Bridging Multimodal Gaps

Solutions for Improving Passenger Experience and Securing On-Time Arrivals

ACI EUROPE White Paper

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Content

1 Executive Summary

European airports sit at a critical intersection of air and ground mobility. As traffic grows and complexity increases, the European ATM Master Plan calls for a more connected and predictable Digital European Sky and sustainable operations. Improving multimodality is a central, yet often underdeveloped component of this transformation. It is however essential in strengthening connectivity, enhancing passenger experience and supporting more efficient and sustainable mobility.

This study, carried out by ACI EUROPE, provides an overview of existing multimodal initiatives, assesses practical opportunities and proposes actionable solutions. It reflects input from an Expert Group of over 40 European airports, including major hubs, medium-size airports, and regional airports across more than 20 countries. This diversity ensures that the findings are relevant to different levels of multimodal maturity, governance models, and local mobility structures. The participating airports mirror the wide range of operational conditions present across Europe, which allows the insights to be meaningfully interpolated to a wider European context. As a result, this study captures a spectrum of operational realities, from highly integrated transport settings to regions where alternatives to private car travel remain limited, ensuring that the proposed measures are both ambitious and realistic for implementation across Europe.

Across the airports of the Expert Group, the analysis revealed multimodal gaps in four key areas: organisation, technology and data-sharing, regulation, and infrastructure. Multiple airports face challenges driven by a car-centric mobility behaviour and inconvenient or poorly communicated sustainable alternatives, reducing the overall effectiveness and attractiveness of multimodal access to airports for both passengers and staff. Moreover, inconsistent stakeholder coordination and financial constraints like parking revenue trade-offs hinder a long-term implementation of multimodal initiatives. Gaps in data-sharing, missing system interoperability and data privacy concerns further limit the development of seamless multimodal solutions.

The report proposes five solution areas to close these multimodal gaps:

1. Integrated multimodal mobility platforms enabling real-time information exchange and seamless journey planning.
2. Strengthened stakeholder coordination and governance, including structured cooperation with municipalities and transport operators.
3. Measures to promote a modal shift for passengers and staff through targeted incentives and improved service design.
4. User-friendly luggage solutions to make public transport and shared mobility more attractive.
5. Improved disruption management through integrated landside-airside operations, enhanced data sharing and the use of tools like digital twins.

These solutions support the ATM Master Plan's objectives on digitalisation, trajectory-based operations, improved predictability and environmental performance. Integrating multimodal data feeds and coordinating landside processes with the Airport Operations Plan (AOP) directly contributes to a more resilient and efficient network, reducing knock-on delays linked to late passenger arrivals.

The study presents recommendations for the two key areas – multimodality and disruption management, consolidating solutions identified by the Expert Group and airports' best-practice examples into concrete measures. These are structured across three contexts: operational, research and innovation, and policy and regulatory.

Tactical recommendations focus on improving operations by enhancing coordination, communication, and service continuity using existing infrastructure and tools, delivering immediate benefits for passengers and staff. Strategic recommendations for operations like system integration, stakeholder alignment and infrastructure upgrades require structural reforms, long-term investment, and regulatory alignment. The proposed operational recommendations are complemented by research, innovation, and policy recommendations such as interoperable data standards, clarification of responsibilities, multimodal accessibility requirements, smart baggage solutions and targeted funding. The developed recommendations enhance reliability, connectivity, predictability and sustainability across the European aviation system and assist airports in improving passenger experience and efficiently managing flows, security and baggage.

2 Introduction

In the context of growing environmental concerns, rising passenger volumes and the need for more resilient transport systems, the integration of multimodal transport at airports, especially in Europe, has become increasingly important. Multimodality is widely recognised as a key enabler of both sustainable mobility and improved passenger experience. However, achieving true multimodality at European airports remains hindered by a range of significant bottlenecks and challenges. Important issues include regulatory barriers, infrastructure limitations, technological constraints and insufficient data sharing. These obstacles prevent seamless coordination between airports and other modes of public transport, impacting connectivity, accessibility and the overall passenger experience. Moreover, opportunities to reduce congestion and emissions are missed.

This study aims to assess and enhance the integration of multimodal transport at European airports. By focusing on improving connectivity, accessibility and satisfaction for both passengers and airport employees, the study addresses the need for a more user-centric and operationally efficient mobility ecosystem, while also supporting more reliable, on-time arrivals. The study follows a structured, participatory approach to assess and improve multimodal transport integration at European airports. A crucial element throughout the process was the continuous collaboration with the Expert Group, primarily through a series of workshops, complemented by interviews and targeted meetings with ACI EUROPE.In two phases, several workshops were conducted to gather information from the Expert Group.

- The first phase contained four workshops. In the first one, the current state of multimodal integration was assessed and existing measures as well as best practice initiatives were identified. Workshop two focused on operational challenges and bottlenecks and examined common challenges faced by different airports, while the third workshop developed a shared vision for future multimodal airports integrating strategic objectives such as sustainability, connectivity, accessibility and passenger and staff satisfaction. The fourth workshop translated insights into actionable recommendations, clustered around five key areas: developing integrated multimodal mobility platforms, strengthening stakeholder involvement, promoting modal shift, enabling smart luggage solutions and improving disruption management.
- In the second phase, two workshops were held with a stronger focus on passenger flow optimisation and disruption management. In these workshops, an extended Expert Group of operational experts from various airports discussed existing data sources and information sharing procedures and developed measures with a stronger focus on flow management and operational efficiency, as well as extending the Airport Operations Centre (APOC) to include the landside.

3 Definitions

To provide clarity on key concepts relevant to this study, the following definitions are introduced to avoid ambiguities surrounding the terminology used in the context of airport accessibility and transport integration. While the term landside can be interpreted in different ways, in this study it refers to the areas and processes encountered by passengers prior to passing through airport security. This includes landside transport access (e.g., public transport, private vehicles), orientation and navigation to the terminal (wayfinding), as well as check-in procedures.

A distinction is made between intermodal and multimodal transport, as summarised in the table below. Intermodal transport refers to travel chains involving different modes of transport that are only partially coordinated, often resulting in separate tickets, unsynchronised schedules and longer transfer times. In contrast, multimodal transport describes a more integrated system, where various modes are fully coordinated, for example through synchronised timetables, single-ticket systems, unified information platforms and improved transfer infrastructure. The differences between these two concepts are illustrated in Table 1.

Non- or Partially Coordinated—Intermodal Transport	Fully Coordinated—Multimodal Transport
Separate tickets	Single ticket
Timetables—non-synchronized arrival/departure times causing longer waiting times at transfer points	Timetables—synchronized arrival/departure times among transport operators, enabling shorter waiting times at transfer points
Longer walking distance between terminals during transfer due to current location of terminals and stops	Better location of terminals and stops—shorter walking distance between terminals during transfer
Multiple information sources	Single information platform
Responsibility of passenger or transport operator involved (each mode independently)	Responsibility of passenger or responsibility shared among transport operators involved
Luggage check-in at the airport	Possibility of remote luggage check-in
Access facilities (elevators, ramps, vertical and horizontal escalators, automated people movers)	Additional access facilities at transfer between terminals and stations for all modes of transport

Table 1: Comparison of Intermodal and Multimodal Transport Coordination[1]

[1] Sourced from Babi´c, D. et al.: Integrated Door-to-Door Transport Services for Air Passengers (2022): From Intermodality to Multimodality. Sustainability 2022, 14, 6503. https://doi.org/10.3390/su14116503.

4 Assessment of the Current Situation

To understand how airports can improve multimodality, it is essential to first assess the current landscape of efforts, systems and challenges. This includes discussing and reviewing existing multimodal initiatives at European airports and identifying the main challenges and bottlenecks that hinder seamless integration.

A central finding during the conducted workshops was that airports differ significantly in their perspectives on their role in managing disruptions and monitoring passenger flows. Some view the airport primarily as a physical space, where various independent service providers operate. In this case, the airport refrains from taking an active coordination role and does not engage much in structured collaboration with stakeholders. Other airports see themselves as central coordinators responsible for ensuring a seamless passenger experience, especially in times of disruption. This approach requires the airport to take initiative in identifying relevant stakeholders and fostering cooperation among them, ranging from transport providers and security agencies to customer service teams, to enable effective information exchange and joint problem-solving.

A further area of tension lies in the conflict of interest between ensuring smooth and efficient passenger departures and the airport's increasing reliance on non-aeronautical revenues, particularly from retail and parking. Airports often aim to maximise passenger dwell time in commercial areas past security, which can conflict with initiatives aimed at streamlining landside access or encouraging the use of public transport over private car travel. Measures such as reducing on-site parking spaces or promoting seamless drop-off options – though beneficial from a mobility or sustainability perspective – can negatively impact the airport's earnings from parking, a traditionally significant revenue source. This financial dilemma highlights the challenge of aligning commercial interests with passenger-centric and environmental goals and is further discussed in the section on challenges later.

