that remain unaffected by changes in weights. Ranking agreement should therefore be assessed alongside the ability to distinguish among alternatives.

4.5 Benchmarking against TOPSIS and VIKOR

Table 10. Benchmark scores and average ranks under hybrid weights

Airline	RADAR-2	Rank	TOPSIS	Rank	VIKOR Q	Rank
AJet	0.0579	7.5	0.1886	7	0.8358	7
Corendon Airlines	0.0579	7.5	0.3779	6	0.7145	6
EasyJet	0.1866	3	0.7017	3	0.2514	3
Eurowings	1.0000	1	0.8114	2	0.0283	2
Norwegian	0.9313	2	0.8962	1	0.0000	1
Pegasus Airlines	0.0667	4	0.4375	5	0.6153	5
SunExpress	0.0579	7.5	0.1077	8.5	1.0000	8.5
Wizz Air	0.0579	7.5	0.1077	8.5	1.0000	8.5
Vueling Airlines	0.0664	5	0.4836	4	0.4505	4

Under hybrid weights, RADAR-2 ranks Eurowings, Norwegian, and EasyJet first through third. TOPSIS and VIKOR both place Norwegian first, Eurowings second, and EasyJet third. RADAR-2 places Pegasus fourth and Vueling fifth; both benchmarks place Vueling fourth and Pegasus fifth. Corendon and AJet rank sixth and seventh in both benchmarks, while SunExpress and Wizz Air share positions eight–nine (average rank 8.5). RADAR-2 merges those final four alternatives into one tied group.

Under hybrid weights, RADAR-2 agrees with both TOPSIS and VIKOR at $\rho = 0.9265$ and τ -b = 0.8024. TOPSIS and VIKOR produce identical hybrid rankings with $\rho = 1.0000$ and τ -b = 1.0000. RADAR-2 yields six distinct scores and six tied pairs among 36 possible pairs (16.7%). Each benchmark method yields eight distinct scores and one tied pair (2.8%). This tie corresponds to the identical SunExpress and Wizz Air rows. RADAR-2 therefore preserves fewer distinctions in this application. The number of distinct scores does not establish substantive accuracy. Benchmark rankings do not constitute an external ground truth.

VIKOR does not satisfy the acceptable-advantage condition under any of the four weighting approaches. The gaps between the two lowest Q values are 0.0874 under PSI, 0.0174 under LODECI, 0.0166 under CRISUS, and 0.0283 under Hybrid. All gaps are below $DQ = 0.125$. The acceptable-stability condition is satisfied under every weighting approach. Eurowings has the lowest Q under PSI and LODECI. Norwegian has the lowest Q under CRISUS and Hybrid. Nevertheless, all four approaches identify the same compromise set consisting of Eurowings and Norwegian. Under hybrid weights, Norwegian has $Q = 0.000000$. Eurowings has $Q = 0.028277$. Norwegian's lowest Q therefore

does not justify recommending it as the sole compromise solution.

Table 11. Rank agreement across methods

Weights	Method A	Method B	ρ	τ -b
PSI	RADAR2	TOPSIS	0.9440	0.8641
PSI	RADAR2	VIKOR	0.9614	0.9258
PSI	TOPSIS	VIKOR	0.9328	0.8286
LODECI	RADAR2	TOPSIS	0.9440	0.8641
LODECI	RADAR2	VIKOR	0.9614	0.9258
LODECI	TOPSIS	VIKOR	0.9832	0.9429
CRISUS	RADAR2	TOPSIS	0.9265	0.8024
CRISUS	RADAR2	VIKOR	0.9265	0.8024
CRISUS	TOPSIS	VIKOR	1.0000	1.0000
Hybrid	RADAR2	TOPSIS	0.9265	0.8024
Hybrid	RADAR2	VIKOR	0.9265	0.8024
Hybrid	TOPSIS	VIKOR	1.0000	1.0000

4.6 Weight and Parameter Sensitivity

Ten small changes were made to the hybrid weights. The original ranking was preserved in six cases for RADAR-2. It was preserved in all ten cases for TOPSIS. For VIKOR, it was preserved in eight cases. These findings apply only to the small weight changes tested. They do not show that the rankings would remain unchanged under larger or different changes in weights.

Table 12. Broad weight sensitivity over 10000 simplex draws

Method	Eurowings first	Norwegian first	Other first	Full ranking retained
RADAR2	62.85%	37.15%	0.00%	30.93%
TOPSIS	45.90%	54.10%	0.00%	26.95%
VIKOR	57.27%	42.73%	0.00%	21.66%

A total of 10,000 weight combinations were tested. In RADAR-2, Eurowings ranked first in 62.85% of the draws. Norwegian ranked first in 37.15%. The corresponding percentages were 45.90% and 54.10% for TOPSIS. They were 57.27% and 42.73% for VIKOR. No other airline ranked first.

