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Analysis of Ground Handling Performance Criteria Using the Fuzzy LAAW Method

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ABSTRACT

The Balanced Scorecard (BSC) constitutes a strategic management framework that systematically translates an organization's vision and strategy into quantifiable objectives, operational actions, and key performance indicators (KPIs). Against this background, the present study aims to determine the relative importance levels of performance indicators within a multi-criteria decision-making (MCDM) framework. To this end, a structured survey instrument was administered to 37 upper- and middle-level managers employed at a ground handling company operating in Türkiye. The analytical framework encompassed four principal dimensions — financial performance, customer relations, internal processes, and human development — comprising a total of 21 sub-criteria. Criteria weights were subsequently derived through the application of the Logarithmic Additive Weighting Coefficient Estimation (LAAW) method, which is grounded in fuzzy logic theory. The empirical findings reveal that the prioritization of performance criteria remains broadly consistent across different managerial levels; customer satisfaction and financial performance were consistently identified as the most critical dimensions across all respondent groups. Nevertheless, operational-level managers were observed to assign comparatively greater weight to human resources management and operational efficiency. These findings suggest that a comprehensive and robust assessment of ground handling performance necessitates the simultaneous consideration of not only customer-oriented and financial outcomes, but also human capital development and operational process optimization. Accordingly, the study offers a strategically informed reference framework for decision-makers and practitioners operating within the aviation industry

1. Introduction

The aviation sector has undergone rapid and profound transformation in recent decades, propelled by globalization, escalating passenger demand, and continuous technological advancement. Within this broader transformation, ground handling operations have emerged as a critical determinant of passenger satisfaction, operational efficiency, and overall airport performance. Operations

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encompassing check-in procedures, baggage handling, ramp services, aircraft cleaning, and passenger guidance constitute the primary points of contact between the passenger and the airline, thereby exerting a direct influence on the perceived quality of the travel experience. Empirical evidence in the extant literature corroborates the significant impact of ground handling performance on overall service quality perceptions (Hatipoğlu et al., [1]).

The pivotal role of the aviation industry in sustaining global economic growth, facilitating tourism, and enabling international trade is well established. Intensifying competition among airlines and the sustained growth in passenger volumes have collectively elevated service quality to a position of strategic prominence. In this environment, competitive advantage is no longer determined solely by flight safety and operational efficiency; passenger experience and satisfaction have equally become indispensable dimensions of organizational success. Given that ground services represent the passenger's first and last interaction with the airline, any deficiencies in these operations bear the potential to significantly impair passenger perceptions and overall satisfaction.

Against this background, a growing body of research has directed attention toward the systematic measurement and evaluation of ground handling performance using advanced analytical frameworks. Mugabo and Gökdalay [2] developed a hybrid performance measurement model for ground handling companies, employing Fuzzy AHP for criterion weighting and scientifically deriving strategic weights for dimensions such as service continuity, safety, and operational speed, using Antalya Airport as a case study. In their evaluation of aircraft marshalling processes, Joshua et al. [3] applied a critical weighting technique, assigning objective weights to criteria including operational efficiency (0.10), safety (0.10), and cost (0.19), subsequently identifying the optimal marshalling technology through the VIKOR method. Asker et al. [4] examined the financial performance of airport groups in the post-pandemic period using the LOPCOW method for criterion weighting, underscoring the decisive role of financial structure and profitability in organizational performance.

Parallel to these operational studies, the broader service quality literature has provided foundational frameworks for performance assessment. The SERVQUAL model, introduced by Parasuraman et al. [5], remains one of the most widely adopted instruments for evaluating service quality across industries. Within the aviation domain, Chen and Chang [6] demonstrated that airline service quality constitutes a key determinant of customer loyalty, while Park et al. [7] established a direct relationship between service quality and passenger satisfaction. Collectively, these studies affirm that effective management of operational processes not only reduces costs but simultaneously enhances the customer experience — with on-time performance, baggage delivery efficiency, and staff conduct emerging as particularly salient performance determinants.

In light of the foregoing, the systematic measurement of ground handling performance and the rigorous identification of its determinant criteria represent both a scholarly and practical imperative. Accordingly, this study aims to examine the influence of ground handling operations on organizational performance indicators through a multi-criteria decision-making (MCDM) framework. For this purpose, the Logarithmic Additive Weighting Coefficient Estimation (LAAW) method, grounded in fuzzy logic, was employed to determine the relative significance of performance criteria on the basis of expert assessments. The LAAW method represents a methodologically robust and relatively novel approach to criteria weighting, demonstrating particular efficacy in MCDM contexts by enhancing the consistency and reliability of expert-derived weights. Following the identification and operationalization of ground handling-related criteria, importance scores were computed and analyzed, yielding empirically grounded recommendations for strategic decision-making in the aviation industry.

2. Literature Review

The evaluation of ground handling service quality in aviation constitutes an inherently complex decision-making challenge, owing to its multidimensional structure and the interactive nature of its numerous performance indicators. While earlier studies predominantly relied on subjective scales to measure factors influencing customer satisfaction, contemporary methodological approaches increasingly require objective, mathematically grounded frameworks for criteria weighting. In this context, the Logarithmic Additive Weighting Coefficient Estimation (LAAW) method — a multi-criteria decision-making (MCDM) technique that determines criterion weights through logarithmic transformations — offers a strategically significant tool for establishing the hierarchical importance of ground service parameters, thereby enabling rational prioritization and resource optimization in the pursuit of enhanced customer satisfaction.

Ground handling operations are widely recognized in the literature as one of the most fundamental components of the aviation system, providing all services necessary for the safe and efficient handling of aircraft and passengers during their time at the airport (Aydın and Yörükoğlu, [8]; Yüksekbilgili, [9]). Encompassing both technical and operational tasks, these services exert a substantial influence on the overall passenger experience. Metaphorically described in the literature as the "backstage" or "kitchen" of aviation, ground operations, though largely invisible to passengers, directly condition the functioning of the entire system (Aydın and Yörükoğlu, [8]). Accordingly, the scope of ground services extends across flight safety, operational efficiency, service quality, and passenger satisfaction. Their strategic significance transcends micro-level apron activities; at a macro level, ground operations serve as a critical regulatory mechanism for the balanced and stable functioning of the global air traffic network (Zagrajek and Hoszman, [10]). Empirical evidence further demonstrates that disruptions in ground handling processes amplify volatility across the air traffic system, generating cascading delays and operational disruptions that extend well beyond the affected flight (PR et al., [11]; Zagrajek and Hoszman, [10]).

From an economic standpoint, the effective management of ground services contributes not only to the financial performance of individual airlines but also to the broader economic development of national and regional economies (Eski and Tasus, [12]). Research examining the relationship between operational inefficiencies and fuel consumption indicates that the optimization of ground handling processes could yield approximately a 3.5% reduction in overall operational costs, while simultaneously reducing ground-level engine emissions — a consideration of growing relevance for environmental sustainability objectives (Gładyś et al., [13]; Tucci and Facchini, [14]).

Safety management constitutes another critical dimension of ground handling performance. Given that apron operations are inherently high-risk environments, systematic risk assessment is essential. The literature identifies the combined management of operational speed and precision as a decisive factor for apron safety (Gül and Ak, [15]; Yazgan et al., [16]). In parallel, the human dimension has been established as a significant determinant of ground service performance; employee job satisfaction is identified as a direct antecedent of service quality and a prerequisite for operational excellence (Yüksekbilgili, [9]).

Technological innovation has increasingly shaped the ground handling domain. The application of artificial intelligence to shift scheduling has been proposed as a means of reducing human error in operational decision-making (Değirmencioğlu and Macit, [17]). Studies on autonomous tow tractors at hubs such as Prague Airport underscore the necessity of integrating new safety standards — including digital mapping and emergency stop protocols — into technology adoption processes (Kurzweil and Kolarova, [18]). Traffic simulations at Tokyo International Airport have similarly examined the compatibility of autonomous ground service vehicles with existing traffic flows in terms of speed and safety parameters (Kuroda et al., [19]). The transition to electric ground support equipment (eGSE) has emerged as a focal area for the 2025–2026 period; research conducted at major airports including Amsterdam Schiphol and Dallas-Fort Worth demonstrates that balancing electric vehicle charging demands with overall energy requirements necessitates mathematical optimization models (Bose et al., [20]; Timmermans et al., [21]).

