A CRITIC-WISP Multicriteria Framework for Sustainable Vertiport Planning in Urban Air Mobility: Operational, Socio-Environmental, and Decision Analysis

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Abstract

Urban Air Mobility (UAM) has emerged as a strategic alternative to mitigate congestion and sustainability challenges in large cities. However, the implementation of vertiports, essential infrastructure for electric vertical take-off and landing (eVTOL) aircraft, represents a complex sociotechnical challenge involving regulatory, economic, technical, and socio-environmental variables. This study proposes a hybrid multicriteria framework integrating CRITIC (Criteria Importance Through Intercriteria Correlation) and WISP (Weighted Sum Product method) to support decision-making in selecting the most suitable strategy for deploying sustainable vertiports in urban environments. Three alternatives are considered-central urban, peripheral/ground-based, and integrated multimodal vertiports-and evaluated against five criteria: cost, logistical capacity, operational safety, perceived noise, and social acceptance. CRITIC was applied to determine objective criterion weights, while WISP enabled the incorporation of subjective expert judgments. The results identified the peripheral/ground-based vertiport as the most advantageous alternative, with superior technical performance and community acceptance. The study helps address gaps in urban air infrastructure planning and provides scientific support for public management, regulatory agencies, and strategic decision-makers.

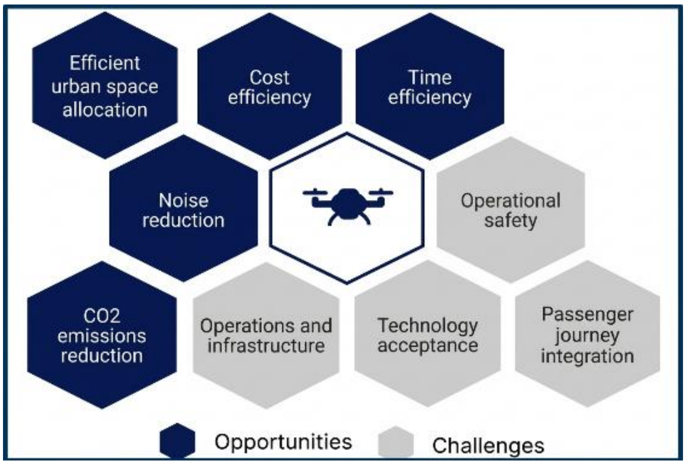
Keywords: *Urban Air Mobility, Vertiport, Sustainability, CRITIC-WISP, eVTOL.*

1. Introduction

Urban Air Mobility (UAM) has emerged as one of the main drivers of transformation in contemporary transport. Driven by recent advances in electric vertical take-off and landing aircraft (eVTOLs), the saturation of ground transportation networks, and global decarbonization agendas, UAM constitutes a sociotechnical ecosystem in which technologies, regulations, infrastructure, and social perception interact dynamically.

Within this context, vertiports play a central role by integrating air operations into the urban environment and concentrating functions such as passenger processing, electric charging, light maintenance, and multimodal connections. International organizations such as ICAO, NASA, FAA, and EASA emphasize that these facilities should operate as small, highly complex airports, with stringent requirements related to energy, safety, and operational fluidity. Figure 1 presents a synthesis of the main opportunities and challenges associated with this new transport mode.

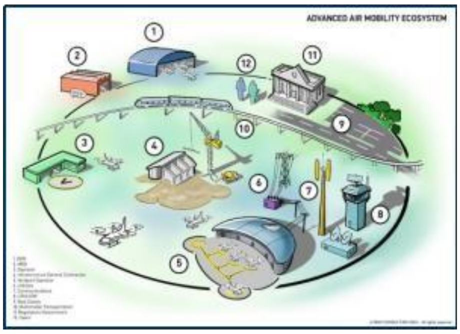
Figure 1 – New mode: opportunities and challenges



Source: Authors (2026)

The UAM ecosystem is composed of multiple actors, including operators, regulators, urban managers, energy providers, and real estate agents. The interdependence among these actors, represented in Figure 2, reinforces that the viability of UAM depends not only on technological solutions but also on institutional arrangements capable of coordinating interests and ensuring safety and operational continuity.

