



The Future of Multimodal Transport: Horizon 2040

Workshop – Modus project

Online, January 19, 2021

Modus



Founding Members



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.

Workshop Motivation

Thank you all for joining the Modus workshop on January 19, 2021!

The goal of the workshop was to **complement the research in Modus** in regard to identifying and discussing the **drivers as well as enablers that shape the future demand for and supply of mobility.**

Please find all presentations and results from the workshop attached.

We are happy to stay in contact and engage in further discussions, please engage with us via our communication channels.

Overview



Welcome and Introduction

Session 1: Multimodality Objectives and Future Scenarios

Session 2: Multimodality Enablers (interactive session) and Results

Overview



Welcome and Introduction

Session 1: Multimodality Objectives and Future Scenarios

Session 2: Multimodality Enablers (interactive session) and Results

FACTS & FIGURES

PROJECT BUDGET

1.52 M€

EU CONTRIBUTION

0.99 M€

DURATION

30 MONTHS

01.06.2020

TO

30.11.2022

GRANT AGREEMENT

N° 891166

7 PARTNERS

FROM

5 COUNTRIES

PROJECT COORDINATOR

BAUHAUS LUFTFAHRT

WORK PROGRAMME

H2020-SESAR-2019-2

Modus Project Consortium



Bauhaus Luftfahrt (BHL) – coordinator



Ecole Nationale de l'Aviation Civile (ENAC)



University of Westminster (UoW)



Innaxis (INX)



International Union of Railways (UIC)



Skymantics (SKY)



EUROCONTROL (ECTL)



Moving towards a Multimodal European Transport System

Manifold challenges ahead!

- Enabling a **seamless passenger journey**, including multiple providers and information
- Meeting **environmental goals** and facilitating a sustainable transport system
- Identifying and developing **new business models** that enable a multimodal transport system
- Tackling the **implications and changes** resulting from **COVID-19**
- Rethinking the use of current **infrastructure** and future challenges
- ...



Passenger travel chain from door to door



Societal trends

- Pressure from civil society for climate change mitigation
- Natural disasters are increasingly interpreted as results of climate change.

Changing awareness among passengers

- #Flygskam (no flights in 2020)
- Fridays for Future
- Increasing "carbon conscience"

Changing behaviour?

- Value-action gap: Passengers fly despite concerns about their emissions.
- Willingness to pay for own emissions remains low.

2021 – European Year of Rail

EYR2021: an opportunity to foster seamless multimodal solutions

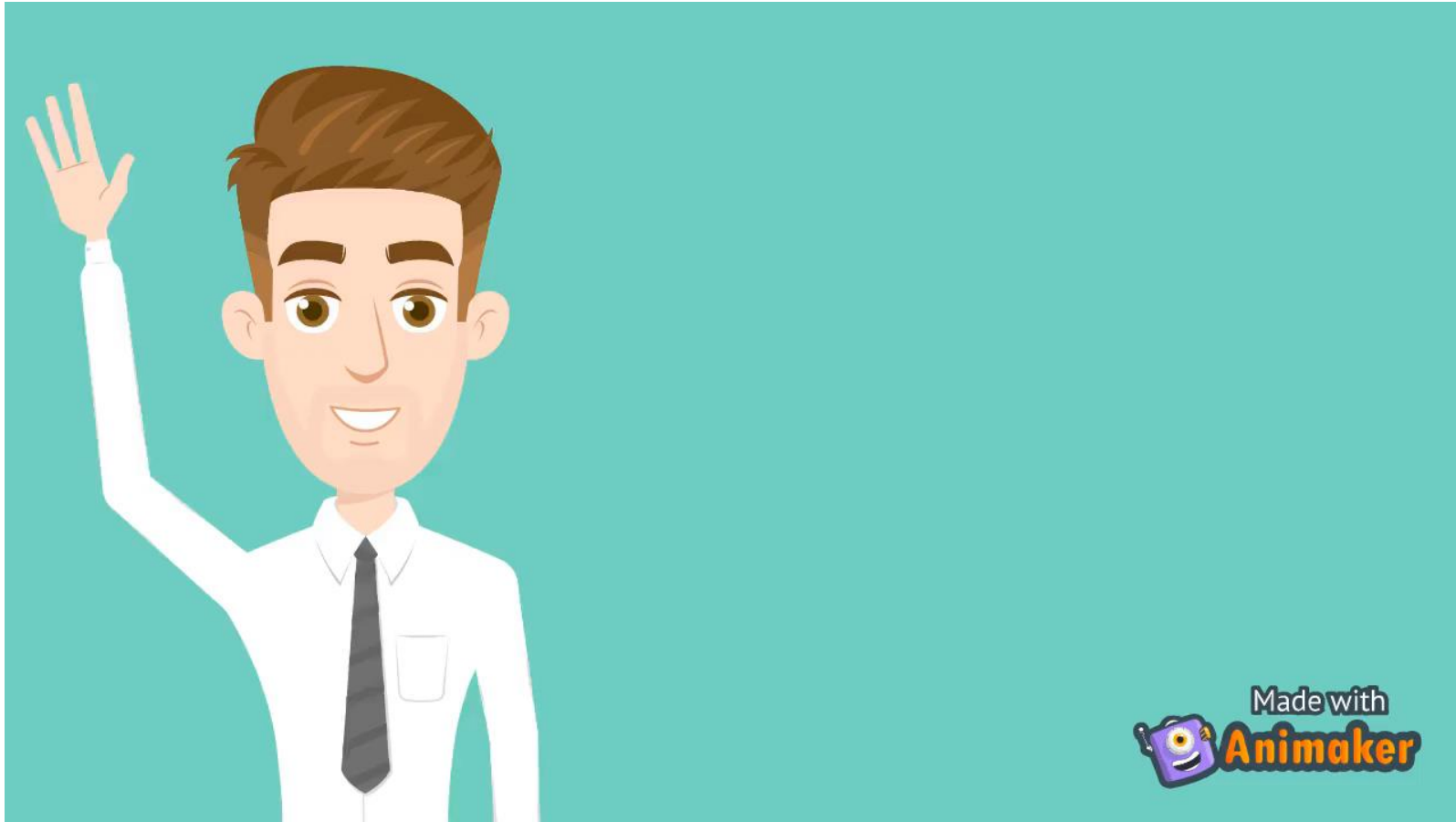


“Our future **mobility** needs to be **sustainable, safe, comfortable and affordable**. Rail offers all of that and much more! The European Year of Rail gives us the opportunity to **re-discover this mode of transport**. Through a variety of actions, we will use this occasion to help rail realise its full potential. I invite all of you to be part of the **European Year of Rail.**”

Adina Vălean, European Commissioner for Transport

Join us on a Multimodal Journey

You can find the video on our Modus website: <https://modus-project.eu/>



The high-level objective of Modus is to analyse how the **performance of the overall transport system** can be optimized 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 door-to-door goal and a seamless journey experience for passengers.

1. Identifying and assessing **(future) drivers for passenger demand and supply of mobility**, and how these affect passenger mode choice,
2. Applying and further advancing existing models to determine the **demand allocation across different transport modes, especially air and rail**, and the effects on the overall capacity of these modes, and
3. Developing and assessing **performance and connectivity indicators** which facilitate the identification of gaps and barriers in meeting **high-level European (air) transport goals, and solutions** to gaps can be addressed.

Modus Workshop Objectives

Understand and gather – your views, across different sectors, on the evolution of multimodal transport experiences for the 2040 horizon.

Complement and analyse – the findings and analyses conducted within Modus so far.

Consolidate and assess – new paths facilitating the implementation of a truly multimodal European transport system.

Session 1 – Multimodality Objectives and Future Scenarios

Which are the most **important drivers** fostering a multimodal transport system?

1. Findings from an expert survey conducted within Modus (M. Fu)
2. Challenges and opportunities for a future multimodal European transport system (A. Paul)

Session 2 – Multimodality Enablers

How can a **multimodal system** be realised?

1. What are infrastructure needs and respective feasibility?
2. Which business models can support and enable multimodality?
3. What do passengers of the future look like in terms of personalisation, travel services?

Welcome and Introduction

Session 1: Multimodality Objectives and Future Scenarios

Introduction

Modus Expert Survey

Challenges and Opportunities for a Future Multimodal European Transport System

Session 2: Multimodality Enablers (interactive session) and Results

Session 1: Objectives

Understanding the future environment

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

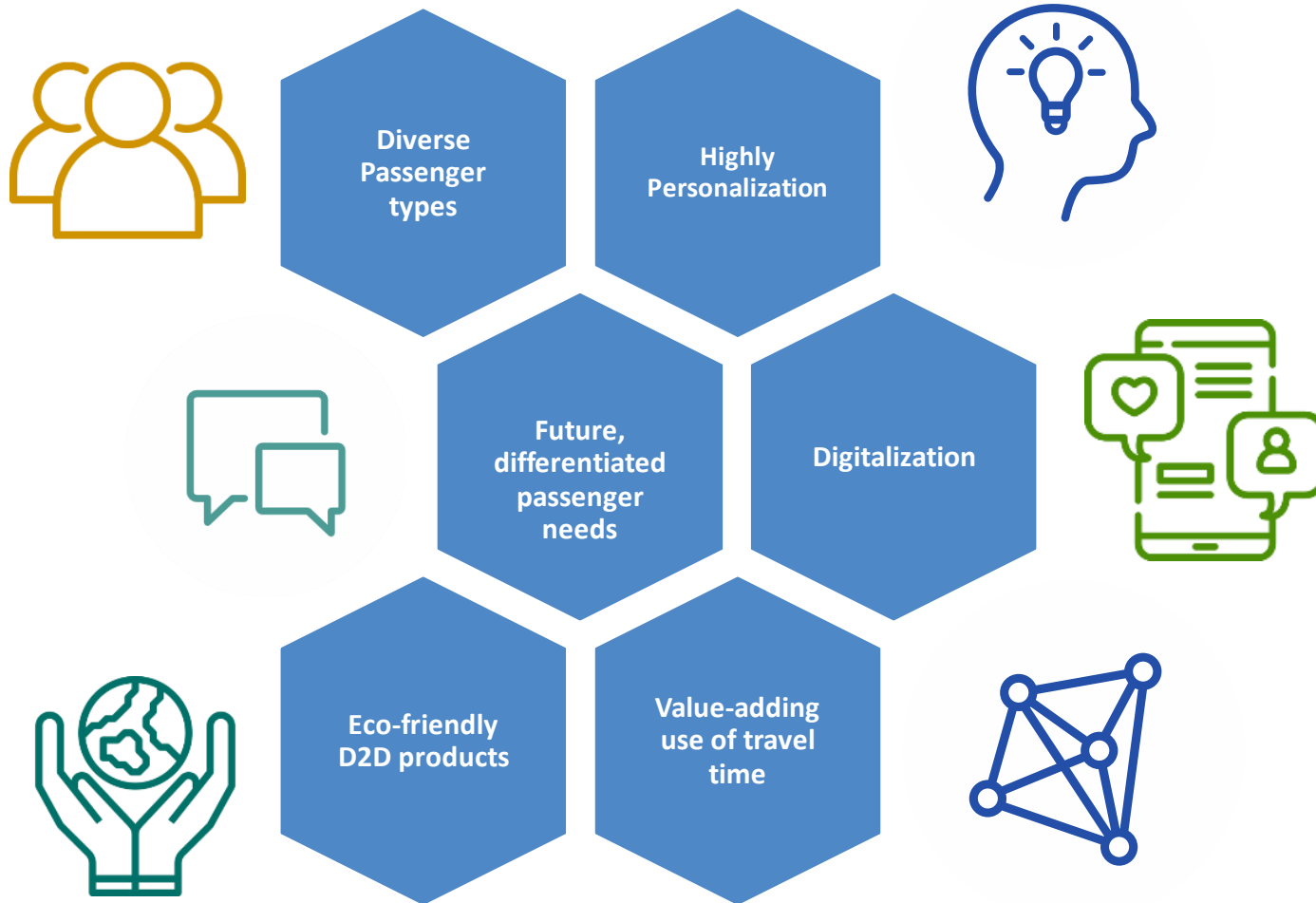
Modus wants to understand and analyse the drivers that shape the demand and supply of a future intermodal system.

