# What could future air-rail multimodal mobility look like?

2<sup>nd</sup> Modus workshop Online, February 14, 2022





This project has received funding from the SESAR Joint Undertaking under the European Union's Horizon 2020 research and innovation programme under grant agreement No 891166.





Modus project and workshop introduction

Presentations and key discussion points on

- Modus scenarios
- Modus use cases
- City archetypes

Workshop summary and way forward





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## Multimodal European Transport

### Manifold challenges ahead!

- Enabling a seamless passenger journey, including multiple providers and travel information
- Addressing data, digitalisation and privacy aspects along the journey
- Meeting **environmental goals** and facilitating a sustainable transport system
- Identifying and developing new business models that enable a multimodal transport system
- Rethinking the use of current infrastructure and future challenges



### Modus Objectives and Consortium Medus SES

High-level objective of Modus to analyse how performance of the overall European transport system can be optimised by considering the entire door-to-door journey holistically and considering air transport within an integrated, intermodal approach

Understand in a better way how ATM and air transport can better contribute to improve passengers' intermodal journeys and how this translates into an enhanced performance of the overall transport system Explore and model the connection and dependence between ATM/ air transport and other transport modes, with a special focus on the interplay between short and medium air and rail connections Identify the main barriers in achieving European (air) mobility goals and how air transport can evolve by efficiently connecting information and services with other transport modes to achieve the 4 hours doorto-door goal and a seamless journey experience for passengers.

### https://modus-project.eu/



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### **Modus Structure and Progress**



Scenarios and use cases enable the assessment of different future development paths of the European transport system, with a specific focus on air-rail development in Modus.





### "What could future air-rail multimodal mobility look like?"

The SESAR project 'Modus' is exploring the future landscape of air-rail multimodal travel, under a range of **future scenarios and use cases**.

The main objective of the workshop is to discuss ideas from panellists on what models need to include in order to be useful to a range of stakeholders. What is Modus doing well, and what is missing?

We will have a lively discussion with two roundtables with industry stakeholders and interactive boards for participants.





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# **Explanation workshop approach**



### (1) Feedback participants

All participants of the workshop were asked to provide their feedback on an interactive board, regarding the scenarios, use cases and city archetypes

- Good: Good points to highlight
- Bad: The points that make no sense or are otherwise considered bad
- Missing: The points to be included or taken into consideration

### (2) Roundtable discussion

With stakeholders from both the air and rail sectors the ideas and discussion points from the Modus presentations and the interactive participant board were discussed:

- What is Modus doing well, and what is missing?
- Insights from different sectors and business areas

### **Modus Scenarios 2040**

Nadine Pilon | Modus consortium

**2**<sup>nd</sup> **Modus workshop** Online, February 14, 2022





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# European High-level Mobility Goals Modus SESAR

- <u>Connectivity</u>: reduction of travel time and connection of remote regions
- <u>Environmental impact</u>: reduced reliance on fossil fuels, reduction of CO2 emissions and internalisation of external costs
- <u>Integration of additional demand</u>: adjusting and extending capacities and aiming at a more efficient resource allocation
- <u>Technological innovation and (widespread) implementation</u>: development of more fuel-efficient, hydrogen-powered and (hybrid-)electric aircraft; continued fleet renewal; to ensure that low and zero-emission technology options are deployed (through retrofitting and appropriate renewal schemes in all transport modes)

# Future Supply and Demand Scenarios



### **Scenarios**

- Derived from European high-level mobility objectives, existing scenario studies as well as the work conducted within the Modus project
- Focus on particular aspects envisaged for the future, and that have the potential to significantly change the transport system
- Time horizon: 2040
- Four scenarios
  - 1. Pre-pandemic recovery (baseline)
  - 2. European short-haul shift
  - 3. Growth with strong technological support
  - 4. Decentralised, remote and digital
- Scenarios presented in **Deliverable 3.2**

# Future Supply and Demand Scenarios





### Scenario 1: Pre-pandemic recovery

- Network structures remain similar to todays
- Implementation of innovative technologies facilitates the reduction of emissions in air transport



### Scenario 2: European short-haul shift

- High share of short-haul air traffic replaced by air-rail cooperation
- High quality of transport network with HSR services on short-haul distances



### Scenario 3: Growth with strong technological support

- Higher growth rates of the transport sector until 2040 than the baseline
- uptake of technological innovations to both reduce emissions and alleviate capacity shortages in air transport

### Scenario 4: Decentralised, remote and digital mobility

- Population becomes more dispersed across rural and remote regions with increased options for remote working and virtual meetings
- More decentralised air transport network, additional railway stations
- Technological innovations for regional aircraft

# Scenario 1 – 'Pre-pandemic Recovery' (Baseline Scenario)



The European transport market recovers to pre-crisis levels; air transport and railway network structure remain similar to today's. The implementation of innovative technologies as well as market-based measures facilitate the reduction of emissions in the individual transport sectors.

