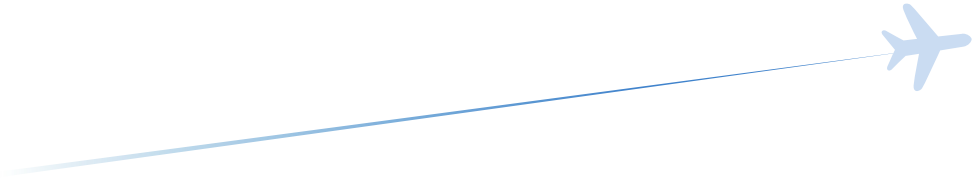

Report on Customer Journeys

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SYN+AIR

SYNERGIES BETWEEN TRANSPORT MODES AND AIR TRANSPORTATION

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Abstract[1]

The present document is the produce of Task 3.1, which goal is to capture the passenger side of multimodal air travel and create the foundation for further work by providing quantified metrics to neighbouring tasks. Deliverable 3.1 details the process, research, design of the material that was required for achieving this goal, ranging from the extensive literature research on air travel, to creating personas, customer journeys and a large-scale passenger survey, which ultimately led to the creation of 23 validated and quantified customer journeys.

The deliverable sets out by investigating previous works on multimodal trip chains of air travel. Firstly, past projects of similar scope were reviewed in terms of how the research was conducted and for the purpose of identifying concepts that could be used as the springboard for the work in this Task. Followingly, airport operations and concepts of multimodality were documented, along with ways of approaching the passenger side of air travel, through a thorough examination of past and current practices. In addition, methods for creating personas and customer journeys were researched along with ways of conducting a survey research, ranging from sampling to dissemination strategies.

A collaborative, creative approach, with multiple internal brainstorming sessions, was the approach that was followed, which sprouted from the solid foundation of the literature research. Through these sessions, the personas of SYN+AIR were created, along with the first tentative customer journeys. This process led to the production of a pool of dozens of questions that could be used in the survey to quantify the trade-offs of passengers during a multimodal trip. A survey was therefore created, reviewed, piloted, and was subsequently translated in all languages of the project team.

[1] The opinions expressed herein reflect the author's view only. Under no circumstances shall the SESAR Joint Undertaking be responsible for any use that may be made of the information contained herein.

Once the survey reached its final form, containing mobility pattern questions, stated preference questions for given scenarios, and a socioeconomic session, it was disseminated by all partners. More than 2200 responses were collected, ranging further beyond the goals set for this task. The results were consistent with the literature and abundant for comprehending how travellers function in a multimodal air travel context. The results underwent statistical analysis for identifying patterns of behaviour and correlations between attitudes and characteristics. Trade-offs between factors that affect the decision-making of air travellers were identified and quantified, and the overall results produced metrics that are presented both per country and per persona.

Based on the analysis of the findings, the customer journeys were finalised and validated through the application of the choice set that each mapped persona was found to adhere to. In total, 23 validated customer journeys were created, including the interactions of the passengers with the various trip stages, and their attitudes towards their choices and possible alternatives.

Table of Contents

List of Tables

List of Figures

A list of relevant acronyms and terminology can be found in Annex A.

1 Introduction

The main objective of this deliverable is to present the way of the development of SYN-AIR's Customer Journeys that capture the experience and interactions of the user when executing a door-to-door journey by plane.

The first objective of the task is to create personas that will serve the purpose of the task. Various types of users are to be identified by the project team and used for the creation of the journeys. For that purpose, literature research for the creation of personas needs to be conducted for assessing which customer segmentation is to be followed. These assumptions are to be validated by the end of the task.

The next objective is to create the customer journeys, using the base analysis scenarios of SYN+AIR (Annex D). The goal is to capture the experience of the users across the entire span of the Journey, by having the various personas interact with the multiple touchpoints of the journey.

The third objective is to identify the interactions and touchpoints within those Customer Journeys and to quantify passenger trade-offs. For that purpose, part of the objective is to deploy a questionnaire for determining users' trade-offs when executing multimodal journeys. Accordingly, carry out an extended analysis of the selection criteria of users when choosing among multimodal alternatives.

The final objective of the task is to gather data that will be used for the upcoming stages of the project and produce a descriptive analysis of the findings. The data needs to reflect respondents from the 4 participating countries (Serbia, Greece, Spain, Italy), gathering a minimum of 1200 responses. The findings are to be analysed in order to provide insight of user behaviour when executing a multimodal door-to-door journey and create metrics that will be valuable for the creation of Smart Contracts by TSPs.

2 The document is GDPR compliant and in line with the regulations of the personal data protection. All the needed actions about the survey participants and their rights have been stated in the ethics deliverable D1.1 and D1.2. Literature research and relevant works

2.1 Past projects of similar scope & past surveys on airport passengers

2.1.1 Introduction

The literature research aims to provide an understanding of the full impact and touchpoints of a service (airport service and ground access system services – TSP services) with the customer, as it has been captured in past projects and similar studies. The literature review covers passenger needs and requirements in a multimodal travel chain of door-to-door trip – D2D and represents a base for exploring the connection and dependence between air transport and other transport modes. To achieve seamless D2D travel, it is important to understand all phases of an air trip, from the planning phase to the end of the journey (Figure 1).

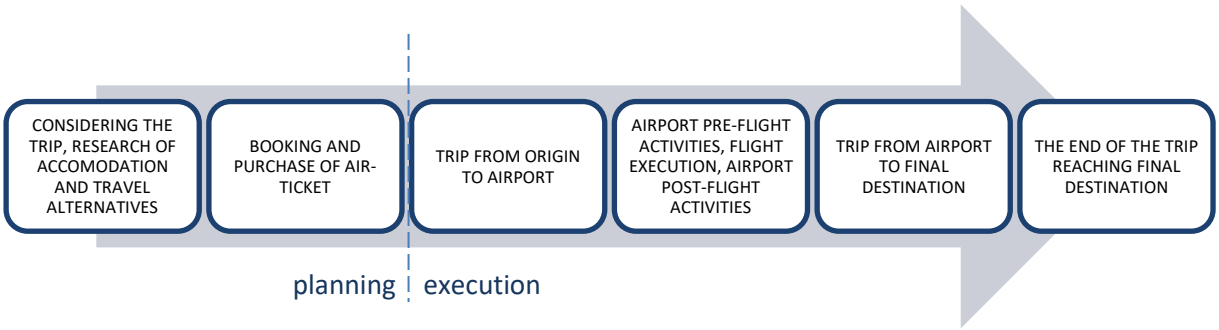

Figure 1: The passenger perspective of air travel from planning to execution

As one of the objectives of SYN+AIR is to develop a customer journey for the entire multimodal chain, the following chapters of the literature review provide input, taking into consideration passenger's perspective regarding multimodal D2D trip, mode choice, airport and airline choice, considerations of travel attributes and passenger profiles. At the end of current section, special attention is given to surveys in the air transport and multimodal transport research area.

The **planning** phase encompasses making plans about the trip, research of accommodation and travel alternatives, as well as decision-making activities including booking and purchase air ticket. Prior to the trip, passengers decide about the travel mode to reach the airport.

The **execution** phase includes travel from origin (home, hotel, business site, etc.) to the airport, airport pre-flight activities, flight execution, airport post-flight activities, and trip from the airport to the destination. The door-to-door trip consists of [1]:

- **Door-to-Kerb** (kerb is the point of arrival at the airport): multi-modal, public/private transport;

- **Kerb-to-Gate**: includes airport processes, check-in, baggage drop-off, security, immigration and boarding, as well as the initial movement from arrival at the airport to the terminal door;
- **Gate-to-Gate**: covers boarding, off-block, taxiing-out, take-off, climb out-cruise-approach, landing, taxiing-in, on-block and disembarkation. This is the "air side" of the process, but it also includes all flight connections and the transfer processes involved in these.
- **Gate-to-Kerb**: from arrival at the destination terminal building through luggage reclaim, immigration and customs, to the point of departure from the airport;
- **Kerb-to-Door**: multimodal, public/private transport.

This review is based on relevant papers and projects from the past few years in order to cover the latest findings and results. The literature review is divided into several sections such as airport accessibility, intermodal passenger transportation, passenger segmentation, passengers' choices and airport/passenger surveys. The breakdown of the various components of the analysis is presented in Figure 2.

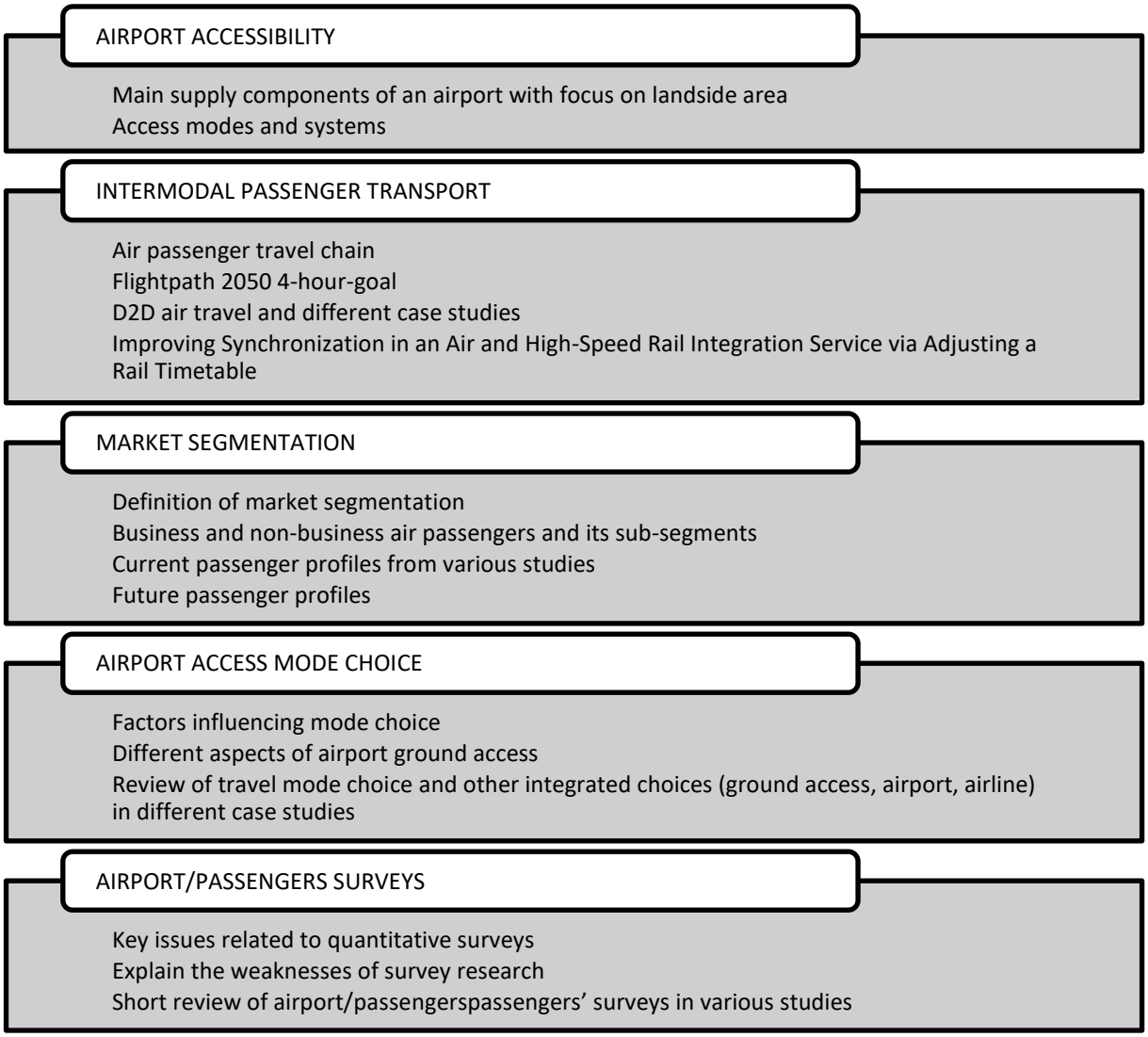

Figure 2: Concept of the literature review of projects with similar scope

2.1.2 Airport accessibility

Each airport consists of two supply components: the airside and the landside area. The airport airside area consists of terminal airspace, runways and taxiways, and apron/gate complex, all intended to handle aircraft of different

size (seating capacity) operated by different airlines [2]. The landside area encompasses air passenger and cargo terminal(s), technical complex, and landside access to modes and their systems.

Since the airport itself is not a primary destination, consideration must be given to airport access by different modes of transportation, since it serves as a hub for further travel. At most large airports, the landside access modes and systems are based on the road and railway transport modes, such as cars, taxis, buses, the streetcar/tramway, LRT (Light Rail Transit), subway/metro, regional/national conventional and HSR (High-Speed Rail), TRM (Trans Rapid Maglev), and recently futuristic HL (Hyperloop) system. All above-mentioned modes and their systems usually operate together through cooperation and/or competition. At the smaller regional airports, most frequently is the road-based transport as airport ground access mode, such as buses, taxis and cars [2].

In general, the accessibility is achieved by using different transport modes and their systems, particularly in the case when the airport is located relatively far from the households or hotels, in both urban and suburban areas. There are two concepts of accessibility. The first concept refers to "location" where the accessibility of certain places is estimated according to the available transport infrastructure and transport services. The second concept is related to "distance" which connect a pair of locations through any transport mode and its systems. The accessibility can be expressed in terms of time, cost, energy consumption, etc. [2].

2.1.3 Intermodal passenger transport

The passengers' travel chain for each individual traveller represents intermodal trip consisted of the following stages: access to the airport by different ground transport modes/systems, airport and non-airport activities in terminal before flight, airline flight, airport activities in terminal after flight and egress from the airport to the final destination by different ground transport modes/systems. Total travel time consists of pre-flight time, flight time and post-flight time.

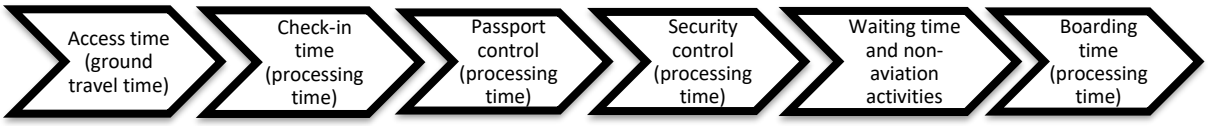

Figure 3: Pre-flight activities and times

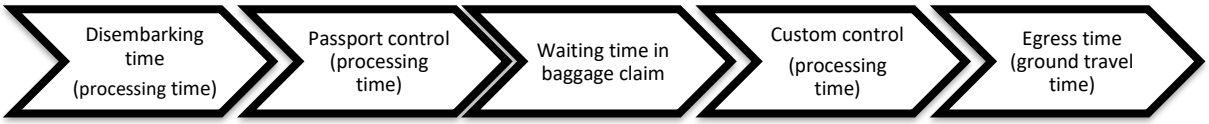

Figure 4: Post-flight activities and times

Generally, air travels are intermodal journeys because passengers, beside airplane, always use different transport modes from their origin to the airport and from the airport to their final destination. The European Commission published the Report of the High-Level Group on Aviation Research, titled as Flightpath 2050 [3]: Europe's Vision for Aviation, where five goals regarding the air transport sector are presented. One of those is that "*90% of travellers within Europe are able to complete their journey, door-to-door within 4 hours. Passengers and freight are able to transfer seamlessly between transport modes to reach the final destination smoothly, predictably and on-time.*" [3].

During the journey, various disruptions may occur caused by airport bottlenecks or access road/rail congestions. It is especially important to identify passenger and baggage flow bottlenecks at airport as well as primary cause of bottlenecks phenomena and take measures mitigating the impact of bottlenecks on passengers' travel time. Besides, travel time to/from airport depends on period of day during which the journey is realised (peak or off-peak period).

Existing literature shows that the above-mentioned goal set in Flightpath 2050 [3] is difficult to achieve. Door to door travel times by different airport ground access systems for 22 large EU airports for two months of 2016 are included in analysis by Rothfeld et al. [4], as a part of project DATASET 2050. Travel times have been collected using the Google Maps Distance Matrix API for all combinations of airport, travel direction, travel mode, three weekdays, and five different time of day. Considering the time requirements for other parts of the travel chain (related to airport activities such as check-in, security, passport control, flight time etc.) time remain for airport access and egress is 50 min (in both directions). After splitting the 50 min to access (25.5 min) and egress (24.5 min) times (based on the ratio of estimated airport egress versus access speeds), it is evident that the four hours door-to-door goal can only be achieved by driving from within 25km of an airport. The authors emphasized that 33% of the EU population are living within 25km of an airport with at least one million passengers in 2015. The authors point out that choice of transport mode has the highest impact on estimated ground system travel time. The analysis shows that travel times by public transport are greater than travel times by car or taxi. This is a reason why passengers with a higher value of time use car/taxi instead of public transport. Rothfeld et al. [4] found that average travel times depend significantly on the mode of transport (car vs. public transport), with car access times being in the range of 24-45min for six of the largest European airports, compared to public transit times of 55-95 min. This research shows that observed European airports' access and egress infrastructures could not provide satisfactory airport accessibility in view of the goal "door-to-door within 4 hours".

