

MAIA

Multimodal Access for Intelligent Airports

WHITE PAPER

MOBILITY INNOVATION AND AIRPORT ACCESS

LESSONS LEARNT FROM MAIA AND WAY FORWARD



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Editors and contributors

Manon Coyne (POLIS)

Juan Blasco Puyuelo (NOMMON)

Behzad Bamdad Mehrabani (TRANSPORT & MOBILITY LEUVEN)

Sebastian Hoerl (IRT SYSTEM X)

Bojana Mirkovic & Nikola Ivanov (FACULTY OF TRANSPORT & TRAFFIC ENGINEERING, UNIVERSITY OF BELGRADE)

Sonia Ramirez Ballesterero & Elke Bossaert (BRUSSELS AIRPORT)

Editing and layout: POLIS

MAIA Objective

The MAIA project developed a set of data analytics and modelling tools as a basis for two passenger mobility innovations: shared autonomous vehicle fleets and unmanned aerial vehicle fleets. The MAIA tools monitor and anticipate changes in passenger behaviour due to these new options, optimise vehicle dispatch under multimodal disruptions, and recommend appropriate locations for vertiports.

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Introduction

Setting the context

Air travel is multimodal by nature. Any passenger using air transport services needs to combine them with other modes to complete the access and egress legs to the airports.

To improve both the quality and efficiency of the passenger journey, **a multimodal approach is needed**. This not only **boosts aviation competitiveness** by enhancing the passenger experience and maximising capacity, but also helps **lower aviation's environmental impact**. While airports serve as vital nodes in transport networks, and a seamless interface between air and ground transport is required to meet passenger expectations and system performance targets, their access is at the same time one of the main sources of both traffic and emissions[1].

Multimodality strategies must take into account that airport access is an ever-changing context permeable to mobility innovations. These are understood as a variety of new mobility solutions, emerging with the progressive digitalisation of transport systems, and often grouped under the banner of “smart mobility”. Concepts such as shared mobility, demand-responsive transport (DRT) and mobility as a service (MaaS) are already changing the mobility landscape of European cities and regions. These innovations seem to be the prelude to deeper transformations that will come from the hand of vehicle automation, such as Cooperative, Connected and Automated Mobility (CCAM) and Urban Air Mobility (UAM), **which generate new exploratory research needs related to their efficient integration as airport access options**.

The rapid evolution of mobility technologies promises substantial improvements to transport systems' efficiency & sustainability. These new options have great potential to:

- Improve airport accessibility and enlarge airport catchment areas (by providing additional and/or faster connectivity with certain areas);
- Increase the resilience of the door-to-door passenger journey (by adding new flexible alternatives to the access and egress legs);

- Lower the environmental impact of conventional vehicles (by reducing emissions due to airport access and egress); and
- Facilitate the implementation of coordination mechanisms between air transport and access modes (thanks to the higher flexibility provided by shared autonomous services).

However, the integration of new mobility technologies and services into existing airport access frameworks remains a critical challenge, and it is still unclear how they can help manage airport accessibility challenges. Questions such as their complementarity with existing access modes, infrastructure needs within and outside the airport, and the applicability of these new mobility concepts to different airport access contexts deserve further research[2]. The lack of comprehensive data on the operational capabilities, passenger acceptance, and capacity and environmental impacts of these new modes complicates their full adoption.

The MAIA project

To address these challenges, the MAIA project has developed a suite of data analytics and modelling tools that support the evidence-based design and implementation of multimodal airport access solutions, focusing on fleets of Connected Cooperative and Autonomous Mobility vehicles (CCAM) and electric Vertical Take-Off and Landing aircraft elevating Urban Air Mobility (UAM). These developments were driven by the main research question of **how to leverage mobility innovations to improve airport accessibility**.

In the context of transportation systems, airport accessibility is defined as “a measure to describe how difficult it is for potential air passengers to reach a particular airport”[3]. Criteria to measure airport accessibility are mostly based on travel times for various transportation modes within the airport catchment area. The catchment area is “the geographic area from which a large proportion of an airport’s outbound passengers originate from, or inbound passengers travel to, and their geographic distribution within this area”[4].

Based on this definition and criteria, **MAIA has assessed the accessibility conditions and challenges for European airports**, and the **risks and opportunities brought about by CCAM and UAM to face such challenges**. High-level requirements for analytical tools to help aviation take advantage of such opportunities were derived from this first assessment.

Based on these requirements, three solutions are proposed to prepare airports for an optimal implementation and operation of innovative multimodal airport access services based on CCAM and UAM technologies:

- **MAIA-Engine**, a toolset for a passenger-centric implementation of innovative multimodal airport access services. This is a SESAR Solution at TRL-1 that provides data analytics and modelling tools for understanding passenger expectations and modelling their behaviour. In particular, this toolset produces estimates of the demand captured and modal shifts induced in airport access due to the introduction of new modes of transport under different service configurations, a key aspect when assessing the impacts of innovative multimodal airport access services.
- **MAIA-CCAM**, a vehicle dispatching tool to support the operation of shared autonomous vehicle fleets in airport access. This is a SESAR Solution at TRL-1 that defines a CCAM service that helps autonomous mobility providers operate in a way that they are able to mitigate the impacts of unplanned disruptions, thanks to fleet dispatching algorithms adapted to the context of airport access.
- **MAIA-UAM**, a vertiport site selection framework to support the implementation of airport access services based on electric Vertical Take-Off and Landing (eVTOL) aircraft. This is a model-based SESAR Solution at TRL-1 which supports airports, city governments and other UAM decision-makers to select locations for vertiports across urban areas and at airports.

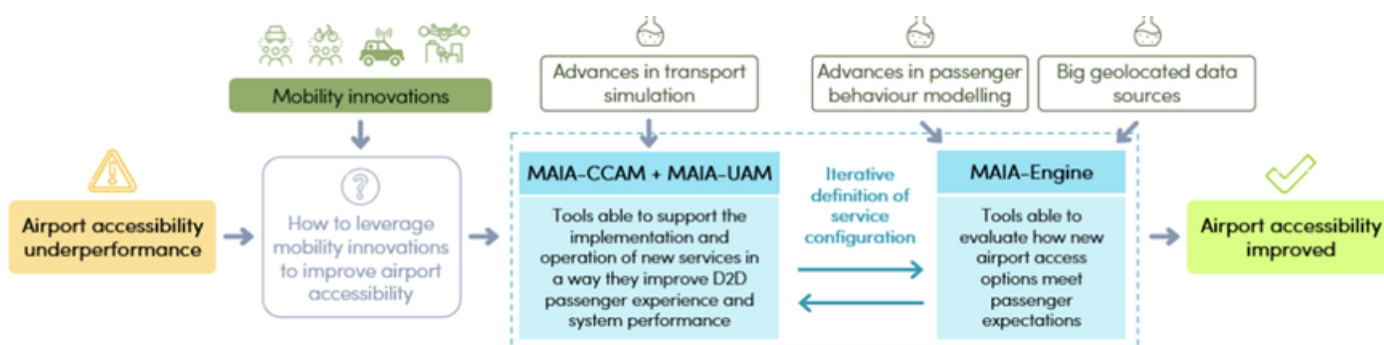


Figure 1 - MAIA overall concept

The MAIA White Paper

The MAIA White Paper provides a high-level view of the main results and conclusions of the EU-funded MAIA project. It targets decision-makers at an executive level to promote the project results and foster their adoption and further development. It also launches a debate on the potential of new mobility solutions to improve airports' sustainability and integration into local and regional transport networks, bringing relevant inputs to assess use cases and define priorities.

It is intended for the following readers with specific objectives:

- **Airports** with solutions to improve their performance as multimodal hubs and reduce road congestion;
- **Ground mobility service providers**, covering all transport modes from rail to road, and especially autonomous shuttle fleets' owners and managers, to provide them with insights on the relevance of and requirements towards their services in the context of airport operations;
- **UAM service providers**, drone and vertiport operators with requirements and recommendations to optimise their integration into local, regional, and airport access transport networks;
- **Public transport operators** with solutions to support modal shift from private cars to public transport, and to complement existing offers;
- **Vehicle manufacturers and equipment providers** with requirements towards their products based on expected service performance;
- **Airlines** with insights to increase air passengers' satisfaction;
- **Parking and infrastructure operators**, as well as energy suppliers with potential impacts of mobility innovation and multimodal services around airports;
- **Transport authorities** with insights on potential improvement of airports' integration in their local and regional transport networks;
- **European, local and regional authorities** with inputs for future urban, regional, and international mobility network development;
- **Insurers and funding organisations** with methods, tools and data on airport access service assessment;
- **Researchers and the SESAR 3 JU** with inputs for further research and development.