From a passenger experience perspective, current research consistently indicates that passengers establish a direct perceptual link between ground service quality and overall airline quality. Baggage delivery times and staff problem-resolution capacity have been identified as the most salient determinants of overall passenger satisfaction (Hatipoğlu et al., [1]; Herc et al., [22]).

The methodological landscape for ground handling performance evaluation has evolved considerably, with MCDM approaches occupying a central position in the literature. Criteria weighting methods provide a formal mathematical basis for identifying which factors merit prioritization, thereby promoting more objective and consistent decision-making. In the context of ground handling agent selection, the Best-Worst Method (BWM) has been employed for criteria weighting, with findings indicating that service quality represents the most important criterion from a business-to-business (B2B) perspective (Bakır et al., [23]). The Analytic Hierarchy Process (AHP), applied in performance analyses of ground handling companies operating in Türkiye, enables the hierarchical evaluation and weighting of multiple criteria (Aydın and Yörükoğlu, [8]). Hybrid models integrating AHP with fuzzy logic have further been applied to equipment procurement processes, establishing a balanced decision mechanism between technical adequacy and cost considerations (Shen et al., [24]; Tao et al., [25]).

Fuzzy logic-based weighting methods offer particular advantages in decision environments characterized by uncertainty. The Fuzzy SWARA method, applied in airport infrastructure evaluations, identified runway length and taxiway capacity as the most critical factors (Özdağoğlu et al., [27]). In models designed to enhance airline ground operations, Fuzzy AHP analyses revealed that flight schedules and routes constituted the highest-weighted criterion (0.30), followed by counter services (0.26) (Kulaklı and Şahin, [28]). Entropy-based weighting methods have been employed in financial performance analyses to examine the effects of crisis periods — such as the COVID-19 pandemic — on ground service companies (Bakır and Akan, [29]; Kurşuncu and Seçilmiş, [30]).

Among fuzzy-based MCDM methods, the LAAW method was introduced and validated by Deveci et al. [26] in a study involving 33 experts from 22 countries. The study evaluated technical, economic, environmental, and social-political dimensions in the context of energy project site selection, identifying solar radiation, economic performance indicators (net present value, internal rate of return, and return on investment), carbon emission savings, and policy support as the most critical criteria. The method was developed specifically to address inconsistencies in expert evaluations and to support more rational, sustainable decision-making processes.

Risk assessment constitutes a further thematic strand in the ground handling literature. Safety parameters have been weighted using quasirung fuzzy methods to prioritize risks associated with flight schools and ground training programs (Gül and Ak, [15]), while FRAM-based fuzzy logic integrations have been proposed for dynamic monitoring and assessment of operational risks (Tengiz and Unal, [31]). Beyond ground operations, MCDM methods have been applied across a broad range of aviation management domains, including competency assessment in maintenance organizations (Saitoglu and Apak, [32]), new flight destination selection (Akman et al., [33]), in-flight service quality evaluation (Akdeniz, [34]), pilot selection criteria development (Kurnaz et al., [35]), and ground service factor weighting using SWARA, VIKOR, and COPRAS methods (Asri et al., [36]; Ghoushchi et al., [37]). This breadth of application underscores both the interdisciplinary relevance of the subject and the methodological diversity characterizing contemporary aviation research.

3. Methodology

The LAAW method represents a contemporary weighting approach that enables the determination of criterion weights in a more consistent and reliable manner by processing decision-makers' evaluations through a mathematical framework grounded in logarithmic transformation. The method has attracted considerable attention in the literature owing to its capacity to transform subjective expert evaluations into a systematic and mathematically traceable framework, its flexibility in computational procedures, and its broad applicability across diverse decision-making contexts. It has been extensively employed in studies pertaining to logistics, supply chain management, and the service sector, demonstrating particular efficacy in problems characterized by uncertainty and involving the simultaneous evaluation of numerous criteria (Pamucar et al., [38]).

The present study employs the LAAW method — a fuzzy logic-based MCDM technique — to assess the influence of ground handling operations on organizational performance indicators in the aviation industry from a multidimensional perspective. In complex operational systems such as ground handling, where multiple criteria must be evaluated concurrently, a precise understanding of the relative importance of each criterion is essential for informed decision-making. The LAAW method was selected on the basis of its capacity to systematically integrate mathematical consistency with expert judgment. The method determines importance levels by leveraging the logarithmic relationship between the criterion priority vector and the absolute anti-ideal point. This approach offers substantive methodological advantages over conventional weighting techniques, including a reduced number of required pairwise comparisons, minimization of evaluative inconsistencies, and enhanced reliability in problems involving a large number of criteria. Furthermore, the incorporation of fuzzy logic enables the model to accommodate inherent uncertainties in expert assessments, thereby yielding more realistic and robust outcomes.

3.1 Research Design and Method Selection

The methodological framework of this study was designed to measure the influence of aviation ground handling processes on organizational performance indicators. The decision-making process is structured around four sequential stages: (i) identification of evaluation criteria, (ii) collection of expert assessments, (iii) calculation of criterion weights, and (iv) analysis and interpretation of results. The criteria examined within the scope of ground handling services encompass multiple operational and service-oriented dimensions, including operational efficiency, service quality, time management, staff performance, and customer interaction. Each criterion was incorporated into the analytical framework on the premise that it exerts a direct or indirect influence on the relevant performance indicators.

3.2 Fuzzy Numbers and Mathematical Foundations

In this study, triangular fuzzy numbers (TFN) were used to express uncertainties in expert opinions. A fuzzy number $\tilde{z} = (l, m, u)$ where these values represent the lower, middle, and upper bounds, respectively. Thanks to this framework, as noted in Eq. (1), experts are able to make assessments based on ranges rather than exact values, and uncertainties in the decision-making process can be modeled more accurately (Pamucar *et al.*, [38]).

$$\mu_{\tilde{Z}}(\lambda) = \begin{cases} \frac{\lambda - l}{m - l}, & l \leq \lambda \leq m \\ \frac{u - x}{u - m}, & m \leq \lambda \leq u \\ 0, & in\ other\ cases \end{cases} \tag{1}$$

3.3 The Implementation Steps of the LAAW Method

3.3.1. Creation of the Criterion Priority Vector

In the first stage, the identified criteria were evaluated by experts, and fuzzy priority values were assigned for each criterion. After defining a set of n criteria, the experts prioritize the criteria by assigning a higher TFN from the fuzzy scale to the more important criterion while assigning a smaller TFN from the fuzzy scale to the less important criterion.

We thus obtain the fuzzy priority vector $\Upsilon^t = (\tilde{\theta}_1^t, \tilde{\theta}_2^t, \ldots, \tilde{\theta}_n^t)$ where $\tilde{\theta}_j^t = (\theta_j^{(l)t}, \theta_j^{(m)t}, \theta_j^{(u)t})$ represents the TFN from the fuzzy scale assigned by the expert t $(1 \leq t \leq k)$ to the criterion n (Pamucar *et al.*, [38]).

3.3.2. Determination of the Absolute Anti-Ideal Point

To enable comparisons within the model, a reference point representing the lowest performance is identified. This point is referred to as the absolute anti-ideal point and is shown in Eq. (2).

$$\breve{\xi}_{AIP} < \min(\tilde{\theta}_j^t, \tilde{\theta}_j^t, \ldots, \tilde{\theta}_j^t) \tag{2}$$

This point is determined based on the lowest value among all criteria and serves as the primary reference for calculating the relative strengths of the criteria (Pamucar *et al.*, [38]).