Grimme and Maertens [5] gave their interpretation about "door-to-door within 4 hours" goal. They wrote that 90% of trips involving at least one flight segment and car traffic as airport access/egress mode within and between the EU-28 member states could theoretically be completed door-to-door within 4 hours. The authors proposed simple methodology based on flight schedules and origin-destination passenger demand data at airport-pair level. Different assumptions on airport access and egress times have been used to simulate the door-to-door travel chain. Travel costs, frequencies and capacities were not considered. They found out a relatively large share of intra-European air total travel time larger than 4 hours in a case of one non-stop flight. Also, they claim that "air trips in the EU are relatively long, as 46.9% of trips exceed 1000km, and 12.8% of trips exceed 2000km". The obtained results in this research are similar to results of the project DATASET 2050. The sensitivity analysis in combination with empirical findings on average airport access, egress and process times shows that in many cases total travel time of 4 hours is unfeasible.

Monmousseau et al. [6] used aggregated Uber data, daily average travel times between city zones in five different time periods such as early morning, morning, midday, afternoon and evening in order to analyse D2D travel time from Paris to London and Amsterdam. Data was collected over the first three months in 2018. The authors assumed that passengers spent time at airport was 90 min in case of departure, and 45 minutes in case of arrival, at railway station 15 min before trip and 10 min after trip, and at Eurostar station 45 min before trip and 10 min after trip. Two case studies are presented, from Paris to London and from Paris to Amsterdam, by air and by rail. The authors pose three questions: At what time of day should the trip start? On what day should the trip take place? Where does the trip end? Based on comparison between different modes (air vs. rail) from Paris to London in all cases travel time by rail is smaller than travel time by air. It is not possible to achieve goal "from door to door within 4 hours" from Paris to London by air. The shortest travel time by air is possible to achieve during Saturday and Sunday. The analysis of travel time from Paris to Amsterdam shows that the total travel times by air and by rail are similar and very close to 4 hours. In the morning, rail is faster, and in afternoon the total travel time is shorter in a case of air transport.

Román and Martín [7] conducted discrete choice experiment with the aim to better understand passengers' preferences in the integration of HSR[2] and air transport. Analysis of the passengers' preferences was done with respect to some six basic attributes: travel time, travel cost, connecting time, egress time, fare integration and baggage integration. The research focused on routes linking the Island of Gran Canaria with different cities in mainland Spain, through a connection at Madrid–Barajas Airport. A stated choice (SC) experiment was conducted

[2] High Speed Rail

and the travellers were confronted with the choice between the current alternative (Air–Air) and the Air–HSR option. In the first two groups of respondents (passengers at the airport) the current trip was observed as a trip, and for the other two groups of respondents (city sites - civil departments and University) the last trip from the previous 12 months was observed. The analysis showed that it is preferable to develop attractive intermodal alternatives in terms of in-vehicle, connecting, and access time, rather than integrating airport processes. Fare integration is also very valued. Results also show different pattern regarding the preferences between business and private trips. Punctuality and safety associated with HSR were positively valued. Summarized details of all the surveys from papers reviewed, are presented in Annex C.

Sauter-Servaes et al. [8] examined the impact of Air and Railway travel on climate change and shifting travellers from air to rail with the aim to reduce environmental impacts. They showed that the existing applications significantly underestimate the travel time by air because they do not include the actual waiting time at airports and local access and departure time at airports, while for rail they include them. Future research should consider the extent to which passengers perceive positively the time spent waiting at the airport or train station (shopping, eating or working). It should also consider how the size of airports and train stations affects the accuracy of travel time information. Besides, the average stage travel times for business trips, private trips and all trips were obtained (average total travel time for all trips door-to-door air travel 417 minutes and average total travel time for all trips door-to-door rail travel 275 minutes).

Freitas et al. [9] developed the recursive logit model for intermodal urban travel demand analysis. In addition to applying this model to the city of Zurich, authors used binary logit regression to find the most important socio-economic determinants for intermodal travel in Switzerland based Swiss Mobility microcensus (BFS and ARE, 2017). Literature review presented by Freitas et al. [9] shows some multimodal travellers' socio-economic characteristics and attitudes, such as: younger individuals tend to switch more often between transport modes within a trip than older travellers, higher income individuals are more intermodal than lower, women than man. Intermodal travellers can thus be characterized as urban, young, female, well-educated and childless. The data used in the research were obtained from the survey of household trips of the Swiss population from 2015, which is conducted through computer-assisted telephone interviews every 5 years. Respondents were asked for socio-economic characteristics, mobility tools they possess (car, transit tickets), irregular mobility behaviour (overnight travel, day trips), attitudes about mobility and transport policies and daily mobility behaviour. The survey was stage-based, meaning that respondents were asked about each individual stage within each trip. It showed that owning a car or a bicycle has a negative effect on intermodal travel because both of these methods are very flexible and allow door-to-door travel. Also, intermodal travel is more attractive when it comes to longer routes. The study confirmed the result that women make more intermodal trips than men, which is in line with the fact that the owners of vehicles are mostly men, as well as that the presence of children in the family has a negative effect on intermodal travel.

Vespermann and Wald [10] define intermodal terminals as places where transition from one mode to another is done, therefore an airport is considered as intermodal terminal in focus. As surface system authors define infrastructural connection of an airport to its surroundings (both ground access and water access included) and it consists of multiple service providers. Car (private, rental, taxi), bus/coach or train/metro are the most common airport access modes. A survey on intermodal passenger air transportation with the aim to elaborate on the current and future situation at major airports is presented. In the following, the survey is briefly summarized: as respondents, intermodal managers (persons responsible for airport planning and/or related activities) were contacted at 102 airports worldwide including 30 most heavily traffic and obtained 41 response (21 from Europe, 13 from America and 7 from Asia/Oceania). The results of the survey indicate that most of the access and egress trips to an airport are conducted by car, but with major regional differences. European airports show also high share of passengers that arrive at the airport either by train or metro:

Table 1: Modal splits at European airports [10]

	No. of airports	Car	Bus/Coach	Train/Metro	High-speed train	Other

Europe	21	66.6 %	12.0 %	17.1 %	3.0 %	1.3 %

About the current relevance of intermodality in the time of survey (2007/8) following attitudes stands out: “intermodal concepts represent an important competitive advantage for an airport” (mean: 4.6 with range from 5-strong approval to 1-strong rejection), “the schedules of the different transportation modes are coordinated” (mean: 3.6 but with range from 5-strong approval to 1-strong rejection), “customer expectations concerning intermodal concepts are evaluated on a regular basis” (mean: 3.8 with range from 4-approval to 1). In the sequel of the paper, four main motives for the airports of intermodal development were identified: expansion of catchment area, intention to increase airside capacity at the airport, meeting customer needs for a “seamless” transportation chain and address environmental and landside congestion issues. All respondents evaluated their attitudes according to the previous motives. In accordance with that, airports were classified into 4 clusters based on the analysis of responses. As an example of the best intermodal practice Frankfurt airport is selected since there was a joint investment between the airport and the railway company, which allows the passenger with one purchased ticket check-in in the area of station that has a direct connection to the automated baggage of the airport handling system.

For achieving the goal of Flighpath2050 [3] for a 4-hour door-to-door journey in Europe, the BigData4ATM [11] project poses the question of extending research that utilizes the large amount of data available from smart devices. BigData4ATM [11] has a goal to investigate these new opportunities of large-scale dynamic data in combination to more traditional databases which can be explored to test hypothesis about travellers’ behaviour and intermodality. Mobile phone data proved to be useful in the analysis of door-to-door, door-to-kerb and kerb-to-gate mobility but restricted to analysing one country at a time. Twitter data showed its potential for characterizing transport demand at the continental level. The credit card records showed their potential to analyse passenger mobility and expenditure patterns at intra airport. Google data and Public transport Smart Card data showed usefulness at door-to-kerb and kerb-to-door. In gate-to-gate mobility FlightRadar24[3] data were used. Concerning door-to-door passenger journey, information which can be collected may be: passenger profile information, residence/accommodation at destination, length of the stay at the destination, visited places, frequency of the trips etc. In the terms of kerb-to-gate and gate-to-kerb obtained data, they could be used to identify and predict bottlenecks and to collect real-time information about airport services. Some results of case study on Spanish airports were presented by García-Albertos et al. [12].

Mujica Mota et al. [13] notice that abundance of information from personal mobile devices combined with the information available from different stakeholders could be used for short-time predictions of passenger flows and strategy development. The authors give a brief overview of IMHOTEP project aiming to use this information to improve passenger travel experience by providing decision support tools for real-time decision making. The concept of ‘Passenger Activity-Travel Diary’ is introduced in which each stage of the journey contains following data: start/end time and location with the set of additional attributes such as ‘activity type’, ‘transport mode’, etc., while departures, connections and arrivals are observed as main operations. In the sequel of the paper, details on modelling the passenger flows and passenger terminal process simulation model are provided.

Door-to-Door Information of Air Passengers (DORA) finished in September 2018 achieving the goal of project to design and establish an integrated information system with the aim of optimizing travel from origin to the departing airport and from the arrival airport to the final destination. It provides mobile, seamless, and time optimized route recommendations for travels to the airport and time optimized routing within the airports through the integration of the real time information about disorders in ground transportations and on incidents in airport terminals. Reduction of time is achieved on three levels: real time-based intermodal routing services for landside transport,

[3] https://www.flightradar24.com: Popular flight tracker that tracks planes in real-time and gets latest flight status & airport information

reduction of time spent in terminal based on better information provided by the detection system and personalized indoor routing. Within the DORA a smart phone application is designed providing a single point of visualisation of the overall trip.

2.1.4 Market segmentation

Market segmentation is the process of dividing potential customers into smaller consumers groups - segments. Market segments represent groups of customers who share similar preferences and characteristics. In order to tailor their products and services to the needs of passengers, airlines, airports or transport service providers in a ground access, transport sector divides passengers into different segments (groups). This is a way to improve understanding of customers' preferences and buying behaviour. Depending on the purpose and the final goal, different market segments could be distinguished.

Wittmer and Hinnen [14] identify the (1) **situational segmentation** methodology, based on the travel context of the passengers (grouping passengers according to booking preferences and travel requirements); the (2) **socio-economic segmentation**, based on personal and social characteristics such as gender, nationality, religion, age, physical (dis)abilities (which may require special assistance such as the use of wheelchairs), relationship status, income, first language, occupation, education/qualifications, whether passengers are travelling alone, in a group, in a family group or with babies or young children. ; and the (3) **psychographic segmentation**, based on criteria such as personal values, behaviour and attitudes (trip motivation: the reason for travelling, destination, length of flight: short or long haul, length of total time away from home, travel class: economy, economy plus, business or first class, travel experience: frequency of flying, cultural background of the passenger, airline preference, membership of airline or alliance loyalty programme and environmental considerations).

Within literature review, classification of passengers at Copenhagen International Airport is presented by Harrison, Popovic and Kraal [15]. This original classification represents four market segments: **attention customers** who arrive super early and prefer a short and direct path to the gate, **experience customers** (leisure travellers, view airport as a part of their travel experience, have the time and preference for personal assistance), **efficiency customers** (business travellers, prefer direct path to the gate, adopt use of self-service offerings at the airport), **selection customers** (leisure travellers, view airport as a part of their travel experience, adopted to use of self-service offerings at the airport).

Harrison, Popovic and Kraal [15] proposed four market segments based on qualitative research conducted in situ at Brisbane International Terminal during 2012–2013. The interview transcripts were analysed and coded according to time sensitivity, degree of engagement, proficiency of traveller and trip purpose. The **airport enthusiast** category represents the subgroup of passengers who are engaged in the airport environment and are not sensitive to time (35% of passengers). The **time filler** category of passengers represents the passengers who do not engage in the airport environment and for these passengers' time spent at the airport is waste of time (48% of passengers). The **efficiency lovers** are the category of passengers who are sensitive to time and do not engage in the airport environment. These passengers express distress and show a very low tolerance for queuing (17% of passengers). **Efficient enthusiast** is a category of passengers who are sensitive to time and engage in the airport environment (0% of passengers).

Previous passenger profiles examples are quite detailed and exhaustive. Depending on the topic of research and specific interviews and surveys that need to be conducted, the number of segments should be determined. At least two segments are used in transportation modelling, most often business and leisure travellers. Business travellers are time sensitive and relatively indifferent to fare levels, while leisure travellers are price sensitive and show more flexibility about travel time. Many researchers also use four market segments which cover two leisure and two business subsets or three leisure subsets and one related to business.

Table 2: Passengers profiles proposed in DATASET 2050

Passenger profile	Main travel purpose	Predominant Age Group	Income level	Amount for transport expenditure	Use of technical devices and respective retrieval of information	Length of stay	Travel activity (trips per capita)	Travel party size
Exclusive Experience Traveller	Private	25-64	Medium/ High	Medium	Medium to high frequency	More than 3 nights	1.1	1 - 2 people
Family and Holiday Traveller	Private	25-44	Medium	Medium/ Low	Low to medium frequency	More than 7 nights	0.9	≥ 3 people
Best Agers	Private	65+	Medium	Medium	Low frequency	More than 3 nights	0.7	1-2 people
Youngsters	Private	15-30	Low	Low	High frequency	More than 3 nights	1.1	1 - 3 people
Executives	Business	40-65	High	High	High frequency	1-2 nights	1.5	1-2 people
Price-conscious Business Traveller	Business	25-44	Medium	Medium	Medium frequency	1-2 nights	0.8	1-2 people

Concerning passenger profiles considered in past research projects of similar scope, the six different passenger profiles are determined in the project DATASET 2050. Proposed profiles are based on the data available from the sample of European countries (Table 2, Table 3). As expected, high value of time belongs to business travellers (Executives and Price-conscious Business Traveller), low value of time belongs to other passenger profiles, except in a case of Exclusive Experience Traveller. The trip length in terms of nights staying is a parameter affecting the luggage requirements (check-in luggage or hand luggage) and number of bags.

Table 3: Using different ground access mode by passengers' profiles, DATASET 2050

	Public transport	Private car (park and travel)	Kiss and Fly	Taxi	Private car (park at airport)
Exclusive Experience Traveller	Yes	No	No	No	No
Family and Holiday Traveller	Yes	Yes	No	No	No
Best Agers	No	Yes	Yes	No	No
Youngsters	Yes	No	No	No	No
Executives	No	No	No	Yes	Yes
Price-conscious Business Traveller	Yes	No	No	No	No

The MetaCDM project (Multimodal, Efficient Transportation in Airports – Collaborative Decision Making (A-CDM)) examined how door-to-door air passenger journeys can be modified to cases of serious disruption by adapting to encompass ground transportation and other alternatives, with focus on four key areas: airport resilience, A-CDM, multimodal connectivity and the passenger experience. For the scope of survey conducted within the project, two main travellers' profiles are highlighted:

Empowered travellers - who control their own trip, independently access the desired information, plan and reserve certain parts of the trip independently, react to plans and adapt them to the circumstances.

Guided travellers - who entrust most of their planning and delivery to an agent and rely on their agent to possibly adjust the itinerary to new circumstances.

For the needs of DORA project passengers were divided into two main groups with different travel motives: leisure and business travellers. Due to the comprehensive survey conducted within the DORA project, following traveller groups within leisure travellers are observed: **young**, **family**, **middle-aged** and **senior travellers**. At the same time, among business travellers' groups of business travellers below and over 35 years of age were considered.

Budd [16] identified eight behaviourally distinct groups of passengers with varying potential to reduce their private car use. A face-to-face survey with passengers at Manchester Airport was conducted. As six factors affecting ground access travel behaviour authors consider:

- **Mode choice** - whether the passenger had travelled by car, drop-off, taxi or public transport.
- **Trip purpose** - whether the passenger was travelling for predominantly leisure or business purposes.
- **Luggage** - whether the passenger was travelling with checked-in luggage or not.
- **Travel group size** - whether the passenger was travelling alone or as part of a group.
- **Time of access** - whether the passenger travelled to the airport in the early morning peak period between 05:00 and 07:00.
- **Journey distance** - whether the passenger's journey origin was less than, more than or equal to, 60 minutes' drive from the airport.

As a result, eight behaviourally distinct passenger segments were subsequently identified using cluster analysis: complacent motorists, dogmatic drop-offs, ardent taxi users, devoted drivers, conflicted greens, environmental champions, pessimistic lift seekers and public transport advocates. For each of the segments potential second best mode is proposed.

2.1.4.1 Future air passenger profiles

In IATA's Vision 2050 document [17], an optimistic view of the customer of the future is given. It is pointed out that price represents main driver of consumer choice. Business travellers still value their time above all, while older travellers value a high level of comfort and convenience. People are becoming increasingly concerned about the environment, which further affects the choice of travel. Influence of the environmental issues has a growing trend. For one segment of travellers "just travelling by air is not enough, they want a personal and unique experience". These very experienced passengers tend to seek something 'extra'. Some operators pay special attention to adolescent and offer them special sections on their larger aircraft where have opportunity to meet, play games, and even establish friendships with people of their own age. Passengers from developing countries are using air transport services for the first time becoming more numerous. This segment is the fastest growing comparing with others. The purpose of first travel is VFR, often followed by leisure travels.