The White Paper focuses firstly on the context around the development of the MAIA solutions, the objectives behind the work conducted, and the outcomes resulting from this, to be exploited further. In the second, third and fourth parts, the MAIA White Paper presents the three main tools developed in the project, framing the problem they are solving, planning their design and performance parameters, and anticipating disruptions and requirements. In the final part, concrete recommendations towards the target audiences are defined, based on the conclusions of the project, and the overall contribution of the project to airports' sustainability and regional integration is summarised. A future outlook in terms of research needs is proposed as well, in the perspective of exploiting the MAIA results in further research aiming for later-stage implementation.

1. Assessing the demand for airport access via CCAM and UAM with MAIA-Engine

Mobility innovations based on CCAM and UAM services will only influence airport access if used by passengers. Therefore, passenger experience is a key parameter to consider when designing the integration of innovative solutions in airport access services. It appeared as a higher priority than parameters related to environmental and societal impacts or mobility service operations. In particular, a primary challenge is to understand the shifts in passenger behaviour in the presence of these new transport modes.

Airport access from the passengers' perspective

The first investigations in the MAIA project have collected a list of factors influencing air passengers' choices in terms of solutions to access airports[5]:

Access experience

- Reduce travel cost (e.g., public transport ticket prices)
- Reduce travel times to/from airports
- Reduce the number of transfers to the airport (e.g., provide direct rail links)
- Increase the level of service
- Improve accessibility for all passengers (e.g., disabled/person with reduced mobility)
- Improve accessibility for airport workers
- Improve real-time disruption information

Capacity and reachability

- Increase the airport's catchment area
- Improve connections between nearby airports (e.g., between Paris Orly and Charles de Gaulle)
- Reduce traffic congestion around airports
- Reduce public transport saturation around airports
- Increase parking availability
- Increase electrical supply for new electrical solutions (inside and outside the airport)

Resilience

- Increase adaptability to passenger behavioural changes (e.g., lifestyle changes, residence location, environmental awareness)
- Increase adaptability to new airport access services
- Improve ground access resilience (e.g., reduce recovery times after disruptions)

Managing access

- Nudging travellers towards more sustainable access options
- Improve integration between access transport modes (e.g., solve policy and regulation issues)
- Improve the financial sustainability of access mobility options

Environmental and social impact

- Reduce GHG emissions
- Reduce noise emissions
- Improve local air quality
- Reduce disruptions to the local community in the vicinity of the airport
- Improve road safety in airport access

Consultations with experts in the field have shown that passenger experience aspects were prioritised over other considerations. In particular, travel time and travel time reliability are consistently identified as factors with the most impact, and are very variable from one mode to another. In particular, as the MAIA results suggest, the difference in travel time between using personal vehicles and public transportation is a critical aspect of the airport access challenge[6].

There are multiple reasons behind these differences:

- Limited-service hours: public transport may not operate 24/7, which can be problematic for travellers with early morning or late-night flights.
- Inconsistent frequency: buses or trains may not run frequently, leading to long waiting times and potentially missed flights.
- Limited routes: some airports are not well-connected to the public transport network, especially in smaller cities or rural areas.
- Lack of direct routes: passengers may need to make multiple transfers, which can be time-consuming and confusing.

- Lack of coordination: poor coordination between different modes of public transport (e.g., buses, trains, trams) can make transfers between them difficult.

These reasons represent important obstacles to using public transport, especially in multimodal frameworks, which airport accessibility strategies must work on solving. New mobility systems can act as an opportunity to improve operational and financial performance and support reputational considerations[Z], effectively complementing public transport to deal with the identified challenges. But how?

Expected changes with CCAM & UAM

CCAM

Investigations in the MAIA project have led to the conclusion that CCAM has the potential to help address some of the identified challenges in airport access. It is viewed as a viable option, with prototypes already in progress, and its inclusion in airports is expected in the short to medium term.

In terms of sustainability, CCAM technologies provide a pathway to significantly **reduce GHG emissions from airport access**. The service is anticipated to function as shared transportation, with some (limited) potential to replace trips that would otherwise be made by private vehicles, in addition to trips made by taxis and public transport. Because CCAM is shared and on demand, users benefit from a comfort level comparable to a private car while paying a lower price than for a private vehicle, even more so considering users do not need to pay for parking. Furthermore, CCAM can apply differentiated pricing, offering lower fares for passengers willing to share their ride and higher fares for those preferring to travel alone. Coordination with public transport is essential to make sure that CCAM services do not cannibalise already existing clean access options.

CCAM is considered an option to **enhance airport accessibility**. The service can connect the city centre or key points, such as business areas, to the airport. Additionally, it can serve as a last-mile transport to connect airports with other modes of transportation, such as linking train stations or parking to airports or connecting nearby airports. Its ability to operate flexibly across many locations, supported by efficient pooling of passengers, enables a high level of coverage and operational feasibility.

Furthermore, the combination of last-mile connectivity, demand-responsive transport, and fixed-route systems offers potential solutions to unlock the full potential of CCAM. As an on-demand service, it can **improve responsiveness to disruptions** more effectively than trains and modes of transportation with fixed routes and schedules. The optimisation of fleet operations will be key to avoiding an excess of empty trips and vehicle distance travelled that would lead to an increase in congestion and disruptions to local communities. Efficient CCAM services that complement public transport options can help significantly **reduce travel times**, which is one of the key airport accessibility challenges identified by MAIA.

It should be noted that the potential of CCAM can be unlocked only if it is perceived as a safe, easy-to-use, shared and reliable mode targeting all types of users, and if appropriate regulations are implemented.

UAM

The MAIA research activities have concluded that UAM airport shuttle services have the potential to address the needs of passengers with a high value of time in the medium term. UAM airport shuttle services are one of the most prominent UAM services, offering passenger transportation from metropolitan areas to airports, using highly automated and efficient air vehicles. These vehicles, eVTOLs, are regarded as a disruptive technology, offering improvements compared to conventional helicopters for transportation of passengers and goods across urban areas, owing to comparably lower noise, zero emissions and higher cost efficiency.

UAM airport shuttle services could be implemented to **target business passengers initially**, with a potential to scale up operations to target other passenger segments as the UAM concept and eVTOL technology mature. It is a competitive option for medium- to long-distance airport access and egress, offering **significantly reduced travel times** and enabling to **address connectivity gaps**, particularly for remote and underserved places[8]. There is potential for quick airport-to-airport transfers in large metropolitan areas as well, and for integration with other UAM services: intra-city and inter-city passenger and cargo operations.

It is important to note that the impact of these services will be largely determined by the adoption and acceptance of these modes by the public. Presently, the major barriers for UAM implementation are the lack of a clear regulatory framework for safe eVTOL operations and potentially high costs of the service.

There is a need for policymakers and authorities to keep up with the eVTOL industry's pace and to support UAM from a regulatory perspective, while city governments could assess different incentive schemes for stakeholders to make investments in vertiport infrastructure, enhancing UAM services. Planning the placement of vertiports and their integration in urban environments, especially at airports, will largely determine UAM services' feasibility.

MAIA-Engine capabilities & expected users

Studies in the MAIA project have shown the key role of user acceptance and trust of CCAM and UAM solutions to fulfil the potential of these innovations in airport accessibility support. In that respect, the first tool developed in the MAIA project, MAIA-Engine, enables **traveller behaviour and transportation demand analysis**. This analysis covers passenger characteristics, expected changes in travel patterns with new access options, and overall expected travel demand shifts from traditional to new mobility options. Four components described below support this key analysis.

MAIA-Engine components

- Algorithm for passenger profiling and airport access characterisation

This component leverages large-scale geolocation data and passenger surveys to describe airport access demand and generate detailed profiles of airport users. It aims at capturing characteristics crucial for adopting new airport access services, such as group travel dynamics and trip purpose (business/leisure). This enriched passenger information supports the understanding and prediction of passenger behaviour and needs.