4.1 Landside Access

As part of the study, airport representatives were asked about landside access to and from the airport, particularly which modes as alternatives to a private car are currently available and which modes are most frequently used by passengers and staff (see Figure 2). Based on input from 40 airport representatives, the results cannot be seen as fully reflective of all European airports, but they do highlight relevant mobility options within those that took part. A complete list of the survey participants is provided below:

- Amsterdam Schiphol Airport
- Athens Airport
- Barcelona El Prat Airport
- Berlin Brandenburg Airport
- Bologna Airport
- Brussels Airport
- Billund Airport
- Cologne Bonn Airport
- Dublin and Cork Airport
- Eindhoven Airport
- Frankfurt Airport
- Geneva Airport
- Helsinki Airport
- Keflavík Airport
- Larnaka and Paphos Airport
- Liège Airport
- Ljubljana Airport
- Lyon Airport
- Madrid Barajas Airport
- Melilla Airport
- Milan Bergamo Airport
- Milan Malpensa Airport
- Milan Linate Airport
- Menorca Airport

- Munich Airport
- Ostend Airport
- Palma de Mallorca Airport
- Riga Airport
- Rome Fiumicino Airport
- Stockholm Arlanda Airport
- Stuttgart Airport
- Turin Airport
- Thessaloniki Airport
- Valladolid Airport
- Venice Marco Polo Airport
- Vilnius Airport
- Warsaw Chopin Airport
- Zurich Airport
- 14 Regional Greek Airports (Fraport)
- 10 Portuguese Airports (ANA)

Taxis and public transport buses are the most universally available alternatives, reported by nearly all respondents. Rental cars, bikes, carsharing and ride-hailing services (e.g. Uber) are also widely accessible. Just over half of the airports offer airport express buses and hotel shuttles, while around 45% provide dedicated staff shuttles or connections to commuter and regional or national rail services. Less commonly available modes include ridesharing (offering a seat in a private car), e-scooters, high-speed rail, metro lines, boats or ferries and people movers (automated transport systems, e.g. the Marconi Express in Bologna). Additionally, several airports reported other available options, including walking, motorcycles, tour operators' buses, parking lot shuttles, self-service bicycles, private vans and minibuses.

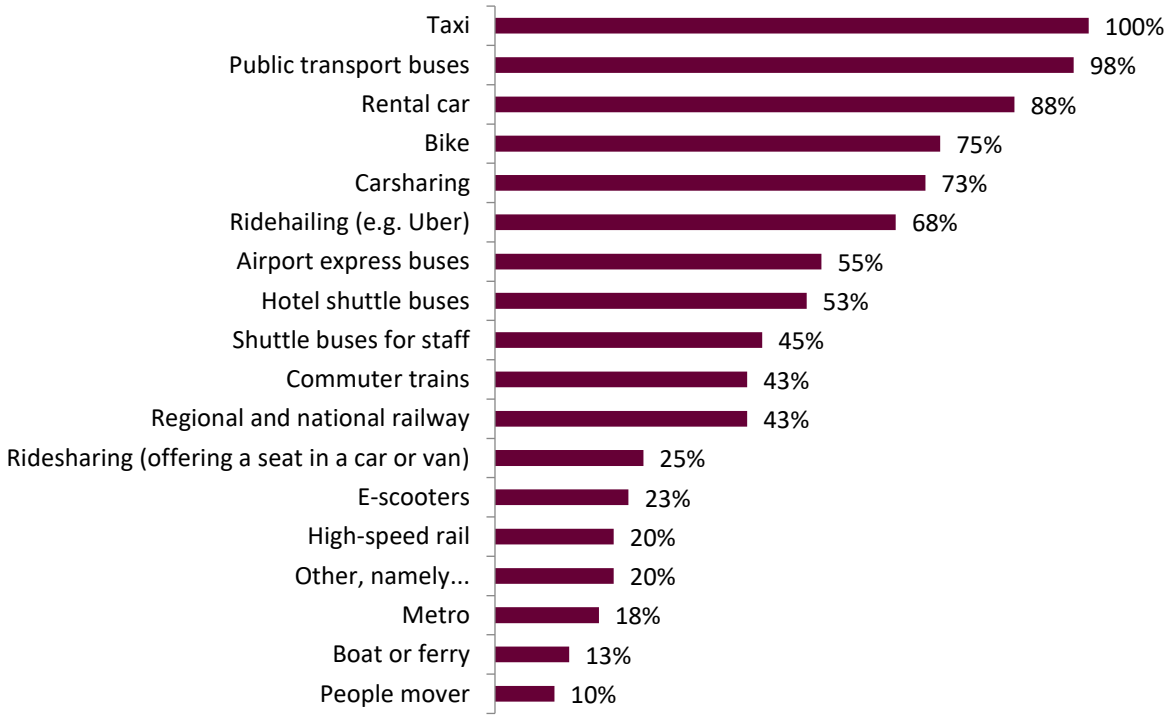


Figure 1: Overview of available alternative transport modes at the airport, n = 40.

However, availability does not directly correspond to usage. Figure 2 illustrates which modes are most frequently used by passengers and staff. Taxis remain the most commonly used alternative option, followed by public transport buses. While regional or national rail and commuter trains are available at several airports, their usage is significantly lower compared to taxis and public transport buses. Airport

express buses and ride-hailing services are also used less frequently despite being widely available. High-speed rail, metro lines and shuttle buses for staff see relatively low usage, while people movers are less frequently used – likely due to their limited availability across airports. Similarly, modes such as bikes, carsharing, e-scooters as well as ridesharing (i.e. booking a seat in a private car) are available but not widely used. Boats or ferries were also indicated by a small number of airports and show minimal usage. Some airports additionally reported the use of tour operator buses and private vehicles.

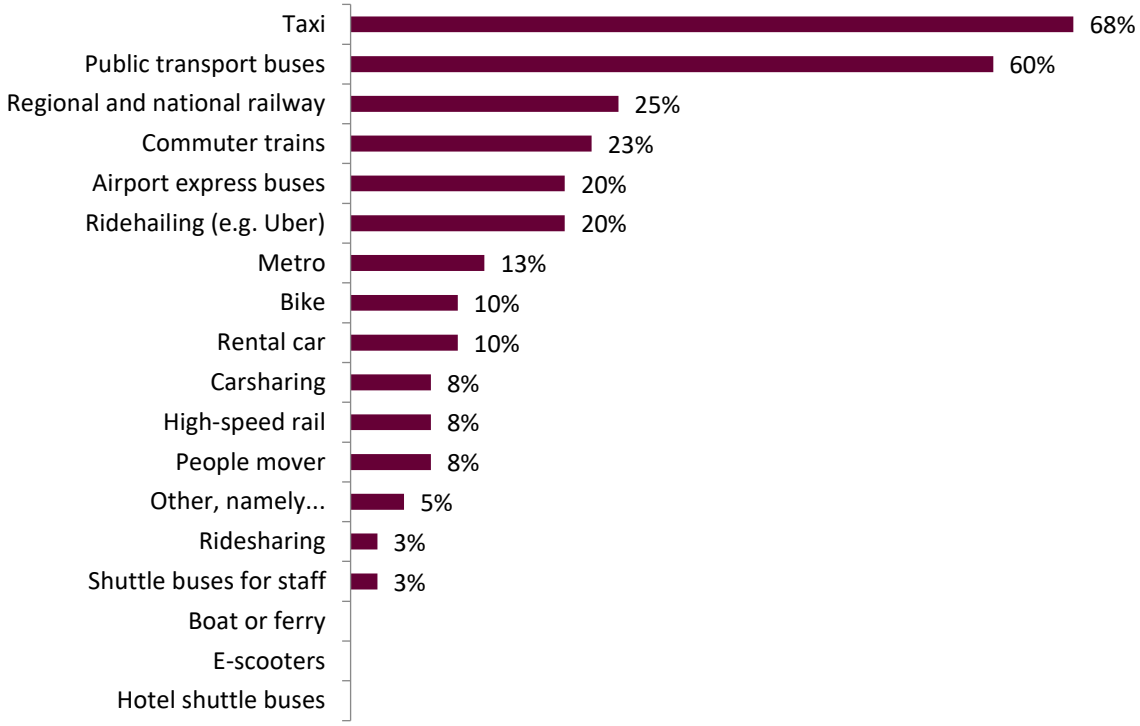


Figure 2: Overview of popular alternative transport modes at the airport, n = 40.

4.2 Data Sharing

The following overview outlines the main categories of data sources currently used by airports to stay informed and coordinate passenger flows and disruptions. The extent to which these data feeds are currently shared between stakeholders varies considerably across European airports, which results from the differently perceived role and responsibility of the airport as a single-source-of-truth and the willingness of stakeholders to collaborate.