Figure 2 – Urban Air Mobility ecosystem

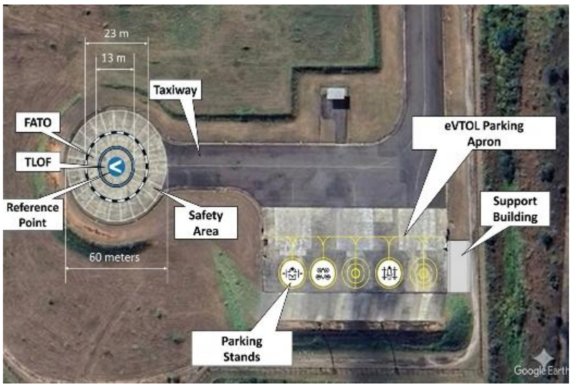


Source: Authors (2026)

In Brazil, this debate has advanced especially in the Sao Paulo Metropolitan Region, which concentrates the largest helicopter fleet in the world. This characteristic suggests a promising environment, but it does not guarantee the automatic adaptation of existing helipads. Studies indicate that a large share of these structures will not meet the requirements for obstacle-free zones, energy capacity, and safety standards. As demonstrated by ANAC (2021), the direct conversion of helipads into vertiports is rarely feasible without substantial interventions.

In addition to physical constraints, there are regulatory challenges related to risk management, emergency response, access control, passenger inspection, and AVSEC protocols. From a risk-based perspective, (Calogero, 2024) highlights that vertiports must incorporate layers of security aligned with international guidelines. This regulatory pathway is summarized in Figure 3, which presents a regulatory sandbox model articulating certification, operation, infrastructure, and security.

Figure 3 – Vertiport regulatory sandbox

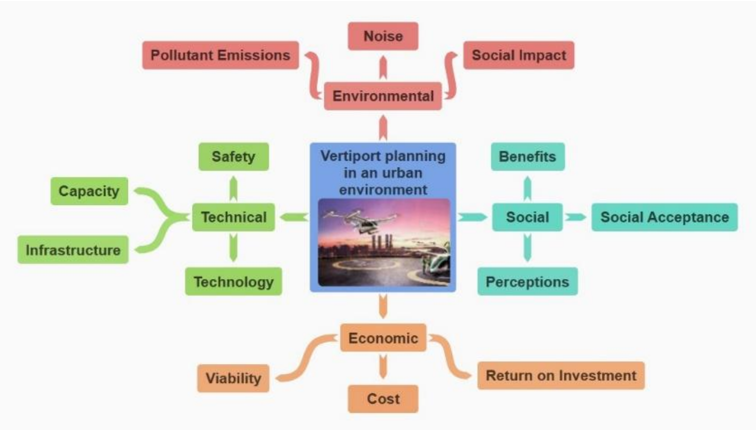


Source: Authors (2026)

Another important vector concerns public acceptance. Recent research shows that factors such as risk perception, noise, technological reliability, and visual impact strongly influence the social legitimation of eVTOL operations. Thus, even technically viable solutions may face resistance if they are not integrated with adequate communication strategies and urban design.

To structure the multiple relevant dimensions in vertiport planning, a conceptual mind map was developed (Figure 4), bringing together environmental, technical, social, and economic aspects and highlighting the need for multicriteria tools capable of integrating objective indicators and subjective perceptions.

Figure 4 – Mind map of critical vectors in vertiport planning



Source: Authors (2026)

This study proposes a hybrid CRITIC-WISP multicriteria framework to support the selection of sustainable vertiport typologies for UAM. While the CRITIC method determines objective weights from the variability and correlation among criteria, the WISP method incorporates expert judgments and socio-environmental preferences. This methodological integration makes it possible to simultaneously capture empirical evidence and qualitative perceptions, thus reflecting the sociotechnical nature of the decision problem more faithfully.