Generally, passenger profiles are changing over time. Passenger profiles in time to come depend on future trends in socio-economic, demographic and technological factors affecting travellers' behaviour. This claim is confirmed by Cho and Min [18]. They considered the characteristics of LCC passengers and non-LCC passengers through similarities and dissimilarities in two-time horizons (2005 and 2015) in USA. The main finding is that airline-type passenger segments are dynamic and constantly changing. The analysis is based on demographic data per diem, income, age and household size) and trip related data (airport access time, checked bags, terminal wait time and trip duration).

Attitude towards the environment is likely to be one of the important characteristics in the future passenger profile. Bruder Encler (2017) considers correlation between environmental concern and air travel and also examines sociodemographic, spatial and attitudinal predictors of air travel for private purposes. The data used for analyses

are obtained in two phases on the basis of the Swiss Environmental Survey 2007, followed by mail and phone interviews. To briefly summarize the results: the lognormal hurdle indicates that more environmentally conscious people are less likely to travel by air, and if they do, they travel less. The green voters are rather less likely than many other voter groups to opt for air travel. Also, living closer to airports, in particular to large ones, is correlated to more air travel.

Kluge at al. [19] determined six future air passenger profiles for 2035, reflecting major developments faced by the European transport sector (DATASET 2050); Cultural seeker, Family and holiday traveller, single traveller, best agers, environmental traveller, digital native business traveller.

It is expected that Covid19 pandemic will influence the market segmentation in the airline industry and in other modes of transport as well. The future market research may indicate new segments, based on passengers' attitude towards pandemic or some other external global disruptions.

2.1.5 Airport access mode choice

The factors influencing choice of the airport landside access modes and their systems or individual /private cars are following: availability, access time, access cost, transport service frequency, reliability, punctuality, and convenience of the arrival time at the airport, convenience of storing and retrieving luggage and whether access with transfer or without transfers is. The access time and price are directly proportional to the airport access distance at almost all landside access modes and their systems across many European and US airports [2].

Air travellers' access mode choice models are based on individual characteristics (gender, age, car ownership, income etc.) and alternative-specific attributes. To understand airport accessibility, researchers take into account trip purpose (business or leisure air trip), solo/group journey, the size of passenger group, number of baggage etc.

Generally, as it is mentioned before, air passengers could be divided into business and non-business categories. Despite diversity within each category, separate modelling for business and non-business segments is usually used.

The literature review offers diverse approaches regarding the study of airport ground accessibility which has been largely investigated in different ways, such as:

1. access mode choice in the light of passengers' preferences and behaviours,
2. modal split to determine market share,
3. integrated airport choice and access mode choice,
4. integrated choice of airport, airline, and access mode,
5. access mode choice in an airline type choice context (LCC and FSC),
6. modal splits for relocated airports or
7. an assessment of the introduction of a new mode.

The most important issue is to understand passengers' preferences and behaviours with respect to the access mode choice. Therefore, market segmentation has an important role in modelling airport ground access.

Birolini et al. [20] consider access cost and time as two most significant parameters that negatively affect access mode choice regarding alternative-specific attributes. Both access time and cost can be split into various components, such as in-vehicle travel time, waiting time and walk distance for time and parking cost, toll charges, gasoline cost, public transport ticket cost for cost. The total travel time (TT) is split into in-vehicle travel time (IVTT), which measures the time actually spent traveling, and out-of-vehicle travel time (OVTT) (the walking time plus the transfer time). Bergantino et al. [21] note that airport choice depends on price and quality of air services offered at a specific airport, but also on the time and cost required to access it. Akar G. [22] examined factors that affect the airport ground access mode choice and how some characteristic categories of passengers (those who are most concerned about travel, those who worry most about price or those who worry about other factors such as luggage, flexibility of departure time and time of the current and return flights) take the alternative mode choices.

Concerning the attitudes, the most important factor to consider alternative modes was reliability, followed by travel time to the airport, and flexibility of departure time for both business and non-business travellers. Business travellers cited travel time and time of current flight important factors in higher percentage than non-business. Reliability was highly valued in both categories, while cost was not chosen as an important factor by some survey respondents. The top five most important factors for respondents that affected the mode choice they took on the survey day, in descending importance, were time of current flight, travel time, flexibility in departure time, comfort, and time of return flight.

There is research with focus on specific categories of airport ground access mode users such as airport employees [23], elderly passengers [24], 'meeter-greeters' - friends or relatives of passengers, when three or more people accompany a passenger [25] etc. A brief overview of selected papers on mode choice is presented in Annex A. It points out the topic, case study and main findings in research.

2.2 Airport operations & concepts

Due to the increasing traffic flows of passengers choosing air transport, airways companies are facing with the numerous of activities for achieving passengers' satisfaction and maintaining higher quality of service standards. Mostly, the concept of the airport operations refers to the passengers' activities, such as baggage handling systems, aircraft maintenance and passenger security [26]. These operations are performed by ground services such as loading/unloading of luggage into/out of the aircrafts, transfer of baggage, aircraft parking assistance, etc. and they affect airports' operational and financial performances. Another paper proposed by Sumathi & Parthasarathi [27] considered airport operations, such as the administration operations (e.g., the operations involved with the common use of facilities and services, passenger services, tie-up services), financial operations, daily monitoring (the performance of ground operations handled by ground handlers for smooth and effective functioning), quality control, flight operations, etc. Furthermore, Tabares [28] focused on the airport operations regarding pandemic-free travel concept due to the Covid situation.

In general, the airport systems consist of numerous aspects which are often correlated with the activities and operations related to the landside and airside area of the airports. The airport airside refers to the airport surface (terminal airspace, runways, gate complex, etc). The landside area refers to the passengers' arrival/departure at/from the airport terminal and from the airport terminal to the airplanes and it consists of the air passenger and freight/cargo terminal(s), technical complex, and landside access modes and their systems.

Air passengers and freight/cargo terminal(s) are considered as one of the main components of the air transportation system; the technical complex is related to the infrastructure and airport facilities, while the landside access modes and their systems are related to the accessibility of air passengers, freight/cargo shipments, airport employees to/from the airport [2]. In particular, the efficiency and airports' accessibility depend on the collaboration of each transportation mode in the multimodal transportation system. The term accessibility is referred to a measure for reaching the airport by using different transportation modes (PT, MaaS, Rail). In such a way, the measure of accessibility is based on the number of opportunities which can be reached with a given travelled distance, time, travelled costs, etc. The next chapter discusses the access/egress at the airport in relation to ground operations and services that are the issues that mostly affect the competitiveness of air terminals.

2.2.1 Landside airport area

The landside area of airports involves passengers' pick-up/drop-off curb areas, the transportation infrastructure, and the access of multimodal transportation modes [29]. Therefore, airports can be accessed from their catchment areas by different transport modes and there are several attributes and factors that influence the airport landside access/egress, such as [2]:

1. the availability of the particular transportation mode in preferred time period;
2. access time in the terms of the time needed for reaching the airport;

3. access cost related to the price to be paid at the arrival of the airport;
4. transport service frequency of particular transportation mode and the waiting time;
5. reliability of the transportation mode according to the scheduled services, comfort, etc..

However, the transportation access modes do not only differ between airports, they also significantly differ among travel segments within one airport. Available transportation modes usually differ both in travel time and travel cost, where some travellers prefer a more expensive but faster mode, while others choose a cheaper but slower transportation mode. Non-residents have a much lower car share and since they usually do not use their own private car, they use public transport more intensively. Business travellers generally have a stronger preference for MaaS since they are willing to pay more to decrease travel time and achieve comfort.

2.2.2 Landside performance

The airport access/egress performance could be measured through different indicators such as airport connectivity and quantitative attributes. The paper proposed by [30] defined the connectivity measures as average and variance of walking time (to a service point), average and variance of waiting time (for scheduled/non-scheduled services), average and variance of travel time (on a given mode and path), and average and variance of scheduled headway. The authors referred to the quantitative attributes such as smoothness of a transfer, availability of easy-to-observe and easy-to-use information channels, and overall inter-modal connectivity satisfaction. Moreover, the evaluation of the intermodal airport ground service connectivity in the paper was defined based on three criteria cost-efficiency, cost-effectiveness, and service effectiveness.

3.1.2. Landside airport operations

Each operation, including the landside of the airport, related to the incidents that may occur with vehicles, traffic flow, passengers' quality of service, etc. is measured and controlled by airport operators [29]. The duties of the airport operators are corelated with the airport's size, while any airports use security personnel to manage traffic at the pick up/drop off areas. However, the airport operators were firstly involved with the economic benefits from the airport infrastructure and ground handling services, while nowadays, they are more interested in the revenues from the multimodality and airport connectivity. The presence of ground transportation mode accessibility increases the number of working places, shops and services located at the airport area, which financially benefits to the airport system [31]. This is achieved through customers' facility charges, e.g., fee charged to the users for accessing the airport access roads by different transportation modes. Therefore, one of the main roles of airport operators is fulfilling users' expectations through the proper design of the airport access roads, and the management of the ground services (planning, monitor, and supervisor of services and activities in ground transportation areas). Also, these operations include [29]:

- Resolving daily issues such as conflicts between transportation service providers;
- Managing daily traffic issues, vehicle queue management;
- Evacuation of vehicles and personal during emergency;
- Involvement with parking lot operations;
- Monitoring daily activities related to the maximum allowable parking time;
- Providing and monitoring customer services;

The passengers using private car have a limitation related to the maximum dwell time at the curb side. However, only licences taxi drivers are allowed to access airport, while the bigger number of taxi vehicles could lead to the congestions at the airport's curb side, and this could be omitted by establishing "hold lots". Additionally, managing taxi service operations, could lead to increasing the overall efficiency of the ground transportation systems at the airport. In the case of MaaS transportation service (taxi and ridesharing apps such as Uber or para-transit services), passengers usually book the vehicles in advance through apps or Internet. The main feature of MaaS is the lower travel costs, although the travel time could be higher since it has to make stops according to each passenger request in case of car-pool services. Public transportation (mainly, bus services) and rail services are driving on fixed

schedules and are offering the lowest price [29]. Streeting et al. [32] defined some actions which should be considered in a short- and long-term period for improving efficiency of airports efficiency. In long term period, the authors referred to:

- Giving opportunity to new mobility for improving operational and financial performance;
- Developing strategies based on a robust understanding of passenger responses to mobility options;
- Plan future mobility changes, and incorporate flexibility into infrastructure designs;

In the further will be described the access/egress activities/operations for each of the above-mentioned ground transportation modes.

2.2.3 The car and MaaS access/egress operations at airport

The operational performances of MaaS companies with respect to airport landside accessibility, are related to the capacity, quality of service provided to users, transport work and technical productivity [2] The capacity is referred to "traffic" capacity with the maximum number of passengers which can be transported through the "reference location" during given period of time under given conditions (e.g., constant service demand, service demand with average delay). Quality of service refers to the infrastructure and vehicles' airport accessibility. In the case of MaaS, it is related to the performance indicators such as the convenience of access, reliability, punctuality, internal comfort, and safety. The "transport work" is the product of the vehicle capacity and transport distance during a given period of time. For example, if the distance between a user's home and the entry of airport passenger terminal is 15 km, the transport work to be carried out by private car or taxi (with the capacity of four seats) will be 60 km. The technical productivity is defined as a product of the vehicles seating capacity or the user's occupancy and the average travel speed along the route between a given airport and its catchment area, for a given period of time.

The airports operational services are mostly designed with the specific area for MaaS drop-off and pick-up places, but due to the growing demand, many airports have resulted in congested curbs and roadways at peak periods which lead to modifying curb assignments. The practice study [33] adopted the strategies for managing ground access activities and airport operations with the focus on: i) demand management for decreasing the congestion and maintaining operations; ii) enhancing the landside level of service, revenue optimisation and environmental goals. Additional operations are related to specifying the pick-up and drop-off locations, inner/outer curbs, define routes to/from staging area to terminals, specify staging lot dwell time limit, establishing intermodal centres for all commercial ground transportation operations, provide adequate capacity, etc. Also, in shared taxi operations different situations should be considered, e.g., how to match customers together in a shared ride, where some providers could match only passengers approximately close to each other's destinations, according to the first pick-up requests, etc. [34]. Moreover, since MaaS applications continue to develop, airport operators must invest in improving digital sharing for informing passengers with ground transportation options and the influence of different access modes [33]. Implementing MaaS through smartphone apps would support easier multimodal trips that could easily incorporate more than two modes of transportation. Moreover, the taxi access/egress fares could be quite expensive for longer distances especially in United Kingdom and Switzerland (e.g., London Gatwick, Heathrow and Stansted), while in Greece, Italy and Spain are relatively lower [31]. In Table 6 are reported some studies that investigated and analysed MaaS accessibility at airports.

2.2.4 The bus access/egress operations at airport

The access/egress to the airport considering Public Transportation (PT) is sometimes inopportune since ground access modes are mostly dominated by MaaS. The study proposed by [35] stated out that passengers who tend to use PT more frequently (more than seven times a week) and solo passengers, are more likely to choose bus, while business-class air passengers are more likely to use MaaS transportation.

For example, the factors that affect the usage of PT services, as defined by National Academies of Sciences, Engineering, and Medicine (2008), are:

1. door-to-door transportation since many air passengers are willing to pay additional fares for door-to-door services because of the reliable travel time even though the travel costs are higher;
2. pick-up/drop-off locations;
3. frequency of service, etc.

Other factors, proposed by Rohani et al. [36] are population characteristics, economic conditions, cost and availability of other transportation modes, travel conditions, fares level. There are several studies in the literature that investigated the airport accessibility by PT, as reported in the Table 6.

Nowadays, airports tend to design the bus-only lanes for connecting the airports with the city centres or the most frequent destinations, to increase the efficiency of PT operations such as a travel speed and travel time reliability. Therefore, the availability of express bus services (bus-only lanes) access to the airport have become attractive to air market segments since they could lead to significant travel time savings compared to multi-stop bus services, [33]. Additionally, the express busses could offer better service than regular buses for the airport transfer, even though the fares are higher than the regular service, since they are equipped for larger amounts of baggage [31].

The report provided by Interreg [37] defined the advantages of bus services, compared to rail services, such as lower cost of express bus services and bus fare multi-journey ticket discounts. However, the bus services tend to have more changes (timetable, service) than rail services and are highly influenced by the congestion on the road network, especially in peak hours. Additionally, operators often have difficulties in providing accurate information, and delays of bus services are more frequent. In some cases, private bus services and airport operators have the business relationship, and the bus services are required to have permission for picking up/dropping off passengers at the airport, respect the airport regulations and pay the fees. In the other cases, any licensed private bus services could pick up passengers, which could lead to the imbalance between the demand for PT and the number of providers [38]. The airport managers could improve the operational performance with the PT through the usage of the airport curb side as a transit hub. In these cases, public bus schedules are designed so that bus drivers can transfer to the other routes stopping at the airport, which lead to improving the public transit access to the airport [39].

There are several studies in the literature that investigated the airport accessibility by bus, as reported in Table 7.

2.2.5 The rail transport access/egress operations at airport

The railway accessibility at airport mostly requires the connection with the public or private transport to accomplish the door-to-door (D2D) journey. Additionally, the passengers are interested in travel time to arrive/leave to/from the train station or airport, as well as the total D2D travel time and quality of service.

In general, the express train services are the faster and more expensive transit mode (e.g., Stockholm Arlanda or the London airports Gatwick, Heathrow and Stansted), compared to express/regular busses. However, the choice of rail transportation avoids roads' traffic congestions and achieves several advantages such as decrease of travel/waiting times, short-distance accessibility, as well as a high frequency. For example, the connection of Frankfurt airport with high-frequency long-distance trains to the German and European rail network increases the accessibility of airport's catchment area. However, the airport operators are interested in increasing the attractiveness and competition of the rail transportation through the proper infrastructure availability as well as creating various ticket options for travellers such as purchasing the combination of rail and air ticket. These tickets are more convenient for passengers since they offer lower prices compared to regular long-distance rail transportation [31].

The connection of rail transportation with airport's catchment areas requires the decision making of transportation operators regarding infrastructure investments in building railways, stations/terminals, etc. However, the main

performances of the rail transport landside accessibility could be divided in infrastructural, technical/technological, operational, economic, environmental, and social performances [2]. The factors that affect the usage of rail services comprise sufficiently high passenger numbers (to cover costs and allow a frequent service), the existence of local rail services (to minimise construction costs), easy connections. Therefore, connection of the rail transportation with airport access/egress factors depends on a several factors, such as rail station accessibility, parking availability at rail station, baggage trolleys and ramps at the rail station, etc. Additionally, the Rail operators are interested in increasing the demand between the airport and the destinations their rail service would reach and the ability to attract passengers from road modes, through the agreements with as many as possible airlines. However, one of the biggest obstacles for rail infrastructure operators are benefit/cost ratios, where the low-cost carriers often offer lower prices than the offers of private rail operators for high-speed rail routes. Rail service operators, as well as the rail infrastructure operators, are concerned that improving the rail airports' accessibility and competitiveness with other transportation modes. However, one of the obstacles for rail operators is the requirement related to the capacity of airline hubs in the case that rail operators do not have enough demand to guarantee feeding of the airlines' hubs [40]. There are several studies in the literature that investigated the airport accessibility by rail transport, as reported in Table 8.