- Algorithm for generating synthetic passenger populations

This component generates a synthetic population of the passengers accessing the airport, including information about the passenger profile and characteristics. This estimation is informed by combining continuously updated data sources, such as Mobile Network Data (MND), census and survey data, to generate large, anonymised, and detailed datasets of synthetic passenger populations. This allows for a detailed representation of passenger demographics and behaviours, which is essential for accurate demand modelling and simulation.

- Algorithm for modelling airport access demand by mode

A discrete choice model is a statistical model predicting the probability that a person will choose one option over others, based on the traveller's characteristics and available transport modes' attributes. This model is first calibrated using real passenger survey data. Once validated, this model is applied to the synthetic population (from the previous stage) representing travellers. Based on a set of assumptions regarding the operational performance of future transport services (CCAM and UAM), the model is then extended to include these new modes. This enables the prediction of travel demand for all transport options, both existing and emerging, and supports the analysis of potential modal shifts in airport access behaviour.

- Algorithm for short-term prediction of airport access service demand

This component applies machine learning techniques based on operational data for real-time forecasting of airport access service needs. These algorithms provide critical support for the planning and implementation of innovative airport access solutions.

Together, these algorithms form a flexible analytical framework adaptable to diverse operational and data environments.

MAIA-Engine results

The capabilities of MAIA-Engine were validated in two case studies conducted at Brussels and Madrid Airports, investigating what the demand will be for CCAM and UAM for accessing these airports in the future[9]. The Brussels case study results are used below.

Assumptions made were that people will react to these new transport modes similarly to how they do with current modes (determining the discrete choice model equation describing traveller behaviour), and innovative services considered will have the following characteristics:

- UAM: 120 km/h cruise speed, €5/km fare, 10-min access time
- CCAM business: fare = taxi fare, access time = car access time
- CCAM economy: fare = 0.5× taxi fare, access time = 1.5× car access time

Based on 2023 survey data from the Brussels airport and open access Belgian population data, a synthetic population was developed. Then, a discrete choice model was applied to the synthetic population, leading to a prediction of the adoption of different travel modes to access the airport, including UAM and CCAM modes (Figure 2).



Figure 2 - UAM (up) and CCAM (down) predicted demand to access Brussels Airport

UAM demand appears the most prominent among passengers living within a 10-kilometre radius of Brussels Airport, for the assumed price of 5EUR per km. This indicates that UAM is currently a viable option primarily for short-distance travellers, who slightly benefit from improved travel times for reasonable costs due to shorter aerial distances. However, it's important to note that this demand is highly sensitive to the location and number of vertiports available. If more vertiports were added further from the airport, the potential catchment area for UAM could expand.

The CCAM option shows notable interest among travellers from longer distances. Since its cost is assumed to be half that of a taxi, it presents an affordable and appealing middle ground between high-cost private transport and slower public options. It seems especially useful for those in semi-urban and suburban regions who might lack direct access to traditional modes or prefer a more comfortable and efficient alternative. Its attractiveness for long-distance travellers also suggests the importance of positioning CCAM services as a complementary rather than competing mode with buses and trains.

The shift from traditional modes to these two innovations predicted with MAIA-Engine is shown in Figure 3 below.

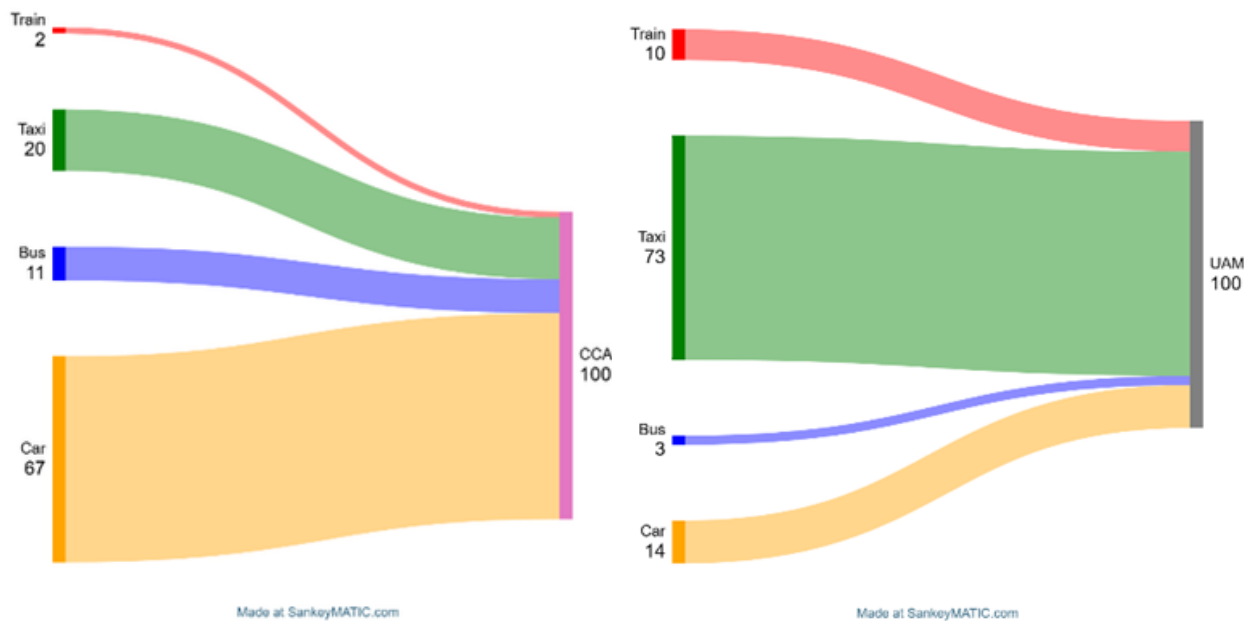


Figure 3 - Predicted modal shift towards CCAM (left) and UAM (right)

The conclusions in terms of demand were the following: CCAM and UAM are expected to reshape airport access, with a mass-market replacement for private cars through CCAM, and a premium service for time-critical travellers with UAM. For CCAM, expected demand amounts to 6,8% of all air passengers, which comes from car users (67%) and taxi users (20%). Because CCAM offers comfort, privacy, and flexibility like cars, and is cheaper than a taxi but more convenient than a bus/train, it appeals to car users looking for convenience without driving, sensitive to airport access cost and time equally, with origins spread around Belgium. For UAM, the expected demand is 4,7% of air passengers, coming from taxi (73%) and car users (14%). UAM services have similar attributes to taxis: they are on-demand, direct, private, fast, and also perceived as a premium service. They attract time-sensitive, high-income travellers, originating from urban centres around Brussels airport.

MAIA-Engine exploitation

Leveraging the rich datasets, advanced modelling techniques, and insights produced with the MAIA-Engine tool can inform decisions to align them with technological advancements and evolving traveller needs. Besides, the demand estimates provided by MAIA-Engine form the foundation for other stages in the MAIA project, ensuring that each step is guided by a robust understanding of emerging trends and technologies in passenger mobility.

2. Optimising CCAM fleet deployment for airport access with MAIA-CCAM

While the CCAM potential to improve airport access was addressed in previous parts, it remains to be shown how this potential can be exploited. A condition already identified above is the uptake of the services by users and decision-makers at different levels, including the airport operators. To support this uptake, the MAIA project has developed the MAIA-CCAM tool, which enables a comprehensive assessment of CCAM-based airport access solutions (CCAMAAS). The assessment improves the relevance and efficiency of the service, which is a key factor in its acceptance and use.

CCAMAAS characteristics and quality criteria

Service characteristics

CCAMAAS are envisioned as fleets of self-driving vehicles operated as taxis in a ride-pooling format: vehicles pick up and drop off passengers at different spots along their route to and from the airport. The directions, trajectories, and pickup plans of each vehicle of the fleet are optimised through a central dispatching tool. The airport context provides certainty on some demand aspects, which facilitate CCAMAAS operation: demand is highly bundled to the airport and highly balanced, with equivalent flows to and from the airport.