In this context, the study contributes to the literature in three main ways: it proposes a hybrid CRITIC-WISP framework specifically adapted to vertiport planning in dense urban environments; it systematically integrates psychosocial criteria that are often neglected in technical UAM models; and it empirically demonstrates the superiority of intermodal solutions from a socio-environmental multicriteria perspective.

2. Theoretical Framework

2.1. Urban Air Mobility: Evolution, Concepts, and International Foundations

Urban Air Mobility is defined as an integrated low-altitude air transport system using small aircraft for short- and medium-distance travel in urban or peri-urban environments. The literature highlights UAM as a response to congestion, emissions, and inefficiencies in ground transport systems, while also emphasizing its regulatory, technological, and social uncertainties (Brunelli; Ditta; Postorino, 2023; Wu; Zhang, 2021).

From a conceptual perspective, UAM articulates operational dimensions (routes, fleet, demand), regulatory dimensions (aircraft certification, airspace management, safety requirements), energy dimensions (charging infrastructure, management of electricity demand), environmental dimensions (emissions, noise, land occupation), and social dimensions (acceptance, risk perception, accessibility). Di Mascio, Del Serrone e Moretti (2025) point out that the maturity of UAM depends on the convergence of these elements, in a way analogous to the historical evolution of rail and metro systems, but with additional challenges arising from the shared use of urban airspace.

Public acceptance, in particular, has been treated as a critical variable. Empirical studies indicate that noise perception, reliability, privacy, and visual impact are decisive factors in citizens' willingness to accept eVTOL operations in their neighborhoods (Alinezhad; Khalili, 2019; Sahoo; Goswami, 2023). These aspects have direct implications for vertiport planning, since technical decisions such as flight altitude or infrastructure location may be reconfigured by psychosocial factors.

Although organizations such as ICAO, EASA, FAA, and NASA have already published guidelines for UAM operations and vertiports, the scientific literature indicates that system consolidation will depend on the integration of business models, urban planning, and collaborative governance mechanisms (Sahoo; Goswami, 2023). In this sense, multicriteria frameworks become essential for balancing the different objectives and constraints present in complex urban scenarios.

2.2. Vertiports: Definitions, Technical Requirements, Architectures, and Challenges

Vertiports are infrastructures dedicated to eVTOL operations, where landing and takeoff, passenger processing, battery charging, maintenance, and integration with other transport modes take place. Vertiport design must consider characteristics of the urban fabric, land-use restrictions, air traffic corridors, energy requirements, and noise zones (Di Mascio; Del Serrone; Moretti, 2025; Sengupta et al., 2025).

Vertiport location constitutes a classically multicriteria problem: population density, accessibility, acoustic impact, operational risk, availability of physical space, and compatibility with urban zoning are among the factors that need to be considered simultaneously (Brunelli; Ditta; Postorino, 2023; Yedavalli, 2021). EASA (2022) organizes these requirements into three central dimensions: physical infrastructure (air traffic control, approach routes, charging, hangars); technological infrastructure (communication, sensors, flow automation, integration with UTM systems); and urban integration (land use, noise, accessibility, and modal connectivity).

In Brazil, ANAC (2021) discusses the functional typology of vertiports for the Sao Paulo Metropolitan Region, highlighting three configurations (Figure 5): central urban vertiports (rooftop facilities in dense areas), peripheral ground-based vertiports (areas intended for operational expansion), and integrated multimodal vertiports (intermodal hubs). Each typology presents advantages and limitations in terms of cost, capacity, operational safety, noise, and social acceptance, reinforcing the need for a structured analytical model to compare them.

Figure 5 – Functional typology of vertiports

Source: Authors (2026)

2.3. Operational Safety and AVSEC Applied to Vertiports

Operational safety is a critical axis for the viability of UAM. Studies discuss risk models for eVTOL operations in urban environments, considering system failures, interference from buildings, adverse weather conditions, and interaction with other transport modes (Elizebeth et al., 2025; Du et al., 2024). The introduction of highly automated aircraft adds new sources of uncertainty, requiring performance-based and risk-based safety approaches.