2.3 Using personas and customer journeys for air transport

This chapter aims to research methods for creating personas and customer journeys by investigating relevant academic and scientific works and exploring the methods for representing air and land travel accurately. In addition, the chapter will create a list of potential schemas that could be used to depict the customer journeys and identify ways to accurately represent the interactions with the system from the traveller's perspective.

2.3.1 Representing travellers with personas

Personas are representations of archetypical users. They aim to comprehend and visualise these users' objectives and motivations, together with their relationships with existing products, with a focus on the psychological aspect of user choices and experiences. Personas are ultimately used to define what users aspire to gain by using a product or service.

Personas facilitate the understanding of user behaviours, needs, characteristics and limitations. Having a small set of personas makes real users more tangible, especially for large organisations or multi-partner projects with a diverse group of stakeholders where some of them may not be familiar or involved with the user research. The real users are presented to the team via these personas, described with a realistic name, a photo, some demographic information and a textual description to make them credible representations of the user population [41].

There are two main methods for designing personas:

Method 1: Data-driven persona design

Qualitative data can be organised to show common trends, and what the relevant user characteristics are in relation to the product in question. After mapping the distinctive factors among users, the next step is to translate these factors' broader variables. Each participant was then classified according to his or her position on this range. After some iterations, patterns of characteristics and clusters of users emerged, indicating where some participants could be grouped as one of the user personas [41].

Method 2: Conceptual persona design

A conceptual design defines personas which represent the characteristics of the target customers. In order to define a persona conceptually, the following areas of analysis need to be addressed:

- who are the customers?
- what are their needs?

- what is their lifestyle?
- what do they want?
- what motivates them?
- which devices/technologies they use?

Personas that are frequently employed within the transportation industry are described extensively in chapter 2.1.4.

2.3.2 Customer Journeys for land and air travellers

The use of Customer Journeys is rather popular in the field of marketing and advertising, since it is a tool that enables conceptualisation of customer needs and interactions, represented and visualised to analyse customer's user experience with a product. These characteristics of Customer Journeys render them incredibly useful for SYN+AIR, since the 'product' in question is a door-to-door trip using land and air transport. The aim of customer journeys at this point is to comprehend the ways that a traveller interacts with the various components of the trip.

Design Methods for creating Customer Journeys:

- **Service blueprinting**

Service Blueprints typically emphasize real-time interactions and reveal more information about the background of the operations. Blueprints are not intended to capture the sentiment of the user in detail, if at all, since the focus is on the process of how each action is carried out [42]. This representation would be useful in the case of synergies between TSPs, since the interactions and data exchange that takes place in the background, could be represented visually. Figure 5 describes the service blueprint of a traveller staying at a hotel, which could similarly potentially be used for the interaction of a traveller with air travel.

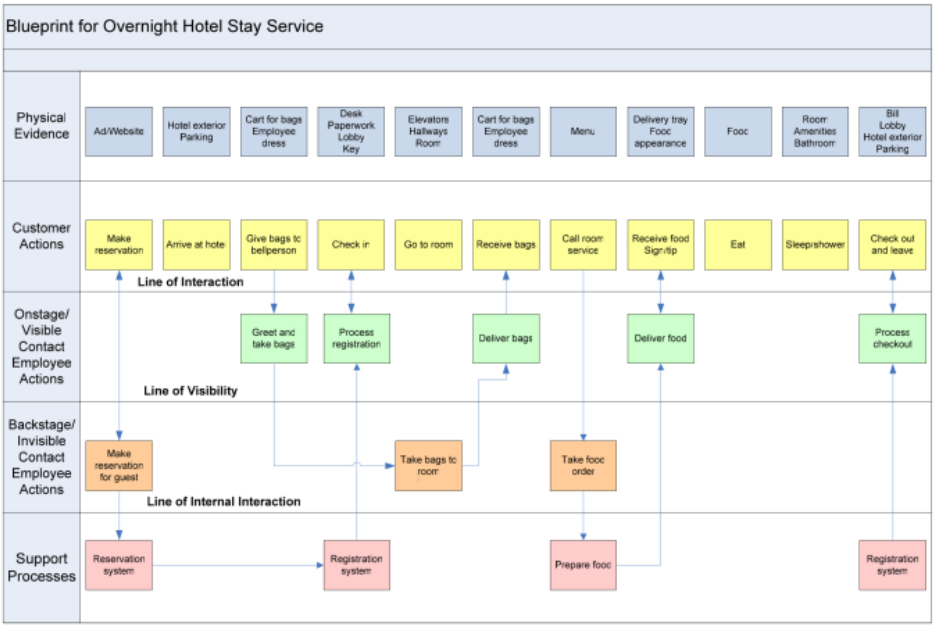

Figure 5: Blueprint for overnight hotel stay (Bitner, 2007)

- **Service Mapping - service encounter model**

The service encounter model (Figure 6) allows the representation of interactions and roles, keeping the customer in the middle. The service mapping paradigm is not solely about marketing, but rather covers production, delivery, innovation, administration and more. The actor of several functions of the process may often be the same person or entity, and therefore this representation emphasises the role of the actors behind each process. On the downside, the distinction between actors and entities is not strict, but rather inclusive and abstract, and the customer experience is not captured at all. [43]

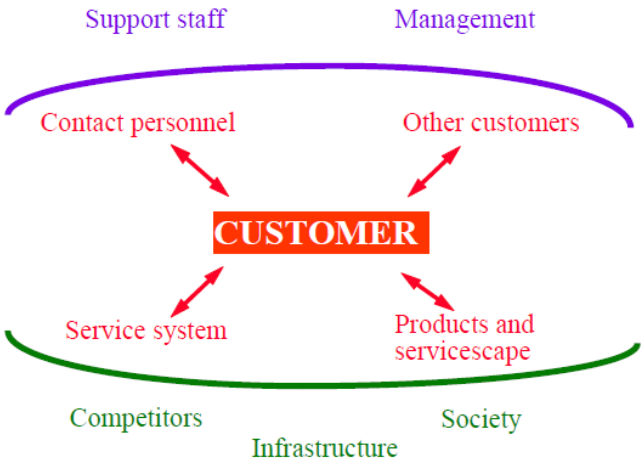

Figure 6: Service encounter model [44]

- **Sequential Incident Laddering Technique (SILT)**

The SILT is a variation of the Sequential Incident Technique (SIT). The SIT aims to capture the customer service experience layer that emerges through the interactions of the customer with the service layer of a journey. A vertical mapping (i.e., laddering) of each experience to the personal values of a customer is explored in parallel. Combining the laddering strata and SIT into the sequential incident laddering technique (SILT), allows this method to identify the relevant stakeholder stimuli which triggers the most protruding emotional responses to customers. While this is an excellent concept to grasp the emotional condition of the customer, this design method does not explore the interactions between stages, nor the processes that lie behind the touchpoints of the user.

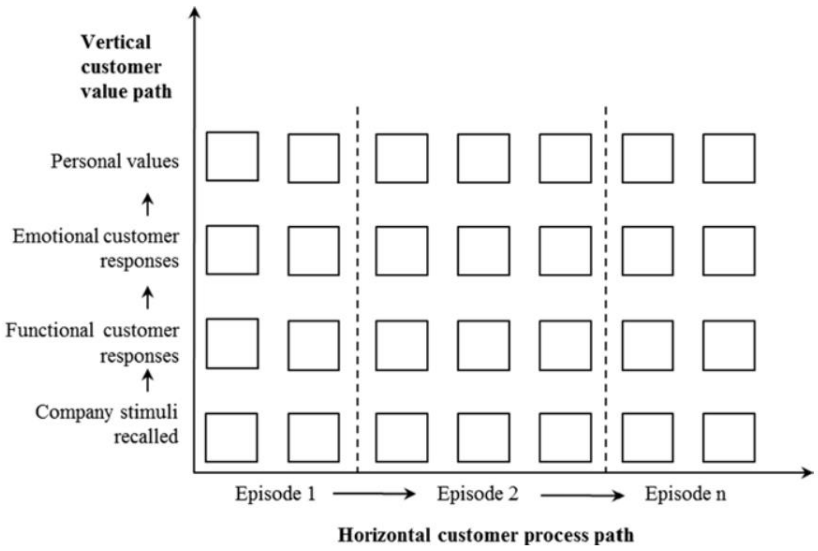

Figure 7: Key features of the SILT [44]

2.3.3 Elements to be captured within a Customer Journey

Typically, a Customer Journey aims to capture the stages that a customer undergoes during the process of making use of the product. For example, an ordinary customer journey may include the discrete stages of Awareness,

Discovery, Purchase, Bonding, Advocacy. These stages may often appear in different variation, for instance, Awareness, Consideration, Purchase, Experience, Loyalty. There is no golden rule for setting the category names or the number of stages in a pre-defined manner, as these are always to be tailored to the needs and purpose of the product.

Representing a Customer Journey by the above-mentioned categories is oriented primarily towards marketing, and it will need to be adjusted to be suitable for the purpose of describing the various stages of a customer's trip. For making this possible, the Customer Journey should be focusing on the sequence of events during the trip of a user and should represent each interaction between the user and the system, namely the touchpoints of a Customer Journey.

A touchpoint signifies the moment when a customer will come in contact, use, or interact with any component of the trip chain. For example, a traveller may be travelling by train. In that case, they will issue the ticket, validate the ticket, travel by train, exit the train station. Depending on the level of analysis and the resolution depth that the Customer Journey is aiming at, the user in question may have had one single touchpoint (with the train operator), or several touchpoints (with the ticket issuing machine, the validation gate, the train, the train station).

2.3.4 Airport/passengers surveys

To provide meaningful results, the survey has to satisfy the following conditions: correct definition of population, sample must be representative of the population, respondents should understand questions and have required knowledge, be willing to participate and corporate [22]. These conditions often are not satisfied and mistakes such as sampling errors, nonresponse, ambiguity of question or answer, inability to formulate response, unwillingness to respond or interviewer error, appear. The development of new forms of communication technologies is accompanied by adaptation of survey methods. However, there are three most prevalent methods of conducting surveys: face to face or personal interviews, telephone interviews, and self-administered surveys.

The absence of the interviewer in self-administered surveys makes the open-ended questions quite useless because there is no one present to explain things to the respondent. This type of interviews is frequently used in airplanes, restaurants, hotel to assess customer satisfaction with the offered service. In self-administered surveys additional effort must be put in identification of study participants and to obtain a valid mail or email address or location to distribute the questionnaire. Disadvantages such as identity of the respondent, the speed of response, the order in which questions are exposed and answered implies that long questionnaires cannot be used in this method. Nonresponse also poses a significant problem when conducting an online survey (web or e-mail survey), as further explained below. Some of the main advantages of online surveys are global reach, minimal costs, flexibility of design, accessibility, ease of data entry and analysis, convenience, quick results, better response rates and greater accuracy. On the other hand, the main flaws are related to sampling issues such as lack of quality random sampling, mainly unknown characteristics of people in online communities, technological variations, privacy and security issues, difficulty reaching some types of participants.

Measurement is a standardized process of assigning numbers or other symbols to certain characteristics of the objects of interest, according to some pre-specified rules and scaling is the process of creating a continuum on which objects are located according to the amount of the measured characteristic they possess.

The following part of this chapter focuses on survey sampling problems.

2.3.4.1 Types of online surveys and associated sampling methods

A survey study is launched in order to understand how the participants behave, how they function and what they value most. It is therefore import to disseminate the survey along the relevant channels in order to target the correct groups that are needed for the purpose of the study. There are therefore various approaches regarding the sampling methods and dissemination strategies that are important to be explored for the purpose of choosing the set of strategies that are more suitable for the present project, particularly since the foreseen method of conducting the survey is through online participation. Fricker (2008) describes different types of online surveys and sampling methods in probability and non-probability-based sampling categories. The summarized sampling methods are presented in Table 6 of Annex A. Following, basic notions are introduced regarding sampling:

1. Probability based sampling:
    1.1. Surveys using a list-based sampling frame (sampling from a closed population) requires only contact information (e-mail) and represents simple random sampling. It is desirable to have additional information about contacts to assess nonresponse effects. This kind of survey is usually conducted within the organizations such as companies, government organizations, universities, magazine subscribers etc. In a more complicated sampling schemes, such as stratified or cluster sampling, it would be desirable to have additional information about participants (membership to particular strata) which sometimes makes it difficult or impossible to implement on online survey. In such situations multi-stage sampling procedure may be required, but it is quite demanding to plan and prepare. Note here that even if some organization maintains a list of e-mail addresses for everyone in the organization it does not necessarily follow that every individual on the list has equal access. Lack of equal access could result in significant selection and nonresponse biases.

1.2. Surveys using non-list-based random sampling (sampling from general population) allow for the selection of a probability-based sample without the need to enumerate a sampling frame. It is clear that members of general populations are more difficult to contact because a list of e-mail addresses with a wide enough coverage to serve as the sample frame is not usually available, so potential respondents must first be contacted through a conventional mode (RDD).
1.3. Intercept surveys are pop-up surveys on the web. Frequently these surveys use systematic sampling for every k^{th} visitor to a website or web page. Note that sampling every n^{th} visitor constitutes a probability sample only if one defines the target population as visitors to this particular website. Their main weakness is nonresponse and possibility that the same visitor of the website participates more than once (that might be prevented by use of cookies).
1.4. Pre-recruited panel surveys are a group of potential survey respondents, recruited by some probabilistic method, who are available for repeated surveying and who are generally recruited via some means other than the web or e-mail – most often by telephone or postal mail. The advantage of this method is speed of online surveys and short process of recruiting respondents, while main drawbacks are "panel fatigue" when participants tire of filling out surveys and "panel conditioning" when they learn to provide the easiest responses.

2. Non-probability sampling methods:
2.1. Entertainment polls conducted on websites or at television shows.
2.2. Similar as 1.1, are unrestricted self-selected surveys. Those are surveys posted on a website and open for anyone to participate, without any restriction.
2.3. Surveys using harvested email lists whose application is very questionable and even unethical getting into privacy issues.
2.4. Volunteer panel group of individuals who have volunteered to participate in future surveys. They are different from pre-recruited panels, since the volunteers are not recruited using a probability-based method. Volunteer panels of Internet users are fast growing in industry of late and there are companies who offer conducting such types of research. Subjects are selected for the panel by submitting demographic information at a portal, then are asked to participate by invitation-only to a survey. Although researchers have more information about the subjects, the base of this approach is still self-selection.

To summarize, for research using online surveys is essential to decide whether they require probability or non-probability-based sample before conducting a survey. If the non-probability-based sample is not satisfying then the method of contacting respondents must be carefully considered. In all cases probability-based sample, only sampling from a closed population such as from organizations with well-defined e-mail addresses allows online survey. At the end, note that combining a large convenience sample with a probability sample, although sometimes seems possible is not useful in the practice.

As an addition to the analysis above, a short review of airport/passengers surveys from selected papers is presented in the Annex C. For each research, the following information are given: survey method and technique, type of questions, topics of research, place and time of survey, number of respondents and whether sample description is available. Note that SP is abbreviation for stated preference and RP for revealed preference.

It can be seen from the Annex C that surveys were mostly conducted face-to-face and in minor number by telephone interview. Only Sauter-Servaes et al. [8] obtained information from application designed for the occasion of research. Stated preference was often used, sometimes in combination with the revealed preference. Hess [45] notes that with increasing need for accurate forecasting in air travel, an attention must be put on modelling techniques with a particular reliance on discrete choice models. Results of the analysis showed that a standard modelling approach is not appropriate when dealing with datasets that include a current trip as one of the alternatives. In those cases, the asymmetrical models seem to be more useful.

3 Designing Personas, Customer Journeys and Passenger Survey

3.1 Methodological approach

The strategy for retrieving quantifiable metrics for the choices and interactions of passenger has its basis on the literature review that was presented on chapter 2. Based on these initial findings, multiple brainstorming sessions were organised in the context of the task (i.e., persona design workshop, customer journey creation workshop, survey design and survey questions workshops) in order to establish a questionnaire that serves that purpose.

The definition of the personas that are executing the journeys is the first step of the process. A requirement is to cover a broad range of travellers, to capture as many multimodal trip chains as possible via the different ways that different personas interact within a similar travel setting (e.g., a business travel may choose to travel by a different mode than a leisure low-budget traveller). In this step, the tentative functional (e.g., age group, experience, goals) and non-functional (e.g., behaviours, needs) characteristics of users are determined. Followingly, the tentative customer journeys are defined, based on the 12 base analysis scenarios of SYN+AIR (referenced in Annex D), so as to identify touchpoints and potential interactions.

With the assistance of these first tentative customer journeys, and through creating a process of considering different travel situations and potential outcomes, a first set of survey questions is derived. These questions will be included in a passenger survey to capture the traits, and preferences of the respondents, in order to verify, validate or reject the tentative customer journeys. In that way, the priorities and choices of the passengers are captured and can be used for identifying pain points of the existing layout of multimodal trip chains.