Sharing results from an expert survey which provides an initial assessment of important drivers shaping the European transport system.

Highlight initial outline of challenges and opportunities for a future multimodal transport system.

Section 1: Objectives

Understanding the future environment



Source: Door-to-Door Travel in 2035 – A Delphi Study”, Kluge, U., Ringbeck, J. and Spinler, S., 2020, Technological Forecasting & Social Change, 157, 120096



Modus Expert Survey

Modus project
Mengying Fu

Online, January 19, 2021

Modus



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Session 1: Modus Expert Survey

Tackling the future of mobility: welcome to 2040!

- Capture the expertise of various experts from different transport sectors
- Identify possible futures for European travelers
- Outline factors with the most influence on the evolution of travel

Expert survey

Modus goal:
Identification of future drivers of demand and supply

Literature review

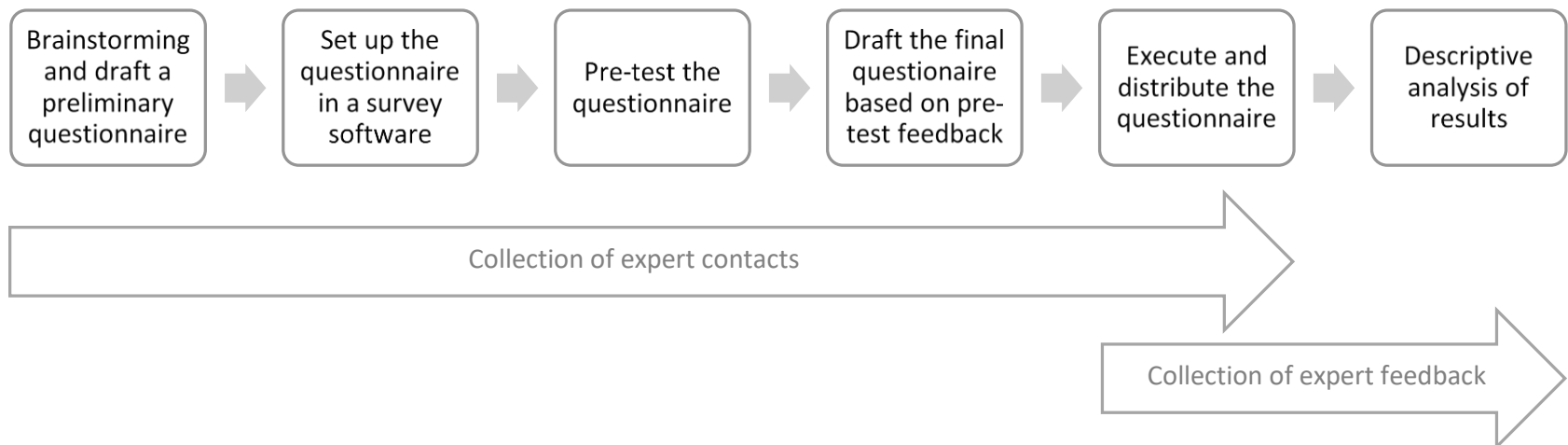
Mode choice modelling

- Identify the drivers of future demand and supply
- Depict factors defining future multimodal journeys

- Identify the impact of passenger behavior and preferences on modal choice
- Impact on modal market shares

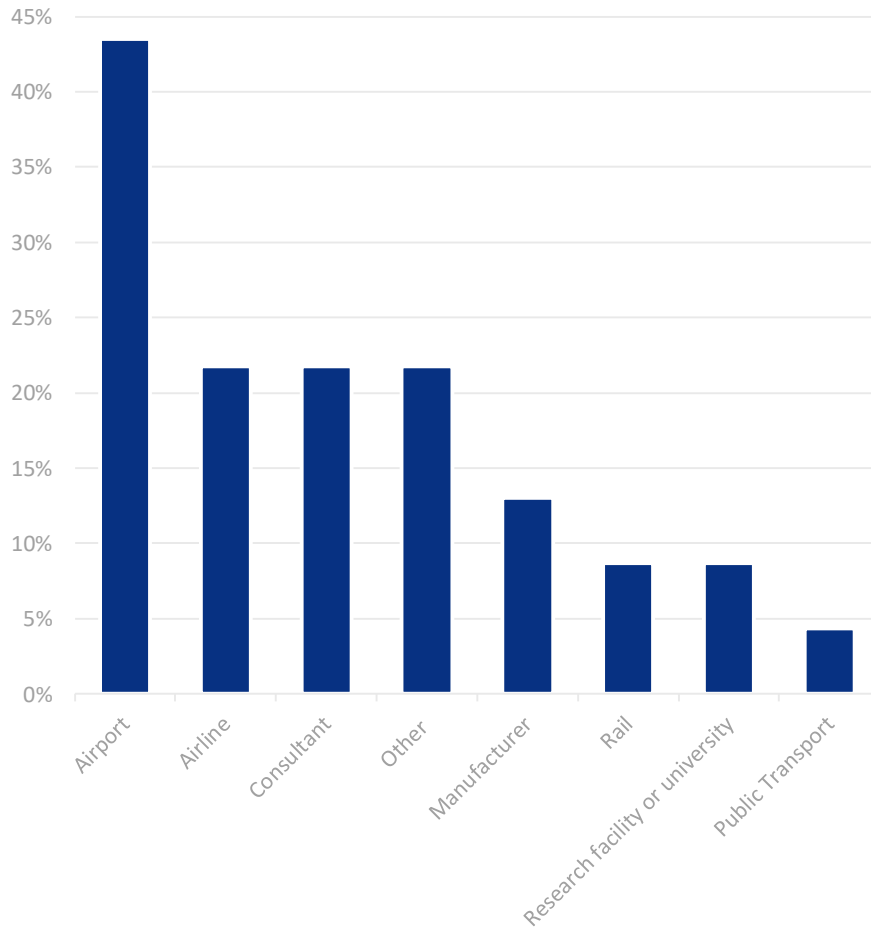
Survey Approach

- Data collection period: **October – November, 2020**
- Total responses: **35** subject matter experts
- Survey completion rate (all questions answered): **63%** (22/35)
- Typical time spent: **20 min.**
- Results are analyzed based on the completed responses of each question
- Focus is on **travel segments within Europe** as part of a multimodal journey with **time horizon of 2040+** (i.e. well beyond the current COVID-19 crisis)

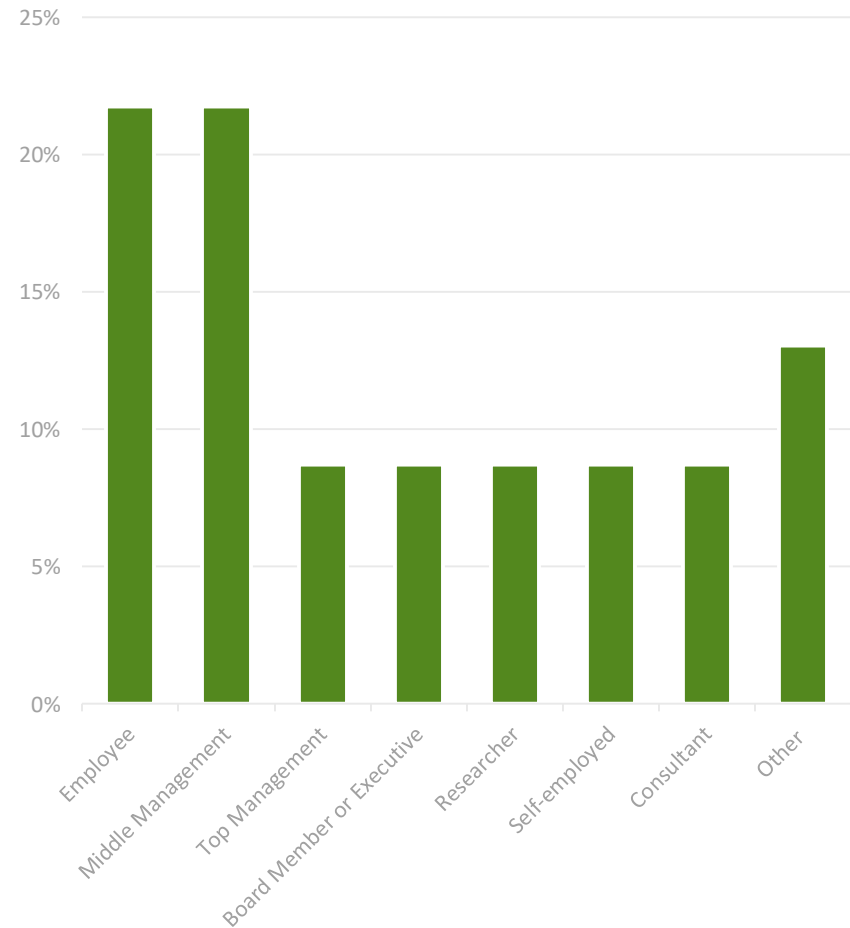


Overview Demographics (1/2)

Industry / transport mode



Working Position



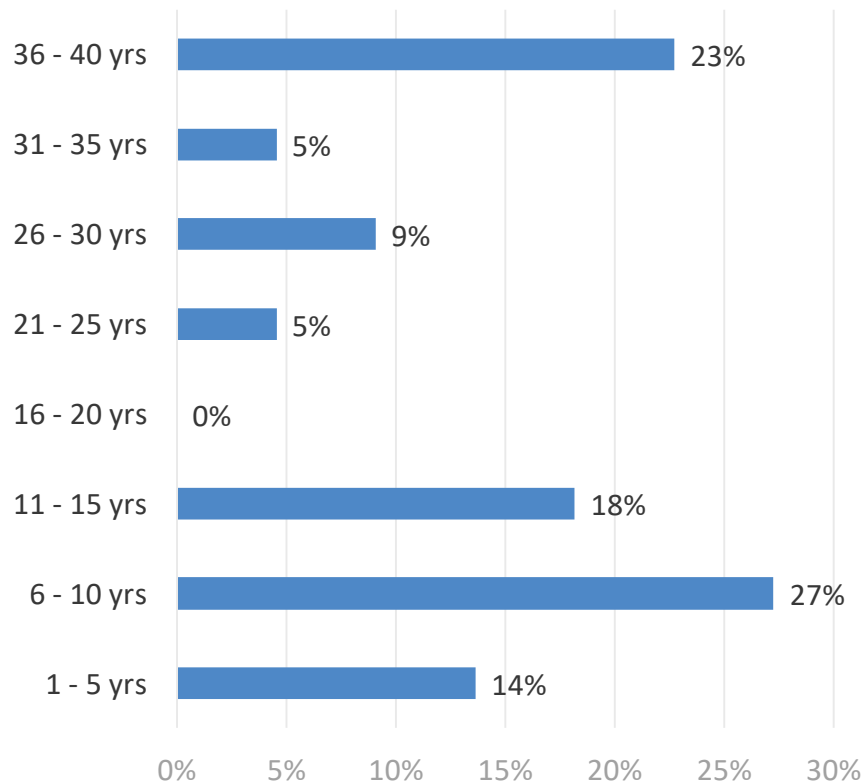
¹Others: large trade association, travel and tourism; advocacy group; NGO; aeronautics industry; transport distribution

²Six respondents (6/23) have selected more than one category of industry/transport mode. Therefore, the total percentage is over 100%.