Some airports receive information directly from transport operators, including real-time updates via APIs, for example from trains and people movers (e.g. Marconi Express in Bologna Airport). They have implemented ecosystems for sharing information between the airport and local public transport providers, however the level of detail available on these platforms is often limited. Common ways of data sharing are also alerts about construction sites and emails regarding strike schedules or route closures. Some airports receive data through semi-formal channels such as WhatsApp groups used by

road infrastructure operators. In most cases, however, these systems rely on a "pull" approach: airports must actively query the information instead of receiving push notifications automatically. In some cases, public transport providers also share data beyond disruptions, including passenger profiles and insights into how travellers arrive at the airport. Additional inputs such as crowding levels on people movers or real-time arrival data enhance the airport's ability to anticipate bottlenecks and manage access flows more effectively. However, such data integration remains the exception and is often limited to specific projects or pilot phases.

Another important source consists of open data services such as national or regional APIs for trains, buses and roads. Airports also use public platforms such as strike notification portals or weather channels to detect disruptions. More advanced data comes from professional sources such as air navigation service providers (ANSPs), meteorological agencies and systems like Notice to Airmen (NOTAMs), which provide time-sensitive alerts on potential hazards or changes that could affect flight safety, and Eurocontrol's Network Manager (NM), which manages and optimises the entire European air traffic management (ATM) network to ensure the safe and efficient flow of air traffic across Europe. These offer critical insights, particularly regarding weather-related disruptions. Some airports are even exploring AI-supported meteorological forecasting to anticipate extreme events.

A diverse set of other inputs like user-generated alerts or civil protection warnings also play a role. Airlines and airports frequently share operational updates, often informally, and sometimes faster than official channels. Complementing these external signals, airports increasingly rely on internal monitoring systems to track passenger flows. These include queue length counters, waiting time measurements at security and passport control and boarding pass scanning data. Such internal sources are vital for early disruption detection but are not always connected to broader, cross-stakeholder data-sharing frameworks.

In summary, while many data sources exist and are actively used, the integration and operational use of these vary widely. The level of data sharing and the speed and structure of information flow depends heavily on each airport's governance model and its willingness to assume a coordinating role in disruption management.

4.3 Existing Multimodality Initiatives

Airports across Europe are actively implementing initiatives to enhance passenger experience and multimodal connectivity. These efforts can be grouped into five main categories, each reflecting a distinct focus and approach. The overview below outlines these categories and highlights representative initiatives to illustrate how airports are addressing multimodality in practice.

Category	Initiative Examples
 Infrastructure On-site and surrounding physical developments that enable more efficient access to and movement within the airport. Projects focus on connecting airports with other modes of transport and encouraging the use of low-emission or shared mobility options.	▪ People Mover (Marconi Express) Landside transport system connecting Bologna Central Station and Bologna Airport to ensure seamless city–airport access. ▪ OLGA (Holistic Green Airport) A Horizon 2020 project aiming to reduce environmental impact, including development of a hydrogen plant to power both internal airport shuttles and external bus services with involvement from Paris-Charles de Gaulle, Milan Malpensa, Zagreb, and Cluj Airport. ▪ Mobility Hub Centralised areas that combine public transport access with shared micromobility services to support alternative transportation options, for example at Brussels, Berlin, Schiphol, Oslo, Copenhagen Airport and various others. ▪ Cycling Lanes Connecting to EuroVelo 7 A dedicated cycle path is currently under construction to connect Bologna Airport with the EuroVelo 7 corridor, providing a carbon-neutral link between the airport and the city. ▪ Improvement of kerbsides and landside vehicles and people lanes Continuous improvement in ANA's airports – capacity, bus lanes, Taxi/TVDE lanes, RPM conditions, etc.
 Research and Development Projects and networks that drive innovation in airport multimodality. These initiatives focus on developing forward-looking concepts, digital frameworks and governance models to support	▪ SIGN-AIR A SESAR 3-supported initiative to create a web platform for Transport Service Providers to generate and manage data-sharing agreements and smart contracts across modes. The SIGN-AIR platform allows airports, airlines, railway operators, and other Transport Service Providers to establish and oversee

Category	Initiative Examples
sustainable, data-driven and collaborative mobility across transport modes.	contractual relationships while retaining full control over their own data and that of their customers. ▪ MultiModX A SESAR 3 project developing coordinated air-rail solutions to improve efficiency, predictability, sustainability, and passenger experience. It provides decision support tools and passenger-centric metrics to manage disruptions such as delays, missed connections, and cancellations. ▪ TRANSIT A SESAR 2020 project developing multimodal key performance indicators, mobility data analysis methods, and transport simulation tools to evaluate the impact of innovative intermodal solutions on the quality, efficiency, and resilience of the door-to-door passenger journey. ▪ X-TEAM D2D A SESAR 2020 research project addressing seamless door-to-door (D2D) travel by integrating air transport into multimodal networks including rail, road, and sea. The project developed a Concept of Operations (ConOps) for total traffic management, defining system architecture, requirements, and service blueprints to model passenger interactions across the entire D2D journey. X-TEAM D2D assessed barriers, enabling technologies, and user needs over baseline (2025), intermediate (2035), and final (2050) horizons, focusing on journey efficiency and travel quality for passengers. ▪ STARGATE A Horizon 2020 EU Green Deal supported project focusing on creating an intermodal hub through innovative governance and tools that support the digitalisation and decarbonisation of passenger and freight transport, such as autonomous vehicles pilot, electric as well as hydrogen charging station. With EU

Category	Initiative Examples
	funding secured bicycle parking has been installed, bicycle counters have been introduced and signage supported wayfinding for passengers and staff. Brussels Airport takes the lead together with a consortium of 21 partners. ▪ IMHOTEP A SESAR 2020 R&D initiative focused on enhancing integration between airports and ground transport stakeholders to improve the efficiency, reliability, and resilience of the door-to-door passenger journey. IMHOTEP developed a decision support tool that extends Airport Collaborative Decision-Making (A-CDM) to terminal access and egress, integrating high-resolution passenger movement data and predictive models to anticipate passenger flows. The methodology was validated through case studies at Palma de Mallorca and London City airports, enabling stakeholders to simulate "what-if" scenarios and make more informed operational decisions. ▪ MAIA (Multimodal Access for Intelligent Airports) A SESAR JU-funded initiative using artificial intelligence and data analytics to advance multimodal airport access through the integration of shared autonomous vehicles and unmanned aerial vehicles ▪ IARO (International Air Rail Organisation) A global association that promotes best practices and facilitates knowledge-sharing on sustainable airport access, with a particular focus on developing and operating rail links to airports and advancing air–rail intermodality. ▪ LIFE-MOONSET An EU LIFE co-funded consortium project piloting innovative and sustainable on-demand transportation solution for nighttime workers and those with

Category	Initiative Examples
	demanding work schedules at Vienna and Lisbon Airport. This project promotes behavioural change. ▪ Brussels Airport Intermodal Hub Terminal Zone (CEF Study project) EU-supported studies focused on the final design of the intermodal hub and the improvement of overall connectivity to the terminal zone of Brussels Airport.
 Digital Solutions Digital platforms are essential for enabling coordination across transport modes. This category includes systems that support real-time information exchange, disruption management and integrated journey planning, which enhances both operational predictability and passenger experience.	▪ PRECINCT A part of the EU project that developed a model-driven and collaborative management platform. Supported by a digital twin, the platform brought together mobility stakeholders by enabling data sharing, applying critical infrastructure protection models and offering new resilience services. Involvement of scientific, regulatory and private partners including Athens and Bologna Airport. ▪ PRIAM A SESAR 3 initiative envisioning a future where regional Innovative Air Mobility (IAM) services enhance Europe's transport networks. Using digital twins, AI tools, and shared mobility data, PRIAM analyses passenger needs, plans resilient IAM infrastructure, and optimises service performance to enable seamless, efficient, and environmentally friendly multimodal travel. ▪ Travel Wise A SESAR JU and Europe's Rail JU project aimed at enabling intermodal air-rail traffic orchestration by developing a shared methodology, roadmap and supporting technologies to allow data sharing between air and rail operators to optimise passenger experience. Involvement of 31 consortium partners including Brussels, Athens, Schiphol and Bologna Airports as well as Groupe ADP.