The methodology that was followed for creating validated journeys consists of the steps taken in order to achieve the main objectives of the task. In particular, the steps followed were:

- Define the **customer segmentation** and representative **personas** for air travel.
- Define **tentative customer journeys** based on the interactions of the personas and the base analysis scenarios defined in the GA.
- Produce **questions** to quantify interactions, user traits, user mobility preferences.
- Launch a **passenger survey** across all four project-partners' countries to capture passenger choices and preferences.
- Use the findings of the survey to produce **validated customer journeys** .

3.2 Design of Personas for air travel

3.2.1 Customer segmentation

Based on previous studies and past works, as these are analysed specifically in chapter 2.1.4, the market base can be segmented across multiple dimensions of analysis. For the scope of SYN+AIR, there are two main dimensions of analysis that were dimmed to be significant and across those two axes the initial segmentation took place:

- Price sensitivity, and
- Time sensitivity

Across those two axes, there was the need to include both business and leisure travellers, while also groups that shared different travel traits, such as group size and availability. The segmentation that was decided is consistent with the existing literature, where most travellers fly for leisure and a smaller fraction flies for business. The customer segmentation is depicted in Figure 8 below:

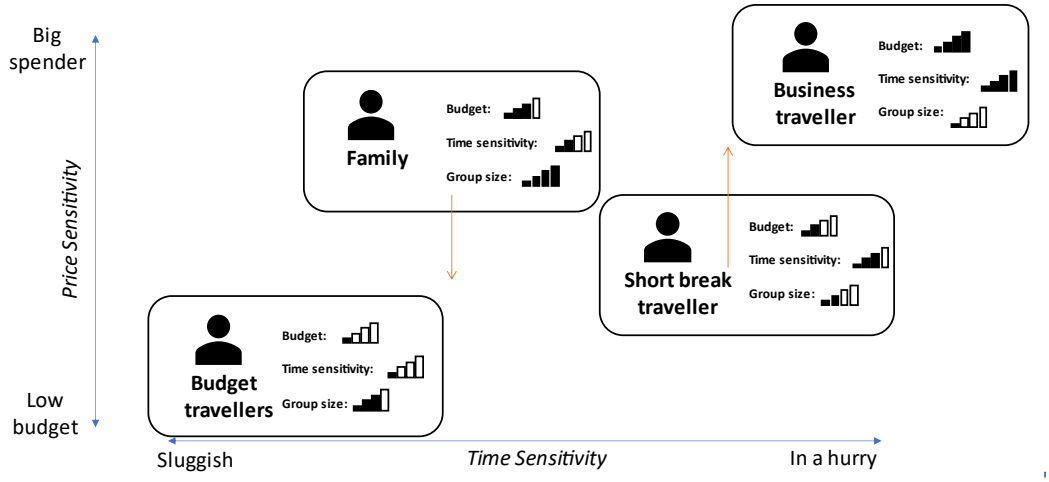

Figure 8: Tentative customer segmentation in SYN+AIR

3.2.2 Personas of air travel

According to that segmentation of Figure 8, some representative personas of air-travel were decided that would encapsulate all those different characteristics. Those personas are able to capture the variations that are influencing travel patterns, and choice preferences. **The names of the personas are fictional, and the persons portrayed are not based on real people.** The personas that were chosen are the following ones and the descriptions of their traits and preferences are described in the following pages:

- **Selma |** Budget Traveller
- **Robert |** Family Traveller
- **Berta |** Short break Traveller
- **Axel |** Business Traveller
- **Nisha** ♿ **|** Business PRM Traveller

Selma | *Budget Traveller*

Budget	€
Time Sens.	
Group Size	
Other	

Description

- 20 years old
- On a tight budget
- Travelling with 3 friends

Behavior

- It's about the journey, not the destination
- Will research alternatives in order to save money
- Open to change and new experiences

Needs and motivations

- Doesn't matter if the travel experience is not great, as long as it is cheap
- Not willing to spend money that she did not plan for

Robert | *Family Traveller*

Budget	€€€
Time Sens.	
Group Size	
Other	

Description

- 2 adults in their 40s
- 4 underage kids
- Carrying ski equipment

Behavior

- Does not like unexpected surprises
- Have planned everything in advance, in detail
- Would like to stay loyal to their schedule

Needs and motivations

- Need to be safe and stay together at all times
- May need time buffers between connections

Berta | *Short break Traveller*

Budget	€€
Time Sens.	
Group Size	
Other	—

Description

- 50 years old
- Travelling with her spouse
- Working until Friday evening
- Working on Monday morning

Behavior

- Spontaneous travellers, they don't want to bother with too much planning
- Need quick and inexpensive travel solutions

Needs and motivations

- Don't want to have delays from and to the airport due to work
- Need to have clear information about their trip

Axel | *Business Traveller*

Budget	€€€€
Time Sens.	⧗⧗⧗⧗⧗
Group Size	🧍
Other	▬

Description
- Workaholic
- 30 years old

Behavior
- No budget constraint
- May have to amend a reservation if needed
- Very important to be on-time and to not lose time

Needs and motivations
- Needs to be able to work during the trip

Nisha ♿ | *Business PRM Traveller*

Budget	€€€€
Time Sens.	⧗⧗⧗⧗⧗
Group Size	🧍
Other	♿

Description
- Workaholic
- 25 years old

Behavior
- Always in a hurry
- May have to amend a reservation if needed
- Very important to be on-time and to not lose time

Needs and motivations
- Needs to be able to work during the trip
- Needs special assistance and more time to move around

3.3 Design of the tentative customer journeys for air travel

Customer journeys describe the different stages of a persona's travel sequence and the interactions at the different touchpoints with the modes of transport and -in the particular case of air travel- with the airport operations. The reason for designing customer journeys, is to evaluate all these interactions from the standpoint of the passengers, and thus be able to comprehend the inner workings of how information is communicated and also which aspects of the journey could be obstructing the continuity of a seamless door-to-door journey.

Through the production of customer journeys, the intention at this design phase of the task is to produce questions that can capture the traits, preferences and inclinations of the respondents. For achieving this objective, the consortium partners took part in a brainstorming exercise where all 5 personas were matched against all of the 12 different base analysis scenarios of SYN+AIR. The objective was to create a diverse range of tentative customer journeys, which would capture different modes of transport, different passenger needs and thus different outcomes. Within those tentative customer journeys, project partners were asked to simulate the interactions that each persona would have with the different stage of an air travel multimodal trip, and to write down the projected outcome of that interaction. A workshop was eventually organised among partners, with the guest participation of Dr. Milan Janic, senior researcher at the Department of Transport & Planning, and Research Professor at the Faculty of Transport and Traffic Engineering of the University of Belgrade.

The scope of the workshop was to create multiple tentative customer journeys in order to extract questions that could be used within the survey. In particular, the workshop participants were asked to fill-in the following fields of each customer journey:

- **Journey**: The mode(s) that the persona chose

- **Actions**: The interactions between the persona and the TSPs. Also includes the touchpoint if applicable. E.g.: bought a ticket (action) at the Ticket Vending Machine (touchpoint)
- **Needs**: The preferences of the persona, their constraints, their expectations
- **Emotions**: May be left blank. If a certain interaction is considered to be a "pain point" for the persona, the emotions of the persona should be captured in this field

Most importantly, the participants were asked to formulate questions that would then be used in the passenger survey for identifying those attributes of each journey. The outcome of the Customer Journey Workshop led to the formulation of 33 tentative customer journeys and, respectively, 85 questions in total. The questions that were generated are detailed in Annex D and were used as the initial inspiration for creating the passenger survey of T3.1.

3.4 Creation of the survey

Based on the previous activities' results (3.2and 3.3) we had significant resources to be used for the creation of a passenger survey; the customer segmentation and respective personas, 33 tentative customer journeys, 85 tentative questions, an extensive literature review for air travel and similar research. The roadmap for launching the questionnaire needed to cover the ground in relation to what the objectives should be, who is going to answer the questionnaire and how the questionnaire is going to lead to understanding how the passenger interact with the components and stages of multimodal air travel.

Five main steps were identified to be completed for a successful launch of the survey:

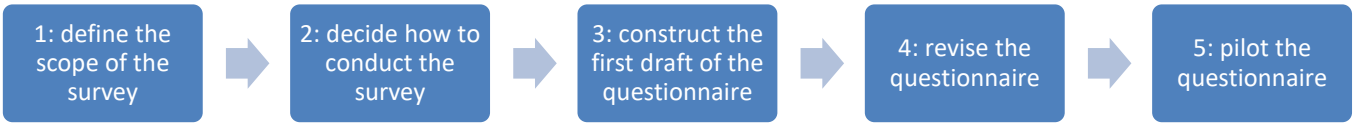

Figure 9: SYN+AIR process for creating the passenger survey

The first step for creating the survey was to carefully re-visit the initial scope of the survey. The rationale is that at that stage, the literature review was already complete, and multiple survey studies were analysed in depth, meaning that the survey scope should be a precise, short and unambiguous message, which can be encapsulated within one sentence. The scope of the passenger survey was ultimately formulated as follows: "*quantify the trade-offs that users consider when selecting travel alternatives and identify traveller characteristics that reflect their emotions, attitude, and travel behaviour*".

The second survey design step was to decide how to conduct the survey. First and foremost, the survey was decided to be conducted solely online, due to strong restrictions imposed by the SARS-COV-2 pandemic. Also, the sample was to mainly be carried out across the main four participating countries (ES, IT, GR, SR) in the native language of each country, plus an English version of the questionnaire should also be available.

The platform for disseminating the survey was the EU survey platform[4], which enables a high confidence of data integrity and privacy. Some softer constraints that were decided in this stage included the maximum time for completing the survey, which was set for a maximum of 20 minutes, and also the requirement that all questions should be mandatory so as to have usable data, also for the purpose of building a demand model (within Task 4.2).

The third step of the process construct a first draft of the questionnaire, covering three main areas, as they were identified during the literature review: **Mobility profile**, **Travel preferences**, **Sociodemographic profile**.

The first part of the questionnaire consists of questions that aim at identifying the respondents' **mobility profile**. For this purpose, respondents are asked about how often they travel by plane, what the purpose of their travel

[4] EU survey platform: https://ec.europa.eu/eusurvey/home/welcome

most commonly is, how they research information and when and what their habits and routines are regarding check-in, carrying luggage, etc. A majority of the questions in this part focus on the modes of transport that travellers prefer to use, as for example which mode they prefer to use, or what their stance is towards transferring to another mode. Furthermore, respondents are asked about their attitude towards factors that affect their mode choice, and how important they deem these factors to be. According to the literature review of chapter 2 and especially chapter 2.1.5, the factors selected to be evaluated are waiting time, travel time, cost, reliability, security, weather, crowdedness, trip purpose, and familiarity with the city.

The next part of the questionnaire, **Travel preferences,** presented 3 different hypothetical scenarios and required the respondent to choose a mode in each different case:

A. bus or train to get to the port,
B. car or train to get to the airport,
C. train or plane to get to your destination

In each case, the respondents were also asked to justify why they made their choice.

Finally, the **Sociodemographic profile** part of the questionnaire includes a few questions which refer to the socio-demographic characteristics of the respondent (gender, age, income level, occupation, household size) and also questions on whether a traveller has disabilities that may affect their travel experience.

The 4th survey design step required all partners to review and revise the questionnaire, and also to translate it to their respective native language.

At the 5th and final step of the survey design process, the questionnaire was piloted amongst partners and colleagues. This brought forward corrections that were to be made, so as to meet a higher quality of coherency and meet the time constraints set in step 2. The approximate time for answering all questions was consistently below 20 minutes for all pilot participants, in accordance with the goal set in the 1st step of the survey design process The pilot responses were discarded once the final version of the survey was available.

Finally, the survey was disseminated across multiple channels so as to reach a diverse crowd and thus grasp a more accurate representation of how passengers travel and what they consider to be important. The data collection started on 31st of March 2021 and was finalised on 18th of May 2021. The English version of the questionnaire can be found in Annex F. The dissemination of the questionnaire, collection of responses and subsequent data processing were performed in compliance to the ruling of the ethics committees of the participating institutions, and with the knowledge and consent of the survey participants.

4 Questionnaire's results and findings

4.1 Survey results

The passenger survey was disseminated across the 4 pilot locations (Greece, Italy, Serbia, Spain) and a total of 2251 responses were collected. This section displays the findings and highlights of the statistical analysis of that sample, along with the quantified trade-offs for passengers. The chapter concludes with the validated customer journeys as they are derived from the responses to the survey.

4.1.1 Homogeneity analysis

As a first step of the statistical analysis of the sample, a homogeneity analysis was performed to identify whether the differences of the responses among countries was significant or not. To this end, the number of respondents per country for each answer to each question were calculated and a chi-square test was applied. The result was that the value of chi square was calculated to be 8.339 and the corresponding p-value was 0.000, for 700 degrees of freedom. Evaluating this outcome, it signifies that the responses to the questionnaire vary significantly among the people from different countries. As a result, since the homogeneity test was not successful for a confidence level of 90% for the majority of the responses to the survey, the presentation of each question that is presented in Annex G, is categorized per country and is not presented in aggregate.

4.1.2 Descriptive statistics and notable findings

This section presents findings from the survey that cannot be directly derived by the presentation of the responses per questions, but rather should be observed relatively to other findings of the survey. For instance, how do business travellers react to stress factors in relation to leisure travellers? How is mode preference diversified across countries? What are the decisive factors for choosing to travel by bus over train?

On aggregate, the total sample consisted of 54.4% female respondents, 44.5% male respondents, and 23 individuals that chose to not disclose their gender. The average respondent was 39 years old, with the majority of the sample being between from 18 to 60 years old, as seen in Figure 10. The average income of the respondents, in a scale from Low to High, was Average for the majority of the sample (61.1%), with just 20.6% indicating that their household income is High. In terms of employment, 51.7% of respondents is employed in the private sector, 27.5% employed in the public sector and 10.5% of the sample is a student. The remaining portion of the sample is either retired, unemployed or 'other'. The average household size ranges from 1 to 9, with an average of 3 people living together in a household. Finally, very few households have no cars (12.2%), most households have 1 car (43.2%), 36.3% of households have 2 cars and 8.23% of households have more than 2 cars.

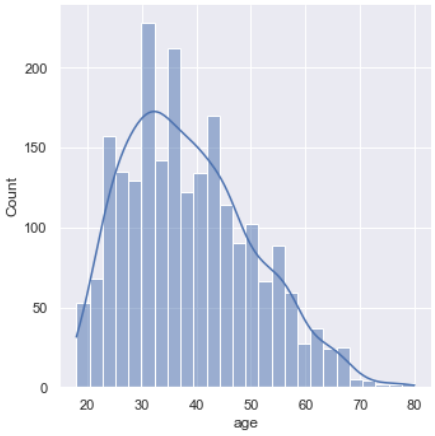

Figure 10: Age distribution of the sample

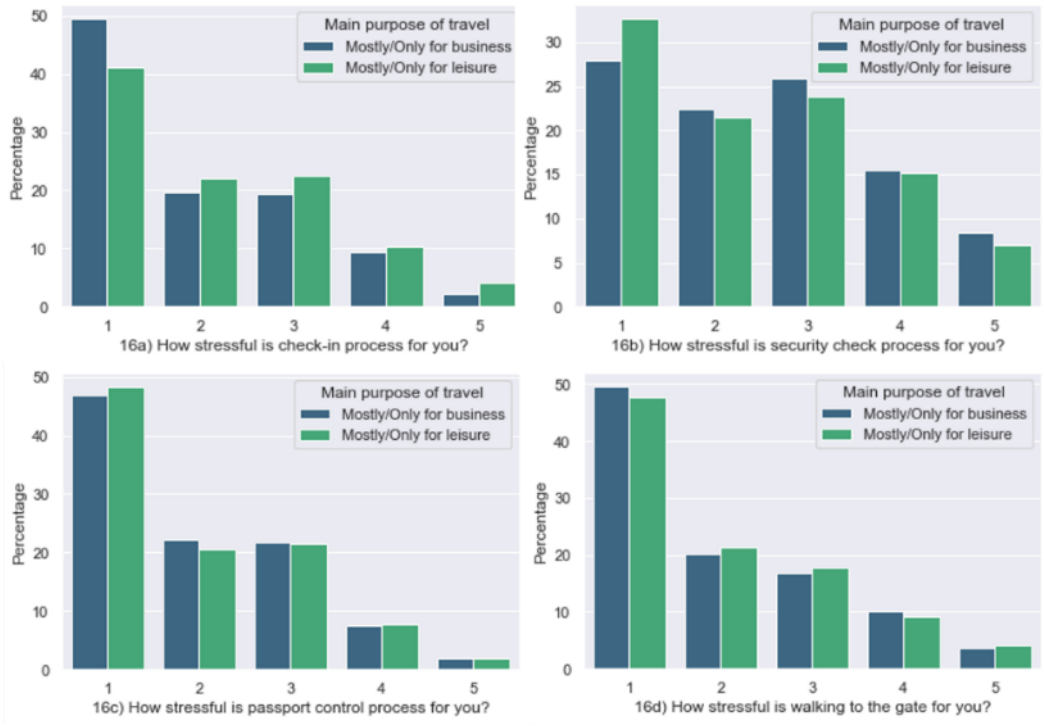

Figure 11: Stress perception of processes per purpose of travel (1: Not stressful, 5: very stressful)

From the charts above (Figure 11) it appears that passengers exhibit similar low stress levels, independently of their purpose of travel (business or leisure). Nevertheless, security check process seems to stress them the most.