Assessment criteria

CCAMAAS quality and efficiency cover adaptability to air passengers' needs, efficiency of operations, profitability, and environmental impact. Specific indicators are needed to enable comparisons between different deployment scenarios and facilitate deployment decisions. The MAIA-CCAM tool enables the calculation of the following indicators:

- Request processing time
- Request rejection rate
- Customer waiting time at pickup
- Delay at drop-off
- Total vehicle travelled distance
- Empty travelled distance share
- Distance ratio showing the profitability of the service

Assessment method

MAIA-CCAM enables a strategic evaluation of different CCAMAAS deployment scenarios in order to reveal service benefits and operational challenges, highlighting the most relevant scenarios. The toolset allows the user to perform simulations of different demand configurations, strategic deployments, and operational parameters.

Input data is required to define the simulation.

- Demand configuration: number and characteristics of passenger requests for the CCAMAAS. A direct case would be to obtain request data from a real-world taxi operator. It should contain the origins and destinations of the observed trips (one of the two being the airport) and the desired departure and arrival times of the customers. In most cases, especially when making assumptions on future scenarios, such direct demand data is not available. However, they can be generated with the MAIA-Engine tool.
- Strategic deployment:
 - Supply characteristics (number of vehicles available and number of seats for each of them)
 - Transport network (digital representation of the road network in the operating area around the airport, representing in detail the roads that can be used by the simulated CCAM service to correctly calculate distances and travel times in the system. MAIA-CCAM provides a tool to extract such information from ubiquitously and openly available data from OpenStreetMap)
 - Service guarantees (maximum allowed wait times, maximum detours).
- Operational parameters: dispatching objectives considering various user profiles (economy, business, premium) that are treated differently in the dispatching algorithm to propose different service levels.

The objective of MAIA-CCAM is to understand how many vehicles are required to serve the demand in CCAM requests. To perform this analysis, the following steps are followed: CCAM demand is obtained from MAIA-Engine, describing trips from and to the respective airport using the CCAM mode (1); the demand is analysed to identify potential operating areas based on their request density (2); the demand data set is enriched with service-related attributes such as request maximum wait time (3); CCAM simulations are performed, to size the fleet for the core operating area, and to assess the fleet performance on additional operating areas.

MAIA-CCAM results

As for MAIA-Engine, MAIA-CCAM was tested in two case studies around the Brussels and Madrid airports. These case studies have produced some results in terms of demand and service requirements for these two airports.

Planning demand and operating areas

In the Brussels case, the demand is derived from a synthetic population of Belgium to which a discrete mode choice model has been applied in MAIA-Engine, extracting all trips using CCAM. Major demand clusters are around Brussels (B), Antwerp (A), Mechelen (M) and Leuven (L), both for Leisure and Business (Figure 5).

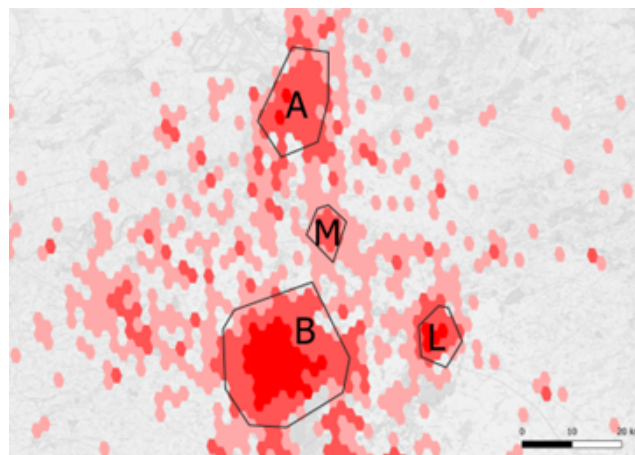


Figure 5 - Major demand clusters around Brussels, Antwerp, Mechelen and Leuven

Considering the demand size, Brussels is defined as the “core area” for operations. Characteristics are described in Table 1.

Zone	B	A	M	L
Operating area surface [km ²]	301	119	29	40
Expected requests	2,388	335	78	167
Request density	7.9	2.8	2.7	4.2
Average distance to BRU [km]	10	34	14	16

Table 1 - Service characteristics for Brussels case study

Enrichment components of MAIA-CCAM are used to define attributes per request: maximum wait time and detour factor, allowed pooling, stop duration, and time period between submission and planned departure (submission slack).

Analysing service performance

- Fleet size

The MAIA-CCAM fleet simulation components are used to size the CCAM fleet corresponding to the demand described above (Figure 6). To serve the demand in Leisure passengers, about 70 vehicles are required, such that only about 5% of requests per day must be rejected. For the Business demand, a dedicated fleet of about 30 vehicles is required to fulfil the smaller, but more constrained, demand. The threshold of 5% is an arbitrarily chosen criterion in this case study and could be defined differently in future studies.

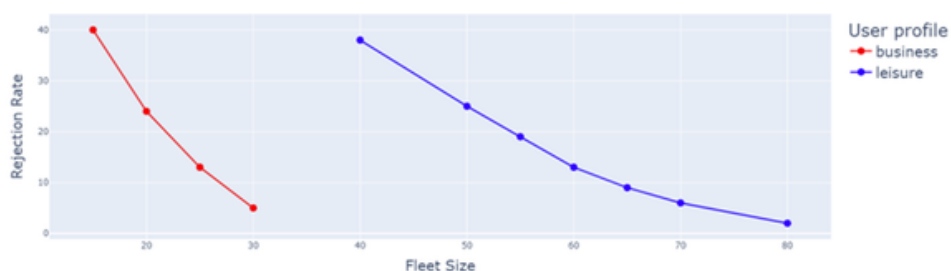


Figure 6 - Brussels fleet sizing

- Fleet efficiency

Then, in terms of fleet performance (Figure 7), the total distance travelled and the occupied distance are calculated, defining the empty share and the customer distance, which represents a revenue for the operator, given a certain transport fee. Finally, a distance ratio is obtained, which is the ratio of the distance bringing revenue (customer distance) over the overall distance driven.

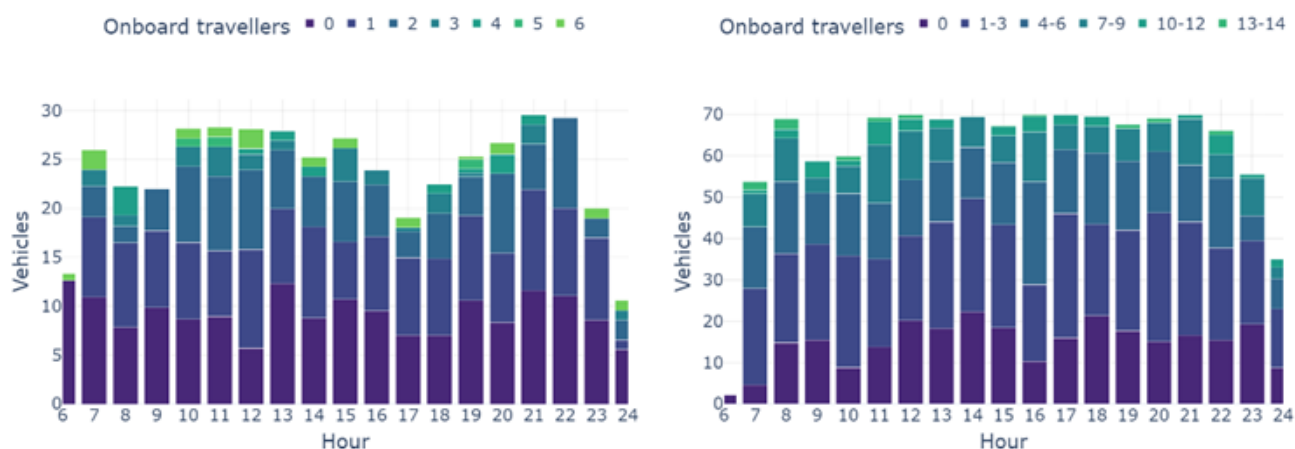


Figure 7 – MAIA-CCAM fleet efficiency analysis for Business (left) and Leisure (right) passengers in the Brussels case study

- Cost efficiency

Based on the fleet efficiency and daily per-vehicle, per-distance, and per-request costs obtained in previous research[10], the fare required to run a cost-covering service is calculated, both for per-distance and per-request fare models (Table 2).