Category	Initiative Examples
	▪ Real-time public transport information, for example at ANA Airport arrival and baggage claim halls and at Berlin Airport (AIRVIS – Intermodal Traffic Information System: links public and private control centres to manage incidents and optimise airport access). ▪ Muoversi in Lombardia A Mobility-as-a-Service (MaaS) travel planner platform co-developed with the Lombardy Region, allowing users to plan multimodal trips to and from Milan and Bergamo airports.
Partnerships with Mobility Operators Collaborative initiatives between airports and regional public mobility providers, MaaS platforms and service partners to enhance multimodal access and journey continuity. These partnerships aim to simplify planning and ticketing for passengers, improve commuting options for airport staff and support sustainable transport modes.	▪ Malpensa Express Collaboration with Trenord, focused on sharing information and joint initiatives to encourage train travel among passengers. ▪ Covered Bicycle Planning An initiative with parking operators to support staff and eco-friendly commuter access through secure bicycle facilities. ▪ Maas4RER A project under Italy's National Recovery and Resilience Plan aiming to fully digitalise and connect local public transport, with Emilia-Romagna serving as the pilot region using platforms such as Roger. ▪ Trenitalia-Marconi Express Integrated Ticket Collaboration between Trenitalia, MEX (Marconi Express) and TPER (Transporto Passeggeri Emilia Romagna) to offer an integrated ticket combining rail and monorail journeys to and from Bologna Airport. ▪ Project MuoviAMOci A Home-Work Travel plan at Bologna Airport aimed at improving airport community access to the workplace to satisfy mobility needs, improving road congestion and reducing energy consumption through an

Category	Initiative Examples
	integrated subscription that includes trains, buses, people movers and shared mobility. ▪ Lufthansa Express Rail A collaborative service between Lufthansa and Deutsche Bahn on selected high speed train routes, included in the airfare, offering guaranteed connections with automated rebooking, baggage drop-off at Frankfurt Airport's AirRail Terminal. ▪ Rail&Fly A flexible ticketing option available through Deutsche Bahn and numerous partner airlines, valid from over 5,600 stations across Germany, not included in the airfare, with no automatic rebooking and travel possible on any train up to one day before departure or after arrival ▪ Mobility Stakeholders Groups & Sustainability Forum Six groups (one each for ANA's Airports regions – Porto, Lisboa, Beja, Faro, Açores and Madeira), including Airports, Public Transport Operators, Municipalities and Metropolitan Managers. They collaborate to implement mobility solutions around these airports, with commitment agreements for each party, under decarbonisation goals (including *Airport Carbon Accreditation*). The first 3-year cycle ends in 2025. A sustainability forum with these and other stakeholders was held in 2025 to mark the beginning of a new cycle. ▪ Airport's Sustainable Mobility Studies ANA's mobility studies include passengers and staff surveys, but also workshops and consultations with/to Mobility Stakeholder Group participants (see above) and other airport areas employers, such as handlers, retail, airlines, suppliers, etc.

Category	Initiative Examples
 Awareness Raising Activities Initiatives and events that promote sustainable mobility among passengers, staff, and local communities. They encourage greener travel choices, foster environmental responsibility, and highlight the benefits of reducing transport-related emissions.	▪ European Mobility Week An annual European Commission initiative for Sustainable Urban Mobility that encourages cities and towns across Europe to dedicate one week to promoting sustainable travel, including greater use of trains and buses by passengers and staff. ▪ Environment Day (VINCI Group) and Roadshows (ANA) These events include awareness activities such as bike-to-work day, awards for environmental ideas, provision of (e-)bicycles to staff, beach cleaning, training and demonstrations of e-cars and calculating CO_2 emissions per person and per event based on the transport mode used.

While these initiatives demonstrate meaningful progress, the overall maturity of multimodality across Europe remains uneven. A limited number of airports – most notably those with strong regional transport ecosystems or active participation in EU-funded innovation projects, such as Bologna, Brussels, Athens and Schiphol – have begun to implement coordinated, data-driven solutions and more integrated passenger services. These airports often benefit from established partnerships with public transport operators, access to real-time data and long-term strategic planning frameworks. However, for most airports, multimodality is still developing, with efforts often limited to isolated pilot projects or improvements to individual modes rather than system-wide integration. This variation in maturity levels underscores the need for more consistent governance frameworks, clearer responsibilities and scalable digital tools to ensure that multimodal services can evolve beyond localised initiatives.

4.4 Challenges and Bottlenecks

Several challenges and bottlenecks have been identified that are critical for improving multimodality at airports. They span four dimensions: organisational challenges, where fragmented responsibilities and limited coordination between stakeholders hinder progress; regulatory, where inconsistent or outdated frameworks fail to support integrated planning and operations; technological and data-related, where interoperability issues, data availability and lack of real-time information sharing restrict seamless travel; and infrastructure, where missing physical or digital infrastructure hinders the integration of different transport modes.

Mobility behaviour was identified as a significant challenge to advancing multimodality at airports. Both passengers and airport staff often display a strong preference for car-centric mobility, which is rooted in convenience, habit and perceived reliability. This tendency is reinforced by a lack of attractive incentives to shift towards public transport or shared mobility options as well as misalignment of schedules (see below). Furthermore, the absence of integrated ticketing solutions, such as combined tickets that cover flights and ground transport, makes multimodal journeys less appealing and more complicated to plan.	Organisational Challenge Regulatory Challenge Technological / Data Challenge
Stakeholder management in the planning process was recognised as another central challenge. A lack of coordination and collaboration across the various actors involved often leads to a fragmented planning process. Plans and timelines are often misaligned, resulting in inefficiencies and delays in implementation. Moreover, many relevant stakeholders are only partially or belatedly involved in the planning process, limiting the ability to develop comprehensive, user-focused solutions. The absence of clear multimodal agreements, particularly data-sharing protocols, data formatting standards and procedures for managing service disruptions makes joint action more difficult.	Organisational Challenge Regulatory Challenge
Limited public transport and shared mobility capacities represent an infrastructure-related challenge. Congestion on surrounding roads, particularly during peak hours and while accessing the terminals for departure, creates delays and frustration for both passengers and staff. Compounding this issue is the lack of public transport services that align with the demands of airport operations, such as early morning, late-night, or shift-based travel. In many cases, high-speed or regional rail connections are either missing entirely or are located too far from the terminal to be convenient. The absence of shared mobility fleets and designated service areas, including carsharing zones in close proximity to the airport, further reduces the flexibility of non-car travel options. Lastly, seasonality can impact the efficient utilisation of transport options: it is difficult for public transport, parking lots, and highway lane capacities to adapt to seasonal changes.	Infrastructure Challenge Organisational Challenge
Luggage management is a practical yet often overlooked challenge that affects the usability of multimodal transport options for air travellers. Many public transport systems and shared mobility services are not designed to accommodate passengers carrying multiple or bulky pieces of luggage.	Infrastructure Challenge Organisational Challenge

Limited space on vehicles, lack of designated storage areas and narrow corridors make it difficult to use these services, especially for families or persons with reduced mobility.	
Defining responsibilities is an additional challenge in this context. Airports typically take responsibility for assisting passengers with reduced mobility (PRMs) only up to the point where the passenger transfers to another mode of transport. When a passenger needs support to access a train or other onward connection, that responsibility shifts to the rail operator. From the passenger's perspective, this means they must coordinate and request support from multiple providers themselves, which can create confusion and negatively affect the overall travel experience.	Organisational Challenge Regulatory Challenge
Financial constraints affect investments in multimodal initiatives. Encouraging passengers to use transport options other than the private car results in lower airport parking revenue. Similarly, optimising and reducing connection times at airports might lead to decreasing retail revenues as passengers spend less time waiting. Both revenues represent a significant part of airport earnings. Missing funding options and difficulties in accessing regional, national, or EU-level support hinder the economic feasibility and long-term implementation of multimodal projects. Without clear financial incentives or viable return-on-investment models, many initiatives remain at the pilot stage or fail to scale.	Organisational Challenge Regulatory Challenge
Data availability is a key challenge in enabling efficient multimodal coordination. Real-time data on delays, schedule changes, or disruptions is often missing, which limits the ability of mobility providers and passengers to respond flexibly. Additionally, there is a lack of accessible data on the availability of mobility options, such as shared mobility services, making it difficult to plan seamless, door-to-door journeys.	Technological / Data Challenge Organisational Challenge
Data aggregation and integration remain significant hurdles for the development of seamless multimodal services. There is limited integration of APIs and Mobility-as-a-Service (MaaS) data into a single, unified platform, which restricts coordination across different modes. Standardisation and consistent formatting of data between various stakeholders are often missing, leading to incompatibilities. As a result, interoperability between	Technological / Data Challenge Organisational Challenge Regulatory Challenge