The complete original hybrid ranking was retained in 30.93% of the draws for RADAR-2. This percentage was 26.95% for TOPSIS. It was 21.66% for VIKOR. These values indicate cases in which all nine airlines retained their original ranks. They do not indicate winner retention or an overall success rate. The four tied airlines in RADAR-2 remained in the lowest group in every draw. The results depend on the weight distribution used. They should not be interpreted as probabilities of actual airline performance.

In RADAR-2, the order of Eurowings and Norwegian depends on the weights of C4 and C5. Eurowings ranks higher when the C5 weight exceeds 60% of the C4 weight. The hybrid

weights satisfy this condition. EasyJet remains below both airlines whenever all weights are positive. The order of Pegasus and Vueling depends on the weights of C1 and C2. Pegasus ranks higher when the C1 weight is greater. The tie among the four airlines in the lowest group remains unchanged.

Table 13 examines the VIKOR parameter v at 0.25, 0.50, and 0.75. Eurowings has the lowest Q score at all three values under PSI and LODECI. Norwegian leads under CRISUS and hybrid weights. The acceptable-stability condition is satisfied in all twelve cases. However, the acceptable-advantage condition is not satisfied. Eurowings and Norwegian are therefore identified together as the compromise set in every case. The airline with the lowest Q score is not recommended as the sole compromise solution.

Table 13. VIKOR parameter sensitivity and compromise solutions

Weights	v	Q leader	Q gap	Compromise
PSI	0.25	Eurowings	0.1177	Eurowings / Norwegian
PSI	0.50	Eurowings	0.0874	Eurowings / Norwegian
PSI	0.75	Eurowings	0.0570	Eurowings / Norwegian
LODECI	0.25	Eurowings	0.0231	Eurowings / Norwegian
LODECI	0.50	Eurowings	0.0174	Eurowings / Norwegian
LODECI	0.75	Eurowings	0.0117	Eurowings / Norwegian
CRISUS	0.25	Norwegian	0.0217	Norwegian / Eurowings
CRISUS	0.50	Norwegian	0.0166	Norwegian / Eurowings
CRISUS	0.75	Norwegian	0.0114	Norwegian / Eurowings
Hybrid	0.25	Norwegian	0.0366	Norwegian / Eurowings
Hybrid	0.50	Norwegian	0.0283	Norwegian / Eurowings
Hybrid	0.75	Norwegian	0.0200	Norwegian / Eurowings

Note: $DQ = 0.125$. Stability is satisfied and acceptable advantage fails in all twelve cases. The Q gap is between the first and second alternatives. Every compromise set contains Eurowings and Norwegian.

5. Conclusion

In this study, nine airlines were compared using five benefit-oriented service quality criteria, four weighting approaches, and three ranking methods. Under hybrid weights, derived from the normalized direct product of PSI, LODECI, and CRISUS weights, RADAR-2 ranks Eurowings, Norwegian, and EasyJet in the top three positions, whereas the top two positions are reversed in TOPSIS and VIKOR. Since the "acceptable advantage" condition is not met in VIKOR, Norwegian and Eurowings together form the compromise set. The findings are based on service quality ratings. It does not measure actual baggage delivery time.

The RADAR-2 rule (Komatina et al., 2026), which converts normalized loss values of 0.5 or higher to $RR = 1$, results in four airlines receiving the same final score despite their differing raw profiles. While this equality persists under positive normalized weights, TOPSIS and VIKOR preserve certain differences among the airlines in question. The high rank agreement observed among the weighting approaches demonstrates the similarity of the results in this dataset. It does not prove the equality of actual service quality, the validity of external models, or the overall superiority of any method.

5.1. Research Implications

The comparison demonstrates that weighting approaches alter criterion priorities and the ranking positions of certain airlines. Ranking correlations quantitatively reveal that the agreement between different weighting approaches and methods is not absolute. Local weight changes and extensive weight simulations show that the leading alternative and the full ranking can change. However, across the tested VIKOR parameter values, the leading alternative within each weighting approach and the compromise set consisting of Eurowings and Norwegian remain unchanged. Furthermore, the analysis of normalization effects suggests that consistency must be evaluated in conjunction with the extent to which differences between alternatives are preserved.

Objective weights summarize the characteristics of the decision matrix. The fact that C4 receives the highest weight in the LODECI, CRISUS, and Hybrid methods does not imply that arrival assistance exerts the greatest causal influence on satisfaction. While the alignment of calculations with the specified equations supports reproducibility, the interpretation of findings requires defensible measurement and coding regarding the directionality of criteria.