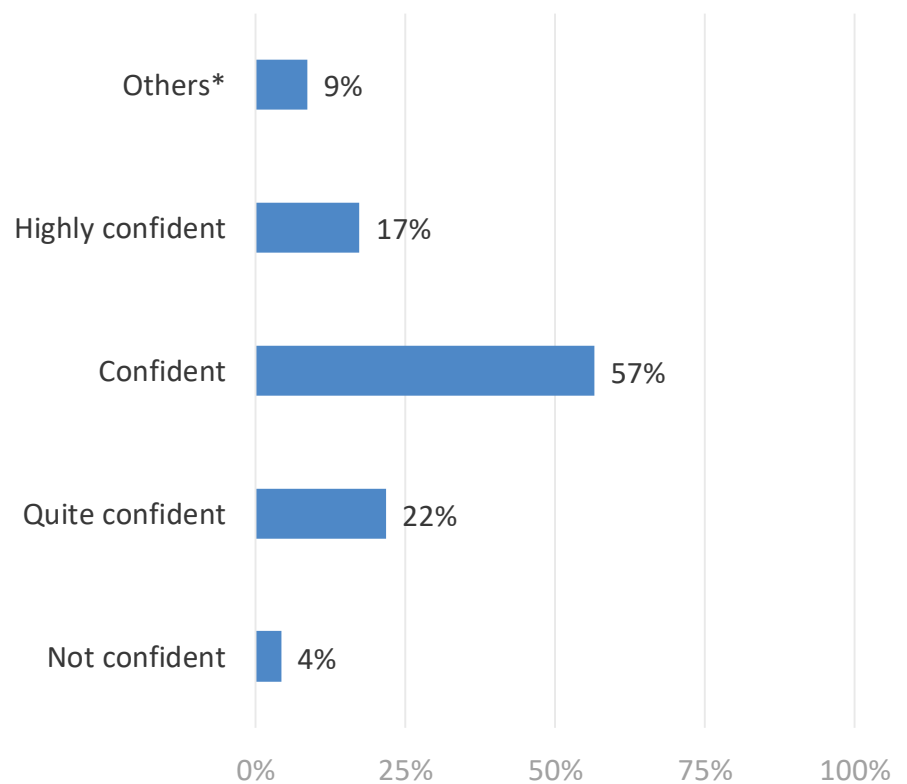
³Others: volunteer; research funding authority; management & expert

Overview Demographics (2/2)

Years of experience



Expertise self assessment



Driver Assessments

Recap

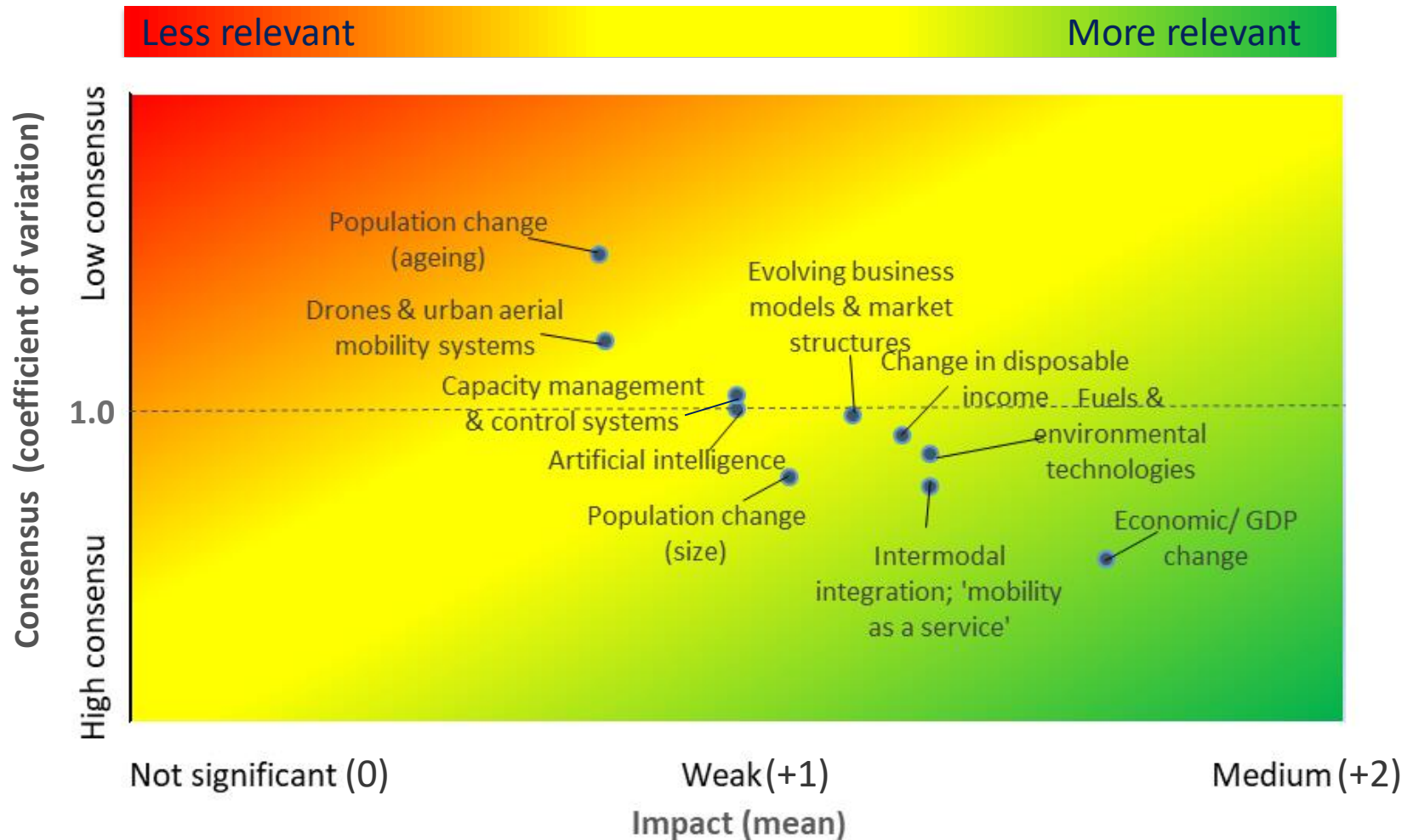
- Assessment of social, technological, economic, environmental and political factors (known as STEEP)

	2040 SUPPLY Air travel	2040 SUPPLY Rail travel	2040 DEMAND Air travel	2040 DEMAND Rail travel
Population change (size) (e.g. higher birth rates; greater life expectancy)	◄	◄	◄	◄
Population change (ageing) (e.g. changing age distribution; persons with reduced mobility)	◄	◄	◄	◄
Immigration (e.g. into Europe)	◄	◄	◄	◄
Urbanisation (e.g. more people living in urban/ suburban areas)	◄	◄	◄	◄
Change in tourism				

Driver effect:

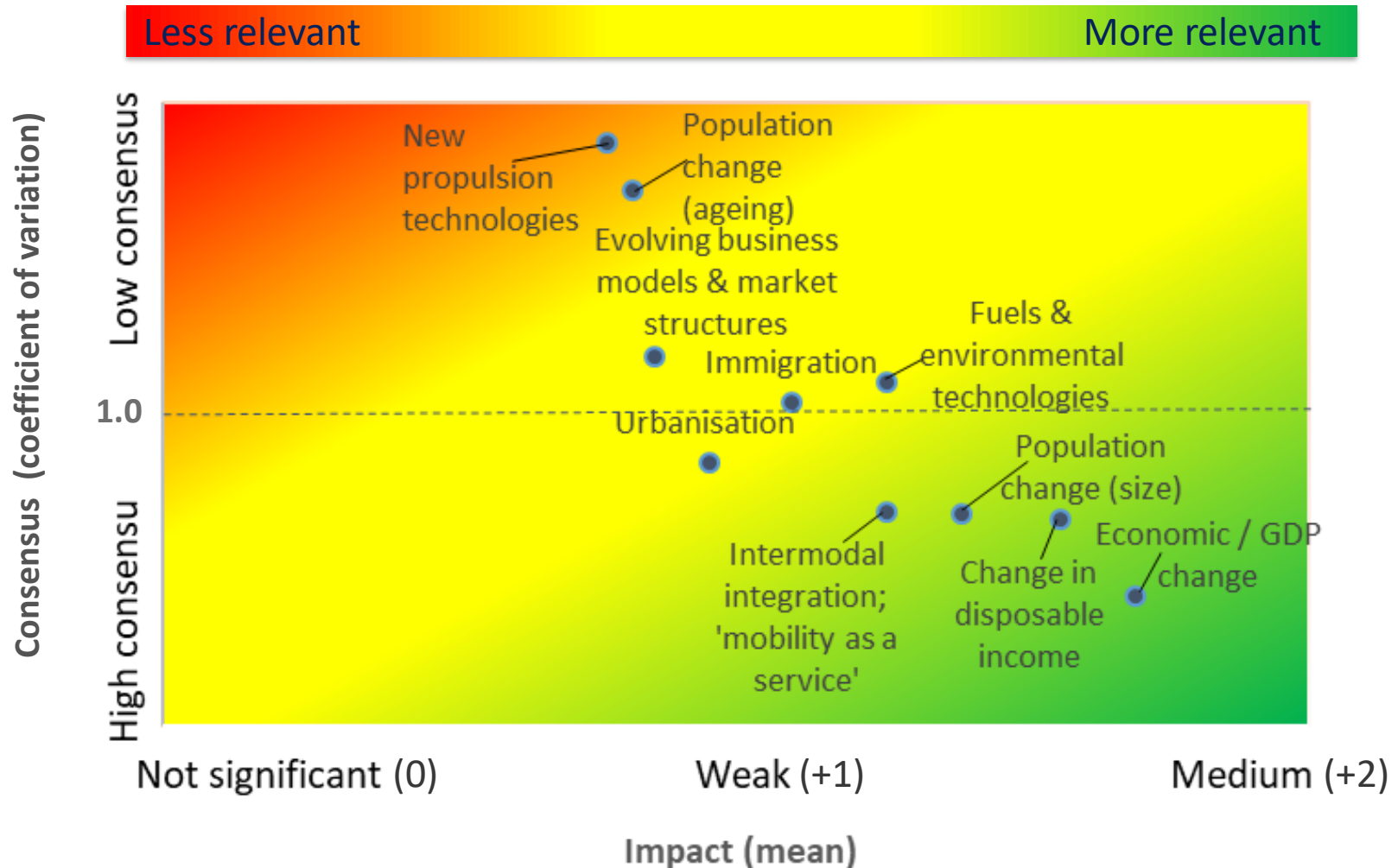
+3 = strong increase
 +2 = medium increase
 +1 = weak increase
 0 = no significant effect
 -1 = weak decrease
 -2 = medium decrease
 -3 = strong decrease
 n/a = don't know / cannot make an assessment