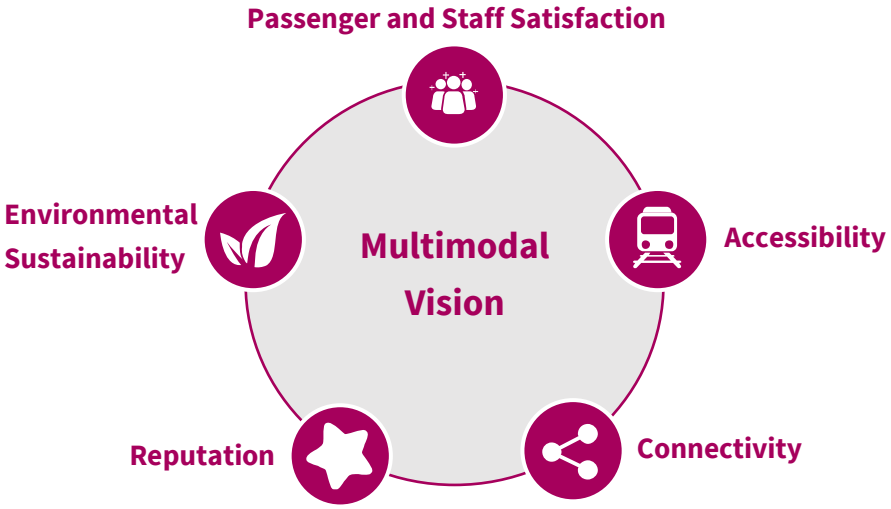
different systems is lacking, preventing real-time collaboration and smooth user experiences.	
Data privacy concerns pose an additional barrier to multimodal integration. Issues related to the tracking of user data and the handling of personal information raise legal and ethical questions, which can limit data sharing between stakeholders and reduce user trust in digital mobility platforms.	Technological / Data Challenge Regulatory Challenge
Information management is a critical area where current systems fall short in supporting multimodal access. There is often a lack of internal monitoring for the arrival and availability of taxis, shared mobility fleets and surrounding traffic conditions. Additionally, passengers and staff are not sufficiently provided with real-time transport information, which limits their ability to make informed travel decisions. The absence of dedicated information points for mobility services within the airport further reduces visibility and accessibility of these options. Moreover, information on public transport options is often designed for local or national users who already understand, for example, the differences between local transport operators or different railway stations. As a result, it can be difficult for passengers, especially international or infrequent travellers, to easily find the right service for their needs, which often leads them to choose easier but less sustainable options such as ride-hailing or taxis instead.	Technological / Data Challenge Organisational Challenge Infrastructure Challenge
Terminal layout and wayfinding present practical challenges for passengers navigating to and from the terminal. Wayfinding is often complex and unclear, particularly when moving between the terminal and bus station, railway/metro station or carsharing areas. Additionally, long walking distances between the public transport facilities and the main check-in area can be inconvenient and time-consuming, especially for travellers with luggage or limited mobility.	Infrastructure Challenge
Staff management issues also affect the success of multimodal airport access. Many employees lack access to facilities such as showers and lockers, which discourages active mobility options like cycling. There is also a shortage of staff to support persons with reduced mobility at key access points such as railway or metro stations. In addition, long-term bike storage options for airport staff are often missing, limiting the practicality of cycling as a regular commuting choice.	Infrastructure Challenge Organisational Challenge

Impact of multimodal disruptions on overall network performance is an emerging challenge that highlights the interconnectedness of landside and airside operations. When disruptions occur on the landside, such as strikes of public transport operators, severe weather, road accidents or unexpected capacity shortages in public transport, the ripple effects often spill over to the airside. Passengers and staff may arrive late or miss flights altogether, creating operational delays, gate and slot inefficiencies, as well as increased rebooking and handling demands. Such knock-on effects can undermine punctuality, disrupt airline schedules and place additional strain on air traffic control (ATC) and ground handling services. The lack of robust contingency planning and real-time information sharing between landside and airside stakeholders further intensifies these impacts, reducing the resilience of the entire network. Strengthening the integration of disruption management processes across all modes is therefore essential to maintaining stable, predictable airport operations.	Organisational Challenge

5 Vision for the Connected Airport

A shared vision for the connected airport sets out a long-term ambition to improve integration and create a more user-oriented and efficient airport environment. Developed together with the Expert Group, it builds on practical input gathered during the study and focuses on five important areas: passenger and staff satisfaction, sustainability, accessibility, connectivity and reputation. Multimodality is seen as a central element in achieving these goals, as it supports better coordination between landside and airside operations and enables a more seamless and resilient airport system.

5.1 Multimodal Airport Vision



Passenger and Staff Satisfaction

A central element of the multimodal airport vision is customer and staff satisfaction. Higher flexibility for passengers and staff using different transport modes as well as smooth and stress-free journeys and transfers will increase their overall satisfaction. In the development of the efficient and inclusive multimodal airport, different generations of passengers and staff are to be considered the same way as people with reduced mobility. Improved multimodality will furthermore have a positive social impact on employees, increasing welfare and life-work balance.

Environmental Sustainability

Aligning with the aviation industry's net zero emission goals, environmental sustainability is a highly relevant reason for improving multimodality and shifting from a car-centric mobility system to public transport and shared mobility solutions. Central goals are reducing scope 3 emissions

in travelling to and from the airport, enhancing life and air quality by decreasing surrounding traffic levels and lowering noise emissions in the airport vicinity.

Reputation

By seamlessly integrating various transport modes into their infrastructure, airports position themselves as leaders in innovation and environmental responsibility. This reputation strengthens the role as vital employment hubs, attracting talent, businesses and partners committed to sustainable growth.

Connectivity

Enhancing digital and physical connectivity is a key enabler for efficient multimodal travel to and from the airport. Central objectives include minimising passenger waiting and transfer times between modes, improving on-time performance and enabling better coordination of transport schedules. Stronger collaboration between airports and digital mobility platforms supports smoother transitions and real-time journey planning. Optimising air-rail connections makes multimodal travel more attractive and reliable for passengers.

Accessibility

Physical accessibility and infrastructure efficiency are fundamental for developing a future-ready multimodal airport. By diversifying transport options, the dependence on road access and the need for extensive parking places and areas will be decreased and airports will become more resilient. Multimodality also enhances accessibility for goods and cargo, supporting smoother logistics operations. Improving the airport accessibility with public transport will impact the local communities positively, especially at city airports where residents benefit from less local traffic.

5.2 Opportunities Through Enhanced Multimodality

Multimodality unlocks powerful opportunities for enhancing the passenger experience and operational efficiency on both the airside and landside. Technologies like LiDAR combined with AI can monitor passenger flow in real-time, identifying bottlenecks and underutilised areas, allowing for smarter resource allocation and proactive disruption mitigation in airside operations. The integration of multimodal data also supports better decision-making through a neutral, central overview of operations, improving communication between stakeholders. This results in fewer irregularities, smoother transfers, also for PRM, and an overall improvement in door-to-door journey quality. Detecting hand luggage volume before gate arrival, for instance, enables more efficient aircraft and gate handling, benefiting airlines and ground services alike. By facilitating data-driven collaboration across modes, airports can recover more swiftly from disruptions and deliver a seamless, integrated passenger journey.

On the landside, multimodality offers a critical opportunity to bridge transport networks and ensure a smooth transition between different journey segments. Real-time coordination between public transport systems, taxis, airport operations and PRM services allows for responsive queue management and enhanced traveller support during disruptions. Centralised and transparent data exchange, covering waiting times, transport availability and baggage flows, empowers stakeholders and passengers alike with actionable insights. For example, enabling passengers to access kerbside areas based on check-in status or boarding passes helps streamline flows and prioritise efficiency. These benefits converge with airside capabilities to ensure continuity and reliability in the door-to-door journey, reinforcing the airport's role as a multimodal hub.

5.3 Multimodality's Role in Improving Overall Network Performance

Total Airport Management (TAM) is a holistic evolution of Airport Collaborative Decision-Making (A-CDM) designed to optimise the operational performance of the entire airport system. By integrating processes across the airfield, terminal areas, and ground transportation, consolidating flight, passenger, and baggage data, and fostering collaborative decision-making among all stakeholders, TAM enables more efficient use of resources, improved predictability, and higher service quality across all airport operations. A central element of TAM is the Airport Operations Centre (APOC), a coordination arrangement in which operational stakeholders collaborate in a structured manner to establish and execute an agreed operational plan. This collaboration can take place physically, virtually, or through a combination of both, and the APOC also serves as the primary interface between the airport and the Network Manager Operations Centre (NMOC). Compared to A-CDM, TAM covers a broader scope, larger physical areas, and longer time horizons, requiring close collaboration between government agencies and industry partners to develop technical standards and operational guidelines, thereby ensuring effective, consistent implementation and a better passenger experience.

In the ideal future state, this integrated approach fully connects airside and landside flows into a seamless operational ecosystem. Multimodality plays a crucial role by linking airport operations with external transport services, enabling real-time data exchange with public transport operators and coordinating disruption management across all stakeholders.

For this, multimodal data feeds such as real-time train or bus schedules and delays, road congestions, parking availability or weather impacts on local transport networks need to be integrated directly into a central digital platform like the Airport Operations Plan (AOP). This would allow operators to proactively adjust resource allocation, turnaround times and passenger flow management in response to changing conditions outside the airport. For example, delays on a major rail line could automatically trigger reallocation of check-in desks or additional staffing at taxi ranks to manage shifts in passenger arrival patterns.

This level of integration would benefit the wider Air Traffic Management (ATM) network by reducing knock-on delays caused by late-arriving passengers. Ultimately, a fully realised TAM framework with landside incorporation will enable airports to operate as integrated mobility hubs that actively shape

the performance of the entire air transport network. This will strengthen resilience during both normal operations and disruptions and ensure smoother door-to-door journeys for passengers.

5.4 From Multimodality to Seamless Airport Processes

In the preceding sections, it was outlined how multimodality can contribute to a better connected and more resilient airport ecosystem that unlocks operational opportunities on the landside and strengthens network performance on the airside. Based on these opportunities and the multimodal vision that was developed with the Expert Group, key areas for improvement that can be identified are enhancing passenger experience and efficiently managing flows, security, and baggage.

The integration of arrival patterns from different transport modes into the airport operational planning allows for anticipating passenger volumes and adjusting terminal processes accordingly. By integrating real-time data from trains, buses and road traffic, fluctuations in arrival flows can be predicted more accurately and further in advance. This enables a proactive management of queues at check-in, security and border control and, as a result, ensures a smoother flow and a higher quality of the passenger experience.