This scenario serves as the **baseline** for the comparison with different future development paths.

# Scenario 2 – 'European Short-Haul Medus SESAR Shift'

A high share of short-haul air traffic is replaced by a cooperation between rail and air, which leads to a reduction in overall air traffic on short-haul routes in Europe.

In this scenario, a high-quality transport network with high-speed rail services on short-haul distances is established, and with clean aviation services improving the coverage of long-haul routes.

Scenario assumptions include that by 2030, **high-speed rail traffic will double** (this mainly concerns major links inter- and extra-EU), and that scheduled collective travel of **under 500 kilometres should be carbon neutral** within the EU. The relevance of rail increases significantly in the segment between 200 to 1500 kilometres.

Furthermore, there is an **increased level of cooperation between air and rail** to provide both door-to-door solutions as well as efficient connectivity of European regions.

# Scenario 3 – 'Growth with Strong Medus SESAR Technological Support'

This scenario exhibits high growth rates of the transport sector until 2040, which significantly exceeds that in the baseline scenario. As a reference for an upper limit for intra-European annual air traffic growth, the Boeing market forecast for the time horizon 2020-2039 is considered.

This scenario emphasises the uptake of technological innovations to both **reduce emissions** and **alleviate capacity shortages**, especially whereby the widespread implementation of respective innovative technologies in the air transport sector exceeds those levels envisaged by Destination2050, Flightpath2050, EU Smart and Sustainable Mobility Strategy, for example.

# Scenario 4 – 'Decentralised, Remote and Digital Mobility'



The trend in urbanisation, as forecast by the UN World Urbanization Prospects, is not proceeding as anticipated in Europe, but the population becomes more **dispersed across rural and remote regions**. These regions are becoming much more attractive due to increased options for remote working and virtual meetings.

In line with the EU Smart and Sustainable Mobility Strategy, remote and rural regions will be better connected to the European transport network.

This also incorporates a significantly increased role of **small and regional airports**, as well as **additional railway stations**, in the network, moving towards a more decentralised (air) transport network structure. This is also accompanied by the widespread implementation of technological innovations for **regional aircraft**.

# Participants' Feedback and Questions (Extract)



Length of development as well as environmental impact of rail infrastructure development to be considered when comparing substitution potential

What are the implications on governance / policy / government across the different scenarios

Importance of the link between ATM (air traffic management) and rail TMS (traffic management system)

Required level of coordination between different modal operators needs to be identified across scenarios

Can automation and autonomisation be considered as freedom from human operators – currently constraining transport supply flexibility

Access to personal data as enabler for progress in optimisation/ efficiency

# **Key Topics from Roundtable Discussion**



Transport strategy should move towards **smart contracts with travellers, and integrated Traffic Management (TM)** independent of the transport mode

- Passengers need transparency on services and regulations
- IT/telecom capabilities need to be aligned with transport strategy (Capacity,..)
- GDPR has to be accommodated with Smart Contracts

## Scenario 2 (**European short-haul shift**), what are the main barriers?

- not enough rail connectivity between cities
- need better connection city-airports
- a system of waves at airport helps the alignment with HSR

Scenario 4 (**Decentralised**, remote and digital mobility):

- how can TM be connected to travel buyers: people but also schools, hospitals, companies employing business travellers, cargo, tourism?
- integrating air & rail systems in mixed modes with their own dynamics: how to identify the barriers?
- TM, a tool to allocate demand to (multimodal) supply
- schedules and fares would have to be thought in a holistic concept with partnerships to facilitate connectivity
- in Scenario 4 there is less scheduled transport; air transport allows for more flexibility
- Drones telecom capacity & regulation conflicts (i.e. 5G) possible



Ulrike Schmalz | Modus consortium

2<sup>nd</sup> Modus workshop Online, February 14, 2022





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# Modus Use Cases Definition & Scope



### Use case definition

- Reflect a particular aspect of the transport system or the passenger journey
- Process with a subset of actors performing specific actions in a well-defined environment

### **Modus application**

- Specific process or element of the multimodal travel chain to achieve strategic goals for the European transport system
- Passenger-focused and supporting multimodal travel processes
- Integration of use cases into Modus model, combined with scenarios

Source figure: Schmalz, U., Ringbeck, J., and Spinler, S., "Door-to-door air travel: Exploring trends in corporate reports using text classification models," Technological Forecasting and Social Change; Vol. 170, No. 4, 2021, p. 120865. doi: 10.1016/j.techfore.2021.120865.