Figure 12 indicates that if all transport modes were available, travellers would prefer to have someone drop them off/pick them up from the airport. The only exception to this can be seen in Spain, where travelling by their own car or getting the metro was found to be a more preferable way of getting to and from the airport. What is worth noting is that nearly 80% of the Greek respondents would choose to travel by car to/from the airport (either park there or have someone else to drop them off/pick them up). Finally, it is interesting to point out that the mode preference of Serbian travellers for metro ranks very high (at around 20%) regardless of the fact that metro is not an available means of transport currently for Serbia, meaning that there is a significant willingness to use metro if it would be available.

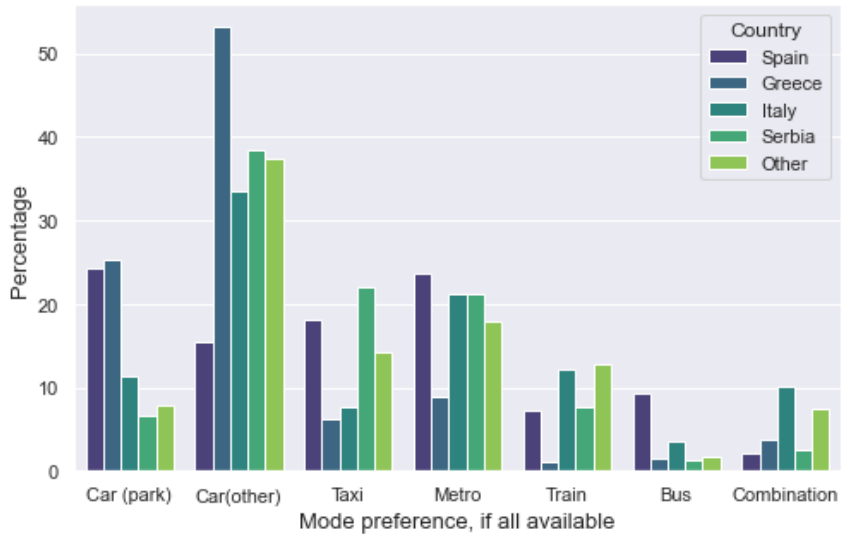

Figure 12: Mode preference, if all available per country

The chart in Figure 13 reveals that people from Spain and Greece would feel a discomfort to take a combination of modes when travelling from the airport to the hotel even in the case where they already knew at the time of booking that they would have to transfer to another mode. On the other hand, respondents from Italy and Serbia would not be troubled by the need to transfer to another mode in the case where they were aware beforehand.

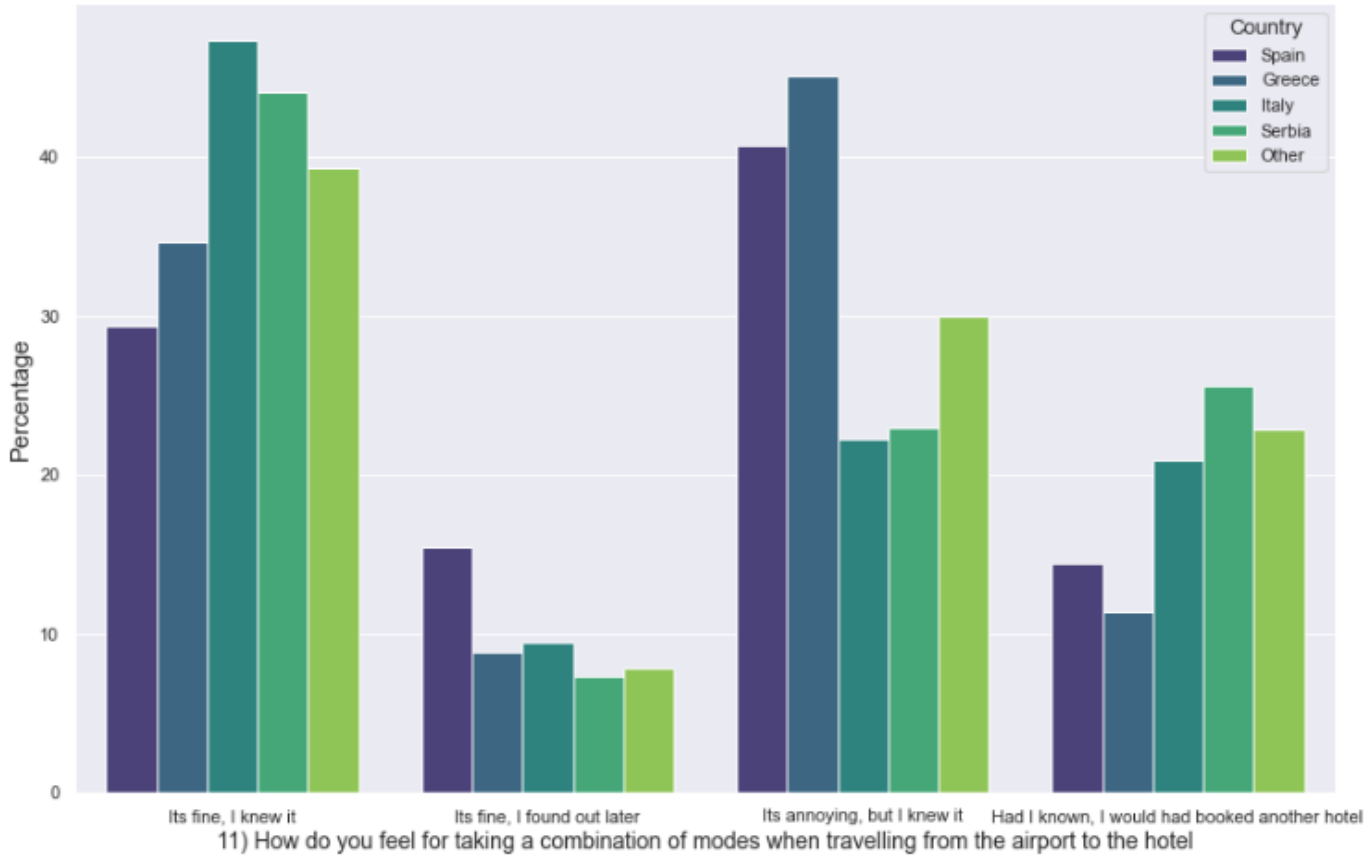

Figure 13: Sentiment when taking a combination of modes for travelling from the airport to the hotel per country

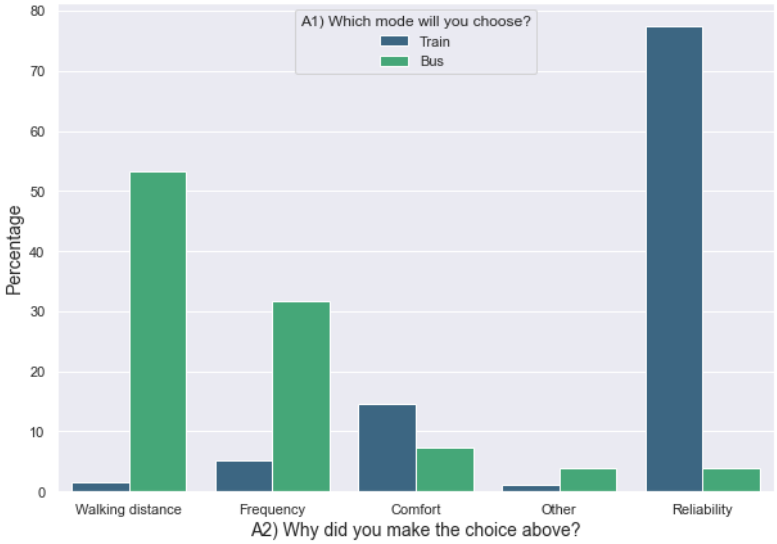

Figure 14: Scenario A

The first travel scenario presents the case where customers can choose to travel between train and bus from the airport to the port. The price is the same, but the bus is more frequent, drops the customers closer to the port and is less fast and reliable than the train. The results indicate that around ¾ of the respondents chose the train over the bus. The chart in Figure 14 indicates that people prefer the train because it is more reliable and comfortable, whereas others choose the bus because it has more frequent routes and is in a closer walking distance than the train.

In the second scenario, respondents had to choose between car and train when heading to the airport for a weekend trip. In both cases the total trip duration was the same, but taking the train required 5 extra minutes of walking. Also, The train costs 20 euros, whereas the car is twice as expensive as the train.

More than half of the respondents chose the train over the car. The chart in Figure 15 reveals that this preference is due to its lower cost.

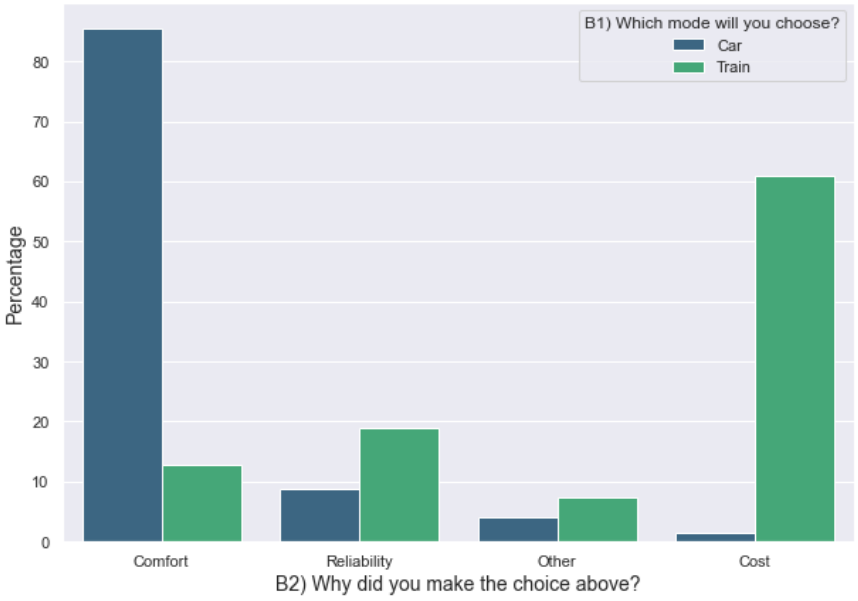

Figure 15: Scenario B

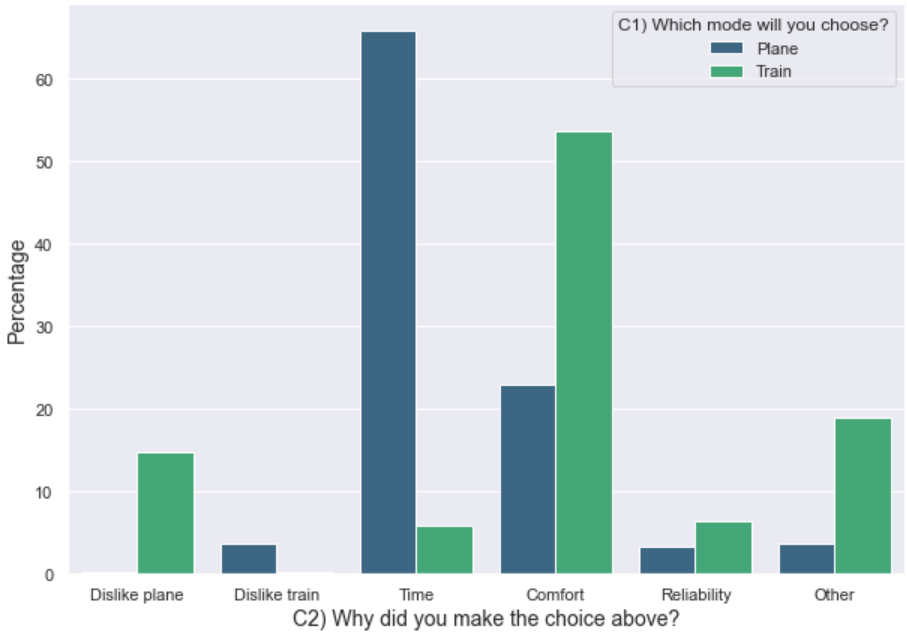

Figure 16: Scenario C

In the third scenario the first case was a trip with 4 hours duration including taking the taxi to the airport, afterwards taking the plane and then a taxi from the airport to the final destination. The second case was a 6-hour trip consisting of a taxi to the station of an intercity train, the train, and a taxi to the final destination. Around ¾ of the respondents choose the plane over the train. From the chart in Figure 16, it is revealed that people are inclined to this option because they save more time.

4.2 Quantified trade-offs of passengers when choosing mode of transport

This section presents the results on the importance of the factors that have been demonstrated by the travellers in each country to be decisive regarding mode choice. That is carried out by identifying the factors that partake in the decision making of the traveller regarding the mode of transport. In order to quantify the effect that each factor weighs on the decision of the passenger, a correlation analysis was carried out to estimate the impact that all variables have with each other. Specifically, the Pearson correlation metric is estimated for each pair of variables and the most impactful ones are presented in this section.

The hypothesis test enables to decide whether a value of the correlation coefficient is “close to 0”, meaning that there is no correlation, or whether it is “significantly different from 0”, meaning that the examined variable has some explanatory strength over the phenomenon that is studied, in this case, the preferred mode of travel.

In the following cases, there is sufficient evidence to conclude that there is a significant linear relationship between the mode that is examined and the variable that is presented. E.g., “there is sufficient evidence to conclude that there is a significant linear relationship between a **preference to travel by train** and **being male**”.

A negative correlation would signify the opposite relationship. That is: “there is sufficient evidence to conclude that there is a significant linear relationship between **not choosing to travel by train** and **being from Greece**”.

The complete correlation analysis can be found in Annex I. The following chapter present a quantified non-exhaustive list of the variables that are ***most impactful for preferring*** (or avoiding) public transport to travel to and from the airport.

4.2.1 Train

The preference of travellers to travel by **train** is positively correlated with being male, also for respondents that consider the level of congestion when they choose mode, being from Italy, when travelling for business, etc. Travellers tend to not choose to travel by train, when they are from Greece, if they are female, and if they believe that waiting time and weather conditions are important factors when travelling.

Gender: Male	0.118
Traffic congestion affects my mode choice	0.102
Country: Italy	0.100
Prefer public transport instead of 2 taxis for large groups	0.094
Purpose: Mostly Business	0.092

Importance of weather	-0.072
Importance of waiting time	-0.087
Traffic congestion does not affect my mode choice	-0.092
Gender: Female	-0.126
Country: Greece	-0.162

4.2.2 Metro

Travellers are more likely to travel by **metro** when they value congestion conditions when selecting mode, when in case of travelling as a large group they prefer public transport instead of two taxis, the cherish reliability, if they have a high income, if they are male, and if they feel stressed by the security check at the airport. Metro mode choice is negatively correlated with low income, with travellers that value comfort, with being female, and for travellers that are from Greece.

Traffic congestion affects my mode choice	0.207
Prefer public transport instead of 2 taxis for large groups	0.153
Scenario B reason: Reliability	0.115
Income: High	0.112
Gender: Male	0.090
Stress at security check	0.079

Income: Low	-0.068
Scenario B reason: Comfort	-0.093
Gender: Female	-0.100
Country: Greece	-0.150

4.2.3 Bus

The preference of travellers to travel by **bus** is positively correlated with being from Spain, considering the frequency of a public transport to be important, being stressed by airport operations, carrying only small luggage, when they only reason for travelling by plane is business and the when the income is low. Travellers tend to not prefer bus when they find waiting time to be important, when their income is high, when they carry large luggage, when they are from Greece or Serbia, and when they mostly travel for business

Country: Spain	0.131
Scenario A reason: Frequency	0.067
Stress at passport control	0.055
Stress at security check	0.054
Stress at check in	0.054
Luggage: Small bag (e.g., backpack)	0.053
Purpose: Only Business	0.053
Income: Low	0.052

Importance of waiting time	-0.040
Income: High	-0.040
Luggage: Large luggage (over 10 kilos)	-0.041
Country: Greece	-0.047
Country: Serbia	-0.050
Purpose: Mostly Business	-0.064

4.2.4 Taxi

The preference of travellers to travel by **taxi** (or similar service) is positively correlated with being from Serbia, travelling mostly for business, having a high income, being elder, being a member of a frequent flyer program and when the research for getting to and from the airport is done no earlier than a day in advance. Travellers who do not prefer to travel by taxi are from Greece or Italy, only travel for leisure, base their preference on the cost of the mode, have a low or average income, and belong to young age groups.

Country: Serbia	0.166
Purpose: Mostly Business	0.109
Income: High	0.108
Age	0.092
Member of a frequent flyer program	0.089
First time searching information about the trip from home to the airport: a day in advance	0.083

Country: Italy	-0.075
Age: 18 to 30	-0.075
Income: Average	-0.075
Income: Low	-0.075
Scenario B reason: Cost	-0.079
Purpose: Only Leisure	-0.090
Country: Greece	-0.134

4.3 Mapping responses to personas

The scope of this section is to identify the personas of SYN+AIR within the sample that was collected, by grouping the respondents based on their choices (e.g., purpose, luggage) and their socioeconomic traits (age, income, occupation). The collected sample includes different kinds of respondents, of different age, gender, employment status, income, purpose of travel, etc. In order to validate the customer journeys for each persona, it is required to identify these personas within the sample. The question therefore becomes: “how many X instances appear in the sample?”, where X is the name of the persona. The reverse process was followed in this step, that is, the criteria that were used to create these personas, were now applied to filter the dataset.