3.3.3. Combining and Aggregating Expert Opinions

The Bonferroni function is used to combine the evaluations of multiple experts. This function allows the opinions of different experts to be consolidated into a single common value, as shown in Eq. (3).

$$\tilde{\theta}_j = \left(\theta_j^{(l)}, \theta_j^{(m)}, \theta_j^{(u)}\right) = \begin{pmatrix} \left(\frac{1}{k(k-1)} \sum_{x=1}^{k} \left(\theta_j^{(l)(x)}\right)^{\alpha_1} \sum_{y=1, y\neq x}^{k} \left(\theta_j^{(l)(y)}\right)^{\alpha_2}\right)^{\frac{1}{\alpha_1+\alpha_2}}, \\ \left(\frac{1}{k(k-1)} \sum_{x=1}^{k} \left(\theta_j^{(m)(x)}\right)^{\alpha_1} \sum_{y=1, y\neq x}^{k} \left(\theta_j^{(m)(y)}\right)^{\alpha_2}\right)^{\frac{1}{\alpha_1+\alpha_2}}, \\ \left(\frac{1}{k(k-1)} \sum_{x=1}^{k} \left(\theta_j^{(u)(x)}\right)^{\alpha_1} \sum_{y=1, y\neq x}^{k} \left(\theta_j^{(u)(y)}\right)^{\alpha_2}\right)^{\frac{1}{\alpha_1+\alpha_2}} \end{pmatrix} \tag{3}$$

Here, (k) represents the number of experts, while (α_1) and (α_2) represent the stabilization parameters. This step ensures that differing viewpoints are balanced in the group decision-making process (Deveci *et al.*, [26]; Pamucar *et al.*, [38]).

3.3.4. Calculation of the Relative Vector

Following the aggregation process, the relative superiority of each criterion relative to the anti-ideal point is calculated and shown in Eq. (4).

$$\tilde{\gamma}_j = \frac{\tilde{\theta}_j}{\tilde{\xi}_{AIP}} \tag{4}$$

This approach allows for more consistent results by ensuring that the criteria are evaluated not relative to one another but against an absolute reference point (Pamucar *et al.*, [38]).

3.3.5. Calculation of Weighting Factors

The weights of the criteria are calculated using a logarithmic transformation and are shown in Eq. (5) (Pamucar *et al.*, [38]).

$$\tilde{\omega}_j = \frac{\ln(\tilde{\gamma}_j)}{\ln(\tilde{b})} = \left(\frac{\ln(\gamma_j^{(l)})}{\ln(b^{(u)})}, \frac{\ln(\gamma_j^{(m)})}{\ln(b^{(m)})}, \frac{\ln(\gamma_j^{(u)})}{\ln(b^{(l)})}\right) \tag{5}$$

Where $\tilde{\gamma}_j = (\gamma_j^{(l)}, \gamma_j^{(m)}, \gamma_j^{(u)})$ represents the elements of the fuzzy relation vector A, while $\tilde{b} = \prod_{j=1}^{n} \tilde{\gamma}_j$. The values of weight coefficients thus obtained satisfy the condition that $\sum_{j=1}^{n} \omega_j = 1$

When ranking the criteria, it is recommended to phase shift the fuzzy value $\tilde{\omega}_j = \left(\omega_j^{(l)}, \omega_j^{(m)}, \omega_j^{(u)}\right)$ using the expression $def(w_j) = \frac{w_j^l + 4w_j^m + w_j^u}{6}$

3.4. Adapting the Method to the Study

In the present study, the LAAW method was applied to evaluate the influence of aviation ground handling operations on organizational performance indicators. Criterion weights were derived on the basis of expert assessments, enabling the identification of which ground service components exert the greatest impact on performance outcomes. The resulting analytical framework is intended to serve as a practical decision-support instrument applicable to strategic planning processes conducted by airlines and ground handling service providers.

3.5. Advantages and Limitations of the Method

The LAAW method offers several methodological advantages that render it particularly well-suited to the analytical demands of the present study. Chief among these is its capacity to yield highly accurate weighting outcomes with a comparatively limited number of expert comparisons, thereby reducing respondent burden without compromising analytical rigor. The method is further distinguished by its effectiveness in minimizing inconsistencies inherent in expert evaluations and by its structural compatibility with complex multi-criteria decision environments. The incorporation of a Bonferroni-based aggregation mechanism enables the balanced integration of assessments from heterogeneous expert groups, mitigating potential biases associated with group decision-making processes. From a computational standpoint, the logarithmic mathematical structure of the method maintains low complexity regardless of the number of criteria under consideration, while still enabling the derivation of consistent weight coefficients through a reduced set of comparisons.

Notwithstanding these advantages, the method is subject to a notable limitation: the reliability of its outputs is contingent upon the quality and representativeness of the expert evaluations on which it depends. Consequently, the careful selection of domain experts and the rigorous design of the data collection process constitute critical methodological prerequisites for ensuring the validity of results.

Within the specific context of ground handling operations, the system under analysis encompasses a set of closely interdependent sub-processes — including apron operations, passenger services (check-in and boarding), baggage handling, aircraft ground operations, and terminal services. Each of these sub-processes directly conditions on-time departure and arrival performance, operational efficiency, service quality, safety outcomes, and passenger satisfaction. The inherent complexity and interconnectedness of these processes necessitate a structured MCDM approach capable of accommodating their multidimensional character.

The application of the fuzzy LAAW method to this operational context is particularly appropriate, as the incorporation of fuzzy numbers into the analytical framework allows for the explicit modeling of operational uncertainties — including delay risks, workload fluctuations, and the influence of human factors — thereby producing criterion weights that more accurately reflect real-world conditions. Key decision criteria identified within this framework include the management of safety risks in apron operations, the optimization of speed and accuracy in baggage handling, and the perceived quality and responsiveness of passenger-facing services. By quantitatively determining the relative impact of each sub-process on overall system performance, the proposed methodology provides a comprehensive evaluation of both the operational and service quality dimensions of the ground handling system. In this regard, the LAAW-based approach functions as a high-precision, analytically flexible decision-support instrument, offering strategic utility for airlines and ground handling providers engaged in evidence-based performance management.

4. Application of the Study

The present study investigates the perspectives of managerial personnel — including station chief managers, directors, deputy general managers, and general managers — employed at a ground handling company operating within Türkiye's aviation sector, with respect to performance evaluation criteria. The survey instrument identified four principal dimensions constituting the basis of performance measurement: financial performance, customer relations, internal processes, and human development. A total of 21 sub-criteria were operationalized under these main dimensions, and their relative importance was systematically assessed. To ensure the consistency and reliability of the findings, the Analytical Hierarchy Process (AHP) method was employed for comparative validation. This approach further enabled the separate examination of performance evaluation tendencies across distinct managerial levels within the organization.

Türkiye has progressively consolidated its position as a strategic hub within the global aviation network, with air transport recording substantial growth in both operational capacity and passenger traffic. Within this context, ground handling operations have emerged as one of the most critical determinants of sectoral competitiveness, extending in significance well beyond the domains of flight safety and operational efficiency (Bahar, [39]; Yaşar & Özdemir, [40]). Ground handling companies operating in Türkiye collectively employ a qualified workforce exceeding 20,000 personnel. Sector data from 2025 indicate that the industry's leading operators successfully managed over 850,000 flights and in excess of 130 million passengers, generating annual revenues of approximately 900 million USD while directly influencing the operational efficiency of more than 10 strategic airport hubs across the country. The breadth of services provided — spanning from the moment a passenger enters the airport terminal through to aircraft boarding — positions ground handling not merely as a logistical support function, but as a strategically significant interface at which customer satisfaction is shaped and sustained. With annual growth rates exceeding 8%, the optimization of service quality under such high operational volumes is essential for preserving the international reputation of Türkiye's aviation industry, as service quality perceptions in ground handling processes exert a measurable influence on both performance indicators and the overall airport experience (Hatipoğlu et al., [1]).

4.1. Establishing the Decision Hierarchy

In order to evaluate performance criteria in a systematic and analytically rigorous manner, a decision hierarchy was constructed in accordance with the principles of the Analytical Hierarchy Process (AHP). This hierarchical structure facilitates a structured decomposition of the decision problem into distinct and manageable levels, thereby enhancing both the clarity and measurability of the evaluation framework. The resulting hierarchy is presented in Figure 1.