Cost per day	Leisure	Business
Fleet cost [EUR]	2,450	1,050
Trip-based cost [EUR]	1,194	272
Distance-based cost [EUR]	4,217	2,248
Total daily cost [EUR]	7,858	3,568
Cost-covering price per request [EUR]	2.56	5.11
Cost-covering price per distance [EUR/km]	0.12	0.26

Table 2 - MAIA-CCAM cost efficiency analysis for Brussels' case study

- Operating area analysis

The indicators are calculated for different area combinations between the clusters identified in the demand definition phase (Table 3). Adding too many and too far operating areas increases the rejection rate, but only slightly. However, the increased rejection rate could be decreased by augmenting the obtained fleet size. These are key pieces of information to improve CCAMAAS relevance and uptake.

Operating area				Requests		Rejections [%]		Distance ratio	
B	A	M	L	Leis.	Busi.	Leis.	Busi.	Leis.	Busi.
•	•			3,375	760	8	5	1.63	0.63
•	•	•		3,412	765	8	5	1.64	0.63
•		•		3,288	742	6	4	1.55	0.60
•			•	3,307	763	7	5	1.54	0.60
•		•	•	3,344	768	7	5	1.56	0.61
•	•		•	3,431	786	9	6	1.65	0.64
•	•	•	•	3,468	791	9	8	1.67	0.64

Table 3 - Operating area design for Brussels

Support airport access resilience to disruptions

One particularity of MAIA-CCAM is that it also introduces disruptions into the initial demand dataset. The disruptions that can be introduced in MAIA-CCAM are:

- Groundside disruptions in which trips ending at the airport are delayed. The disruption is defined by a time period during which requests within a configurable radius around a disruption point (for instance, a rail station) are shifted to a configurable future point in time. This way, a demand surge in that area and at that time can be represented.
- Airside disruptions function in a similar way, but affect a certain configurable percentage of requests departing from the airport within a specifiable time frame. Those are shifted to a specific later point in time to represent a queuing up of the demand at the airport that should be relieved by the help of the CCAM service.
- As a third option, congestion is represented by defining a certain region in the network in which the nominal travel times are modulated by a congestion factor. Such a factor slows down the fleet vehicles, such that they adaptively need to take detours

MAIA-CCAM exploitation

MAIA-CCAM is a simulation toolset that can be used by transport planners and researchers. They can use the framework to configure airport access scenarios consisting of an (external) demand data set. Additionally, they can configure the fleet, the service level, the network characteristics, and introduce disruptions if desired by the use of configuration files following a well-defined and documented format. The users can then run the simulation pipeline, which is provided as a command-line tool. Additional tools and analysis scripts are provided in MAIA-CCAM to produce the relevant maps and graphics showing the relevant KPIs identified during the MAIA project. This way, knowledgeable users of the system can produce outputs that can then be assessed and interpreted by a larger audience.

3. Selecting vertiport locations to support airport access with MAIA-UAM

If CCAM is foreseen as a service soon supporting airport access, UAM integration into airport access remains in a longer-term perspective and in a staged implementation. However, considering the potential benefits of this innovation[11] and the market potential around it[12], as well as the fast technology development and the growing authorities' interest, studies are needed to advance deployment. MAIA-UAM contributes to the definition of vertiport networks (number and location of vertiports) to support the implementation of UAM airport shuttle services.

UAM airport shuttle services' characteristics

UAM airport shuttle services require locations of vertiports both in urban areas and at airports. Two distinct approaches were adopted for these two contexts, considering their inherently different constraints and requirements. Vertiport locations in urban areas are demand-driven and approximated using the centroids of the zip codes, while vertiports at airports are located based on potential candidate sites (on landside or airside) evaluated and ranked to find the most favourable locations with respect to specific criteria. Each approach and the related results are presented below.

City vertiports should be reachable on foot or by other urban transport modes if integrated into multimodal terminals. Stakeholder collaboration at the local level is needed to find suitable vertiport locations offering short and easy access for intended users, while meeting all legal, regulatory and community requirements. Potential candidate sites are existing heliports/helistops, rooftops of buildings and garages, etc.

Vertiports at airports should also enable transfer to and from desired terminals on foot or by car from the land side, and by "ramp direct" from the airside. Available sites will be associated with higher or lower dispersion of the transfer times depending on the overall size of the airport, i.e., terminal complex and number of vertiports placed at the airport. Placement should enable competitive service with other access modes, but also prevent interference with aircraft operations that have a higher priority. Potential candidate sites are heliports and general aviation aprons, and rooftops of passenger terminals, parking garages or hotels on the landside.

In both contexts, key factors influencing the transport mode choice of air passengers to access airports were considered: travel time and travel cost. These factors depend on eVTOL characteristics, accessibility and location of vertiports, routes taken by the eVTOL, operational safety procedures at vertiports, etc. Inputs on these characteristics were collected and used in the MAIA-UAM models from an extensive literature review and stakeholder consultation (face-to-face meetings with airport and helicopter operators, webinars and surveys with experts from multiple fields).

Vertiport site selection

In urban areas – the network perspective

In urban areas, it was assumed that vertiport operators are the entities investing in operations and infrastructure (in combination with public subsidies), playing an important role in defining the most suitable locations for vertiports. From that perspective, the key criteria for location selection are to maximise expected profit with a minimal investment risk.

In MAIA-UAM, an original two-stage optimisation model is developed. The strategic level stage takes stock of all possible decisions on a combination of vertiport location and eVTOL fleet size for sufficiently large numbers of different demand materialisation scenarios. The tactical level stage simulates all scenarios of operation to observe the demand materialisation and calculate the expected profit for each combination of vertiport location and eVTOL fleet size. The objective is to maximise the eVTOL operator's profit.

In the MAIA case study conducted around the city and the airport of Madrid, the Community of Madrid area is observed, with 356 zip codes generating 87% of all airport access trips. The high-level baseline scenario includes a reference eVTOL cruise speed of 120 km/h with 1 passenger per aircraft flying the shortest route distance in the UAM network. The expected revenue is 5 EUR/km with a profit margin of 20%, with fully subsidised vertiports at the airport, and a vertiport cost of 500 thousand EUR in the urban areas (with city subsidies). The considered eVTOL cost is 300 thousand EUR. The airport demand used in this analysis has been estimated with MAIA-Engine, based on the analysis of MND (Figure 8).

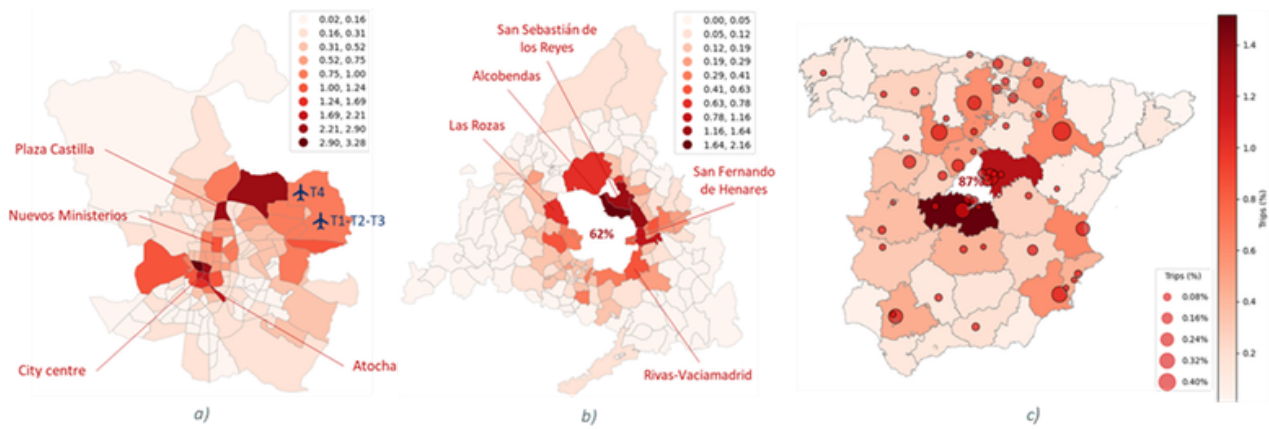


Figure 8 - Madrid Airport passenger demand coming from Madrid City (a), Community of Madrid (b), and Spain (c)

For this case, selected vertiport locations with MAIA-UAM include two vertiports at the Madrid airport (one near Terminals 1, 2 and 3 [V-L2-T123], and one near Terminal 4 [V-L4-T4]), eight vertiports across the community of Madrid area (three in neighbourhoods in Madrid City and 5 in neighbouring municipalities), and eleven eVTOL aircraft (Figure 9).