Security processes also benefit from enhanced multimodal coordination. Sudden surges due to delays of public transport or road congestion can be mitigated when operational teams receive advance alerts. They can, for instance, adjust the security staffing levels, open additional lanes to increase passenger throughput or prioritise delayed passenger using dedicated lines. This helps ensuring that unexpected landside disruptions don't cause missed flights or even broader operational delays. Similarly, efficiency in baggage handling can be increased by multimodal integration. For example, check-in staff can be redeployed, additional conveyor capacities can be activated, or priority processing can be applied for passengers at risk of missing flights.

Based on these key areas for improvement, the following chapter provides concrete solutions, practical strategies and best practice examples to enhance airport operations and the overall passenger experience.

6 Solutions to Enhance Multimodality

Building on existing efforts and ongoing initiatives, enhancing multimodality at airports is essential to improve connectivity, meet sustainability goals and deliver a more resilient and user-friendly travel experience. Survey responses confirm the strategic importance of multimodality in supporting seamless journey and network performance. Based on these insights, five primary solution areas have been identified.

To effectively monitor progress towards a multimodal airport, a range of key performance indicators (KPIs) should be employed. Among the most critical are passenger and staff satisfaction which serve as core indicators of a successful modal shift. Satisfaction can be assessed through both quantitative metrics – such as on-time performance and connection times – and qualitative feedback, for example through survey displays at the airport and transfer areas. Sustainability indicators, particularly greenhouse gas (GHG) emission savings, are equally essential, as emissions reduction is a fundamental objective of multimodal transport strategies. Additionally, KPIs such as the airport's modal split provide valuable insights into accessibility and integration across transport modes.

6.1 Multimodal Mobility Platform

Integrated multimodality platforms facilitate more seamless and user-friendly passenger journeys by connecting public transport, airport systems, and shared mobility services in one digital interface. These platforms improve both operational coordination and travel experience by providing real-time information on schedules, services, ticketing, and reservations across the airport-ecosystem.

To work effectively, they rely on open data standards and clear APIs so that mobility providers and stakeholders can share information easily. Gathering insights through surveys or digital tools helps airports understand how passengers and staff travel and what they need. This knowledge is key for developing a clear multimodal mobility plan that brings together authorities, transport operators, and commercial partners. To ensure reliability, integrated mobility platforms also require clear agreements on roles and responsibilities for providing data, updating information and delivering services.

Learning from best practices shows what works well and where to improve. Providing clear, up-to-date data on arrival times, passenger numbers, related flights, and special assistance needs helps everyone make better decisions. In this way, integrated mobility platforms help airports close information gaps, respond faster to changes, and make sustainable travel choices more attractive for passengers and staff. The following table provides individualised measures and corresponding best-practice examples.

Measures	Examples from best practices
Develop a unified platform for planning and booking multimodal journeys	▪ Jelbi (Berlin): MaaS app integrating urban mobility ▪ Smart Ways to Antwerp: Trip planner showing cost and travel time across modes ▪ Arlanda Airport: Pilot for booking rail, bus and air journeys on one interface ▪ Muoversi in Lombardia: Regional MaaS with airport connections
Enable real-time multimodal information exchange via APIs and provide it to passengers through airport displays and digital interfaces	▪ E015 (Italy), National Access Points (NAP), Regional Access Points (RAP) (EU): Digital ecosystems and access points enabling intermodal data exchange ▪ Trafiklab (Sweden): Enables developers to access real-time multimodal data via open APIs ▪ ANA (Aeroportos de Portugal): provides real-time information on public transport in some airports near terminal exits (arrivals halls and baggage claim hall).
Promote open data standards to support cross-platform interoperability	

6.2 Stakeholder Coordination and Governance

Achieving multimodal integration requires close collaboration between a variety of stakeholders. To effectively monitor passenger flows and manage disruptions, airports need to work hand in hand with airlines, ground handlers, air navigation service providers and special assistance (PRM) service providers. Cooperation also extends to protocol services, immigration, customs, security, VIP services, and the police, who provide critical feedback on incidents in and around the airport.

Equally important is coordination with transport service operators such as buses, trains, metro lines, and taxi companies, as well as local municipalities and public bodies to ensure safe and smooth pedestrian connections and seamless onward travel. Utility providers for water, electricity, and gas, along with weather services, play a vital role in supporting operational continuity. Even restaurants and other on-site service outlets contribute by adapting their services when disruptions occur. By bringing together such a diverse network of actors, airports can strengthen their resilience and ensure that passengers experience reliable, flexible, and well-coordinated travel, even in challenging situations.

Measures	Examples from best practices
Encourage structured cooperation between airports and municipalities, including collaborative financing models and co-investment agreements to support shared multimodal infrastructure	▪ Brussels Airport is an official advisory member in the board of the 'transport region Flemish border', which resides under the Flemish Government and regulates the cooperation between 26 local governments, the public transport companies and other transport providers to develop a regional mobility plan and collaboratively decide on the public transport service for the region ▪ ANAs Sustainable Mobility Groups: (six groups, one per region), municipalities, public transport operators are present and collaborate in planning activities.
Ensure the needs of all user groups are considered by involving commercial operators, employee representatives (e.g. unions) and municipal services in mobility planning	▪ Sustainable Airport Mobility Plan (Brussels Airport): Collaborative governance model where all different user groups are involved, with financial support of EU Green Deal programme STARGATE ▪ Energy/Aviation/Handling Stakeholder Groups (Portugal): Groups with representative commercial operators of different areas ▪ ANAs Sustainable Mobility Studies: conducted in Lisboa, Porto and Faro, studies involve passengers, staff, suppliers, municipalities, public transport operators, retailing, handlers and airlines.
Collaborate with local authorities and service providers to align mobility planning	▪ Samtrafiken (Sweden): National platform enabling the collaboration of public transport stakeholders and provides shared services like Trafiklab
Embed access and modal shift targets into airport concession agreements or permits, with clear accountability for progress	▪ Antwerp and Ostend Airport Permits: Modal split targets with required follow-up ▪ Brussels Airport mobility plan and modal split targets: special requirement in the

Measures	Examples from best practices
	new permit for the airport (license to operate)
Ensure coordination across airport departments (e.g. operations, sustainability, commercial) to align internal objectives	▪ Brussels Airport SAMP (Sustainable Airport Mobility Plan): coordination and cooperation between the different airport departments ▪ ANA Airports: Mobility plans and measures are discussed at a strategic level / with executive management level involvement

6.3 Promotion of Modal Shift

Encouraging passengers and employees to shift from private cars to more sustainable transport options is essential for reducing emissions, easing congestion, and improving airport accessibility. Effective modal shift strategies rely on a well-balanced mix of push-and-pull measures, combining infrastructure improvements with practical incentives and clear communication. Expanding the public transport network and tailoring services to meet the needs of shift workers and those arriving very early or late helps make public transport a viable alternative to driving.

Awareness-raising campaigns and reward programs can further motivate passengers and staff to adopt more sustainable travel habits, while integrating the airport's commercial department into these efforts ensures that initiatives align with broader business goals and passenger needs. By offering appealing public transport options, promoting shared mobility services, and supporting these efforts with coordinated incentives, airports can actively influence travel behaviour and contribute to a more resilient and climate-friendly transport system.

Measures	Examples from best practices
Use digital tools and reward-based programs to promote and monitor sustainable commuting behaviour	▪ CopenPay (Copenhagen): Rewards tourists for sustainable transport choices ▪ App to register sustainable staff commuting (Bologna airport) and smart working: up2go. The Airport Community can register home-to-work sustainable journeys (bike to work, carpooling, public

Measures	Examples from best practices
	transport, smart working, etc.) and calculate trips, km and CO_2 and win prizes.
Use campaigns (e.g. European Mobility Week) to raise awareness and engagement	▪ Bike to Work (Switzerland, Belgium, Emilia Romagna/Italy): Campaign-based incentives to promote cycling. ▪ Smart Ways to Antwerp: Offers subsidies to private citizens for purchasing a new bicycle or e-bike to support modal shift and reduce private car use ▪ Environment Day (VINCI Group), National Environment Day (Portugal): community is invited to participate in several actions
Enhance public transport quality with luggage space, PRM-friendly access and schedules aligned with early/late arrivals or departures and staff shift times	▪ LIFE-MOONSET (ANA): An EU LIFE co-funded consortium project piloting innovative and sustainable on-demand transportation solution for nighttime workers and those with demanding work schedules at Vienna and Lisbon Airport. This project promotes behavioural change.
Promote sustainable staff commuting by developing active mobility infrastructure and facilitating carpooling or shared transport solutions	▪ MuoviAMOci (Bologna/Italy): Home-work travel plan tailored to the airport community ▪ Swedavia Staff Program (Sweden): Public transport and bike subsidies for employees

6.4 User-Friendly Luggage Solutions

For passengers, private cars or taxis are the most convenient option for travelling with luggage. Motivating people to change to alternative modes of transport would therefore also require a user-friendly solution for transporting luggage. These solutions enhance passenger satisfaction, improve the airport's reputation and popularity and reduce emissions as cars are substituted by more sustainable transport modes.