Top Drivers Air Travel Supply



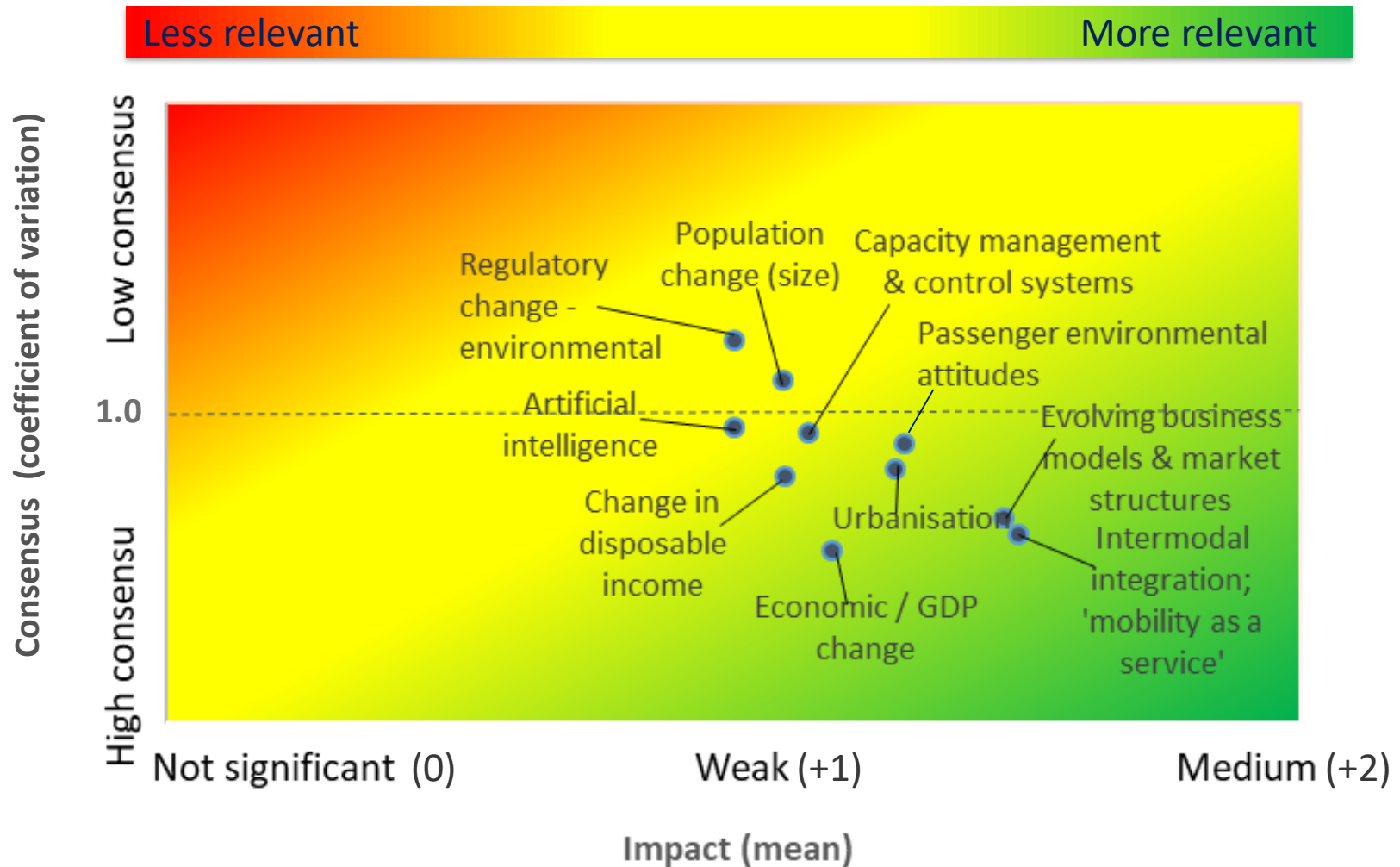
This analysis only includes those factors which are considered to lead to an increase in air travel supply by the experts; factors assumed to have a negative impact are not depicted here since there is very low consensus across experts in regard to factors.

Top Drivers Air Travel Demand



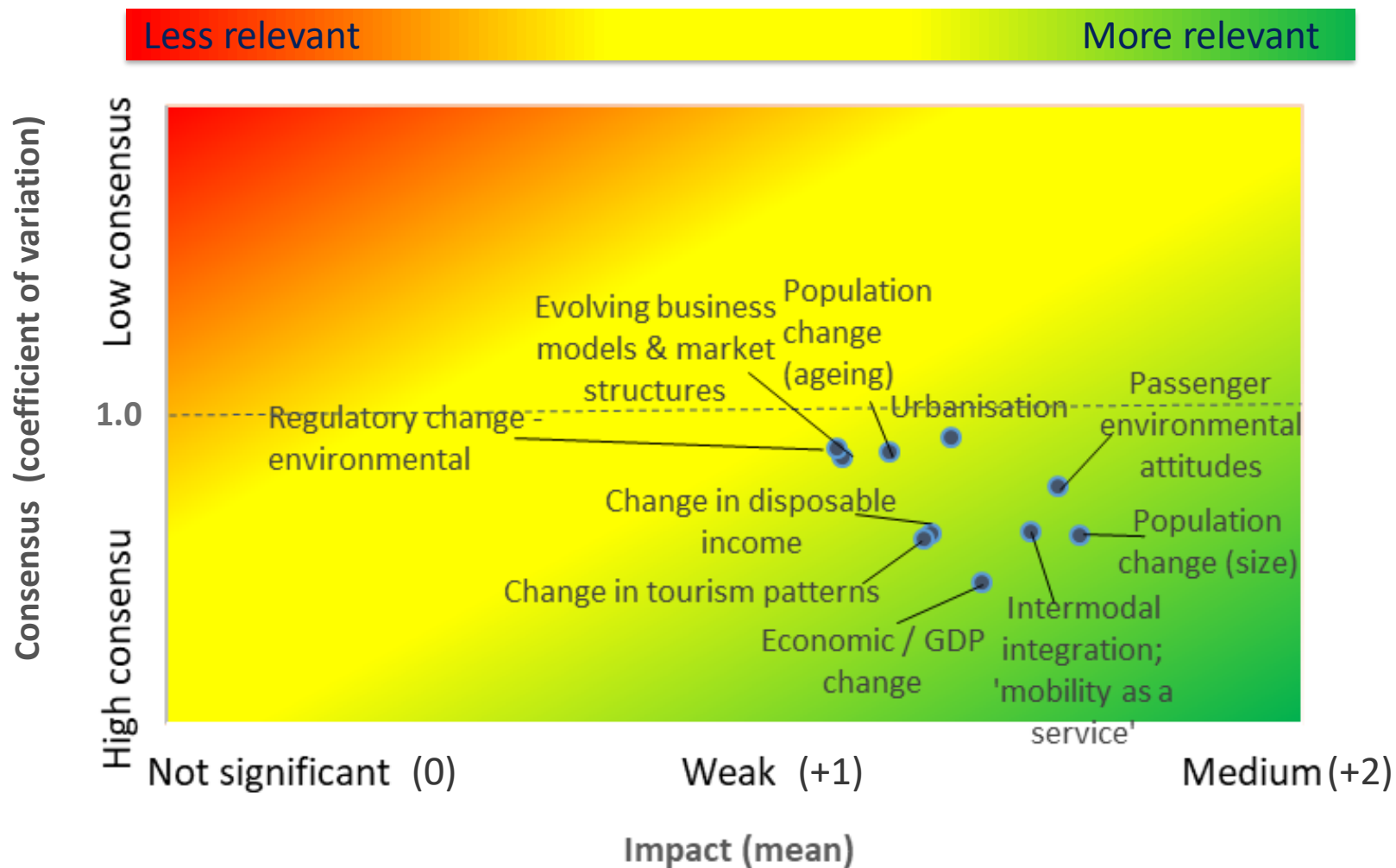
This analysis only includes those factors which are considered to lead to an increase in air travel demand by the experts; factors assumed to have a negative impact are not depicted here since there is very low consensus across experts in regard to factors.

Top Drivers Rail Travel Supply



This analysis only includes those factors which are considered to lead to an increase in rail travel supply by the experts; factors assumed to have a negative impact are not depicted here since there is very low consensus across experts in regard to factors.

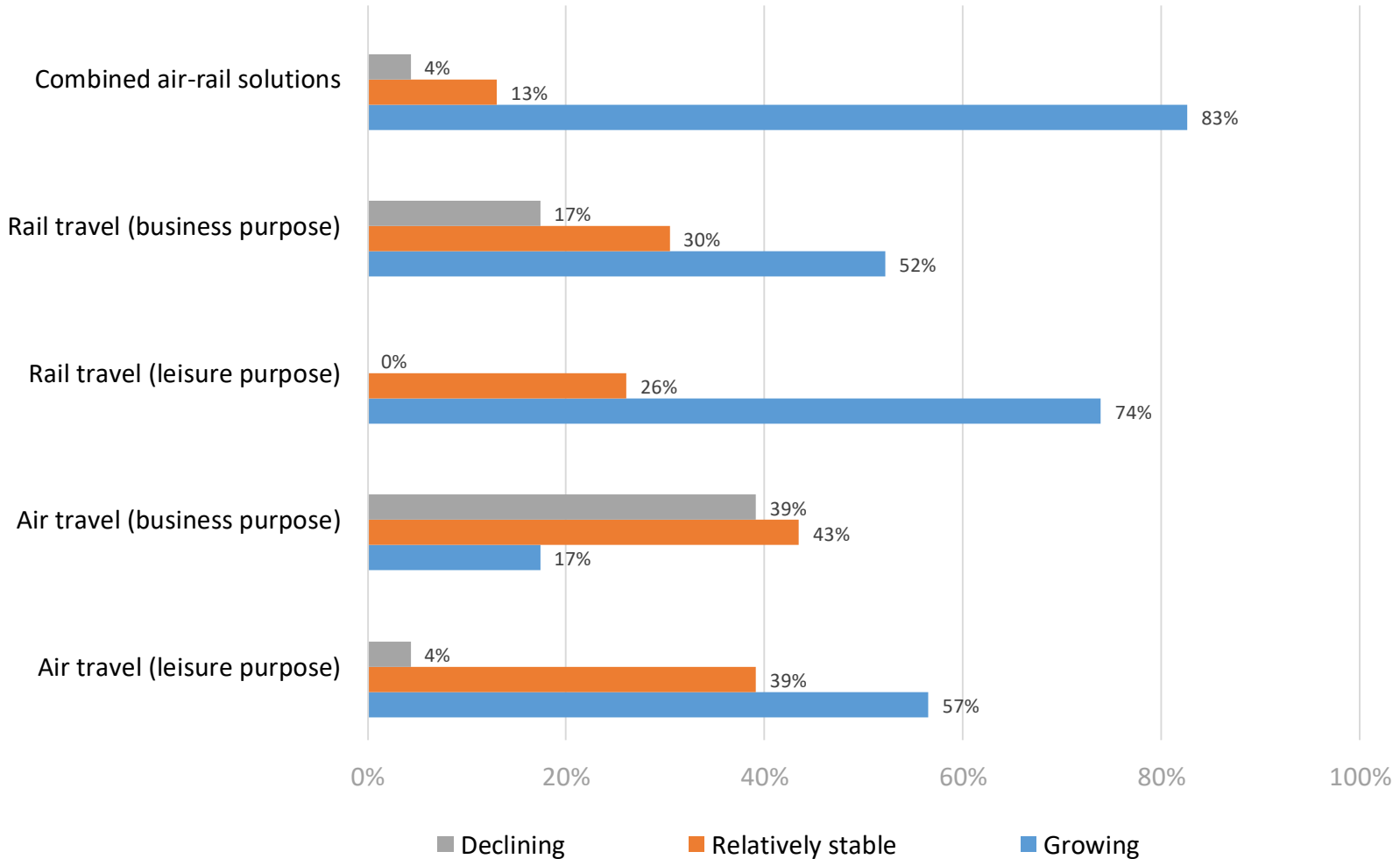
Top Drivers Rail Travel Demand



This analysis only includes those factors which are considered to lead to an increase in rail travel demand by the experts; factors assumed to have a negative impact are not depicted here since there is very low consensus across experts in regard to factors.