In Brazil, ANAC has advanced discussions on requirements applicable to vertiports, highlighting the need for threat and vulnerability assessments, operational risk classification, access control, restricted areas, and contingency plans. AVSEC documents, although focused on civil aviation security, have been used as references for vertiport design, especially with regard to protection against unlawful acts and the management of passenger and baggage flows. Current studies also incorporate risks associated with power failures, interaction with the surrounding urban environment, collisions with obstacles, and user behavior. Moreira et al. (2023) argue that emerging aviation systems in urban environments require risk management models based on systems thinking and multicriteria methods capable of articulating technical, regulatory, and social dimensions.

2.4. Multicriteria Decision Support Methods

Multicriteria decision analysis (MCDA) methods are widely used in infrastructure, urban planning, and transport problems because they address situations in which multiple, conflicting criteria need to be considered simultaneously (Diakoulaki; Mavrotas; Papayannakis, 1995; Mukhametzyanov, 2021). In the case of UAM, these methods make it possible to compare vertiport alternatives using criteria such as cost, capacity, safety, noise, and social acceptance.

The CRITIC method (Criteria Importance Through Intercriteria Correlation) is an approach for determining objective weights based on data variability and the correlation among criteria. The greater the variance of a criterion, that is, its discriminatory capacity, and the lower its correlation with the others, that is, the greater its non-redundant information, the greater the objective weight assigned to it. This characteristic makes CRITIC suitable for problems in which criteria have different scales and relevant correlations (Sahoo; Goswami, 2023).

The WISP method (Weighted Influence Superiority and Inferiority Ranking Method), proposed by Stanujkić wt al. (2021), stands out for integrating objective and subjective weights while preserving coherence and monotonicity in decisions. WISP combines elements of weighted-sum and weighted-product models, reducing distortions associated with normalization and the dominance of extreme criteria. Its hybrid nature allows expert judgments, stakeholder preferences, and weights derived from statistical methods, such as CRITIC, to be incorporated (Alinezhad; Khalili, 2019).

2.5. CRITIC Method

The CRITIC method is used to calculate objective weights for the criteria cost, logistical capacity, operational safety, perceived noise, and social acceptance. Its application follows the classical steps: construction of the decision matrix, data normalization, calculation of standard deviations, estimation of the correlation matrix among criteria, calculation of the information associated with each criterion, and determination of normalized objective weights. The method is particularly appropriate when criteria have distinct scales and when the aim is to derive weights directly from the information contained in the data set.

2.4. WISP Method

The WISP method is used to integrate the objective weights obtained through CRITIC with the subjective weights derived from experts. In infrastructure projects with strong social impacts, such as urban vertiports, greater relevance is typically attributed to socio-environmental aspects and stakeholder perceptions (Stanujkić et al., 2021).

Subjective weights were obtained from specialists in aeronautical engineering, urban planning, air regulation, sustainability, airport operations, and public management, resulting in the Wsub weight matrix. WISP combines these subjective weights with the objective CRITIC weights through a linear combination controlled by parameter beta, which expresses the degree of subjective influence. Sensitivity analysis was adopted with beta = 0.40, 0.55, and 0.70, demonstrating ranking stability with predominance given to expert opinions, consistent with the relevance of public acceptance and socio-environmental impacts in the UAM context.

The CRITIC-WISP integration generates a final weight matrix that supports the ranking of vertiport alternatives by balancing empirical evidence and expert judgment within a strategic multicriteria framework.

3. Methodology

This research adopts a mixed methodological approach, integrating qualitative and quantitative methods to support the selection of the most appropriate vertiport typology for the urban context analyzed. The method was structured into three main stages: problem structuring, determination of objective and subjective weights, and evaluation and ranking of alternatives. Problem contextualization was performed using the CATWOE method, the CRITIC method was applied to obtain objective weights, and the integration of objective and subjective weights was carried out through the WISP method.