Measures	Examples from best practices
Partnerships with local bodies and travel operators to enable smart luggage solutions and grant licenses for luggage carriers from city centres to the airport	▪ Luggage Express (Arlanda Airport/ Stockholm): Allows passengers travelling with SAS to drop their bags in the city centre the morning of departure and explore the city bag-free while the luggage is automatically transported to the airport and checked in ▪ Luggage shipping service (Zurich Airport): Luggage can be dropped off at selected train stations in Switzerland the day before departure, will be transferred to the airport for self-check in, vice versa on the return journey ▪ Zurich and Geneva Airport: Home pickup and automatic luggage declaration and check-in ▪ Air France and KLM's Air&Rail (Brussels): Air France and KLM passengers travelling from Brussels-Midi/Zuid can check in their baggage at the station (including the day before departure), with automatic transfer to their final destination via Paris-CDG. On travel day, only boarding pass collection is required
Provide appropriate buses and trains with luggage areas and storage space	▪ Luggage Express (Arlanda Airport/ Stockholm: ample bag storage space on train

6.5 Improved Disruption Management

Disruptions such as strikes, delays, congestion and extreme weather pose significant challenges for airport access and operations. A well-integrated multimodal system can strengthen resilience by offering passengers and staff real-time transport alternatives and greater operational flexibility. Beyond these immediate challenges, airports must also manage infrastructure and passenger flows sustainably, handle potential utility disruptions and ensure consistent information exchange across all operational domains.

To address this, existing systems and procedures must evolve to enable joint decision-making and continuous demand-capacity monitoring across both airside and landside processes. Extending existing collaborative frameworks such as the AOP to integrate landside processes will create a comprehensive operational view and improve resilience. The single source of truth should be expanded to include network information and demand-capacity data for all processes, accessible in a standardised format and regularly updated by all parties. This also requires a single decision-making environment that connects airside and landside seamlessly. The airport, acting as facilitator and final decision-maker, should moderate information flows and guide coordinated action – especially during irregular operations.

Achieving this means moving beyond the current situation – where airlines mainly provide data inputs – toward two-way transparency of process information in real time, with airlines becoming active participants in the extended APOC to support joint decision-making. While many stakeholders already operate mature systems, these are often not aligned. Existing frameworks like Eurocontrol's SWIM (System-Wide Information Management), which defines common standards, infrastructure and governance for ATM information exchange, together with the gradual shift toward SOA (service-oriented architecture), may support interoperability. However, stakeholders must first agree whether the change represents a new solution or a new way of working and procedural alignment remains critical to ensure consistent and effective collaboration.

Rather than relying on ad-hoc responses or fragmented systems, a shared operational picture should be maintained across all stakeholders, with clearly defined roles, responsibilities and escalation paths. The airport should remain both facilitator and integrator. This clarity enables faster, better-aligned decisions and smoother recovery.

Implementation should follow an incremental approach. Key considerations when implementing coordinated disruption response frameworks include:

- Defining the functionality and scope of the integrated system and decision-making framework, including roles, processes and escalation paths
- Selecting coordination tools and digital platforms that support real-time updates, alerts and cross-stakeholder visibility
- Defining coherent access rights for different user groups
- Ensuring GDPR compliance and data-use protocols

To support this transformation, airports must build internal capabilities in data analytics, invest in robust IT infrastructure and foster a culture of open data sharing. Stakeholders should be engaged early and have the opportunity to influence the system's design, with progress starting from available data and building step-by-step in line with each partner's digital maturity. Strong top-management backing, cross-functional working groups and clear communication of benefits are essential to ensure commitment and adaptability. Once in place, the effectiveness of these measures can be assessed through:

- Active use of the integrated operational environment
- Stakeholder-perceived value and full participation
- Proof that mitigation measures have been implemented
- Benefits and user satisfaction measured through agile methods
- Reduced recovery times
- Improvements in ACI–ASQ indicators

Measures	Examples from best practices
Introduce alert mechanisms between transport operators and airports to anticipate disruptions	▪ Geneva Airport: Train disruptions trigger operational alerts to support decision-making ▪ Oslo Airport: An alerting system is being introduced via AOP and APIs to trigger stakeholder notifications when rail or road traffic conditions approach predefined disruption thresholds ▪ Rome Airport: Receives alert from railway operator during disruptions through an operational channel ▪ Bologna Airport: Receives alert from Marconi Express monorail operator during disruption and alerts from the crowding monitoring system in case of long queues
Extend AOP to include landside processes	▪ ANA Airports: Currently working to include landside processes.
Deploy integrated monitoring tools for capacity and passenger flow across airside and landside	▪ Oslo Airport: Monitors real-time rail, road, and terminal conditions via APIs, sensors and camera systems; data is displayed on APOC dashboards to support operational decisions and demand–capacity balancing ▪ Rome Airport: Testing passenger flow sensors near rail stations to improve intermodal KPIs

Measures	Examples from best practices
Establish a shared digital environment or tool for coordinated operational updates	▪ Oslo Airport: Real-time rail, road and passenger flow information is shared across stakeholders via APIs and made visible through the APOC dashboard ▪ Bologna Airport: Uses real-time data from buses services and people mover to monitor landside access and inform operations ▪ SEA Milan: Receives real-time data in AOP on schedules and congestions; planning to develop an alert system as the next step
Use digital twins and computer vision tools to improve operational planning and passenger flow management	▪ Oslo Airport: Use predictive tools to estimate future passenger locations and demand flows across the terminal
Provide passenger assistance measures during disruptions (e.g. speedy boarding or fast lanes and self-baggage drops for affected intermodal travellers)	▪ Geneva Airport: Security lane facilitation for rail-air passengers during train disruptions (still in pilot phase) ▪ Rome Airport: Coordinates with rail operators to provide bus backup during rail disruptions and supports affected passengers with dedicated staff and coordinated baggage handling services
Notify passengers through shared communication channels or platforms	▪ Rome Airport: Introducing a WhatsApp-based chatbot using generative AI to send disruption updates and other information directly to passengers, beyond airline-controlled channels
Define clear roles and structured decision-making procedures for disruption response, including responsibilities and escalation paths	▪ Rome Airport: Applies predefined procedures in response to disruption alerts, focusing on terminal operations, security control and notifying airlines and police ▪ Oslo Airport: Predefined procedures are applied when disruption thresholds are

Measures	Examples from best practices
	reached, involving relevant stakeholders; escalation paths are still being further formalised
Develop joint contingency plans with regional partners, covering multimodal backup options and shared responsibilities for passenger continuity during disruptions	No examples provided

7 Recommendations

7.1 Operational Context

In the following chapter, the solutions that were identified based on the work of the Expert Group and their input of best practice examples are put into an operational context. For the two key study themes Multimodality and Disruption Management, abovementioned solutions are consolidated into concrete recommendations. They are defined as either strategic or tactical and as either short-, medium- or long-term, integrating immediate actions with longer-term initiatives to enhance overall system efficiency and passenger experience. For each recommendation, benefits and beneficiaries are identified to facilitate an assessment of their relevance.

Tactical recommendations aim to improve coordination, communication and service continuity using existing infrastructure and tools. These actions are often implemented through agile processes, allowing airports to pilot, adapt and scale solutions quickly. They primarily benefit passengers and staff by delivering immediate improvements in accessibility and experience. Strategic recommendations, such as system integration, stakeholder alignment and infrastructure upgrades broaden the range of beneficiaries to include operators, mobility providers and public authorities. They require structural reforms, long-term investment and regulatory alignment. Operators and public authorities take on central roles in shaping planning, governance and funding frameworks.

Multimodality – Strategic Level

The following strategic recommendations indicate how multimodality can be promoted and developed in the short, medium, and long-term by guiding planning, fostering stakeholder collaboration, and aligning policies, infrastructure, and investment to create seamless and sustainable transport options.

Short-Term

Recommendations	Benefits	Beneficiaries
Promote behavioural change through digital tools and incentives	Encourages sustainable travel choices and improves passenger engagement	▪ Passengers ▪ Mobility providers ▪ Local communities
Support active and shared mobility options for staff	Improves staff accessibility, reduces parking demand and supports sustainability goals	▪ Staff

Medium-Term

Establish integrated planning and governance structures	Improves cross-stakeholder coordination and inclusive planning	▪ Airport operators ▪ Public authorities ▪ Transport operators ▪ Staff

Long-Term

Establish long-term cooperation frameworks between airports and public authorities	Enables joint-planning, contingency preparedness, investment and aligned infrastructure development	▪ Airport operators ▪ Public authorities
Embed access and sustainability goals into regulatory and contractual frameworks	Ensures long-term commitment to modal shift and environmental targets	▪ Airport operators ▪ Public authorities

Multimodality – Tactical Level

The listed tactical recommendations outline how multimodal operations can be facilitated in the short, medium, and long-term by implementing practical actions, coordinating day-to-day processes, and optimising infrastructure and services to ensure seamless and efficient passenger and staff experiences.