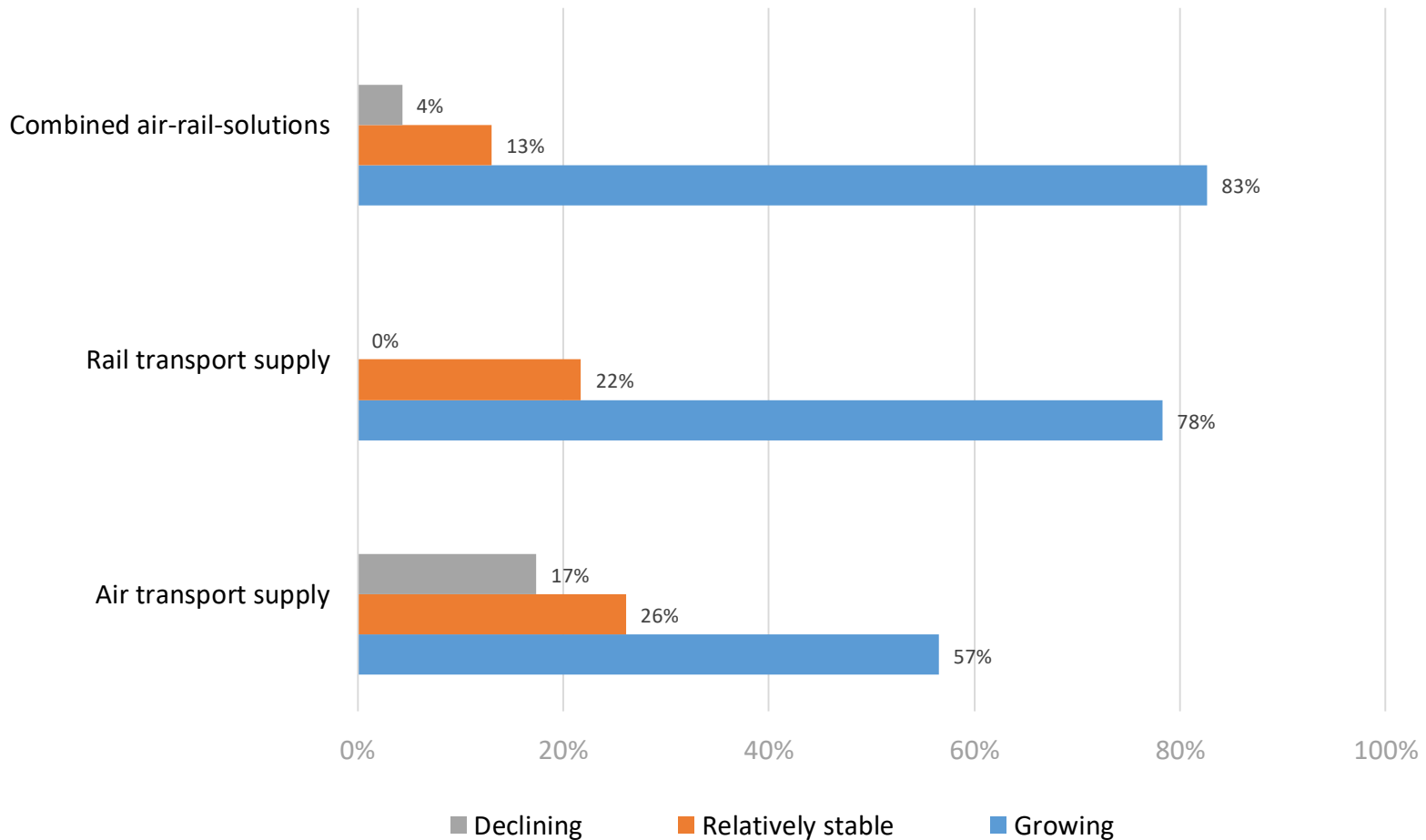
Future Demand

Air and Rail Travel by 2040



Future Supply

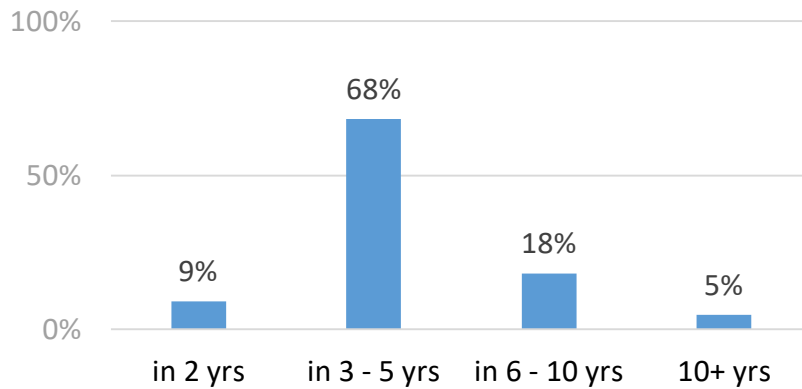
Air and Rail Travel by 2040



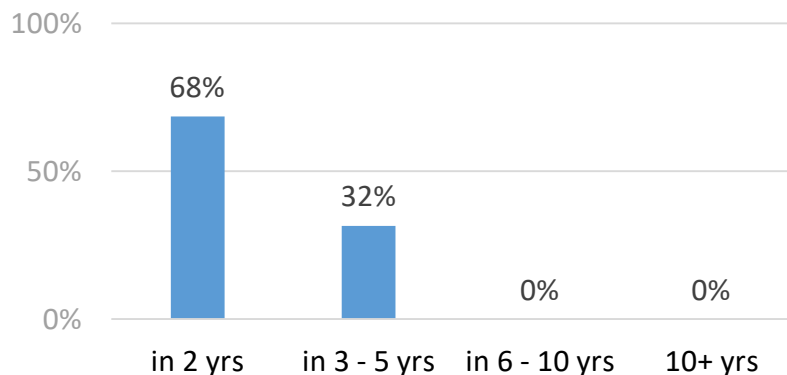
Long-Term Impact of COVID-19

Future Air & Rail (1/2)

When will **air traffic** recover and reach pre-COVID-19 levels?



When will **rail transport** recover and reach pre-COVID-19 levels?



Drivers Recovery (Air & Rail)

air binding business carbon-neutral clear
 climate-neutral common communication
confidence contanination covid
 decline distance drive economic efficient
 emission european example framework guidelines
 immigration infectuous kpi mandatory measures
 mitigation otherwise **passenger** predictive procedures
 propulsion quarantinst **recovery** region
 regulations requirements restrictions root rules
 separation strict sustainable **tests** transport
 travel trust **vaccination**
 widespread worldwide

Long-Term Impact of COVID-19

Future Air & Rail (2/2)

Aspects or areas in the **air transport** sector that will be most affected in the next 10 years

- **Travel by distance:**
 - Short haul/intra-European trips (incl. price), routes with land transport as alternative
 - Inter continental trips, long-range flights for leisure/holiday reasons
- **Travel by purpose:** business, leisure, first
- **Airline business models and revenue** (due to less business travelers; impossible to use all seat capacity)
- **Cabin crew and staff** (staff costs which can be saved by using new technologies and digital solutions)
- **Airport transit time**
- **On-board and border control regulations** (e.g. masks)
- Public health (e.g. pax protection against infection)
- Global economic and political instability
- **Environment** (transition to green aviation) and sustainability
- **Travel mode preferences** (e.g. prefer rail to air → air demand drop)
- **Communication technology**

Aspects or areas in the **rail transport** sector that will be most affected in the next 10 years

- **Local and regional trips;** international connections
- **Travel by purpose:** business, leisure, freight
- **Demand drop** (people will continue to work more days at home)
- Recovering the pre-COVID levels. Being able to compete with aviation in 500km or more trips; Demand will increase more quickly than supply, (regulatory change – increased support for rail)
- Inter-modality
- Seat capacity
- Punctuality
- **High-speed rail** (slow evolution of network)
- **Pax protection**
- **Digitalisation**
- **Travel retail**
- Global economic and political instability (inducing a preference for intra-EU travel)
- Travel mode preference (due to increased environmental awareness)
- **Environment**



Challenges and Opportunities for a Future Multimodal European Transport System

Modus project
Annika Paul

Online, January 19, 2021

Modus



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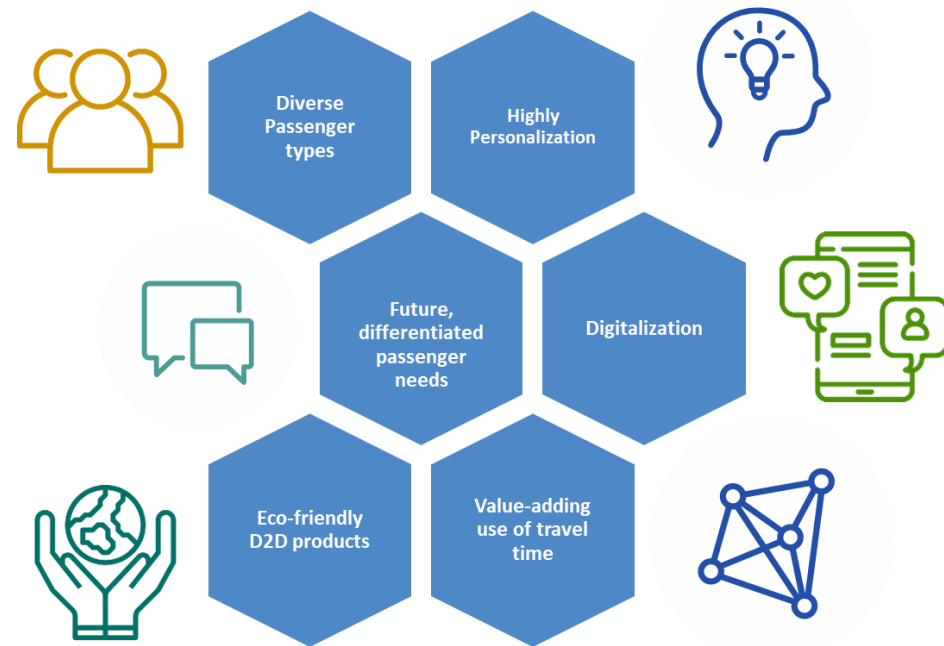