The structuring stage of complex sociotechnical problems, such as vertiport planning for UAM, is particularly challenging. To address this issue, the CATWOE method, originating from Soft Systems Methodology (Checkland; Poulter, 2020), was applied. It makes it possible to systematically identify the main agents (Customers, Actors), the transformation process (Transformation), the underlying worldview (Worldview), the system owners (Owners), and the environmental constraints (Environment).

The application of CATWOE made it possible to map actors such as potential users, eVTOL operators, public managers, regulatory agencies, energy utilities, and local communities, as well as to make explicit the main institutional and environmental constraints. Figure 6 synthesizes the CATWOE representation applied to vertiport planning, showing that the decision is not limited to where to locate but also encompasses how to plan, integrate, certify, and operate this infrastructure in a dense urban environment.

Figure 6 – CATWOE representation

ELEMENTS	DESCRIPTION
C	• Passengers • eVTOL Pilots • Community • Public bodies
A	• ANAC and DECEA • Municipalities • Environmental agencies • Concessionaire construction companies • eVTOL Manufacturers • Vertiport Operators
T	• From a congested, expensive, and environmentally unsustainable urban system to an efficient, safe, sustainable, integrated, and socially accepted air mobility system.
W	• Urban Air Mobility is a strategic infrastructure of public interest, capable of transforming urban dynamics through the integration of technology, sustainability, and social legitimacy.
O	• Public bodies (ANAC, Municipalities, Ministry of Transport) • Private investors • Regulatory agencies • Infrastructure concessionaires • Public-Private Partnerships (PPP)
E	• Aeronautical and urban regulation; metropolitan spatial limitations; public acceptance and perceived noise; environmental impacts; electrical and logistical infrastructure; implementation and operation costs.

Source: Authors (2026)

The CRITIC method, proposed by Diakoulaki, Mavrotas e Papayannakis (1995), is an objective multicriteria approach that combines the contrast intensity of the data, reflected by dispersion, and the degree of conflict among criteria, measured by correlations. Its application determines the objective weights of the criteria considered. Initially, a decision matrix was constructed from empirical data regarding the three vertiport alternatives (A1 - central urban, A2 - peripheral/ground-based, A3 - integrated multimodal) and the five selected criteria (C1 - cost, C2 - capacity, C3 - safety, C4 - perceived noise, C5 - social acceptance). Table 1 presents the decision matrix, with values in their original units, obtained from technical sources such as (ANAC, 2021).

Table 1 – Decision matrix

Criteria/Alternatives	C1: Cost US$ mi	C2: Capacity mov./h	C3: Safety Index 0-10	C4: Noise dB	C5: Acceptance Index 0-1
Monotonicity	Min	Max	Max	Min	Max
A1: Central Urban	15.5	10	7.0	72	0.58
A2: Peripheral/Ground	5.3	20	6.5	64	0.74
A3: Multimodal	20.8	25	8.5	60	0.82

Source: Authors (2026)

The data were then normalised using the reversible min-max method, respecting the maximisation or minimisation nature of each criterion (cost and noise as minimisation criteria; capacity, safety, and acceptance as maximisation criteria). The expressions below summarise the normalisation procedure used in the study. For benefit criteria: $r_{ij} = \frac{(x_{ij} - \min(x_j))}{(\max(x_j) - \min(x_j))}$, For cost criteria: $r_{ij} = \frac{(\max(x_j) - x_{ij})}{(\max(x_j) - \min(x_j))}$, Example 1 - cost minimization for US$ 15.5 million: r_{ij} = (20.8 - 15.5) / (20.8 - 5.3) = 0.3419. Example 2 - capacity maximisation for 10 mov./h: r_{ij} = (10 - 10) / (25 - 10) = 0.0000. Table 2 presents the normalised matrix, which serves as the basis for the subsequent calculation of objective weights.