Short-Term

Recommendations	Benefits	Beneficiaries
Integrated ticketing and booking solutions across modes (e.g., airport shuttle, rail, bus).	Simplifies journey planning, enhances seamless passenger transfers, and reduces stress during disruptions	▪ Passengers / staff ▪ Transport operators ▪ Mobility providers

Medium-Term

Ensure infrastructure and service readiness for airport-specific needs (e.g. PRM-friendly access, security or boarding fast lanes)	Enhances operational efficiency, accessibility and passenger experience	▪ Passengers / staff ▪ Transport operators

Long-Term

Extend airport operational systems (AOP, APOC) to include landside processes	Enables integrated demand-capacity monitoring and coordinated decision-making across airside and landside operations, especially in times of disruption	▪ Airport operators ▪ Airlines ▪ Mobility providers ▪ Public authorities

Disruption Management – Strategic Level

The subsequent strategic recommendations demonstrate how disruptions can be prevented or minimised by guiding comprehensive planning, strengthening stakeholder coordination, and leveraging data, systems, and infrastructure to enhance overall operational resilience.

Short-Term

Recommendations	Benefits	Beneficiaries
Enable real-time, multimodal information exchange and establish alert mechanisms in case of disruptions	Improves coordination, supports proactive disruption response and enhances situational awareness across all transport modes	▪ Passengers/staff ▪ Airport operators ▪ Transport operators ▪ Mobility providers

Medium-Term

Strengthen partnerships with local authorities and mobility providers	Aligns external services with airport operators and improves access	▪ Passengers / staff ▪ Local communities ▪ Mobility providers

Long-Term

Use digital twins and predictive modelling for strategic disruption planning	Supports faster, data-driven decisions and proactive preparedness	▪ Airport operators ▪ Transport operators
Establish shared data governance and resilience frameworks across the transport ecosystem.	Enables secure, standardised data sharing, long-term alignment in disruption management, and regulatory compliance	▪ Airport operators ▪ Airlines ▪ Transport operators ▪ Public authorities

Disruption Management – Tactical Level

The tactical recommendations listed below indicate how disruptions can be managed through proactive and reactive actions, coordinating operational processes and optimising systems and services to maintain continuity and ensure a smooth experience for passengers and staff.

Short-Term

Recommendations	Benefits	Beneficiaries
Provide passenger assistance measures during disruptions	Reduces delays, improves service continuity and enhances passenger satisfaction during disruptions	▪ Passengers

Medium-Term

Notify passengers through shared communication channels or platforms during disruptions	Improves timely and consistent communication during disruptions, reducing stress and confusion	▪ Passengers / staff ▪ Transport operators
Deploy dedicated resilience teams trained across airport and multimodal operations	Ensures rapid, coordinated response to disruptions, minimises service breakdowns, and supports staff preparedness.	▪ Airport operators ▪ Passengers / staff

Long-Term

Develop unified digital platforms for operational coordination and passenger services	Improves real-time coordination and supports consistent disruption response	▪ Airport operators ▪ Passengers / staff ▪ Transport operators ▪ Public authorities

7.2 Research and Innovation Context

While ongoing SESAR initiatives, such as Travel Wise, SIGN-AIR and MODUS, provide a strong technical foundation for multimodal integration, the Expert Group has identified several areas where further research and innovation are needed to improve passenger experience. These research and innovation recommendations complement SESAR's work by highlighting practical gaps from the perspective of European airports. The order of the recommendations listed below is not indicative of ranking.

Recommendations	Benefits	Beneficiaries
Develop digital twins and predictive models	Support disruption management and optimise passenger flow across modes	▪ Airport operators ▪ Airlines ▪ Passengers
Design integrated digital platforms for multimodal ticketing and payments	Enable seamless journey planning and booking across air, rail and urban mobility	▪ Passengers / staff ▪ Transport Operators ▪ Mobility providers
Explore sustainable airport business models	Identify financial frameworks that support airport investment in multimodal infrastructure, beyond dependence on parking revenue	▪ Airport operators
Innovate smart baggage handling solutions, such as city-centre luggage check-in or baggage tagging on air-rail connections	Make alternative transport modes more attractive for passengers with luggage	▪ Passengers
Develop gamified and reward-based engagement tools, with optional behavioural data collection	Encourage modal shift and gain insights into travel choices through user interaction	▪ Passengers / staff ▪ Transport Operators ▪ Mobility providers
Advanced integrated tools for disruption monitoring and response	Improve situational awareness and response coordination by integrating real-time road, rail and terminal data into APOC dashboards and alert systems	▪ Airport operators ▪ Airlines

7.3 Policy and Regulatory Context

The importance of supportive regulatory frameworks and clear governance is also highlighted by many airports to accelerate the implementation of multimodal strategies. These include gaps in legal clarity, data-sharing mandates and stakeholder responsibilities. Drawing on airport perspectives, this study identifies practical recommendations and enablers in the policy and regulatory context that could help translate EU-wide goals into local action.

Recommendations	Benefits	Beneficiaries
Include modal shift and accessibility targets in airport permits (e.g. Antwerp and Ostend)	Gives airports clear goals to plan around and track progress	▪ Airport operators ▪ Transport Operators ▪ Public authorities
Require PRM accessibility planning across all modes, including clear responsibilities between transport providers	Avoids service gaps and ensures more inclusive access	▪ Passengers ▪ Transport Operators
Promote secure and standardised data exchange between airports and transport operators	Support smoother system integration by using common APIs, data-sharing protocols or national access points (e.g. NAP, RAP, E015 as mentioned in Section 6.1) to enhance coordination during regular operations and disruptions	▪ Airport operators ▪ Transport Operators ▪ Public authorities
Clarify stakeholder responsibilities during disruptions and missed intermodal connections, including passenger support procedures	Improve passenger support and accountability	▪ Passengers
Link EU and national funding (e.g. TEN-T, CEF) to multimodal access improvements, including staff	Helps prioritise meaningful multimodal investments	▪ Airport Operators

Recommendations	Benefits	Beneficiaries
mobility services and user-friendly baggage solutions		
Introduce policy incentives and reward mechanisms, such as fee reductions, bike-to-work schemes or employer mobility credits, to encourage modal shift	Encourage sustainable commuting choices by influencing behaviour	▪ Passengers / staff ▪ Mobility providers ▪ Local communities
Encourage structured cooperation between airports and municipalities through mobility or co-investment agreements	Support long-term joint planning, funding and shared infrastructure management	▪ Airport operators ▪ Local communities

8 Summary

The study shows that although many European airports have taken steps toward improving multimodal integration, some gaps remain – particularly at the organisational, regulatory, technological and infrastructural level. These include persistent car-centric travel behaviour, limited availability of real-time data, a lack of digital system integration, gaps in planning coordination and insufficient public transport or shared mobility options at and around airports. Missing funding and incentives remain a barrier to scale up and sustain multimodal initiatives. At the same time, best practices show that progress is possible when digital tools, clear responsibilities and joint planning efforts are in place.

Establishing a multimodal mobility platform involves developing an open, interoperable system that enables real-time information exchange via APIs, supports cross-platform booking and planning and delivers accessible journey information to passengers through digital channels and airport displays. Improving stakeholder coordination and governance requires structured collaboration between airports, municipalities and service providers, through joint planning, co-investment models and inclusive stakeholder engagement, while aligning internal airport departments and embedding clear modal shift targets into operational frameworks. Promoting a modal shift involves encouraging sustainable travel choices through incentives, awareness campaigns, improved public transport services tailored to passenger and staff needs and the development of active and shared mobility infrastructure. Developing user-friendly luggage solutions includes partnering with local stakeholders and transport operators to enable smart, secure luggage handling through licensed carriers, dedicated storage areas on public transport and integrated safety measures. Disruption management requires better integration of landside processes into operational systems like AOP and APOC, supported by shared situational awareness, real-time monitoring tools and clear roles for joint decision-making. Providing timely, consistent communication to passengers is also key to improving response effectiveness.

The study shows that many operational measures, particularly tactical ones, can be implemented in the short term to deliver immediate benefits for passengers and staff, while more strategic, structural improvements require coordinated mid- to long-term planning involving operators, mobility providers and public authorities. Research and innovation recommendations focus on advancing digital capabilities, including digital twins, integrated mobility and ticketing platforms, predictive tools and user-engagement solutions such as gamification. In the policy and regulatory context, the study highlights the need to set clear modal-shift and accessibility targets, ensure coordinated PRM planning across all modes, enable secure and standardised data sharing, clarify stakeholder responsibilities during disruptions, link funding to multimodal improvements, introduce incentives for sustainable travel and strengthen cooperation between airports, municipalities and transport providers.

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- Groupe ADP, France
- Milano Airport, Italy
- Munich Airport, Germany
- Oslo Airports, Norway
- Ostend Airport, Belgium
- Rome Airport, Italy
- Stuttgart Airport, Germany
- Swedavia Airports, Sweden

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