As illustrated in Figure 1, the hierarchy comprises three levels. The first level defines the overarching objective of the study, namely the assessment of managerial personnel performance within a ground handling company in the aviation sector. The second level encompasses the four principal evaluation criteria — financial performance, customer relations, internal processes, and human development — each identified through a synthesis of the extant literature and field-based expert consultations. The third level specifies 21 sub-criteria designed to provide a more granular and operationally measurable basis for performance assessment. These sub-criteria function as essential evaluation metrics for decision-makers and are not assigned exclusively to individual main criteria; rather, they are considered in relation to all dimensions, reflecting the inherently multidimensional and interrelated nature of organizational performance. This design choice explicitly accounts for potential interaction effects between criteria, thereby enhancing the structural validity of the evaluation model.

The hierarchical decomposition renders the complex decision problem more tractable by disaggregating it into clearly defined analytical layers while simultaneously preserving the relational structure among criteria. This framework constitutes the methodological foundation for the application of the AHP method and provides the structural basis for the construction of the pairwise comparison matrices employed in the subsequent analysis phase.

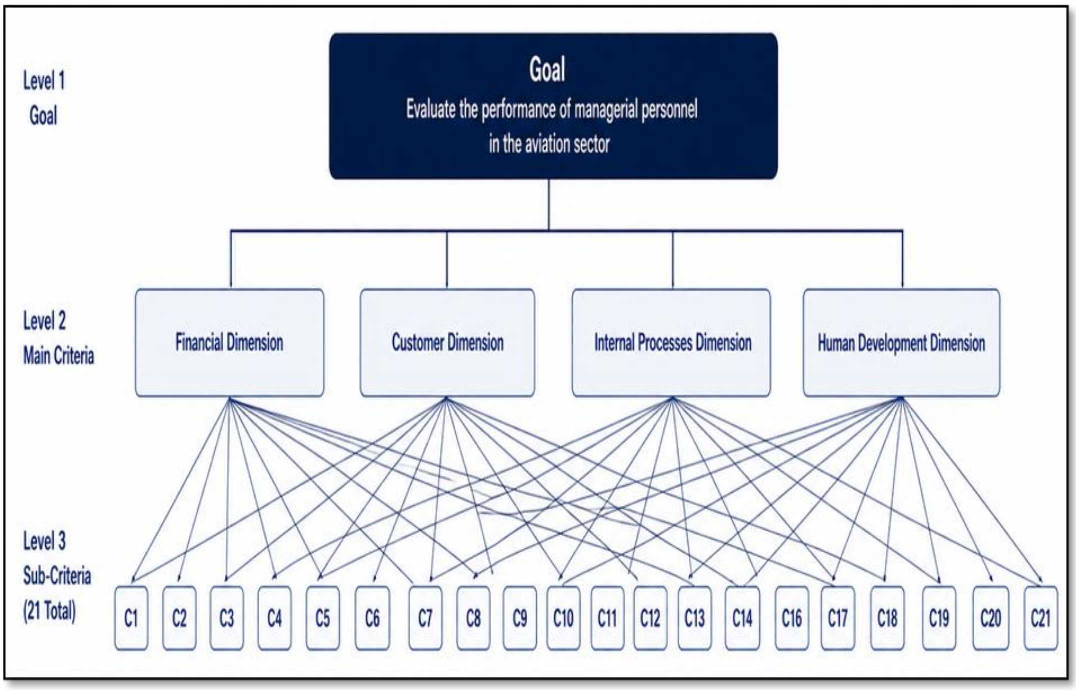

Fig. 1. Decision hierarchy

4.1.1. Definition of the criteria

C_1: *CAPEX/Revenue:* Shows the ratio of capital investments made to total revenue.
C_2: *3rd Party Profitability to Total Profitability:* Represents the share of profit from third-party services in total profitability.
C_3: *Profitability from Additional Services to Total Profitability:* Shows the share of profit from additional services with ESF in total profitability.

C_4: *EBITDA:* Represents the company's operating profit before interest, taxes, and depreciation.
C_5: *Airline Satisfaction Score:* Shows the satisfaction level of airline customers served.
C_6: *Passenger Satisfaction Index:* Visa-Boarding Customer Satisfaction Survey Score.
C_7: *DAI Score:* Check-in Waiting Time Satisfaction Survey Score.
C_8: *Firm-Related Delay Rate:* Shows the ratio of company-caused delays to total delays in operations.
C_9: *FTE PBB (Personnel per Leg):* Shows the average number of employees used per reduced leg.
C_{10}: *KUGE Score:* (Description not provided).
C_{11}: *Equipment Availability Rate:* Shows the availability level of operational equipment.
C_{12}: *The Percentage of Electric Vehicles in the Inventory:* Represents the ratio of electric vehicles to all vehicles.
C_{13}: *Workforce Utilization Rate:* Represents the ratio of total hours worked to total available working hours.
C_{14}: *Defined and Measured Process Rate:* Ratio of defined and measured processes to all processes.
C_{15}: *Voluntary Turnover Rate:* Shows the rate of employees leaving voluntarily.
C_{16}: *Critical Position Replacement Rate:* Shows the percentage of available backup candidates for critical positions.
C_{17}: *Practical Training Hours per Operations Employee:* Shows the average training time per employee.
C_{18}: *Internal Promotion Rate:* Shows the ratio of internal promotions during the year to the average number of employees.
C_{19}: *Manager Assessment Score Average:* Shows the average score of manager assessment results.
C_{20}: *Employee Engagement Survey Score:* Shows the average score of employee engagement survey results.
C_{21}: *Ethics Line Evaluation Score:* Shows the survey score measuring perceptions regarding ethical pipeline processes.

The steps followed in the data collection and evaluation process within the scope of this research are presented below. As shown in Fig. 2, the study began with the identification of the individuals to be included in the research, after which the participants were divided into different groups. Subsequently, a general questionnaire was administered to all participants, and the data obtained were analyzed using the Fuzzy LAAW method. In the final stage, the findings were evaluated.

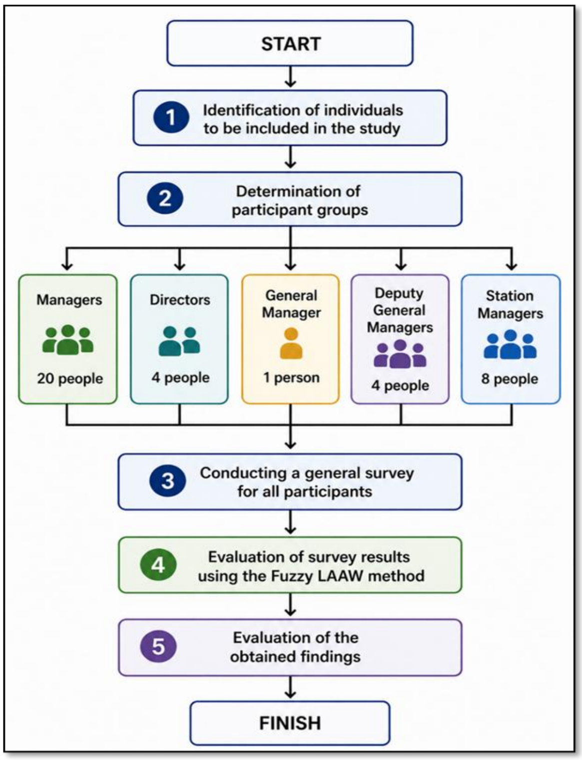

Fig. 2. Steps in the progress of the study

5.Results

In the present study, data obtained from 37 participants were analyzed through a structured multi-group analytical framework. The analyses were organized into four distinct groups in accordance with the hierarchical composition of the participating managerial personnel. The first group comprised the senior management team, consisting of the general manager and deputy general managers. The second group represented a broader managerial cohort encompassing the general manager, deputy general managers, and coordinators. The third group consisted exclusively of station managers, whose evaluations were analyzed independently. The fourth and final group included 20 employees holding managerial positions within the organization, assessed as a distinct analytical unit. This multi-tiered evaluation framework enabled a systematic comparison of performance criterion prioritizations across different levels of organizational management.

The performance evaluation results pertaining to the senior management group are presented in Table 1 and Figure 3. The criteria assigned the highest weights within this group are the Airline Satisfaction Score (0.159), EBITDA (0.117), and the Passenger Satisfaction Index (0.091), collectively indicating that customer satisfaction and financial performance constitute the primary strategic priorities at the senior management level. Conversely, the criteria receiving the lowest weights are the Proportion of Electric Vehicles in Inventory (0.005), Equipment Availability Rate (0.018), and Voluntary Turnover Rate (0.024). These findings suggest that the senior management group directs its evaluative focus predominantly toward strategic and outcome-oriented criteria, assigning comparatively lower priority to operational process details and sustainability-related measures.