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Motivation

A multimodal transport system comprises a multitude of challenges and opportunities

- Meeting diverse passenger needs
- Integrating multiple (transport) providers
- Identifying new partnerships and cooperation
- Introducing new products and services
- Fostering the complementarity between air and rail



Passenger Behaviour and Mode Choice

2035
Environmental Traveller



MAIN TRAVEL PURPOSE BLEISURE

PREDOMINANT AGE GROUP 30 - 44

TRAVEL ACTIVITY 0.5 TRIPS / YEAR

INCOME LEVEL € € € € €

EXPENDITURE ON TRANSPORT ✈ ✈ ✈ ✈ ✈

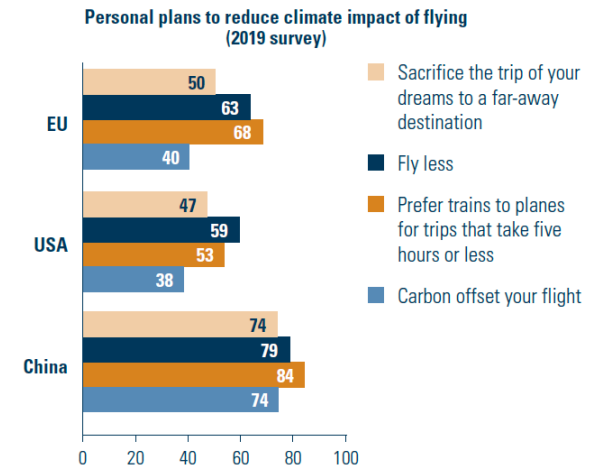
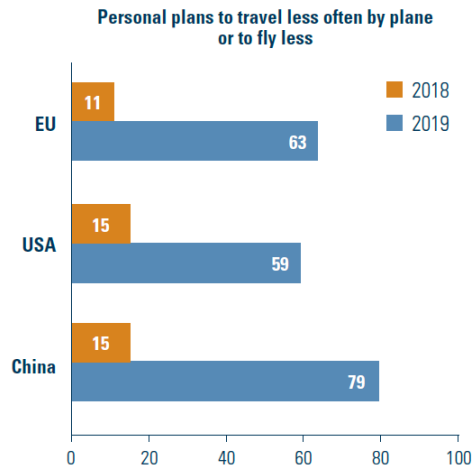
ICT USAGE 📱 📱 📱 📱 📱

TRAVEL PARTY SIZE 🪑 🪑 🪑 🪑 🪑

CHECK-IN LUGGAGE 🧳 🧳 🧳 🧳 🧳

ACCESS MODE CHOICE 🚗 🚗 🚗 🚗 🚗 🚗 🚗 🚗 🚗 🚗

Powered by Pflöchart

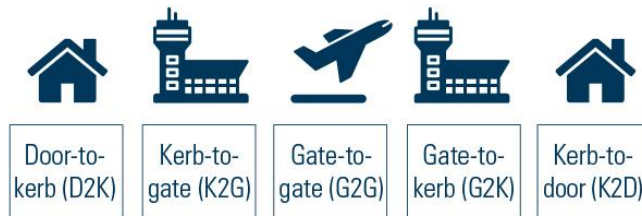


Source: Bauhaus Luftfahrt Yearbook 2019; EIB 1st and 2nd climate survey, <https://www.eib.org/en/surveys/index.htm>

Impact on the (Future) Transport System

Possible effects of **changing environmental awareness and regulations** on demand for air transport

- Carbon off-setting approaches
- Substitution away from air to rail
- No air travel on short-haul routes
- Moving towards more efficient complementarity between air and rail



Passenger travel chain from door to door

Günstigste Option 448 € • 16:55 Std. **Beste Option** 448 € • 16:55 Std. **Am wenigsten CO₂** 1.470 € • 17:32 Std. **Neu** **Benutzerdefiniert** Erstelle deinen Reiseplan

4.310 kg ist der durchschnittliche CO₂-Ausstoß auf dieser Strecke.
Wir zeigen die CO₂-Emissionen an, damit du eine informierte Entscheidung fällen kannst. Die 5 wichtigsten Faktoren der Berechnung werden dir hier angezeigt. Hier kannst du mehr über nachhaltiges Reisen erfahren.

Flugzeugtyp ⌵ Airline-Rating ⌵
Direktflüge ⌵ Passagierauslastung ⌵
Kabinenklasse ⌵

24 % weniger CO₂ Flexible Änderungen COVID-19-Richtlinien > 2 1 0 0

<input type="checkbox"/>	11:40 – 21:05 Virgin Atlantic	1 Stopp CDG	18:25 Std. MUC - LAX	1.470 € Mix & Match Economy Light, Basic Economy Zum Angebot
<input type="checkbox"/>	21:05 – 22:45⁺¹ British Airways	1 Stopp LHR	16:40 Std. LAX - MUC	

23 % weniger CO₂ COVID-19-Richtlinien > 10 1 0 0

<input type="checkbox"/>	7:40 – 18:50 Mehrere Airlines	1 Stopp LHR	20:10 Std. MUC - LAX	448 € Travelgenio Zum Angebot
<input type="checkbox"/>	21:05 – 19:45⁺¹ Mehrere Airlines	1 Stopp LHR	13:40 Std. LAX - MUC	

Codeshare-Flüge verfügbar
450 € flugladen.de 450 € CheapTickets.de 4 weitere

Source: https://www.momondo.de/flight-search/MUC-LAX/2020-12-15/2020-12-22?sort=co2_a

Future Door-to-door Travel Scenarios

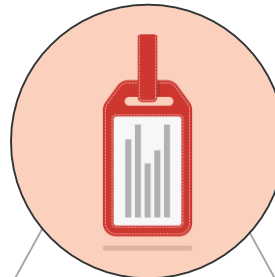
Future D2D Air Travel in 2035

- Alternative future for 2035 towards a full monetization of the cabin by tech companies
- Disrupting the supply side along the travel chain
- Changing revenue streams for transport providers

Game changer

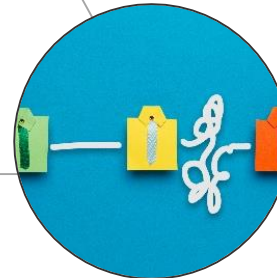


Personalized D2D travel



- Digital-controlled future D2D travel
- Focusing on high personalization and customer needs
- Probable strong impact on D2D mobility offers

Possible Scenarios



Integrated D2D travel

- Focus less on differentiated products from single mobility providers but on collaboration to offer integrated services and create valuable travel time for passengers

Source: "Door-to-Door Travel in 2035 – A Delphi Study", Kluge, U., Ringbeck, J. and Spinler, S., 2020, Technological Forecasting & Social Change, 157, 120096

Realising a Seamless Passenger Journey



"The Single European Rail Area needs to be enhanced and the Commission will consider measures to expand the rail market, addressing the needs of railway undertakings for access to high quality capacity **maximising the use of rail infrastructure**. Cross-border tickets should become easier to use and to buy. Starting in 2021, the Commission will propose regulatory measures to enable **innovative and flexible tickets** that combine various transport modes and give **passengers true options for door-to-door travel.**"

Sources: <https://www.iata.org/en/programs/airline-distribution/multilateral-interline-framework/future-of-interline/>; European Commission (2020), Sustainable and Smart Mobility Strategy – putting European transport on track for the future

How can we enable a truly multimodal European transport system?

1. What are **infrastructure needs** and respective feasibility?
2. Which **business models** can support and enable multimodality?
3. What do **passengers of the future** look like in terms of personalisation, travel services?

Welcome and Introduction

Session 1: Multimodality Objectives and Future Scenarios

Session 2: Multimodality Enablers (interactive session) and Results

Introduction

Topic 1: Infrastructure Needs

Topic 2: Business Models

Topic 3: Passenger of the Future

The goal of Session 2 was to **identify and discuss multimodality enablers** in regard to **future infrastructure needs, potential business model approaches and passenger requirements**.

For this purpose, dedicated groups each focused on one of these topics in interactive sessions, applying an **issue analysis** and using the online tool Mural.

The issue analysis enables each participant to write down their ideas and thoughts on a particular topic. All ideas are grouped into several **distinct clusters** in order to identify and **assess high-level importance for future transport performance and feasibility** and enablers for future infrastructure needs, business model approaches, or passenger requirements.

Session 2: Interactive Brainstorming in Groups

Understanding of **multimodality enablers** for the **3 topics** within different groups

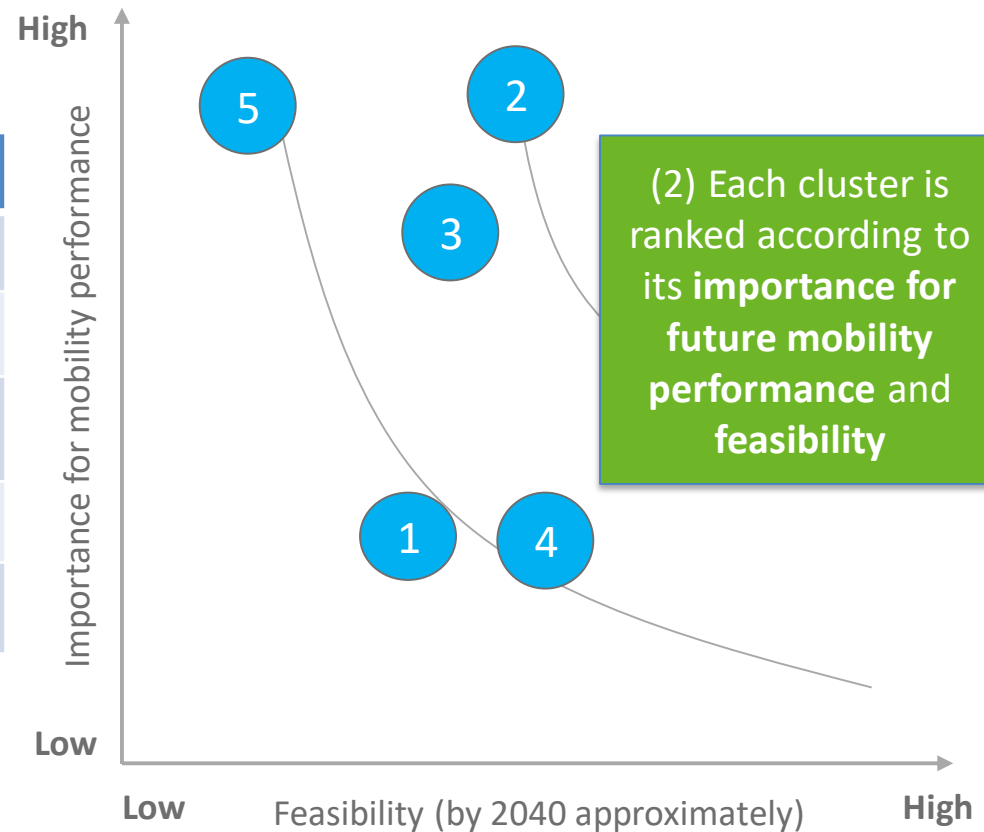
Topic 1: What are the infrastructure needs and feasibilities?	Topic 2: What business models can support multimodality?	Topic 3: Passenger of the future, personalisation, travel services
<ul style="list-style-type: none"> • Increase rail capacity • Rail stations - airport connections • Airport development • Limits to future ICT availability • Complementarity between air and rail 	<ul style="list-style-type: none"> • Who bears the cost? (countries, EU, cities, travellers (ticket price), mobility operators (airlines, rail), infrastructure investors (airports, stations, ...) • Who benefits? • Which players are involved? • Which multimodal innovations are needed? 	<ul style="list-style-type: none"> • How will travellers' needs evolve in 2040? • Who will pay for intermodal solutions ? • What will be the impact of zero-emission vehicles on traffic? (prices, demand, multimodality ?)