Table 2 – Normalised matrix

Criteria/Alternatives	C1: Cost US$ mi	C2: Capacity mov./h	C3: Safety Index 0-10	C4: Noise dB	C5: Acceptance Index 0-1
A1: Central Urban	0.3419	0.0000	0.2500	0.0000	0.0000
A2: Peripheral/Ground	1.0000	0.6667	0.0000	0.6667	0.6667
A3: Multimodal	0.0000	1.0000	1.0000	1.0000	1.0000

Source: Authors (2026)

Next, the standard deviation of each criterion was calculated, representing its capacity to discriminate among alternatives, as shown in Table 3. Criteria with higher standard deviation tend to exert greater objective influence on the decision process because they more strongly differentiate the options analyzed.

Table 3 – Standard deviation of criteria

Criteria	C1: Cost	C2: Capacity	C3: Safety	C4: Noise	C5: Acceptance
sigma_j	0.4150	0.4157	0.4249	0.4157	0.4157

Source: Authors (2026)

The correlation matrix (r_{jk}) measures the degree of dependence among criteria (Table 4), with the aim of identifying redundancies.

Table 4 – Correlation matrix among criteria

Criteria	C1: Cost	C2: Capacity	C3: Safety	C4: Noise	C5: Acceptance
C1: Cost	1.0000	1.0000	-0.8953	-0.1523	-0.1523
C2: Capacity	-0.1523	1.0000	0.5765	1.0000	1.0000
C3: Safety	-0.8953	0.5767	1.0000	0.5765	0.5765
C4: Noise	-0.1523	1.0000	0.5765	1.0000	1.0000
C5: Acceptance	-0.1523	1.0000	0.5765	1.0000	1.0000

Source: Authors (2026)

Based on standard deviations and correlations, the information associated with each criterion (C_j) was calculated, integrating discriminating power and relative independence. Table 5 presents the corresponding values, which are subsequently normalized to derive the objective weights.

Table 5 – Correlation matrix among criteria

Criteria	C1: Cost	C2: Capacity	C3: Safety	C4: Noise	C5: Acceptance
sigma_j	0.4150	0.4157	0.4249	0.4157	0.4157
Cj	0.3524	0.5778	3.1657	0.5778	0.5778

Source: Authors (2026)

Objective weights (W_i) were then calculated by normalizing the information values (C_j), generating relative proportions whose sum equals 1. The weights shown in Table 6 represent the objective component of the hybrid weighting scheme used later in the WISP procedure.

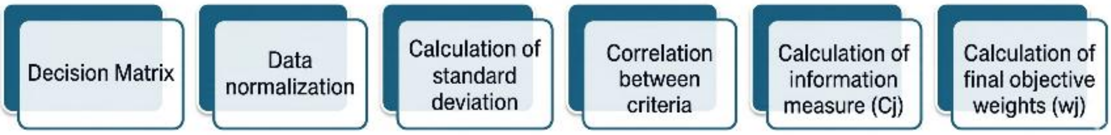
Table 6 – Objective weights calculation

Criteria	C1: Cost	C2: Capacity	C3: Safety	C4: Noise	C5: Acceptance
Cj	2.2212	0.6551	1.3452	0.6551	0.6551
Wj	0.4015	0.1184	0.2432	0.1184	0.1184

Source: Authors (2026)

The CRITIC methodological process, from the construction of the decision matrix to the obtainment of objective weights, is synthesized in Figure 7, which graphically organizes the main stages and facilitates replication of the procedure in other studies.

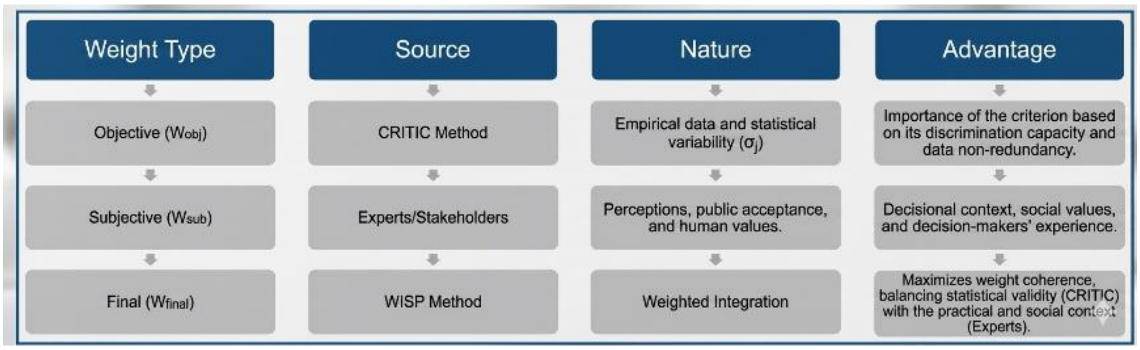
Figure 7 – CRITIC method flowchart



Source: Authors (2026)