Table 1.
Evaluation of the general manager and deputy general managers.

Criteria	Weight	Score
Airline Satisfaction Score	0,159	1
EBITDA	0,117	2
Passenger Satisfaction Index	0,091	3
3rd Party Profitability to Total Profitability Ratio	0,070	4
Employee Engagement Survey Score	0,061	5
Labor Force Utilization Rate	0,055	6
Manager Assessment Score Average	0,052	7
FTE PBB	0,050	8
Critical Position Replacement Ratio	0,037	9
CAPEX/Revenue	0,035	10
Defined and Measured Process Ratio	0,035	11
Firm-Induced Delay Rate	0,030	12
Profitability from Additional Services to Total Profitability Ratio	0,028	13
KUGE Score	0,028	14
DAI Score	0,027	15
Practical Training Hours per Operation Employee	0,026	16
Internal Promotion Rate	0,025	17
Ethics Line Evaluation Score	0,025	18
Voluntary Turnover Rate	0,024	19
Equipment Availability Rate	0,018	20
Proportion of Electric Vehicles in Inventory	0,005	21

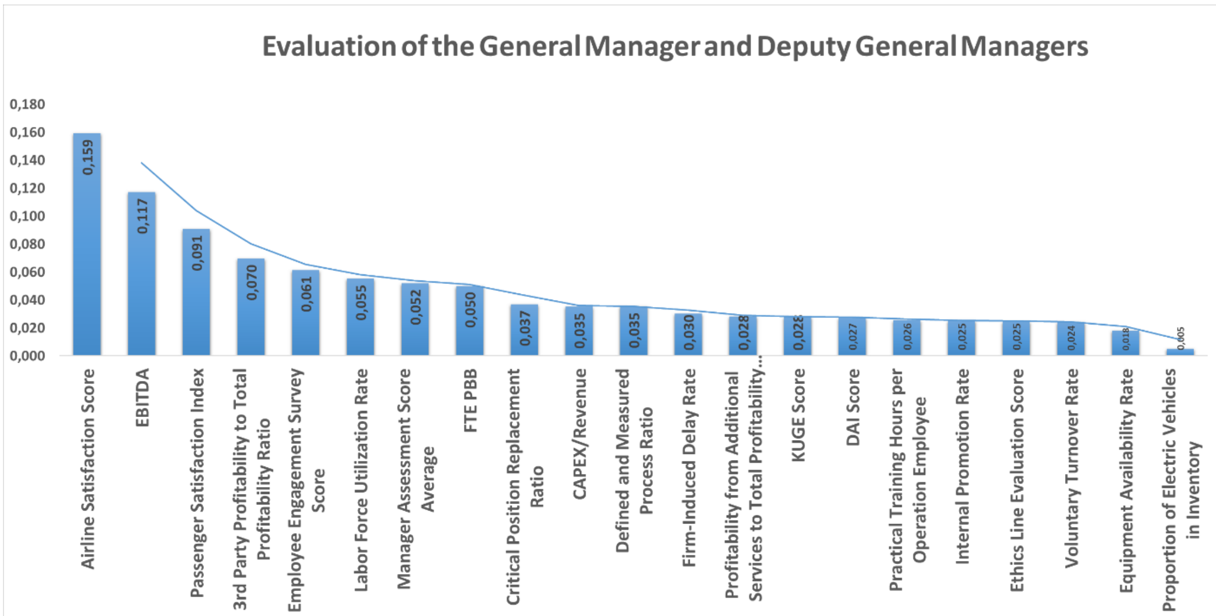

Fig. 3. Evaluation of the general manager and deputy general managers

An examination of the results pertaining to this group, as presented in Table 2 and Figure 4, reveals that the three highest-weighted performance criteria are the Passenger Satisfaction Index (0.127), Airline Satisfaction Score (0.123), and EBITDA (0.116). These findings indicate that customer-oriented indicators are accorded priority alongside financial performance within this managerial group's evaluative framework, reflecting a dual emphasis on service quality and economic outcomes.

Conversely, the three criteria assigned the lowest weights are the Equipment Availability Rate (0.016), Proportion of Electric Vehicles in Inventory (0.006), and Voluntary Turnover Rate (0.022). This pattern suggests that operational process details, sustainability-related measures, and human resources indicators occupy a comparatively peripheral position in this group's prioritization structure relative to strategic and customer-focused dimensions.

Table2
Evaluation by the general manager, deputy general managers and coordinators.

Criteria	Weight	Score
Passenger Satisfaction Index	0,127	1
Airline Satisfaction Score	0,123	2
EBITDA	0,116	3
3rd Party Profitability to Total Profitability Ratio	0,065	4
Employee Engagement Survey Score	0,053	5
FTE PBB	0,050	6
Manager Assessment Score Average	0,050	7
CAPEX/Revenue	0,042	8
Critical Position Replacement Ratio	0,041	9
Firm-Induced Delay Rate	0,040	10
Labor Force Utilization Rate	0,040	11
DAI Score	0,036	12
Internal Promotion Rate	0,034	13
Defined and Measured Process Ratio	0,033	14
KUGE Score	0,028	15
Profitability from Additional Services to Total Profitability Ratio	0,027	16
Practical Training Hours per Operation Employee	0,025	17
Ethics Line Evaluation Score	0,025	18
Voluntary Turnover Rate	0,022	19
Equipment Availability Rate	0,016	20
Proportion of Electric Vehicles in Inventory	0,006	21

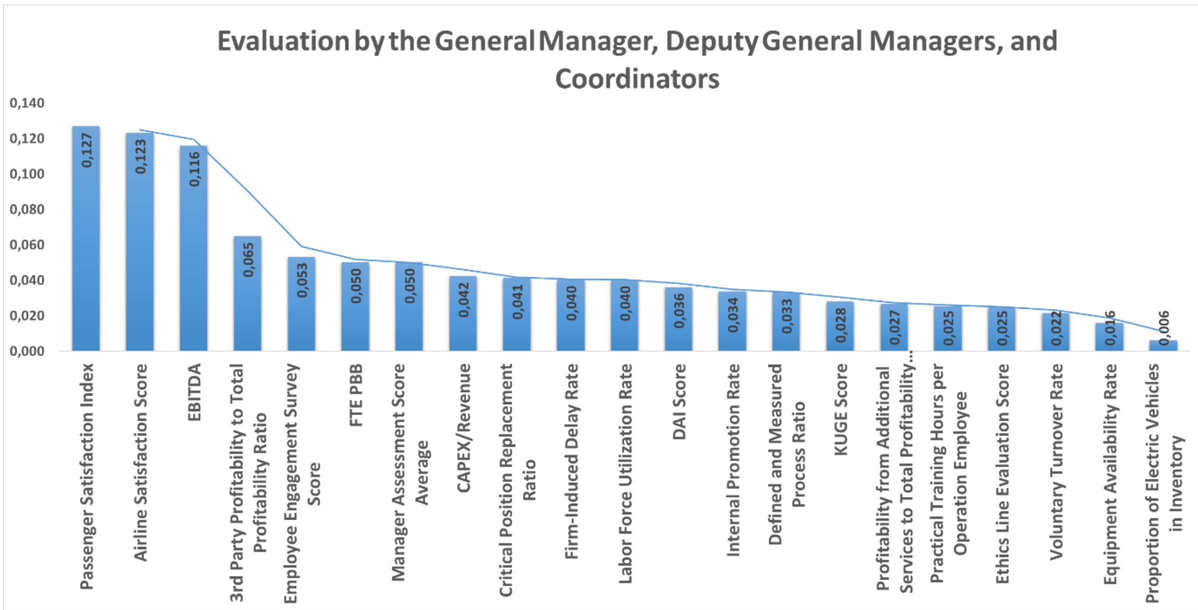

Fig. 4. Evaluation by the general manager, deputy managers and coordinators

An examination of the results for this group, as presented in Table 3 and Figure 5, indicates that the three highest-weighted performance criteria are the Employee Engagement Survey Score (0.160), EBITDA (0.099), and Labor Force Utilization Rate (0.090), respectively. This finding suggests that, within the evaluative framework of station chief managers, human-centered indicators and operational efficiency dimensions are accorded priority alongside financial performance — a pattern that distinguishes this group from the senior and broader management cohorts examined previously.