Assessment of Enablers

Results of Group Brainstorming

Nr.	Cluster name and description
1	<u>Cluster 1 name:</u> Definition
2	<u>Cluster 2 name:</u> Definition
3	
4	
5	

(1) The discussed aspects within each group are clustered, each cluster received a name and a short description (“the cluster is mainly about...”)

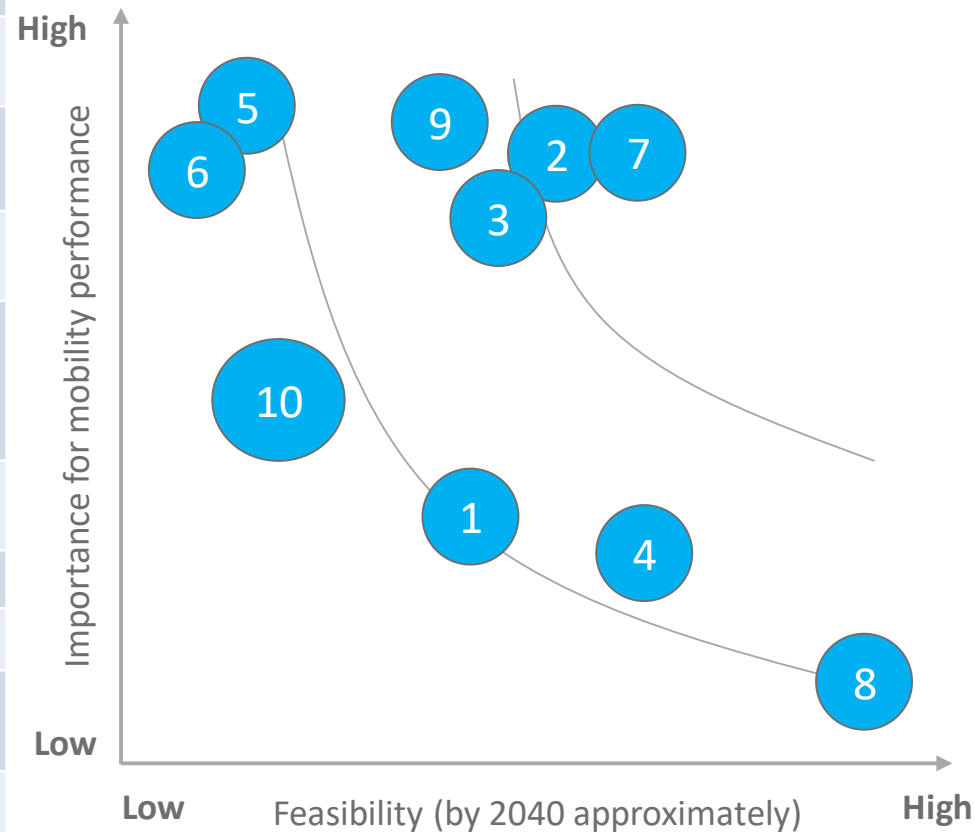


Results Session 2: Multimodality Enablers

(1) What are the **infrastructure needs** and respective feasibilities?

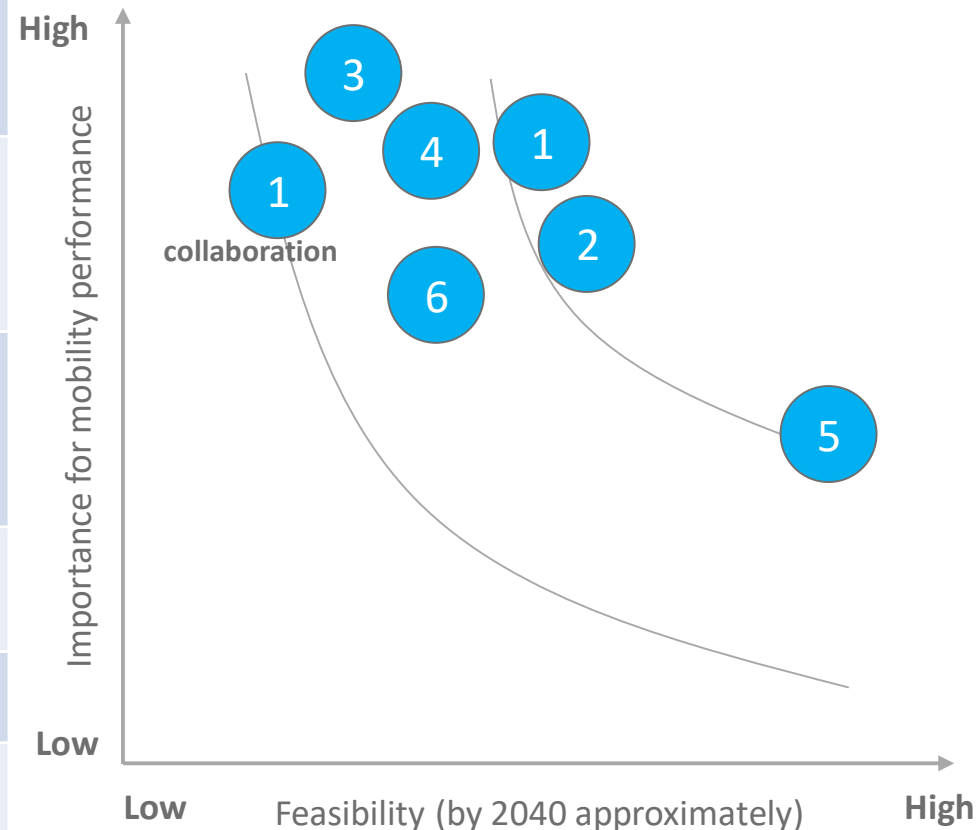
Assessment of Enablers for Infrastructure Needs (Group 1)

No	Cluster name and description
1	Economics: Multimodal trip pack creation & insurance
2	Luggage handling infrastructure: Passengers' expectations re. luggage and multimodal transport
3	Collaborative processing across modes: Coordination of actors across modes for a D2D pax experience (air-rail-urban transport)
4	Passenger planning (ICT needs): Multimodal info to pax in planning & execution
5	Passenger journey experience: Integrated tickets; Fluid & Consistent travel info and facilities across modes on multimodal trip & countries (e.g. Covid); pax diversity (disabled, languages, infrequent travellers)
6	Airport design: Access to several modes at airports, design for more passengers
7	Information/ data sharing: Coordination between modes
8	Environment: Unnecessary trips & noise at airport
9	Connectivity: Urban Air Mobility-rail-train at multimodal hubs; infrastructure funding; parking; airports - city centre links
10	Flexibility – resilience: Disruption for pax and flexibility to recover – buffer times



Assessment of Enablers for Infrastructure Needs (Group 2)

No	Cluster name and description
1	IT System D2D / passenger data sharing / trust between modes / collaboration: D2D development requests data availability and data sharing, collaboration between different transport modes and adapted policies.
2	Information to improve passenger experience: Real time, user-friendly, accessible and accurate information would improve passenger experience before and during the trip. Transfer time, development of intermodal hubs between modes of transport and information in case of disruption.
3	Infrastructure capacity: Infrastructures should avoid bottlenecks, make intermodality possible with better hubs and connections, connecting air & rail with the regional, national and international territory with dedicated policies and funds that would allow it, taking into account new technologies and sustainability issues.
4	Complementarity between air & rail for security: Complementary security policy between air and rail is important to reduce administrative burden.
5	Ticketing interoperability: essential between air & rail to improve D2D passenger experience; has to be flexible in case of disruption.
6	Luggage: Operational and security alignment on luggage handling across air and rail systems is important to enable seamless, intermodal and traceable solutions.

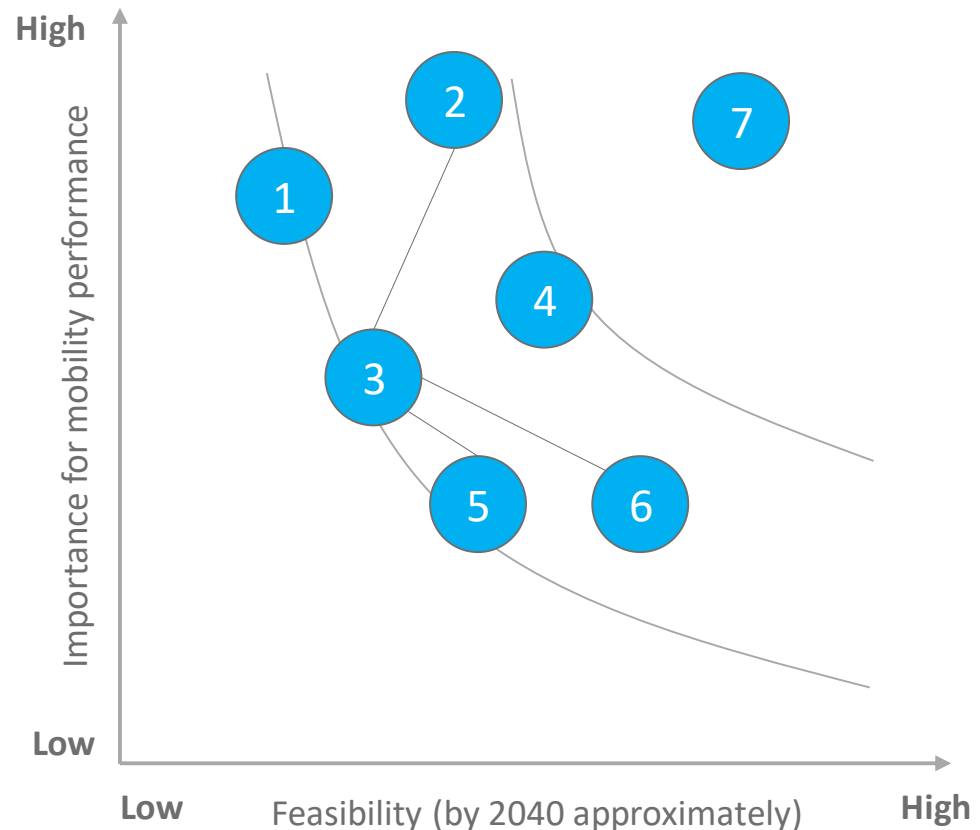


Results Session 2: Multimodality Enablers

(2) Which **business models** can support and enable multimodality?