# **Developing Use Cases**



### **Requirements and approach**

- Representing the different topic areas and hence the Modus objectives as well as European mobility strategies
- Use cases as basis for qualitative and quantitative assessment within Modus
- Comprehensive and manageable set of use cases
   → 4 following use cases
- <u>Use cases presented in D5.1</u>



## **Use Case 1: Flexible Ticketing**



### Flexible ticketing



### Description and application in the quantitative/ qualitative assessment:

Passengers shall be re-booked between air and rail during disruption, subject to capacity constraints;

Potentially introducing some type of prioritisation based e.g. on ticket type and final destination;

Consideration of a specific transport hub perspective, how many different transport modes can be accessed.

Stakeholders	Topic area: Ticketing   Intermodal alignment
<ul> <li>Travellers</li> <li>Access &amp; egress modes</li> <li>Rail stations &amp; airports</li> <li>Operators</li> <li>Distributors (to consolidate operators and act as price aggregators)</li> </ul>	<ul> <li>Indicators (examples)</li> <li>Number of re-accommodated (re-booked) travellers</li> <li>Passenger journey times</li> <li>Delays at various legs of the journey, all during disruption</li> </ul>

## Use Case 2: Personalised Travel



### Personalised travel



### Description and application in the quantitative/ qualitative assessment:

Digital travel platforms, applications and services allow a highly personalised and tailored D2D passenger journey according to passengers' personal preferences supported by a digital travel companion;

Personalisation: Ability to integrate personalised information to fulfil the needs of diverse users will increasingly demand personalisation throughout their travel chain;

Purchase of tickets and services: Enabling a payment process for purchasing mobility and other journey related services.

Topic area: Interoperability and data	Indicators (examples)
<ul> <li>Stakeholders</li> <li>Travellers</li> <li>Digital travel platforms and assistants</li> <li>Operators</li> </ul>	<ul> <li>Number of transport providers and service companies collaborating on a platform</li> <li>Number of functions and services offered to passengers along the journey</li> </ul>

# Use Case 3: Connectivity and Seamless Travel

### Connectivity and seamless travel

### Description and application in the quantitative/ qualitative assessment:

Passengers making longer journeys could be given priority during missed connections and/ or disruptions;

Example: A passenger in London making 3 connections to Lulea in Sweden may be given priority over a passenger going to Paris.

Topic area: Connectivity	Indicators (examples)	
Stakeholders <ul> <li>Travellers</li> <li>Access &amp; egress modes</li> <li>Operators</li> <li>Rail stations &amp; airports</li> </ul>	<ul> <li>Number of passengers travelling on a connection</li> <li>(Average) travel time from door to door on selected city (airport) connections</li> <li>Reachable population (e.g. 4 hours, 7 hours 30 or 9 hours)</li> <li>Number of air/ rail mobility operators on a connection</li> <li>Connection options per day/ week</li> </ul>	





### **Use Case 4: Short-haul Travel**



### Short-haul travel



### Description and application in the quantitative/ qualitative assessment:

Policy incentives are set up in such way that short-haul flights are reduced or banned on routes with a feasible alternative connection, such as high-speed rail;

Passengers booking a journey are offered the transport mode with the least environmental impact (subject to a certain overall travel time benchmark and modal capacity considerations).

	Topic area: Environmental impact	
Stakeholders		
<ul><li>Policy makers</li><li>Travellers</li><li>Operators</li></ul>	<ul> <li>Indicators (examples)</li> <li>CO<sub>2</sub> per passenger kilometre travelled (D2D)</li> <li>Total CO<sub>2</sub> emissions for D2D journey</li> </ul>	

# Participants' Feedback and Questions (Extract)



How does COVID-19 influence use cases, or in broader terms, the passenger D2D travel chain in the long term? Detailed analysis necessary for assessing use cases on more indicators in addition to the  $CO_2$ emission (e.g.  $NO_X$ , emissions, infrastructure energy consumption, etc.)

How to best include the travellers / passengers / guests' perspective towards the use case? How do passengers see their future mobility? Ticketing/data: not just considering consistent ticketing, but also check-in across ticketing types and provider types etc.

New Business models would disrupt/reconfigure the classic plan/book/pay/travel sequence Which barriers need to be overcome to make the use cases a reality, especially given the need of cooperation between modes?