Conversely, the three criteria assigned the lowest weights are the Defined and Measured Process Rate (0.018), DAI Score (0.014), and Company-Related Delay Rate (0.012). These results indicate that process management metrics and certain operational performance indicators occupy a comparatively lower position in this group's prioritization structure relative to criteria associated with employee engagement and workforce productivity.

Table 3.
Station chief managers evaluation.

Criteria	Weight	Score
Employee Engagement Survey Score	0,160	1
EBITDA	0,099	2
Labor Force Utilization Rate	0,090	3
Passenger Satisfaction Index	0,068	4
Equipment Availability Rate	0,057	5
Critical Position Replacement Rate	0,053	6
Practical training hours per operating employee	0,050	7
3rd Party Profitability to Total Profitability Ratio	0,047	8
CAPEX/Revenue	0,045	9
Internal Promotion Rate	0,042	10
Profitability from Additional Services to Total Profitability Ratio	0,037	11

Airline Satisfaction Score	0,036	12
Voluntary Turnover Rate	0,033	13
KUGE Score	0,030	14
FTE PBB	0,030	15
Ethical Line Evaluation Score	0,027	16
Proportion of Electric Vehicles in Inventory	0,027	17
Average Manager Assessment Score	0,025	18
Defined and Measured Process Rate	0,018	19
DAI Score	0,014	20
Firm-Induced Delay Rate	0,012	21

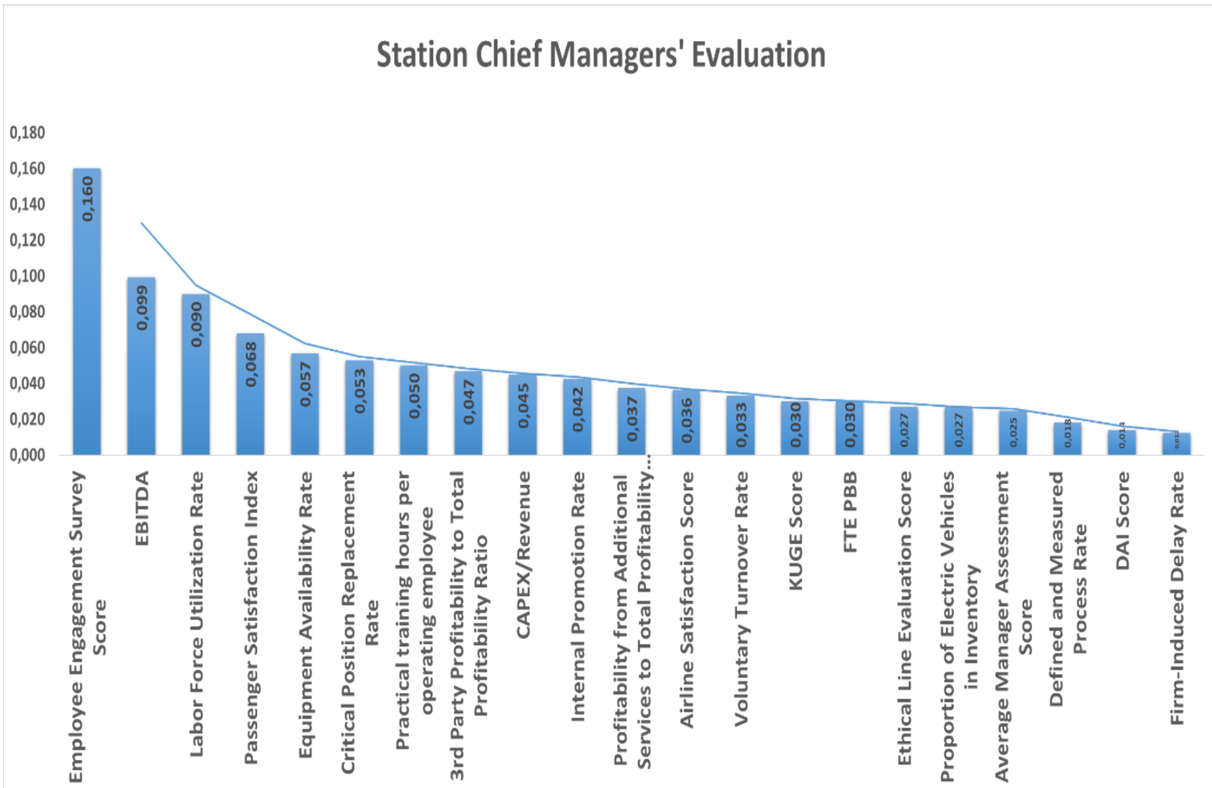

Fig. 5. Station chief managers evaluation

An examination of the results for this group, as presented in Table 4 and Figure 6, reveals that the three highest-weighted performance criteria are the Airline Satisfaction Score (0.140), Passenger Satisfaction Index (0.110), and EBITDA (0.086), respectively. These findings indicate that customer satisfaction measures and financial performance constitute the primary evaluative priorities among managerial-level employees, a pattern broadly consistent with that observed in the senior management and broader management cohorts.

Conversely, the three criteria assigned the lowest weights are the Equipment Availability Rate (0.022), Voluntary Turnover Rate (0.019), and the Proportion of Electric Vehicles in Inventory (0.010). These results suggest that operational infrastructure and sustainability-related indicators occupy a comparatively peripheral position within this group's prioritization structure relative to customer-oriented and financial performance dimensions.

Table 4.
Managers evaluation.

Criteria	Weight	Score
Airline Satisfaction Score	0,140	1
Passenger Satisfaction Index	0,110	2
EBITDA	0,086	3
3rd Party Profitability to Total Profitability Ratio	0,080	4
Critical Position Replacement Ratio	0,054	5
Employee Engagement Survey Score	0,048	6
FTE PBB	0,047	7
CAPEX/Revenue	0,046	8
Manager Assessment Score Average	0,041	9
Labor Force Utilization Rate	0,039	10
KUGE Score	0,038	11
Profitability from Additional Services to Total Profitability Ratio	0,038	12
Internal Promotion Rate	0,037	13
Firm-Induced Delay Rate	0,036	14
Defined and Measured Process Rate	0,031	15
DAI Score	0,027	16
Practical Training Hours per Operation Employee	0,026	17
Ethics Line Evaluation Score	0,024	18
Equipment Availability Rate	0,022	19
Voluntary Turnover Rate	0,019	20
Percentage of Electric Vehicles in Inventory	0,010	21