The WISP method was applied to integrate the objective weights derived from CRITIC with the subjective weights obtained from experts. These specialists work in aeronautical engineering, urban planning, air regulation, sustainability, airport operations, and public management. WISP simultaneously integrates two crucial sources of information for weighting. Figure 8 details the nature, source, and specific advantages of each type of weight considered in the methodology.

Figure 8 – Integration of information sources for weighting



Source: Authors (2026)

The responses were consolidated and normalized, resulting in the subjective weight matrix presented in Table 7, which captures expert assessments regarding the relative importance of the five criteria.

Table 7 – Consolidated subjective weights (Wsub)

Criteria	C1: Cost	C2: Capacity	C3: Safety	C4: Noise	C5: Acceptance
Wj	0.0667	2.0000	1.3333	0.2667	0.3333

Source: Authors (2026)

Final weights (Wj) were calculated through a linear combination between Wsub and Wobj, controlled by parameter beta, which represents the degree of subjective influence. In this study, beta = 0.55 was adopted, assigning 55% weight to expert judgments and 45% to objective weights. This configuration emphasizes socio-environmental aspects and public acceptance in urban vertiport projects.

Once the final weights were established, the Global Performance Index (Si) of each alternative was calculated by multiplying the normalized performance matrix by the weights Wj, in Table 8.

Table 8 – Final performance of alternatives (WISP index)

Alternative	A1: Central Urban	A2: Peripheral/Ground	A3: Integrated Multimodal
Score	0.8044	1.0000	0.8972

Source: Authors (2026)

Table 9 organizes the final ranking, accompanied by qualitative observations on the performance of each typology.

Table 9 – Final ranking of alternatives

Rank	Alternative	Comments
1st	A2: Peripheral / Ground	Presented the best overall balance between lower cost, high operational capacity, lower noise, and good social acceptance.
2nd	A3: Integrated Multimodal	Stood out for the best performance in capacity, safety, noise, and social acceptance, although it was penalized by the higher implementation cost.
3rd	A1: Central Urban	Achieved the lowest overall performance due to high cost, higher noise level, and lower relative social acceptance.

Source: Authors (2026)

These results support the interpretation of the operational, socio-environmental, and urban-planning implications associated with the choice of the most suitable vertiport typology.

4. Results and Discussion

The application of the hybrid CRITIC-WISP framework allowed the performance of the three vertiport typologies to be evaluated in an integrated manner. The combination of objective weights, grounded in data variability and correlation, and subjective weights, derived from expert judgment, resulted in a consistent hierarchy of alternatives. Nevertheless, the final ordering should not be interpreted merely as a technical ranking, but as the expression of central trade-offs in the contemporary UAM debate, especially among operational efficiency, economic feasibility, socio-environmental sustainability, and social legitimacy.

The peripheral/ground-based vertiport (A2) was ranked as the most advantageous alternative, presenting the highest global performance index. This result stems mainly from its more balanced profile across the criteria analyzed: lower cost, good operational capacity, reduced noise levels, and favorable social acceptance, even though it did not achieve the best performance in safety. From a multicriteria perspective, A2's advantage suggests that the attractiveness of a vertiport typology does not depend solely on maximum performance in isolated criteria, but on the ability to reconcile efficiency, implementation feasibility, and lower potential for conflict with the urban environment. In this sense, the peripheral ground-based alternative appears particularly relevant because it reduces economic and socio-environmental barriers, configuring a more robust solution for urban contexts that require a balance between technological expansion and public acceptability.