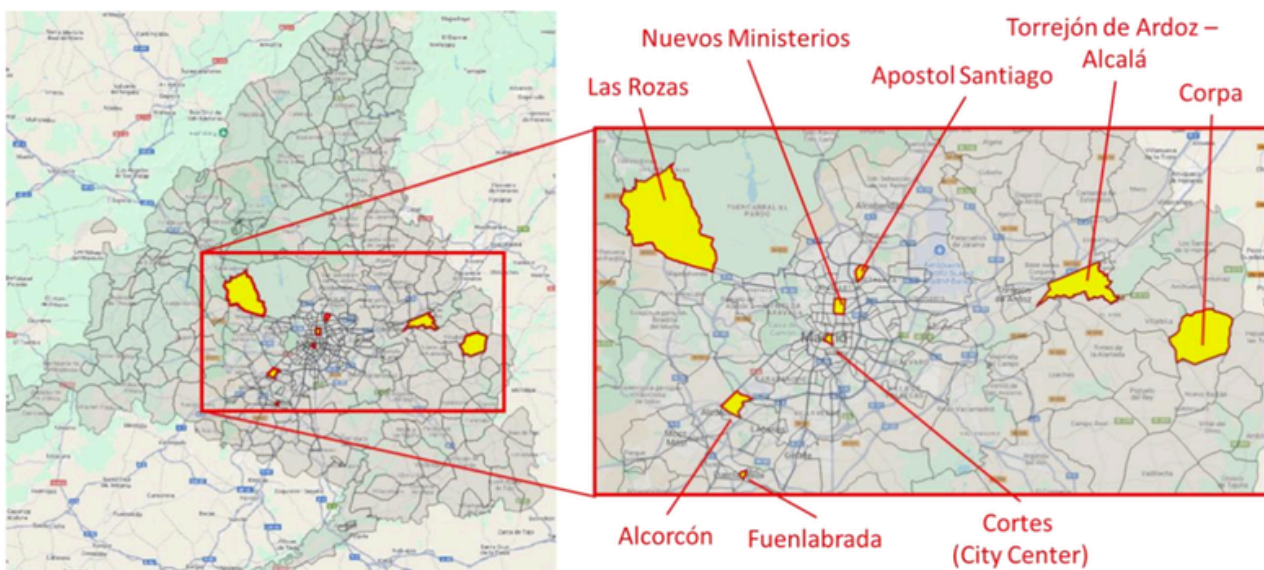


Figure 9 - Selected neighbourhoods for vertiport placement in Madrid urban area

At airports - the micro-location perspective

For the vertiport location at airport facilities, a vertiport micro-location perspective was adopted. It aims to determine the exact location where a vertiport should be built, based on specific requirements. MAIA-UAM takes the perspective of an airport operator, responsible for planning and investing in vertiports at the airport. The selection of vertiport micro-location at airports in the MAIA-UAM approach is based on an evaluation of the following criteria:

1. Vertiport safe integration into the airport environment;
2. Vertiport capacity and cost – derived from the available area and proposed vertiport layout;
3. Vertiport accessibility – travel time vertiport-to-terminal and vice versa.

Interference with aircraft operations is a major concern when placing vertiports in an airport environment. The vertiport location at the airport shall not affect runway capacity or airline operations. Therefore, the method for vertiport site selection at an airport starts with a qualitative assessment of the candidate locations based on their relative position to the runway system, terminal building and urban area. This assessment excludes some of the candidates from further evaluation. MAIA-UAM does not extend to quantitative assessment for this criterion, since neither the eVTOL concept of operations nor the vertiport-specific regulatory framework is fully defined to support it.

The candidates that pass this step are then evaluated and ranked based on the capacity they offer, their cost and accessibility. Different weights can be allocated to these three criteria, affecting the ranking of location options.

- Capacity

A vertiport location is constrained by the physical space available, which influences its capacity (the possible number of eVTOL operations per hour). To assess this constraint, MAIA-UAM includes a model to combine vertiport capacity with different vertiport sizings for selected vertiport layouts. The trade-off between capacity and available space is important in particular for vertiports located at large airports, commonly characterised by large available areas, but expected to serve as hubs for all access and egress trips in the UAM airport shuttle network, especially connecting with vertiports at smaller airports.

The different vertiport layouts proposed are based on existing models for balanced airside capacity usage and planning[13], including durations of the processes (arrival, departure, taxiing and turnaround) and their dependencies, for the specific nature of vertiport operations. Vertiport sizing relies on the regulations[14], specific vertiport layout(s) that can be accommodated in available areas, the number of vertiport elements, and eVTOL dimensions.

The Vertiport Sizing and Capacity (VSC) tool, as part of the MAIA-UAM framework, is available at <http://vsctool.sf.bg.ac.rs/>. It enables a calculation of the vertiport required length, width and total area, and the vertiport capacity (arrival, departure, mixed, gate and overall, measured as eVTOL operations per hour).

The calculation is based on a selected vertiport layout and input parameters, including, for example, the eVTOL aircraft, vertiport elements design options, vertiport operations and passenger processing times, and battery charging policy. In addition, for a defined available area, the tool proposes a vertiport layout with the highest capacity under the smallest area (Figure 10).

To enable service in peak hours under acceptable delay, off-peak periods come with higher requirements for eVTOL staging. The VSC tool aims to find a layout that both provides maximum throughput and fits a maximum number of stands for staging purposes.

Single Area Parameters

Length 1	180
Width 1	140

Results

Gates	3	2	3	4	6	4
Length [m]	90	112.5	108	180	180	150
Width [m]	60	30	60	60	90	120
Total Area	5400	3375	6480	10800	16200	18000
Capacity Overall	32.2	23.8	23.9	50.2	80	64.8

Figure 10 - the VSC tool output: proposed vertiport layout for one of the candidate sites at Madrid airport

- Cost

The cost of the proposed vertiport layout is calculated based on the required area, the number of gates equipped with chargers, and the vertiport type (airside/landside, rooftop/ground).

- Accessibility

Vertiport accessibility is measured as the additional time required for passengers to reach the terminal building from the vertiport site. It is derived from the distance between the vertiport and the terminal, and the average driving speed on public roads (for landside locations) and on apron service roads (for airside locations).

In the Madrid Airport case study, 10 candidate sites were evaluated (seven on landside and three on airside), as illustrated in Figure 11. All locations were considered viable with regard to safe integration into the airport environment.

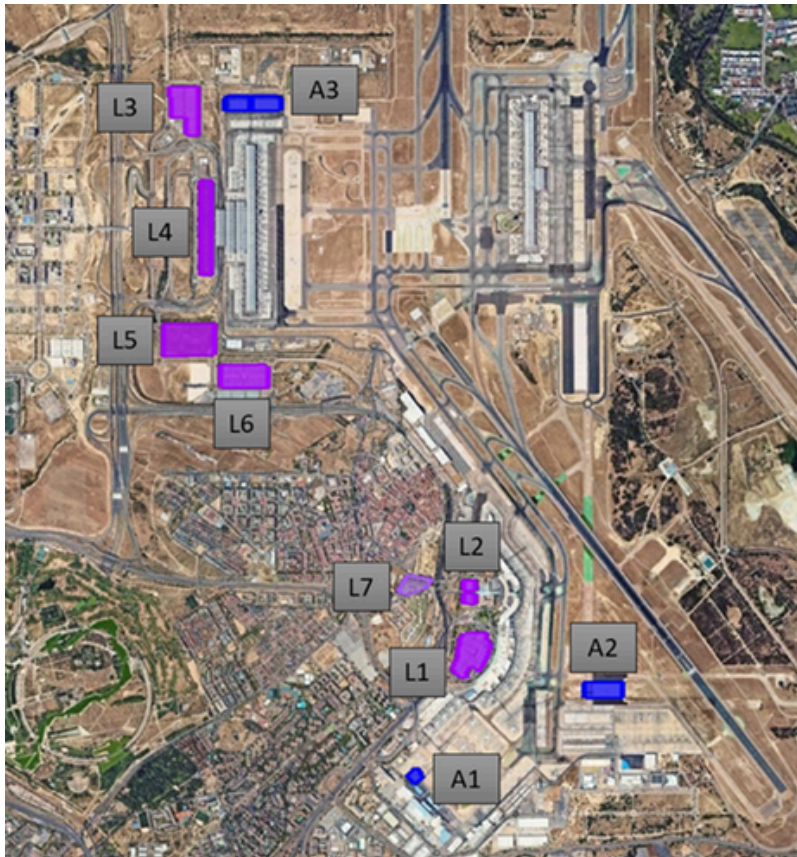


Figure 11 - Candidate sites at Madrid Airport

Figure 12 below shows the ranking - the Simple Additive Weighting method is used, four different approaches to normalise the decision matrix are compared, and equal weights are assigned to capacity, cost, and accessibility.