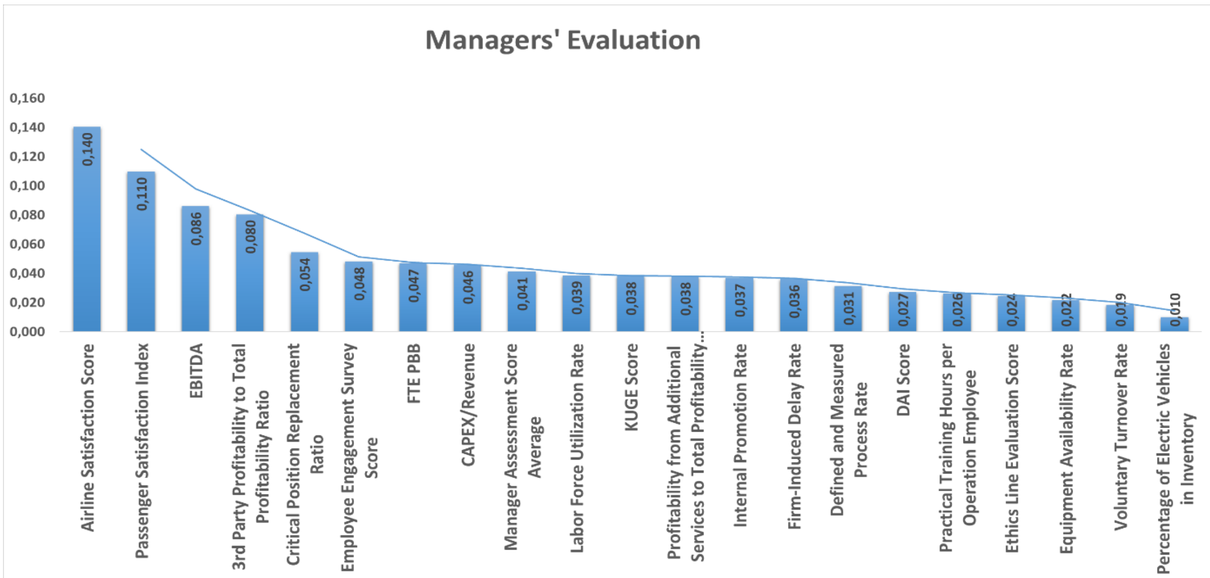

Fig. 6. Managers evaluation

6. Conclusion and Discussion

A collective assessment of the findings reveals both convergent patterns and noteworthy divergences across the different managerial levels examined in this study. A consistent finding across all analytical groups is that customer-oriented criteria — namely the Airline Satisfaction Score and the Passenger Satisfaction Index — alongside EBITDA as a financial performance indicator, consistently occupy the highest-weighted positions in the evaluation hierarchy.

The fact that these three criteria rank prominently across the general manager, deputy general manager, and broader managerial groups suggests that customer satisfaction and financial performance are institutionally recognized as primary performance determinants throughout the organization. This convergence is further reinforced by the second analytical group, in which the same three criteria emerge as the highest-weighted, with only marginal shifts in their relative rankings. Taken together, these findings indicate that the strategic priorities of decision-makers across different managerial levels are broadly aligned, reflecting an organizationally shared performance orientation.

A notable divergence, however, is observed in the results pertaining to the station chief managers group. The comparatively high weighting assigned to human-centered and operationally oriented criteria — most prominently the Employee Engagement Survey Score and the Labor Force Utilization Rate — suggests that this managerial level, by virtue of its closer proximity to field operations, places substantially greater emphasis on human resource efficiency and operational effectiveness in performance assessment. This finding indicates that performance perception is not uniform across organizational levels; rather, it is systematically shaped by the nature and scope of operational responsibilities associated with each position. Units bearing higher direct operational accountability demonstrate a pronounced tendency to foreground the human factor in their evaluative frameworks.

An examination of the lowest-weighted criteria reveals a consistent pattern across all analytical groups. The Proportion of Electric Vehicles in Inventory, Equipment Availability Rate, and Voluntary Turnover Rate recurrently occupy the lowest positions across most groups, suggesting that these indicators — encompassing sustainability metrics, operational infrastructure measures, and certain human resources dimensions — are accorded comparatively limited strategic salience within the prevailing managerial performance orientation.

Collectively, the findings indicate that performance criterion prioritization undergoes a systematic shift along the organizational hierarchy: as one moves from senior management toward operationally oriented managerial levels, the evaluative focus transitions from a predominantly strategic and financial orientation toward a more operationally grounded and human-centered perspective. Nevertheless, the consistent prominence of customer satisfaction and financial performance across all levels unambiguously reflects their status as organizationally embedded key success indicators. This duality — the coexistence of shared strategic priorities and level-specific operational emphases — underscores the necessity of adopting a holistic approach in the design of performance management systems, one that systematically integrates the strategic imperatives of senior management with the operational and human resource priorities of field-level managerial units.

7.Future esearch

The present study examined performance evaluation criteria within an MCDM framework, drawing on the assessments of 37 participants employed at an aviation ground handling company. The participant pool encompassed individuals across multiple managerial levels — including general managers, deputy general managers, directors, and station chief managers — with varying degrees of professional experience. This diversity in organizational positioning and experiential background contributed to the validity and practical relevance of the findings by ensuring a multifaceted representation of managerial perspectives.

Notwithstanding these contributions, the study is subject to certain limitations that warrant acknowledgement. The relatively limited sample size constrains the generalizability of the findings, and future research would benefit from the inclusion of larger and more heterogeneous participant groups to enhance both the statistical robustness and the broader representativeness of results. An expanded sample would not only accommodate a wider spectrum of managerial perspectives but also strengthen the overall reliability of the decision-making framework.

With respect to methodological considerations, the present study employed a single criterion weighting approach — the LAAW method — to assess the relative importance of the identified performance criteria. The application of alternative weighting techniques widely established in the MCDM literature, such as the Standard Deviation method, ENTROPY, and MEREC, could yield valuable comparative insights and serve as a means of cross-validating the consistency of the obtained results. Moreover, the broader integration of fuzzy logic-based approaches in future analyses would more adequately represent the inherent uncertainty in human judgment, capturing the ambiguity present in decision-makers' assessments and thereby producing more flexible and contextually realistic outcomes.

A further limitation concerns the scope of the participant profile. The present analysis was conducted exclusively with managerial-level personnel, thereby excluding the perspectives of operational-level employees. Future research would benefit from extending the participant base to include blue-collar and frontline operational staff, as the incorporation of multiple organizational levels would provide a more comprehensive and nuanced understanding of performance evaluation processes, potentially revealing insights that remain inaccessible within a purely managerial analytical frame.

In conclusion, future investigations employing larger and more diverse sample sizes, methodologically pluralistic approaches, and participants drawn from a broader range of organizational levels are expected to yield more comprehensive, robust, and generalizable insights into performance appraisal processes in the aviation ground handling sector.

References

[1] Hatipoğlu, S., Ergül, H., & Kepti, Y. (2025). Enhancing Service Quality in Aviation: The Critical Role of Ground Handling Services. Politeknik Dergisi, 28(6), 1843-1851. https://doi.org/10.2339/politeknik.1659840

[2] Mugabo, J. P., & Gökdalay, M. (2026). THE PERFORMANCE EVALUATION OF GROUND HANDLING COMPANIES: MCDM APPROACH. Anadolu Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 27(1), 261-292. https://doi.org/10.53443/anadoluibfd.1732609

[3] Joshua, O. N., Idisi, M. M., James, U., & Favour, I. (2025). Investigating Grand Marshalling Operations Alternatives for Guiding Aircraft to their Parking Positions; Crictic-Vikor Approach. https://doi.org/10.21203/rs.3.rs-8213913/v1

[4] Asker, V., Mehmet, Y., & Kasim, K. (2025). The Financial Performance Analysis Using Lopcow and Aroman Integrated MCDM Approach: An Application in Airport Groups. Studies in Business and Economics, 20(3), 28-53. https://doi.org/10.2478/sbe-2025-0043

[5] Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1988). SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality. Journal of Retailing, 64(1), 12–40.

[6] Chen, F. Y., & Chang, Y. H. (2005). Examining airline service quality from a process perspective. Journal of Air Transport Management, 11(2), 79–87. https://doi.org/10.1016/j.jairtraman.2004.08.004

[7] Park, J. W., Robertson, R., & Wu, C. L. (2004). The effect of airline service quality on passengers' behavioural intentions: A Korean case study. Journal of Air Transport Management, 10(6), 435–439. https://doi.org/10.1016/j.jairtraman.2004.06.001

[8] Aydın, S., & Yörükoğlu, M. (2020). Turkish ground handling services firms assessment with neutrosophic multiobjective method. Journal of Intelligent & Fuzzy Systems, 38(1), 545–552. https://doi.org/10.3233/JIFS-179428

[9] Yüksekbilgili, Ö. (2022). Sivil havacılık sektöründe çalışanların iş memnuniyet düzeylerinin yaşam doyumuna etkisinin incelenmesi. Dokuz Eylül Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 24(4), 1822–1839. https://doi.org/10.16953/deusosbil.1092074

[10] Zagrajek, P., & Hoszman, A. (2018). Impact of ground handling on air traffic volatility. Journal of Management and Financial Sciences, 33, 147–155. https://doi.org/10.33119/JMFS.2018.33.8