The integrated multimodal vertiport (A3) occupied the second position in the final ranking. Its performance was strongly favored by superior results in operational capacity, safety, perceived noise, and social acceptance, evidencing high technical and socio-environmental potential. However, this alternative was penalized by its higher implementation cost, which reduced its advantage in overall performance. This finding reveals an important tension in UAM infrastructure planning: technically more complete solutions, and those potentially better articulated with the urban mobility system, tend to require higher initial investment, which may compromise their attractiveness from an economic feasibility perspective. Thus, although A3 represents a highly qualified alternative from a functional and systemic standpoint, its higher cost limits its position in the final ranking.

The central urban vertiport (A1) presented the lowest overall performance among the alternatives analyzed. Although urban centrality may, in principle, favor proximity to demand-generating poles and reduce travel times for certain user profiles, in the context assessed this typology proved less competitive. A1 was disadvantaged mainly by its high cost, lower operational capacity, higher level of perceived noise, and lower relative social acceptance, in addition to only intermediate performance in safety. These results indicate that centrality, although potentially advantageous in terms of convenience and market access, tends to intensify technical, environmental, and regulatory restrictions, increasing the infrastructure's exposure to urban conflicts and public resistance. Evidence from Ayres Jr. (2024) reinforces this interpretation by indicating that a significant share of existing helipads do not fully meet safety requirements for eVTOL operations, making their adaptation a major technical and economic challenge.

In summary, the results suggest that decisions on UAM infrastructure should be understood as choices among different ways of balancing technical performance, economic feasibility, and socio-environmental legitimacy. The peripheral/ground-based alternative (A2) stood out precisely because it offered the most balanced combination of these attributes, whereas the integrated multimodal alternative (A3) demonstrated high potential, although constrained by higher implementation costs. The central urban alternative (A1), despite its apparent locational advantage, proved more vulnerable to economic, environmental, and social conflicts. Thus, the CRITIC-WISP framework proved suitable for supporting decisions in multidimensional and sociotechnical problems by making explicit the tensions among the criteria evaluated and allowing the most advantageous alternative to be interpreted not only in terms of aggregate performance, but also in terms of coherence with urban, regulatory, and social objectives.

5. Study Limitations

Despite its contributions, this study presents some limitations that should be considered when interpreting the results. First, the analysis was conducted with a limited number of vertiport alternatives which, although consistent with typologies recurrent in the literature and in regulatory practice, may restrict the generalization of findings to urban contexts with different configurations. In addition, dependence on secondary data from technical and institutional sources may introduce restrictions related to the updating, granularity, and standardization of the information used to construct the decision matrix.

Second, the incorporation of subjective weights was based on the opinion of a specific group of specialists, which may entail biases associated with the experience, training, or institutional context of these actors, even though consolidation and normalization procedures were adopted. Finally, the proposed framework does not incorporate a dynamic model of demand or the temporal evolution of UAM, treating the decision problem in a static manner. Future studies may overcome these limitations by expanding the set of alternatives and criteria, using primary data, incorporating fuzzy or probabilistic techniques to address uncertainty, and developing dynamic approaches capable of capturing the evolution of demand, technology, and social acceptance over time.

6. Final Considerations

This study presented a Hybrid Multicriteria Framework based on the CRITIC and WISP methods to support decisions on vertiport implementation in Urban Air Mobility. The approach demonstrated the ability to integrate multiple technical-operational, economic, environmental, and social dimensions, offering consistent support for complex decision-making scenarios. The results indicated that the peripheral/ground-based vertiport achieved the best overall performance, highlighting the relevance of balanced solutions aligned with sustainable urban planning. The use of CATWOE helped make actors and constraints explicit, strengthening the legitimacy of the process. As future directions, it is recommended to expand criteria and alternatives, incorporate fuzzy techniques to address uncertainty, and develop computational tools that enable dynamic real-time analyses. The proposed framework may also be adapted to other UAM contexts, such as air corridors, maintenance bases, or logistics hubs, providing a methodological basis applicable to several agents in the ecosystem.

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