The following filters were applied for each persona (fields in green highlight indicate the responses that correspond to each persona as it was designed in chapter 3.2.2):

Selma | Budget Traveller → identified 64 respondents in the sample

2) Main purpose of travelling	20)Age	22)Occupation	23)Household income
Mostly Business	18-29	Employed	Low
Mostly Leisure	30-39	Student	Average
Only Business	40-49	Retired	High
Only Leisure	50-64	Unemployed	Rather not say

Robert| Family Traveller → identified 452 respondents in the sample

2) Main purpose of travelling	20)Age	22)Occupation	23)Household income	24) Household size
Mostly Business	18-29	Employed	Low	1
Mostly Leisure	30-39	Student	Average	2
Only Business	40-49	Retired	High	3
Only Leisure	50-64	Unemployed	Rather not say	More than 3

Berta| Short break Traveller → identified 266 respondents in the sample

2) Main purpose of travelling	20)Age	22)Occupation	23)Household income	24) Household size
Mostly Business	18-29	Employed	Low	1
Mostly Leisure	30-39	Student	Average	2
Only Business	40-49	Retired	High	3
Only Leisure	50-64	Unemployed	Rather not say	More than 3

Axel | Business Traveller → identified 106 respondents in the sample

2) Main purpose of travelling	12) Type of luggage when travelling	20)Age	22)Occupation	23)Household income	24) Household size
Mostly Business	Large luggage	18-29	Employed	Low	1
Mostly Leisure	Carry-on luggage	30-39	Student	Average	2
Only Business	Small bag	40-49	Retired	High	3
Only Leisure		50-64	Unemployed	Rather not say	More than 3

Nisha | Business PRM Traveller → identified 43 respondents in the sample

Especially for the case of Nisha, respondents who selected yes in question 21, regrading disabilities affecting the travel experience were selected, regardless of the other characteristics that Nisha would have (i.e., travelling for business, being young, etc.). In that way, an adequate sample of 43 respondents was gathered, which will enable the validation of the customer journeys that are relevant to PRM journeys.

21) Disability affecting travel experience
Yes
No

The results of the survey analysed per persona can be found in Annex H.

4.4 Validated Customer Journeys

This final chapter of the deliverable concludes with the validated customer journeys, as they have been created during the brainstorming session (Chapter 3.3), and then corrected based on the stated choices of the various personas. The numbers in parentheses, wherever applicable, represent the percentage of prevalence of the given response, as it is derived through the persona mapping process that is described in Chapter 4.3 and the respective results that can be found in Annex H.

The following table (Table 4) represents the high-level list of travel choices made by the personas for each validated customer journey and focus primarily on the mode choice at each leg of the journey. The interaction with the different stages of the trip at the touchpoints (actions, needs, emotions) are described in the expanded version of the list of validated customer journeys which can be found in Annex J of the present document.

Table 4: Validated customer journeys of SYN+AIR

	**Selma | Budget Traveller**			**SYN+AIR Customer Journey 1.1**
	**Robert | Family Traveller**			**SYN+AIR Customer Journey 1.2**
	**Berta | Short Break Traveller**			**SYN+AIR Customer Journey 2.1**
	**Selma | Budget Traveller**			**SYN+AIR Customer Journey 2.2**
	**Axel | Business Traveller**			**SYN+AIR Customer Journey 3.1**
	**Robert | Family Traveller**			**SYN+AIR Customer Journey 3.2**
	**Nisha | PRM Traveller**			**SYN+AIR Customer Journey 4.1**

	Axel | Business Traveller			SYN+AIR Customer Journey 4.2
	Berta | Short Break Traveller			SYN+AIR Customer Journey 5.1
	Nisha | PRM Traveller			SYN+AIR Customer Journey 5.2
	Berta | Short Break Traveller			SYN+AIR Customer Journey 6.1
	Axel | Business Traveller			SYN+AIR Customer Journey 6.2
	Selma | Budget Traveller			SYN+AIR Customer Journey 7.1
	Robert | Family Traveller			SYN+AIR Customer Journey 7.2
	Berta | Short Break Traveller			SYN+AIR Customer Journey 7.3
	Selma | Budget Traveller			SYN+AIR Customer Journey 8.1
	Berta | Short Break Traveller			SYN+AIR Customer Journey 8.2

	Nisha | PRM Traveller			SYN+AIR Customer Journey 9.1
	Berta | Short break Traveller			SYN+AIR Customer Journey 10.1
	Axel | Business Traveller			SYN+AIR Customer Journey 10.2
	Selma | Budget Traveller			SYN+AIR Customer Journey 10.3
	Robert | Family Traveller			SYN+AIR Customer Journey 11.1
	Berta | Short break Traveller			SYN+AIR Customer Journey 12.1

5 Conclusions

In conclusion, the present deliverable puts forward a total of 23 validated customer journeys, in chapter 4.4, that will be used for the upcoming stages of the SYN+AIR project. These journeys provide valuable insight in how a door-to-door journey is carried out by different types of passengers, of different preferences and of different traits.

The real-world preferences and choices of the respondents are captured within these customer journeys and the additional factor analysis of the findings enables a better understanding of how each parameter correlates with each other variable that partakes in the decision-making process for each traveller. These trade-offs of the passenger (in chapter 4.2) will be extremely useful to know, when SYN+AIR will be targeting to enhance the aspects of the door-to-door journey that are hindering the travel experience.

The survey sample was found to be rich in representing different types of passengers, may they be leisure or business travellers, young or older, families or individuals, or persons with reduced mobility. The survey results are therefore successfully matched to the personas that were identified (chapter 4.3), meaning that a validation of the hypotheses that were made during chapter 3 was achieved.

Finally, and equally importantly, this entire endeavour is built on top of an extensive literature review, meaning that SYN+AIR will continue investigating the topic from a solid foundation and will be incrementally contributing to those research objectives by advancing the research one step further with findings from the real-world.

◊

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Annex A Air travel terminology

Term	Definition
ACDM	Airport Collaborative Decision Making (ACDM) is a process in which decisions related to Air Traffic Flow and Capacity Management (ATFCM) at airports are made based on interaction between operational stakeholders and other actors involved in ATFCM and which aims at reducing delays, improving the predictability of events and optimising the utilisation of resources.
ACI	Airport Council International
ACRP	Airport Cooperative Research Program
ADP	Air Demand Peaking (ADP) is related to seasonal, weekly, and daily demand. Weekly peaking is common on Monday mornings and Friday afternoons/evenings, while daily peaking is morning peak, perhaps a midday mini-peak, and a longer, less-pronounced late-afternoon/early evening peak.
AEA	Association of European Airlines
AOP	Airport Operations Plan (AOP) is a single, common and collaboratively agreed rolling plan available to all airport stakeholders whose purpose is to provide common situational awareness and to form the basis upon which stakeholder decisions relating to process optimisation can be made.
APOC	Airport operations centre (AOC) The central organisational unit responsible for airport airside operations
ATC	Air Traffic Control (ATC) is a service operated by appropriate authority to promote the safe, orderly and expeditious flow of air traffic.
ATD	Air transport demand (ATD) is related to “derived demand”, which means that demand in any market is a reflection of the purchase behaviour of many individual customers. Also, ATD it is the subject of market fluctuations regarding volume of traffic flows.
ATM	Air traffic management (ATM) is a function/service established with the objective of contributing to a safe, orderly and expeditious flow of air traffic by ensuring that ATC capacity is utilised to the maximum extent possible, and that the traffic volume is compatible with the capacities declared by the appropriate air traffic service providers. ATM involves airspace design and management (the structuring of airspace blocks, the design of route networks, and the management of traffic flows within the structure), the infrastructure development, and ATC.

ATMOC	Air Traffic Management Operational Concept (ATMOC) is a high-level description of the ATM services necessary to accommodate traffic at a given time horizon; a description of the anticipated level of performance required from, and the interaction between, the ATM services, as well as the objects they affect; and a description of the information to be provided to agents in the ATM system and how that information is to be used for operational purposes.
ANSP	Air navigation service providers (ANSPs) is any public or private entity providing air navigation services for general air traffic/ A body that manages flight traffic on behalf of a company, region or country.
ATS	Air traffic services (ATS) comprise both advisory services and ATC services in route, in terminal areas, and in the immediate proximity of airports
Accessibility	In general, accessibility has been defined as a measure of easiness of reaching the opportunities in terms of goods, services, activities, and destinations.
DRT	Demand responsive transport
Demand data repository	Demand data repository (DDR) provides European airspace planners and airspace users with an accurate picture of past and future European air traffic demand, to meet their planning and monitoring needs.
Fleet management	Fleet management is related to aircraft acquisition and financing, tactical fleet management, asset value maintenance, trading.
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
Interfaces	The interfaces are located on the landside of the passenger and freight terminal(s) towards the airport catchment area. They include the static and mobile components and the supportive equipment. In particular, for passengers, the static objects are parking areas for private cars and taxicabs and the loading and the unloading platforms, and rail and bus stations (terminals). The mobile components are escalators and moving walkways enabling direct and efficient movement of passengers to the airport terminal, and vice versa.
Intra-airport transport systems	They are consisting of mini and standard buses, trains, long moving walkways, etc., which usually operate at the large airports enabling passengers efficient transfer between rather distant terminals.
Landside accessibility of airport	In particular, the landside accessibility of airports has usually been expressed in terms of the distance, time, speed, and costs between airports and their catchment areas. The main attributes of resistance to the airport landside accessibility influencing choice of particular access modes and their systems have shown to be distance, speed, their ratio—access time, and price, independently on the categories

	of users—business/leisure air passengers, airport and other aviation employees, and all others.
Long-run demand management	In the long run, the preferred way to grow demand is to understand available markets and their potential, decide which markets and segments to target, understand the preferences and expectations of the customers in these markets and segments, design service–price offers able to provide the value expected, deliver services to specification, monitor customers' perceptions of service, and adjust service design and delivery to take account of identified service failures and changing consumer preferences and expectations.
MaaS	Mobility-as-Service
MS	Market segmentation (MS) identify groups of buyers who can be distinguished from other groups to help managers understand what is being bought or might in future be bought, by whom, where, when, and why. It can also be applied to identify specific competitors and how to outcompete them for segment dominance.
Network Collaborative Management	Network Collaborative Management (NCM) is the collaborative approach to manage ATM network resources.
Network Operations	Network Operations are the overall of ATM activities occurring in the (European) network.
Network Operations Plan	Network Operations Plan (NOP) is the plan, including its supporting tools, developed by the Network Manager in coordination with the operational stakeholders to organise its operational activities in the short and medium term in accordance with the guiding principles of the Network Strategic Plan.
Operational performance	Operational performances embrace attributes of particular routes/lines such as demand, capacity, quality of service provided to users related to air passengers, airport and other aviation employees, transport work, and technical productivity.
Passenger terminal complex	The passenger terminal complex enables passage of users–air passengers from the airport landside access modes to their aircraft, and vice versa.
Performance Driver Indicator	A measure that directly affects an outcome or achievement of a Key Performance Indicator (KPI). PDI is a performance metric that is associated with a preceding step in a value stream or business process. It will contribute directly to a KPI and may be a component in the way the KPI is calculated.
PT	Public Transport
Service Attributes	The design of airline service involves various service attributes for providing benefits to targeted customers. Which attributes to incorporate and whether each should be priced into the fare or separately charged depends

	upon which markets and market segments are being served, and where the carrier's cost advantage and/or benefit advantage lie.
The airport airside area	The airport airside area consists of terminal airspace, runways and taxiways, and apron/gate complex, all intended to handle aircraft of different size (seating capacity) operated by different airlines.
The airport Ground Access System	Each airport is connected with its catchment area by different ground transport access modes/systems. These are road-based busses, taxi, cars, and rail-based system. A choice of particular access mode depends on characteristics of users on the one hand, and the mode spatial and time accessibility on the other.
The catchment area	The catchment area has been considered as the area around a given airport from where the potential demand—air passengers—tends to use it. The airports can be accessed from their catchment areas by different transport modes and their systems generally classified as the road-based and rail-based modes.
The landside access modes and systems	The landside access modes and systems comprise the road- and rail-based mode and their systems
The landside area	The landside area consists of air passenger and freight/cargo terminal(s), technical complex, and landside access modes and their systems. The first two enable handling users–air passengers and freight/cargo shipments, respectively. The third provides infrastructure, facilities and equipment for aircraft maintenance, and fuel supply. The last enables accessibility of users–air passengers and freight/cargo shipments, airport employees, and others to/from the airport.
Time-elasticity of demand	Time-elasticity of demand describes an inverse relationship, such that decreases in total trip time lead to increases in demand and vice versa.
Transport Service Providers	Transport Service Providers (TSPs) are offering the customer its fare products for purchase (Travel Shopping and Booking and Ticketing). It also provides the travel service corresponding to the fare product (Booking and Ticketing, Trip Tracker & Business Analytics).

Annex B Literature review of papers on airport access mode choice & access/egress at the airport

The three tables below present a collection of papers, journal articles and research work that relate to the problem of mode choice for accessing and egressing at the airport.

Table 5: Review of various papers on airport access mode choice

Authors (year)	Topic and case study	Main findings
Koo, T., Wu, C.L., Dwyer, L. (2010) [46]	Leisure tourists' travel mode choice for dispersal, and the significance of destination in these choices	The dispersal of air leisure arrivals can be facilitated and stimulated by public transport.
Jou, R.C., Hensher, D.A., Hsu, T.L. (2011) [47]	Airport ground access mode choice behaviour after the introduction of a new mode: A case study of Taoyuan International Airport in Taiwan	Out of-vehicle travel time and in-vehicle travel time are two dominant factors that affect outbound travellers' choice of airport access modes. Also, time-savings, no transfers and convenience of storing and retrieving luggage are important for air travellers.
Tam, M.L., Lam, W., Lo, H.P. (2011) [48]	The impact of travel time reliability on mode choice decisions (Airport Express – AE, bus, taxi, private cars, courtesy vehicles). The relative intensity of the relationship between satisfaction level and airport ground access mode choice. Case study: Hong Kong International Airport (HKIA)	77% of passengers used a single mode to access HKIA, and the remaining used a combination of modes. Ground access market was manly shared between buses (44%) and AE (25%), where the main reason for bus choice was low travel cost, and for AE high travel time reliability. Business and long-haul departing air passengers accessing HKIA allowed a larger safety margin (difference between air passengers' preferred arrival time at the airport terminal for check-in and their expected arrival time) than other air passengers.
Akar G. (2013) [22]	Identifying factors that affect the airport ground access mode choice and main factors for certain categories of passengers to choose alternative mode Case study: Port Columbus International Airport in Columbus Ohio	The research confirmed that dominant choice was car as expected (86.9%), followed by COTA bus, taxi and public bus. In a case of hypothetical mode choice (rail service from downtown, bus service from downtown and bus service close to trip origin): 36.7% respondents indicated that they would continue driving, 22.7% would take a shuttle opinion and 19.2% chose rail system from downtown Columbus.
Budd T. (2016) [25]	The role played by airport 'meeter-greeters' in a ground access context Case study: at five study airports Heathrow, Gatwick, Manchester, Stansted and Luton	'Meeter-greeters' and percentage of total passengers is obtained for five observed airports and share of passengers travelling with them by market segment. The environmental and economic implication of 'meeter-greeters' for an airport and possible solutions.

Yang, C.W., Liao, P.H., (2016) [49]	The joint choice behaviour of access, airports, and flights exploring interdependence between choice dimensions and traveller's heterogeneity Case study: from Taipei to Shanghai, Tokyo and Seoul	Access time, access cost, and egress time are effective landside attributes, whereas fare and frequency are important flight attributes for the joint choice of access modes and flight routes.
Bruderer Enzler, H. (2017) [50]	An analysis of airport access, income, political orientations and environmental concern. Case study: catchment area is Switzerland, and 16 airports were included: Zurich, Geneva, Basel-Mulhouse, Lugano, Bern and St. Gallen-Altenrhein in Switzerland, Lyon, Strasbourg, Grenoble and Chambéry in France, Milano, Bergamo and Brescia in Italy, Stuttgart and Friedrichshafen in Germany and Innsbruck in Austria.	This research explores socio-demographic, spatial and attitudinal information of air travel for leisure and VFR purposes. More frequent flyers are younger persons who are in good health and affluent, who live in households without children, do not vote for the Green Party and are rather less concerned with the environment. Furthermore, they tend to live in densely populated areas and have better spatial access to travel opportunities. The results indicate, for example, that given the same levels of income and environmental concern, a person voting for the Green Party is less likely to fly than voters of the other major parties.
Birolini, S, Malighetti, P, Redondi, R, Deforza, P. (2019) [20]	Access mode choice: Evaluation of new direct rail services at Milan-Bergamo airport (LCC airport) in Italy Whether the higher sensitivity of low-cost airline passengers to airline ticket prices implies different preferences regarding their choice of transportation to the airport	They found that low-cost passengers are not exactly low-cost consumers when it comes to the access mode choice. As expected, they find that business passengers are willing to pay more than non-business ones for a reduction in travel time. Both business and non-business passengers favour driving to the airport over all other transportation means (ceteris paribus), while the second most preferred alternative is drop-off. Also, non-business passengers are more prone to use public transport that business travellers, although both categories of passengers exhibit a strong aversion to the train-bus alternative.
Bergantino, A.S., Capurso, M., Hess, S. (2020) [21]	Access mode choice with focus on airport users and non-users as well as an assessment the effectiveness of policy measures aimed at improving surface access by means of public transport services: Accessibility to Bari airport and Brindisi airport in Apulia region in Italy	As expected, travel costs have a lower (negative) influence on the utility of business travellers than for non-business ones. In all the proposed scenarios, car (passenger) remains the alternative with the largest predicted market share.