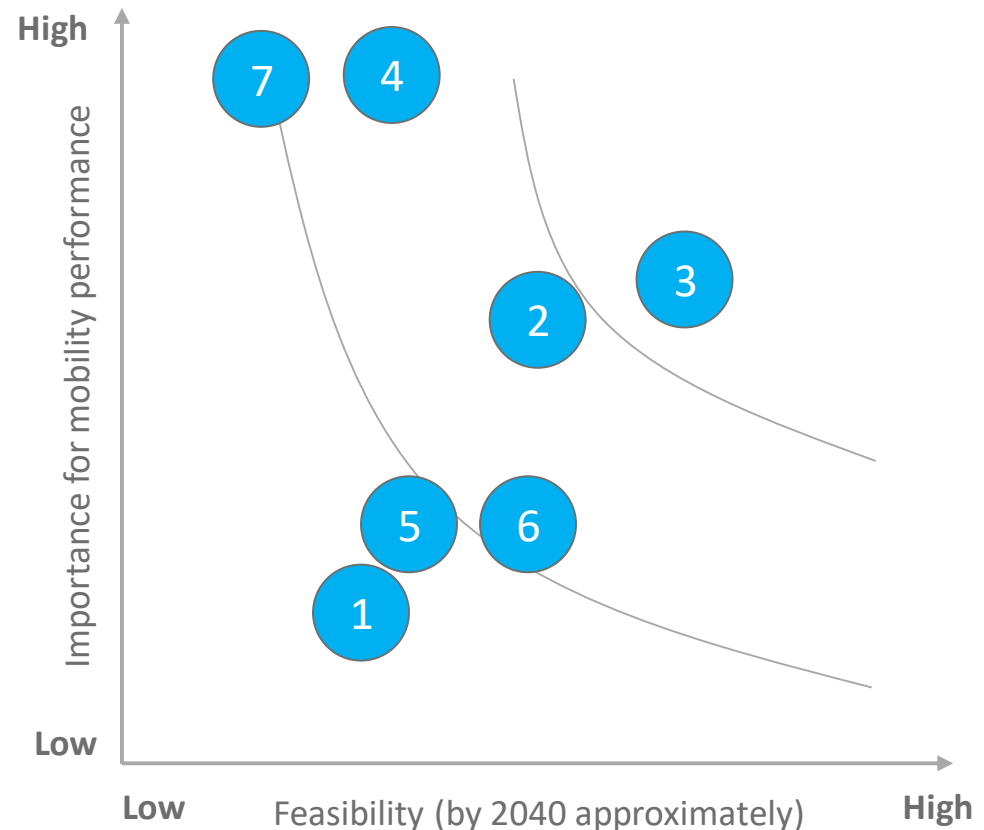
Assessment of Enablers for Business Models (Group 3)

No	Cluster name and description
1	Improved stakeholder stress & inclusivity: improving the journey experience for the passenger, delivering better confidence for all stakeholder types
2	Intermodal transfer accessibility and efficiency: improving connection times and reliability at cross-modal interfaces
3	Provision of a seamless, single booking tool: having single tools / booking services whereby a full D2D journey may be booked
4	Regulation to ensure level playing field for service providers: preventing market dominance or uncompetitive pricing from limited providers, not limiting market access for others
5	Integrated dynamic capacity: ensuring that capacity across modes is integrated and responsive to real-time demand and changes
6	Requirement for integrated, private data: all service providers are able to sell capacity into integrated booking systems, but retain their own supply privacy
7	Better passenger disruption services & tools: e.g. enabling passengers to re-book and re-plan during disruption (further developing existing tools)



Assessment of Enablers for Business Models (Group 4)

No	Cluster name and description
1	Financing infrastructure sustainability: the need for financing/investing in infrastructure (consideration of public/private cooperation)
2	Pax flow at airport: the role of the airport as a connection hub managing flows of pax.
3	ICT on D2D: role of ICT companies on access/egress, considering full D2D trip.
4	Regulatory framework: the role of standardisation, regulation environment, ticketing
5	Air-rail cooperation: sharing/agreeing on market short-haul/etc.
6	Air-rail competition: keeping competition on links
7	Data sharing and management: data sharing between stakeholders (rail/air)

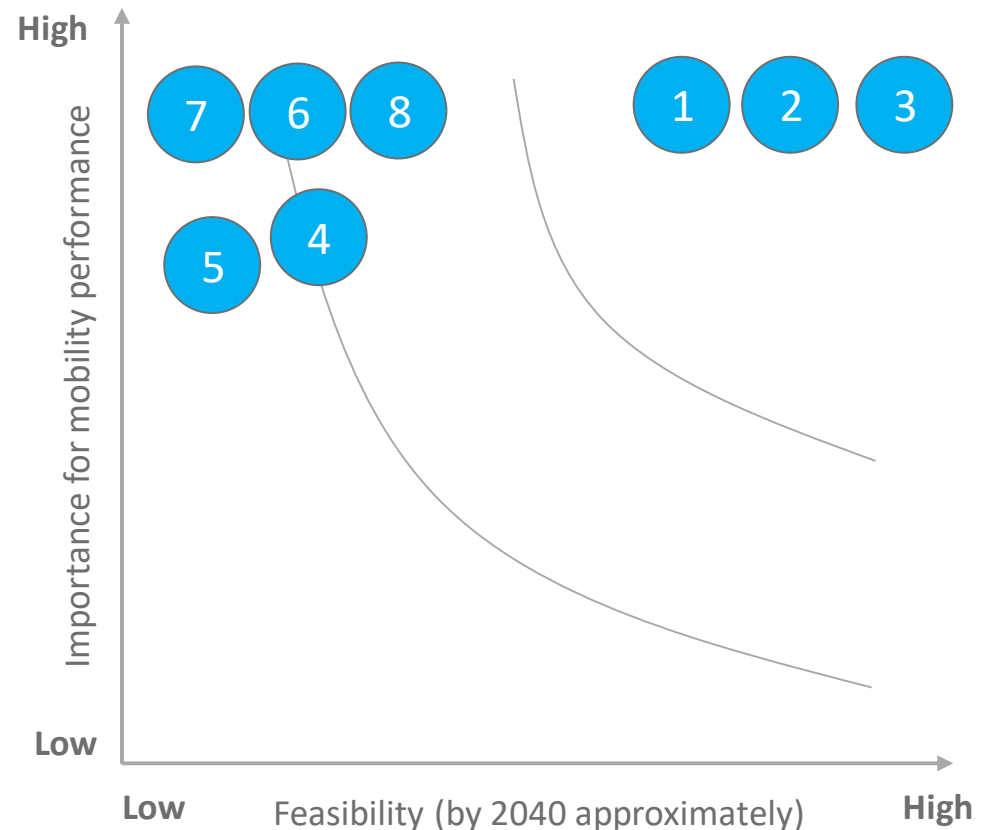


Results Session 2: Multimodality Enablers

(3) What do **passengers of the future** look like in terms of personalisation, travel services?

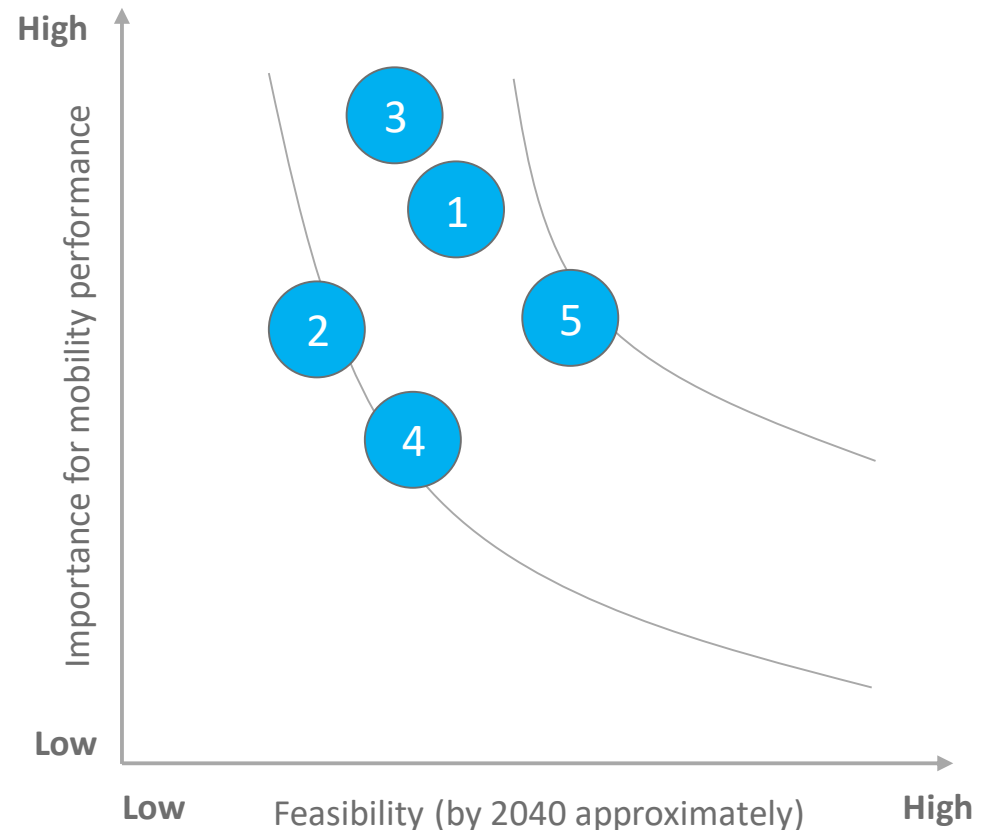
Assessment of Enablers for Passenger Needs (Group 5)

No	Cluster name and description
1	Journey planning: how to improve the D2D options/information for multimodal travel for pax
2	Booking and ticketing: offering one ticket for multimodal trips
3	Regulations: the need for multimodal regulations
4	Information and disruption: information for passengers during disruption
5	Security: streamlining security requirements between modes
6	Network integration: the integration of networks and timetables between modes
7	Price and cost: the process for establishing prices based on costs of travel of the different transport modes
8	Accessibility and comfort: providing better access and comfort



Assessment of Enablers for Passenger Needs (Group 6)

No	Cluster name and description
1	Ticketing innovations: single ticketing; MaaS tickets, one stop shops
2	Seamless and multimodal connections: reducing D2D travel times, seamless travel, travel costs, multimodal offers
3	Green travel: transparency and information, eco-friendly modes through the D2D chain
4	Travel planning: planning & management of disruptions for the demand side
5	Personalisation of travel: inclusion, personal preferences, peace of mind, safety



Summary and Next Steps (1/2)

- There are **multiple challenges and opportunities** when moving towards a **multimodal European transport system**.
- Within Session 2, some key enablers for multimodal transport have been highlighted:
 - **Data as key enabler** for improvement (sharing across providers, security and privacy, initiation of shared platforms).
 - Focus on **regulations** which are an **important foundation** to introduce multimodal solutions.
 - **Passenger focus of utmost importance** when considering infrastructure needs, business models, and door-to-door journeys.

Summary and Next Steps (2/2)

- Have a look at our **upcoming Modus deliverable D3.1 “Future Drivers of Supply and Demand”** (Spring 2021)
 - Identification and assessment of future drivers of supply of and demand for mobility
 - Factors affecting future air-rail market shares
- If you have any questions or would like to learn more about Modus, please contact the Modus project team via the following channels:

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