5.2. Limitations and Future Research

This study evaluates nine low-cost airlines based on five service criteria using data from a single point in time. Consequently, the findings are not based on a representative sample that can be generalized to the entire airline industry or passenger base. In the calculations, differences between star ratings were treated as quantitative values with equal intervals; however, it has not been independently verified that these intervals represent equal differences in terms of perceived service quality. Furthermore, the specific cabin, fare, and airline contexts associated with the recorded scores, as well as the original source records, could not be fully reconstructed. Therefore, the resulting rankings should be viewed not as a definitive measure of the airlines' overall service quality, but rather as comparative results derived within the framework of the specific decision matrix, criteria dimensions, and methodological assumptions employed. Criterion C5 represents a quality rating for baggage delivery service rather than the actual baggage delivery time; thus, it was modeled as a benefit-oriented criterion, consistent with the others.

Future studies could examine the temporal consistency of the results by utilizing a broader dataset of airlines. Harmonizing service contexts, such as cabin class, fare options, and airlines, could enhance comparability among the airlines. The impact of the equal-interval assumption on the results could also be investigated by employing alternative transformations and evaluation methods that account for the ordinal nature of star ratings. Additionally, operational indicators, such as actual baggage delivery time, delay rates, and the frequency of lost or damaged baggage, could be

incorporated into the analysis as separate cost-oriented criteria measured in explicit units. Comparisons with passenger surveys and internal operational data can contribute to assessing the extent to which model results align with perceived service quality and observed operational performance.

5.3. Managerial Implications

The findings of this study provide guidance to managers of low-cost airlines regarding the review of service evaluations and the identification of areas for improvement. While staff support at the destination (C4) receives the highest weight in the LODECI, CRISUS, and multiplicative hybrid weighting methods, boarding process efficiency (C3) holds the lowest weight across these three approaches. In the hybrid weighting method, the weight of C4 is 0.289685, and the priority order of the criteria is $C4 > C1 > C2 > C5 > C3$. This result supports prioritizing the examination of arrival support and check-in service options during internal service evaluations. However, in the PSI method, the quality score for baggage delivery service (C5) receives a weight only marginally higher than that of boarding efficiency (C3). This variation among approaches demonstrates that criterion priorities depend on the weighting rule employed. Consequently, managers should not interpret objective weights as direct reflections of passenger preferences or the direct impact of investments on customer satisfaction; rather, they should use them as comparative indicators to examine practices regarding staff availability, passenger guidance, and service recovery.

The fact that Eurowings, Norwegian, and EasyJet consistently rank in the top three across various methods and weighting approaches indicates that these carriers can serve as benchmarks for the service dimensions analyzed. Nevertheless, the shifting rankings within the top three suggest that no single carrier can be deemed to possess overall service superiority. While Eurowings ranks first in RADAR-2 using hybrid weights, Norwegian holds the top spot in both TOPSIS and VIKOR; the compromise set for VIKOR consists of Norwegian and Eurowings. Therefore, benchmarking studies should consider not only the overall ranking but also the strengths and weaknesses of each airline at the criterion level.

The fact that AJet, Corendon Airlines, SunExpress, and Wizz Air received the same score in RADAR-2 does not imply that their service profiles are identical. The constant-value component of the relative relationship transformation causes different raw scores to yield the same transformed value. Indeed, the arrival support score is 3 for Corendon Airlines, 2.5 for AJet, and 2 for both SunExpress and Wizz Air. These differences indicate that, despite sharing a final score, the airlines may have distinct needs for improvement. It would be appropriate for managers to conduct evaluations for this group by integrating raw criterion scores, TOPSIS and VIKOR results, and internal passenger feedback. The mid-range rankings of Pegasus Airlines and Vueling Airlines also provide a starting point for detailed examinations regarding specific criteria. The fact that both airlines have an arrival support score of 3 warrants a comparison of their practices in this area against those of airlines achieving higher scores. However, the current analysis does not determine how a specific investment might alter the ranking or what the return on such an investment would be. Consequently, potential improvements should be assessed through pilot programs supported by operational indicators, complaint records, and cost data.

Finally, the differences between weighting approaches and the potential for the top-ranked business to change during sensitivity analysis demonstrate the benefit of employing multiple evaluation approaches in quality management. Since the findings are limited to the Skytrax-based decision matrix and the five criteria examined, they should be viewed as an evaluation framework to guide more comprehensive internal reviews rather than as a basis for definitive resource allocation decisions.

Conflicts of Interest

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

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