Modus

Modus: Multimodal mobility scenarios to assess the performance of the European transport system

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Abstract

The need for a seamless and hassle-free passenger journey, increasing environmental awareness, regulatory measures, and capacity shortages across different modes make the evolution of European passenger demand for mobility a significant challenge to predict, as well as its potential impact on the European transport system. The overall performance of the (future) European transport system will depend on alignment and optimisation of multimodal transport, needing to provide a seamless journey for passengers while mitigating (air) capacity constraints.

The four scenarios developed in the Modus project aim at exploring how air traffic management (ATM) and air transport can better contribute to improving passengers' multimodal journeys, at the same time exploring the impact on performance of the overall transport system. Four scenarios are derived from European high-level mobility objectives and existing scenario studies, as well as work conducted within the Modus project. Each scenario focuses on particular aspects that are envisaged for the future, having the potential to significantly change the transport system: (1) pre-pandemic recovery (baseline); (2) European short-haul shift; (3) growth with strong technological support; and, (4) decentralised, remote and digital.

I. Introduction

Currently, the European transport sectors face a wide range of opportunities and challenges, including the decarbonisation debate, the **potential** of digital transformation, the long-term impacts of the Covid-19 pandemic, and the move towards a better and efficient integration of transport modes within Europe.

Four scenarios depicting different potential development paths the European transport system might be facing, are outlined. The scenarios take into account factors such as new regulatory contexts, new environmental standards, or new transport operators' business models, describing the evolution of multimodal supply and demand by 2040, looking at distinct developments for the air and rail transport sectors in the future.

II. Concept and approach

The Modus scenarios are derived from high-level mobility objectives, existing scenario studies, and work conducted within the Modus project. Each scenario focuses on particular aspects envisaged for the future that have the potential to significantly change the transport system as we see it today.

Strategic research agendas and European mobility goals were considered to identify possible development paths of the future European mobility system.

The mobility goals and expected developments[2] relevant for the scope within Modus and taken into account in each of the four developed scenarios[3] are as follows.

Connectivity: This goal includes the reduction of travel time and the connection of remote regions, applicable in Scenarios 2 and 4.

Environmental impact: The reduced reliance on fossil fuels, the reduction of CO_2 emissions and the internalisation of external costs are addressed, and are applicable in Scenario 2.

Integration of additional demand: Meeting increasing transport demand by adjusting and extending capacities and aiming at a more efficient resource allocation within the transport network are of importance in this category, applicable to Scenario 3.

Technological innovation and (widespread) implementation: Goals relating to this topic include the development of more fuel-efficient, hydrogen-powered and (hybrid-)electric aircraft and to bring these into operation through continued fleet renewal, to ensure that low and zero-emission technology options are deployed, including through retrofitting and appropriate renewal schemes in all transport modes, applicable to Scenarios 3 and 4.

2. The relevant high-level strategic agendas and existing scenarios for each item are: (1) Connectivity: 1 2 3 4 5; (2) Environmental impact: 1 3 4 5 6 7 8 9 10, (3) Additional demand: 1 3 5 8 9 11 12 13 14; (4) Technological innovation: 1 5 6 8 9 12 11 13 15

3. Scenario 1 represents the baseline scenario.

III. Modus scenarios

The following overview of the four Modus scenarios briefly emphasises the main and distinct features of each scenario.

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.

References: [14] [16] [17]

Scenario 2 – 'European short-haul 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.

References: [1] [10] [18] [4] [5] [19] [2] [3] [6] [7] [8] [9]

Scenario 3 – 'Growth with strong 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.

References: [20] [1] [6] [9] [3] [5] [8] [11] [12] [13] [14] [15]

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.

References: [1] [21] [2] [3] [4] [5] [6] [8] [9] [12] [11] [13] [15]

Each of these scenarios is described by a set of parameters which vary across the scenarios at the considered time horizon of 2040, as listed in Table 2.

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Modus scenario parameters

Category	Considered parameters
Socioeconomic	NUTS2[4] population, NUTS2 GDP of departing and arriving airports/stations, NUTS2 average households' income
Environmental/ political	Environmental regulations, incentives, restrictions
Transport supply	Rail and air service frequencies; rail supplied capacity (maximum number of carried passengers); air supplied capacity (maximum number of carried passengers); supplied capacity per class (air): first class seats, business class seats, economy class seats; type of train used; travel time (air or rail segment); rail and air departure/arrival punctuality;; quality of on-board service; monthly price index for rail transport; monthly price index for air transport; level of air-rail integration and cooperation
Technological	Implementation degree of new aviation technologies; implementation degree of new rail technologies
Mobility network	Air traffic demand (passengers per city pairs); rail traffic demand (average number of passengers); assumed airspace improvements; assumed rail network improvements; city archetypes (change from current *status quo*)

IV. Further applications

Within further work of the Modus project, these scenarios will be analysed in terms of the distinct impact on e.g. air transport capacities or passenger travel times. Understanding different development paths of the air and rail sector in particular, and the impact on various stakeholders, will enable better informed policy making and better alignment of business strategies.

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KEYWORDS
Air transport, intermodal transport, scenario development, future of aviation

MORE INFORMATION CAN BE FOUND HERE:
modus-project.eu

4. The European Union uses a classification for subnational territory called Nomenclature of Territorial Units for Statistics. NUTS 2 typically has a population 2 0.8-3 million.

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