# Key Topics from Roundtable Discussion (1/2)



### What do travellers want?

- Seamless travel / D2D offers
- Coordinated mobility
- Guarantees / protection
- Perception of comfort and security
- Informed decision-making
- End-user-centric systems
- Affordability (depending on travel purpose)
- Reliability
- Sustainability (future driver on travellers)
- Accessibility (physical and non-physical / inclusion)

**Knowledge about travellers' demand is key**! Potential change from an offered-push system towards a demand-pushed system (e.g. in rural areas)

# Key Topics from Roundtable Discussion (2/2)



- Tickets might disappear in the future and be replaced by smart contracts
- Single vs. flexible ticketing: both are the act of purchasing a ticket; but the way that a TSP realises these two processes differs

### **Connectivity and seamless travel**

- Capturing willingness of travellers to choose/change their mode depending on the amount of carbon released regardless of price
- For fostering connectivity: need for a reliable rail alternative that does not take much longer than flying
- Connectivity in the travel context should just not aim at connected city centres but also points of interest (e.g. airports, suburbs)

### **Personalised travel**

• D2D is considered by airlines and not a new concept anymore

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- Passengers want to be empowered, informed and have a single point of contact; requires data-sharing
- Key to work on standard business processes in the eco-system for data sharing

### **Short-haul travel**

- Environmental indicators important across all use cases
- Ban of short-haul flights might disrupt entire airline business model and weaken market position
- Sustainability becomes increasingly a driver for demands and influences travel choices towards more sustainable forms of mobility

## **Modus City Archetypes**

Elham Zareian | Modus consortium

**2**<sup>nd</sup> **Modus workshop** Online, February 14, 2022





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## **Aims and Objectives**



- Identifying each of the 200 European airports belongs to which NUTS3 regions (small regions, regulated by European Union).
- Combining the air and rail transport mobility of NUTS3 regions results in defining a set of city archetypes.
- Building joint city archetypes, instead of focusing on specific airport/rail stations, addresses more holistically, movements between two regions.
- Development of stochastic landside model of Mercury with a special focus on city archetypes.

# **City Archetypes Classficiation**



City archetype	Airport archetype	Railway connection to airport	Further railway info
Arch-1	Main hub	Good inter-regional, direct HSR to airport	-
Arch-2	Main hub	Good inter-regional, no direct HSR to airport	HSR connected to the City Only
Arch-3	Secondary hub	Good inter-regional, no direct HSR to airport	
Arch-4	Large/Medium	Good interregional, no direct HSR to airport	HRS connected to the region only and/or good mainline rail
Arch-5	National/regional	Near good inter-regional/ NO HSR	

# **City Archetypes Classficiation Criteria**



- City archetypes are defined in a **bottom-up approach**.
- Five levels of city archetype defined (Arch-1 to Arch-5)
- Definitions should allow for change in a meaningful way.
- Necessity of having a 'gold standard' city archetype (Arch-1).
- Having the right data regarding air and rail expansion plans.
- City archetypes are described in <u>Deliverable D4.1</u>

## **City Archetypes Promotion**



### Scenario 2/3





### Scenario 1







## **City Archetypes Demotion**





Scenario 1



Scenario 2







# Participants' Feedback and Questions



The archetypes should take into account the following:

- available infrastructure
- frequency, or other type of quality of service measure of both air and rail
- existence of direct link to the city, which does not need to be HSR (not only the distance from the city centre)
- different goals of travel (e.g. tourism, work)
- different subregions of Europe are at different levels regarding the infrastructure and decarbonisation





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### Workshop summary and way forward

# **Workshop Summary**



Moving towards a **multimodal**, **integrated European transport** system requires close **cooperation** and **coordination** of all stakeholders:

- Further development of intermodality frameworks, more integrated transport solutions and on-demand services
- Assessment of technology enablers
- Data management, data sharing and provision
- Further identification and application of key performance indicators to evaluate transport performance and implemented measures
- Essential to include individual traveller needs along the journey, address their feedback and varying requirements

### Way Forward



Current work focuses on an integrated modelling approach of air and ground passenger transport in Europe and the consideration of passenger mobility metrics that enable quantitative insights into the performance of the European transport network. This enables us to understand the main barriers in achieving European mobility goals. If you have any questions or like to learn more about Modus:

Modus Website https://modus-project.eu/

Modus Twitter @Modus\_project

Modus LinkedIn https://www.linkedin.com/company/ moduseuproject/

### **Modus Coordinator**

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Understand in a better way how ATM and air transport can better contribute to improve passengers' intermodal journeys and how this translates into an enhanced performance of the overall transport system Explore and model the connection and dependence between ATM/ air transport and other transport modes, with a special focus on the interplay between short and medium air and rail connections Identify the main barriers in achieving European (air) mobility goals and how air transport can evolve by efficiently connecting information and services with other transport modes to achieve the 4 hours doorto-door goal and a seamless journey experience for passengers.