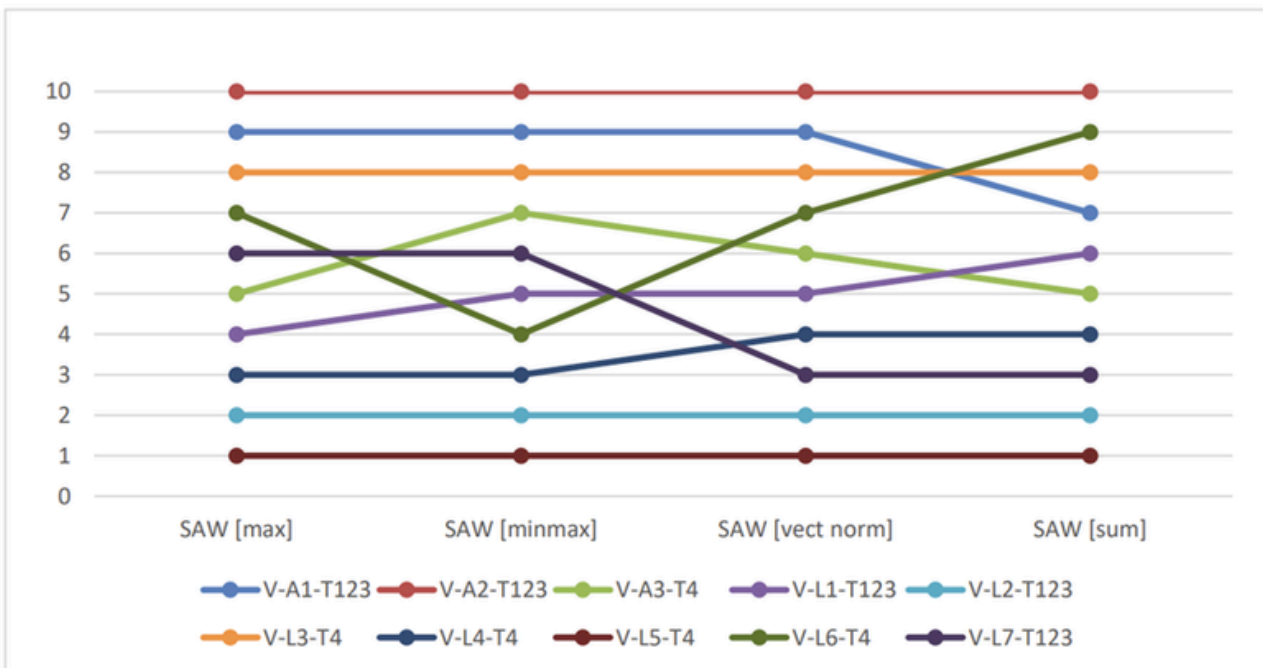


Figure 12 - Vertiport sites ranking for different criteria weights

Conclusion

The three tools developed in the framework of the MAIA project have shown great capacity to enhance innovative solutions for airport access. MAIA-ENGINE can predict user adoption of new services, MAIA-CCAM can optimise CCAM services to better serve needs, and MAIA-UAM can support UAM service deployment with optimised planning of UAM ground infrastructure (vertiports). To ensure their exploitation, next steps are needed in the process of airport access improvement with new smart mobility solutions: improve air passenger behaviour understanding with data sources' combinations, enhance the assessment of UAM service viability considering future regulatory framework, and run tests to collect more input data reinforcing the tools' results accuracy. Stakeholder collaboration across fields is required, but each stakeholder type in the MAIA audience is also expected to find relevant insights from the project results to exploit further:

- **Airport Authorities and Management** can use the data on passenger travel dynamics and predictions on transportation mode choices to better design and manage airport terminals, intermodal hubs, parking facilities, and access routes. Anticipating demand for new services and how these can shape future airport access allows airports to strategically plan their integration, with a focus on infrastructure placement and operating area and capacity, thereby improving accessibility and operational planning.
- **Private Sector Transportation Service Providers** (e.g., Taxi, Ride-Sharing) can apply insights into passenger preferences and forecasted demand shifts to tailor services, pricing strategies, and marketing campaigns. Operators of CCAM fleets or shared mobility services can use MAIA-ENGINE results to identify high-demand zones around airports and optimise deployment and fleets. They can also use MAIA-CCAM to support their fleet dispatching optimisation, and MAIA-UAM to anticipate multimodal mobility hubs' integration in their operational networks. Non-CCAM service providers can understand how the CCAM technology might shape airport access service and adapt their service to ensure complementarity of modes.
- **UAM stakeholders and vertiport operators** can use the MAIA-UAM insights into the estimated demand and required facilities and their location for their services, but also into the demand sensitivity to the size and capacity of the vertiport network, the special requirements about placing vertiport in urban and airport environments, and the factors influencing profit of the airport shuttle services.

- **Public Transportation Operators** can use detailed datasets and demand forecasts to optimise routes, schedules, and fleet sizes for buses, trams, trains, CCAM, and UAM to and from airports. MAIA-ENGINE's individual-level demand modelling can help them adapt services to real-time passenger needs and future technological shifts. MAIA-CCAM helps understand fleet service optimisation with autonomous vehicles, with a potential use in future public transport systems, and MAIA-UAM provides insights to consider for ground multimodal hubs integrating UAM modes.
- **Vehicles and aircraft manufacturers** can use the algorithms and machine learning techniques demonstrated in the project to create or improve products that forecast transportation needs and model travel behaviours. They can also learn about the impacts of eVTOL's characteristics in terms of cruise speed, battery charging times, etc., on the services' potential and related demand.
- **Airlines** can use MAIA-ENGINE to better anticipate their customers' behaviour and support innovations which will benefit them.
- **Parking and Energy stakeholders** can learn from the CCAM and UAM service constraints related to demand and operational conditions for airport access solutions. They can use these insights to contribute to more efficient vertiports and CCAM fleet storage and dispatch.
- **Urban and Transportation Planners** can leverage predictions on modal shifts and transportation demand to plan urban mobility strategies and infrastructure investments that accommodate emerging transportation technologies. The spatial demand patterns provided by MAIA-ENGINE can guide long-term planning around airport catchment areas and intermodal hubs. MAIA-CCAM and MAIA-UAM can provide them with key insights on optimised service operating areas, road/route networks, and key characteristics.
- **Local Government Officials** have an interest in providing a consistent and integrated transport network in their local environment to facilitate and maintain economic development, while taking care of the environmental impact of the transport system. They can implement findings from the project to enhance local transportation systems, improve airport access, and boost local tourism and business sectors.
- **Policy Makers and Regulatory Bodies** can draw on empirical data and model outputs to adopt regulations and incentives that promote the use of travel modes, reducing congestion and environmental impacts. By understanding likely passenger behaviour in response to UAM and CCAM, policies can be better targeted to ensure adoption and equity in service access. Better understanding operational constraints for CCAM operation and UAM infrastructure deployment can support them in defining smarter standards and rules for increased multimodal integration.

- **Investors and Financial Analysts** can assess potential areas for investment based on trends and forecasts provided by the project, such as emerging technologies or growing demand for specific transport services (e.g. CCAM or UAM).
- **Academic Researchers and Consultants** can analyse comprehensive datasets and modelling approaches used in each MAIA tool for academic studies or consultancy projects aimed at enhancing transportation theory and practice. They can also use the tools to run their own case studies, thanks to the tools' flexibility. In particular, Environmental Analysts can use data on modal shifts towards new transportation technologies to evaluate potential reductions in carbon footprints and other environmental benefits.
- The **SESAR Joint Undertaking** can use the findings and methodologies of MAIA-ENGINE, MAIA-CCAM and MAIA-UAM to inform and optimise its initiatives aimed at integrating new mobility services into the European air traffic network. By understanding the potential modal shifts and impacts of autonomous vehicles on airport access, SESAR can better coordinate between air and ground transportation services, enhancing overall travel efficiency and sustainability within the EU airspace. Furthermore, the MAIA tools can support multimodal airport collaborative decision-making and flow optimisation, contributing to SESAR's goal of a seamless and integrated mobility system.