[11] PR, M., & Pothnis, J. A. Y. A. R. A. M. (2025). Aircraft turnaround bottlenecks: Addressing ground handling delays for operational excellence. International Journal of Aviation, Aeronautics, and Aerospace, 12(2), 1. https://doi.org/10.58940/2374-6793.1981

[12] Eski, S., & Taşus, H. S. (2018). Havaalanlarında sunulan yer hizmetlerinin Avrupa ekonomisine etkisi: Türkiye, Almanya ve İngiltere uygulamaları. Kastamonu Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi, 20(1), 56–83. https://doi.org/10.21180/kuiibf.2018136758

[13] Gładyś, S., Kwasiborska, A., & Postół, J. (2022). Determination of the impact of disruptions in ground handling on aircraft fuel consumption. Transport Problems, 17(2), 115–126. https://doi.org/10.20858/tp.2022.17.2.10

[14] Tucci, H. N. P., & Facchini, F. (2025). Ground support equipment and flight delays: A multivariate analysis in different locations. CEAS Aeronautical Journal, 1–19. https://doi.org/10.1007/s13272-025-00891-6

[15] Gul, M., & Ak, M. F. (2022). Occupational risk assessment for flight schools: A 3,4-quasirung fuzzy multi-criteria decision making-based approach. Sustainability, 14(15), 9373. https://doi.org/10.3390/su14159373

[16] Yazgan, E., et al. (2022). Integrated risk assessment in ramp handling operations: Risk mapping for Turkish airports. International Journal of Aviation, Aeronautics, and Aerospace, 9(4), 4. https://doi.org/10.58940/2374-6793.1761

[17] Değirmencioğlu, M., & Macit, A. (2025). Shift Planning with Artificial Intelligence within the Scope of Strategic Decision-Making Approach in Airport Ground Handling Operations. Journal of Aviation, 9(3), 669-675. https://doi.org/10.30518/jav.1724765

[18] Kurzweil, L., & Kolářová, L. (2026). Shifting readiness of Prague Airport for safe operations of autonomous tow tractors. Transportation Research Procedia, 94, 101-110. https://doi.org/10.1016/j.trpro.2026.01.011

[19] Kuroda, Y., Hanaoka, S., Sato, S., & Horiguchi, R. (2025). Traffic Simulation of Automated-Driving Ground Support Equipment at Tokyo International Airport. Aerospace, 12(10), 896. https://doi.org/10.3390/aerospace12100896

[20] Bose, R. K., Kumar, P., Busch, I., Li, W., & Rogers, M. O. (2025, June). Electrifying Airport GSE: Monte Carlo Grid Impacts. In 2025 IEEE/AIAA Transportation Electrification Conference and Electric Aircraft Technologies Symposium (ITEC+ EATS) (pp. 1-6). IEEE. https://ieeexplore.ieee.org/document/11097948

[21] Timmermans, K., Roling, P., Mouli, G. R. C., & Atasoy, B. (2025). The impact of transitioning to electric Ground Support Equipment on the fleet capacity and energy demand at airports. Case Studies on Transport Policy, 21, 101498. https://doi.org/10.1016/j.cstp.2025.101498

[22] Herc, K., Borucka, A., & Kostur-Balcerzak, K. (2025). Modern solutions and automation in ground handling at airports. In Automotive Safety 2024 (pp. 458-467). CRC Press.

[23] Bakır, M., Özdemir, E., & Akan, Ş. (2021). A novel MADM approach to the ground-handling agent selection problem in B2B markets. Journal of Advances in Management Research, 18(5), 684–707. https://doi.org/10.1108/JAMR-05-2020-0069

[24] Shen, C.-W., Peng, Y.-T., & Tu, C.-S. (2019). Multi-criteria decision-making techniques for solving the airport ground handling service equipment vendor selection problem. Sustainability, 11(12), 3466. https://doi.org/10.3390/su11123466

[25] Tao, Y.-J., Lee, H.-S., & Tu, C.-S. (2021). Analytic hierarchy process-based airport ground handling equipment purchase decision model. Sustainability, 13(5), 2540. https://doi.org/10.3390/su13052540

[26] Deveci, M., Cali, U., & Pamucar, D. (2021). Evaluation of criteria for site selection of solar photovoltaic (PV) projects using fuzzy logarithmic additive estimation of weight coefficients. Energy Reports, 7, 8805–8824. https://doi.org/10.1016/j.egyr.2021.10.104
[27] Özdağoğlu, A., Işıldak, B., & Keleş, M. K. (2022). Havayolu sektörü çalışanları bakış açısından havalimanlarının çok kriterli karar verme yöntemleriyle değerlendirilmesi. Süleyman Demirel Üniversitesi Vizyoner Dergisi, 13(33), 34–56. https://doi.org/10.21076/vizyoner.803632
[28] Kulaklı, A., & Şahin, Y. (2023). A combined MCDM approach for improvement of airlines' ground operations performance: A case study from Türkiye. Systems, 11(8), 421. https://doi.org/10.3390/systems11080421
[29] Bakır, M., & Akan, Ş. (2018). Havaalanlarında hizmet kalitesinin entropi ve TOPSIS yöntemleri ile değerlendirilmesi: Avrupa'nın en yoğun havaalanları üzerine bir uygulama. Elektronik Sosyal Bilimler Dergisi, 17(66), 632–651. https://doi.org/10.17755/esosder.346412
[30] Kurşuncu, O., & Seçilmiş, N. (2023). The effect of COVID-19 on the financial performance of ground handling: The example of Çelebi Aviation Holding. Journal of Aviation, 7(1), 83–92. https://doi.org/10.30518/jav.1205072
[31] Tengiz, E., & Ünal, G. (2023). A fuzzy logic evolution of the functional resonance analysis method (FRAM) to assess risk in ground operation. Aircraft Engineering and Aerospace Technology, 95(10), 1614–1623. https://doi.org/10.1108/AEAT-01-2023-0007
[32] Saitoglu, F., & Apak, S. (2021). Multi-dimensional competency assessment: An application in aircraft maintenance organization. Pressacademia, 8(2), 101–128. https://doi.org/10.17261/Pressacademia.2021.1401
[33] Akman, G., et al. (2018). Çok kriterli karar vermede AHP ve TOPSIS yöntemleriyle uçuş noktası seçimi. Erciyes Üniversitesi Fen Bilimleri Enstitüsü Fen Bilimleri Dergisi, 34(3), 45–57. https://izlik.org/JA75LE64JX
[34] Akdeniz, E. (2021). Kabin içi hizmet kalitesi açısından farklı zaman kesitlerine yönelik bir karşılaştırma: En iyi hava yolu işletmesinin seçimi. Elektronik Sosyal Bilimler Dergisi, 20(77), 273–288. https://dergipark.org.tr/en/download/article-file/1217860
[35] Kurnaz, S. (2023). Method of evaluation of military helicopter pilot selection criteria: A novel grey SWARA approach. Aviation, Vilnius Gediminas Technical University. https://doi.org/10.3846/aviation.2023.18596
[36] El Asri, H., Fakhrulddin, A., Al-Humairi, A., & Almhanna, N. (2018). Aircraft ground handling operations: A literature review. https://doi.org/10.20944/preprints201810.0074.v1
[37] Jafarzadeh Ghoushchi, S., Shaffiee Haghshenas, S., Memarpour Ghiaci, A., Guido, G., & Vitale, A. (2023). Road safety assessment and risks prioritization using an integrated SWARA and MARCOS approach under spherical fuzzy environment. Neural Computing and Applications, 35(6), 4549–4567. https://doi.org/10.1007/s00521-022-07929-4
[38] Pamucar, D., Zizovic, M., Biswas, S., Bozanic, D., 2021. A new logarithm methodology of additive weights (LMAW) for multi-criteria decision-making: Application in logistics. Facta Univ. Ser. Mech. Eng. 19 (3), 361–380 10.22190/FUME210214031P
[39] Bahar, E. (2020). Airlines Employees Service Quality Perception of the Ground Handling Management. Journal of Aeronautics and Space Technologies, 13(1), 91-105.
[40] Yaşar, M., & Özdemir, E. (2022). Turning the service quality approach in a different direction: measuring the ground service quality perceptions of airlines by the SERVQUAL method. Management Research and Practice, 14(4), 5-18.