In terms of future research needs, more case studies can be tested with the tools to refine their capacities and improve their accuracy across different geographies and contexts. Additionally, the case studies can be further refined to better capture the evolution of modal shift over time and to more accurately reflect reactions to new modes of transport, allowing for a more timely understanding of how these factors evolve across the years. The underlying assumptions can also be more closely tailored to each case, and the full catchment area could be assessed. Supply-side constraints should be integrated: currently, the models assume full availability of UAM and CCAM services. In future work, incorporating capacity uncertainty, such as reduced eVTOL operation volumes due to meteorological conditions or CCAM available fleet sizes, is crucial for realistic demand forecasting. This will support equilibrium modelling and help align infrastructure investment with actual needs. Finally, additional data sources can enrich different aspects of the tools: the use of stated preference (SP) surveys tailored to UAM and CCAM should complement revealed preference data enriching information of passenger behaviour and transportation service demand; satellite data on land use and UAM impacts such as noise or privacy concerns in urban areas would also be needed for more accurate definition of potential vertiport site locations.

Annex 1 - Definitions and Acronyms

Acronym	Expansion	Definition
Airport accessibility		Measure to describe how difficult it is for potential air passengers to reach a particular airport
Airport airside & landside		The airside of an airport defines the aircraft operations area and its adjacent terrain where aircraft and ground support vehicles operate, and secured areas of (terminal-)buildings. The landside of an airport defines those areas and activities within the airport boundaries, exclusive of the airside. It may accommodate passenger processing, public access, and commercial zones.
ATM	Air Traffic Management	
Catchment area		Geographic area from which a large proportion of an airport's outbound passengers originate from, or inbound passengers travel to, and their geographic distribution within this area
CCAM	Cooperative, Connected and Automated Mobility	Concept that encompasses mobility services based on the use of Connected and Autonomous Vehicles (CAVs). These vehicles (private cars, buses, etc.) are enabled by communication technologies and artificial intelligence systems capable of performing part or all of the driving tasks, based on inputs from onboard sensors, infrastructure, and other vehicles.
CCAMAAS	CCAM-based Airport Access Solutions	
ConOps	Concept of operations	document describing the characteristics of a proposed system from the viewpoint of an individual who will use that system
DRT	Demand Responsive Transport	Flexible public transportation system that adapts routes and schedules to meet user needs, rather than following fixed routes and timetables
EASA	European Union Aviation Safety Agency	

Acronym	Expansion	Definition
EEAB	External Experts Advisory Board	
ERP	Exploratory Research Plan	
EU	European Union	
GDPR	General Data Protection Regulation	
IAM	Innovative Air Mobility	
MaaS	Mobility as a Service	Single, comprehensive, and on-demand mobility service integrating various forms of transport and transport-related services
MAIA	Multimodal Access for Intelligent Airports	
MAIA-Engine		Toolset for a passenger-centric implementation of innovative multimodal airport access services
MAIA-CCAM		Vehicle dispatching tool to support the operation of shared autonomous vehicle fleets in the airport access
MAIA-UAM		Vertiport site selection framework to support the implementation of services based on electric VTOL vehicles
MND	Mobile Network Data	
SESAR	Single European Sky ATM Research	
Spatial analysis		Process of examining, interpreting, and understanding patterns, relationships, and interactions within a geographic space
UAM	Urban Air Mobility	New safe, secure and more sustainable air transportation system for passengers and cargo in urban environments, enabled by new technologies and integrated into multimodal transportation systems. The transportation is performed by electric aircraft taking off and landing vertically, remotely piloted or with a pilot on board

Acronym	Expansion	Definition
U-Space	U-Space	Set of new services relying on a high level of digitalisation and automation of functions and specific procedures designed to support safe, efficient and secure access to airspace for large numbers of drones
eVTOL	Electric Vertical Take Off and Landing	

Table 4 - Definitions & Acronyms

Annex 2 - References

- [1] ICAO (2018). Sustainable Considerations for Airport Surface Access, available online at <https://www.icao.int/>, consulted in November 2025.
- [2] Ugrimurera, J., Severino, J., Ficenec, K., Ge, Y., Wang, Q., Williams, L., ... & Phillips, C. (2021). A modelling framework for designing and evaluating curbside traffic management policies at Dallas-Fort Worth International Airport. *Transportation Research Part A: Policy and Practice*, 153, 130-150; Choi, J. H., & Park, Y. (2022). Exploring economic feasibility for airport shuttle service of urban air mobility (UAM). *Transportation Research Part A: Policy and Practice*, 162, 267-281; X-TEAM D2D Consortium (2022). Deliverable D5.1 Concept of Operations Validation Report, available at: <https://xteamd2d.eu/deliverables/>.
- [3] Reichmuth, J., German Aerospace Centre (2010), Airport Accessibility in Europe, Air transport and Airport research topical report, in analyses of the European air transport market, funded by the European Commission, available at: <https://transport.ec.europa.eu/system/files/2016-09/2010-airport-accessibility-in-eu.pdf>
- [4] UK Civil Aviation Authority (2011), Appendix F: Evidence and analysis on competitive constraint by passenger switching, available at: <https://www.caa.co.uk/media/5xpmhvqx/gal-cap-1134-appendix-f-evidence-and-analysis-on-competitive-constraints-by-passenger-switching-non-con-1.pdf>
- [5] Koster, P., Kroes, E., Verhoef, E. (2011). Travel time variability and airport accessibility. *Transportation Research Part B*, Vol. 45, Issue 10, December 2011, Pages 1545-1559; DATASET 2050 Consortium (2017a). Deliverable 5.1: Mobility Assessment. Available at: <https://doi.org/10.13140/RG.2.2.35316.04482>; Colovic, A., Pilone, S. G., Kukić, K., Kalić, M., Dožić, S., Babić, D., & Ottomanelli, M. (2022). Airport Access Mode Choice: Analysis of Passengers' Behaviour in European Countries. *Sustainability*, 14(15), 9267.
- [6] MAIA Consortium (2024). D2.1 Challenges and opportunities of Mobility Innovations for Airport Access, MAIA Project Deliverable 2.1.
- [7] L.E.K Consulting (2018). The Future of Airport Ground Access. How Airports Can Respond to Disruption, available online at https://www.lek.com/sites/default/files/insights/pdf-attachments/Future-Airport-Ground-AccessReport_0.pdf

- [8] PRIAM Consortium (2024). PRIAM Project Brochure, available online at priam-project-sesar.eu, consulted on November 24, 2025
- [9] MAIA Consortium (2025). D6.1 Transversal MAIA Case studies Report, MAIA Project Deliverable 6.1.
- [10] Hörl, S., Becker, F., Axhausen, K.W. (2021). Simulation of price, customer behaviour and system impact for a cost-covering automated taxi system in Zurich. Transportation Research Part C: Emerging Technologies 123, 102974.
- [11] MAIA Consortium (2025). D5.3 DES HE SESAR solution 0398 concept outline, MAIA Project Deliverable 5.3.
- [12] MarketsandMarkets (2025). eVTOL Aircraft Market: Global Forecast to 2030, Accessed: Oct. 13, 2023. [Online]. Available: <https://www.marketsandmarkets.com/Market-Reports/evtolaircraft-market-28054110.html>
- [13] B. Mirković and V. Tošić (2017). The difference between hub and non-hub airports – An airside capacity perspective, J Air Transp Manag, vol. 62, pp. 121–128, Jul. 2017, doi: 10.1016/j.jairtraman.2017.03.013.
- [14] EASA (2022). Prototype Technical Specifications for the Design of VFR Vertiports for Operation with Manned VTOL-Capable Aircraft Certified in the Enhanced Category (PTS-VPT-DSN), Cologne, Germany, Mar. 2022. Accessed: Jan. 14, 2024. [Online]. Available: <https://www.easa.europa.eu/en/downloads/136259/en>

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