Table 6: Overview of the studies related to the MaaS and car access/egress at airport

Authors	Study	Description

Ji et al., (2017) **[51]**	Comparative Analyses of Taxi Operations at the Airport	The paper investigated taxi operations at the Shanghai's Hongqiao international airport.
Guo et al., (2014) **[52]**	Comparison of emerging ground propulsion systems for electrified aircraft taxi operations	The paper compared various emerging Aircraft Ground Propulsion Systems for electrified aircraft taxi operations.
Sperling & Henao (2020) **[53]**	Electrification of High-Mileage Mobility Services in Cities and at Airports	The paper focused on the electrification of the MaaS vehicles, and identification of the concept for managing and modelling urban electric mobility system.
Budd et al. (2014) **[16]**	Airport ground access and private car use: A segmentation analysis	The paper determined behaviourally distinct segments of airport passengers for identifying those with the greatest potential to reduce their car use.

Table 7: The overview of the studies related to the PT access/egress at airport

Authors	Study	Description
Liu, X. (2020) **[54]**	Assessing airport ground access by public transport in Chinese cities.	The paper investigated the ground assess accessibility to major Chinese airports. The author compared time and monetary costs for travelling between airports and city centres by private car and public transport.
Orth & Weidmann (2014) **[55]**	Airport cities and airport public transport access: Demand balancing or peak exacerbation? Case of Zurich Airport, Switzerland.	The paper presented a generic framework for analysing the impact that non-aviation activities at the airport have on the public transport system by focusing on the utilization of services and distribution of passengers over a day.
Mandle et al., (2000) **[38]**	Use of public transportation by airport passengers	The paper reviewed the opportunity for rail, bus, and van service (i.e., shared-ride, door-to-door van service) at U.S. airports and the

		use of the bus and rail services by airline passengers at large airports.
Malandri et al. (2017) **[56]**	Airport Ground Access Reliability and Resilience of Transit Networks: A Case Study.	The paper analysed the resilience of the transit network accessing the airport, where passengers' delays, generalized costs and changes in the volume-over-capacity ratio after a disruption are proposed to measure the effects of unplanned service disruptions.

Table 8: Overview of the studies related to the rail transportation access/egress at airport

Authors	Study	Description
Leigh Fisher Associates (2000) **[57]**	Lessons learned from successful rail systems	The report focusses on the successful airport rail systems projects and the associated attributes of rail service
Birolini et al. (2019) **[20]**	Access mode choice to low-cost airports: Evaluation of new direct rail services at Milan-Bergamo airport.	The paper investigated the air passengers' access mode at low-cost airports, with the aim of supporting policy makers in evaluating improvements of the current ground access transport system.
Sresakoolchai & Kaewunruen (2020) **[58]**	Comparative studies into public private partnership and traditional investment approaches on the high-speed rail project linking 3 airports in Thailand	The paper analysed benefits and risks of Public-Private Partnership adoption in the High-Speed Rail Project Linking 3 Airports in Thailand
Zhang et al. (2019) **[59]**	Impacts of high-speed rail on airlines, airports and regional economies: A survey of recent research.	The paper reviewed theoretical and empirical findings on the impacts of high-speed rail on airports and regional economies
Murakami et al. (2016) **[60]**	Airport rail links and economic productivity: Evidence from 82 cities with the world's 100 busiest airports.	This paper examined the relationship between airport rail links and economic productivity in 82 cities with the world's 100 busiest airports across 10 regions

Annex C Review of airport/passengers surveys

The following table presents an extensive overview of papers that provide information as to how a survey was designed, carried out, and interpreted.

Paper	Survey method	Survey-based technique/Type of questions	Topic	Place and time of survey/ Number of respondents	Sample description
Koo et al. (2010) [46]	Face-to-face Stratified random sampling technique	Stated choice experiment Not specified	Leisure tourists' travel mode and the significance of destination in these choices	Passengers at the Cairns domestic airport Terminal, 22-27 August 2008 208 received questionnaires,196 usable	Detailed
Jou et al. (2011) [47]	Computerized interactive questionnaire	Data mixture model RP and SP, 3-part questionary (socio-economic, trip characteristics and modal preference)	Air travellers' choice of airport access modes in the presence of a new access system	Passengers who had checked in and were waiting to board their flight at Taoyuan International Airport in Taiwan, 9 days in January 2007 540 received questionnaires	Detailed
Tam et al. (2011) [48]	Face-to-face Stratified sampling Two-wave modal split survey	Data mixture model with RP and SP Combination of open-ended questions and attitudinal statements measured on Likert scale	The impact of travel time reliability on mode choice decisions Air passenger perceived service quality in the calibration of airport ground access mode choice model.	Departing air passengers at Hong Kong International Airport, Jun 30 – July 2, 2004, May 1-3, 2005 891 eligible respondents of which 475 responded in the first wave, 963/519 in the second wave	Detailed
Vesper-mann and Wald (2011) [10]	Intermodal managers at the airports were contacted, not specified how	Combination of open-ended questions and attitudinal statements measured on Likert scale	The current state of intramodality and of potential developments.	Intermodal managers at worldwide airports during 2008 41 received questionnaires	Not specified

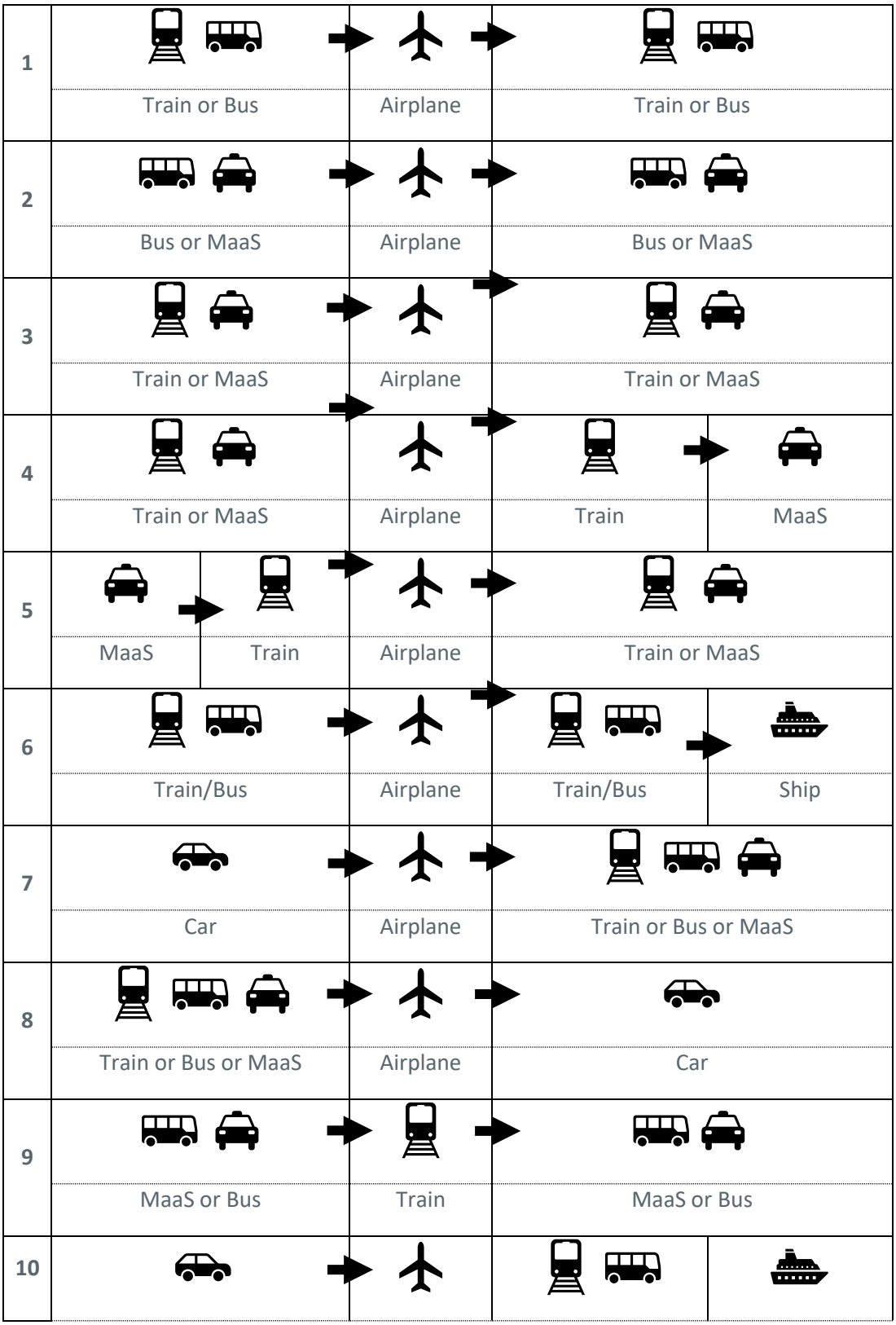
Kuljanin and Kalić (2012) [61]	Face-to-face interviews, Correspondents chosen randomly by poll-takers	2-part questionary (socio-economic characteristics and air travel related behaviour)	Characteristics of both leisure and business passengers	Departing passengers at Belgrade Airport, Serbia 5 surveys between 2002 and 2010 with 1058, 1039, 1109, 1141, 1509 respectively received questionnaires	Detailed
Akar (2013) [22]	Face-to-face, Paper based survey	Data mixture model with RP and SP Not specified	Identifying factors that affect the airport ground access mode choice and main factors for certain categories of passengers to choose alternative mode	Passengers waiting at the gate area at the Port Columbus International Airport, April 2012 642 participants of which 458 complete responses	Detailed
Budd el al. (2014) [16]	Face-to-face, interviewer administered questionnaire	Attitudinal statements measured on Likert scale	Passenger's ground access journey and their flight	Departing passengers at Manchester Airport/ 860	Short
Román and Martín (2014) [7]	Face-to-face computer-aided personal interview	Stated choice experiment Attitudinal statements measured on Likert scale	Understanding passengers' preferences in the integration of high-speed rail (HSR) and air transport	Gran Canaria (check in and boarding at the Airport and two community areas - civil administration departments in the city and various departments of the University of the city of Las Palmas), November 2010-January 2011/ 875	Detailed
Kuljanin and Kalić (2015) [62]	Face-to-face interviews	3-part questionary (travel related questions on ordinal and binary scale, socio-demographic on nominal scale and SP about price and punctuality measured on 5-point scale)	Similarities and difference between traditional full-service network airlines and low-cost airline passengers at Belgrade Airport, Serbia	Passengers at check-in and transit area in front of departure gates at Belgrade Airport, Serbia April-May 2013 766 received questionnaires	Detailed

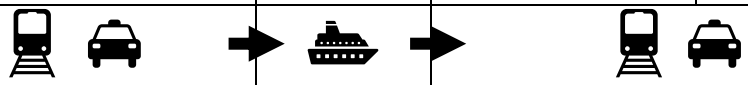
Budd T. (2016) [25]	Face-to-face computer-aided personal interview	Not specified	The role played by airport 'meeter-greeters' in a ground access context	Departing passengers at selected airports in UK, study is conducted annually 3000-70000 respondents depending of the size of the airports	Detailed
Yang and Lio (2016) [49]	Face-to-face, Choice-based sampling	SP Not specified	The joint choice of access mode and flight route	Departing passengers with individual traveling to one of the three targeted cities at TPE and TSA 618 received questionnaires	Detailed
Bruderer Encler (2017) [50]	Telephone interview	Cross-sectional survey data Not specified	Air travel emissions and sociodemographic attitudinal and spatial characteristics	Switzerland, November 2006 and March 2007 3369 received questionnaires of which 3313 usable	Detailed
Birolini et al. (2019) [20]	Face-to-face, using the Computer Aided Personal Interviews	RP survey, 2-part questionary (socio-economic and access mode)	Access mode choice Evaluation of new direct rail services at Milan-Bergamo airport	Outgoing passengers at Milan-Bergamo airport in the period 2013–2016, 7 days sessions each year/2445 received questionnaires	Detailed
Freitas et al. (2019) [9]	Computer-aided telephone interviews	Stage based Not specified	Daily mobility behaviour	Switzerland, January 2015 – February 2016/ 57090 respondents of which 4272 in Zurich	Not specified
Sauter-Servaes et al. (2019) [8]	Real-time travel-accompanying surveys supported by software	Not specified	Collecting and analysing door-to-door travel times by air and rail	Panel organized by a market research institute (March to October 2017, seven German cities)/312 trips recorded (74 air and 238 rail trips)	Short
Bergatino et al. (2020) [21]	Paper-based surveys	Data mixture model with RP and SP Not specified	The analysis of residents' decisions regarding airport access mode	Passengers at Bari and Brindisi airport in three periods 2015-2018, also non-users of	Detailed

				airports 1064 airport users and 165 non-users	

Annex D Base analysis scenarios of SYN+AIR

These are the base analysis scenarios of SYN+AIR, which served as the basis for creating the customer journeys.



	Car	Airplane	Train of Bus	Ship
11				
	Train or MaaS	Ship	Train or MaaS	
12				
	Bus	Train or MaaS		

Annex E Tentative questions derived from the Customer Journey Workshop

These are the 85 questions that were derived from the internal workshop held on the 10th of February 2021, in which 33 tentative customer journeys were created, along with possible questions, most of which were used in the final questionnaire.

1) What mode would you choose?
2) Why would you choose this mode?
3) There is a long queue for security today. Would this affect your emotions?
4) How much is the distance between your transport mode and the airport check-in desk affect your choice of mode?
5) What is the fastest mode?
6) What is the most reliable mode?
7) Why – they tend to spend nice family time vacation?
8) How important is it for you to minimize travel time?
9) When - how scheduling delays affect your emotions
    a. Likert scale
10) How – how much are you willing to wait for train?
11) Is getting a (family) discount on your tickets important for shifting your choice?
12) In case of a disruption, is it important that you maintain your discount?
13) When carrying a lot of luggage, what is the max walking distance you are willing to walk?
14) What is your mode choice to reach the airport?
15) Why do you prefer this mode?
16) When would you use other alternative?
17) How did you plan your travel and purchase the tickets?
18) What is the most reliable mode?
19) When do you book the plane tickets?
20) How much are you willing to pay for transport to have ease of mind?
21) Would you prefer to book your entire journey through a one-stop-shop?
22) How important is to have real time information?
23) If travelling with 4 kids and your spouse, do you prefer to travel by bus or would you order two taxis?
24) In a door-to-door trip, do you arrange for buffers during your plan (i.e. reach the gate 1 hour before take-off)?
25) What is the criterion for choosing MaaS instead of bus at your destination?
    a. Distance to the stop
    b. Unknown routes
    c. Cost
    d. Time
    e. Comfort
26) Is traffic affecting your choice between MaaS or bus?
27) When travelling, do you often shop at the airport?
28) What do you expect from Airport assistance?
29) What would make you feel less anxious?
30) Would you pay more to have a better service?
31) Which mode of transport would you choose when travelling alone and which when you travelling with friends?
32) Why would you choose a specific mode of transport?
    a. Time
    b. Cost

   c. Comfort
   d. Security
   e. Scenic route
33) Do you prefer using self-service machines and mobile/web apps to buy tickets and check in?
34) How do you plan your trip, especially when using train service?
35) What is most stressful when reaching the airport?
   a. Navigating to my gate
   b. Checking in
   c. Dropping-in my luggage
   d. Waiting in line for the security check
36) How useful would it be if your air ticket also provided precise information regarding reaching the airport?
   a. Likert scale
37) When do you first research info about your trip to the airport?
   a. A week in advance
   b. A day in advance
   c. A few hours in advance
   d. I don't plan
38) What is your mode choice to reach the airport?
39) Why do you prefer this mode?
40) When would you use other alternative?
41) How did you plan your travel and purchase the tickets?
42) How important is travel time when choosing a mode to reach the airport?
   a. Train (30 minutes)
   b. Taxi (40 minutes)
43) How important is reliability when choosing a mode to reach the airport?
   a. Train (30 minutes)
   b. Taxi (20-40 minutes)
44) I need an internet connection while:
   a. Going to the airport
   b. At the airport
   c. On the plane
   d. After landing
   e. On the way from the airport
45) Are you a member of a loyalty program?
46) What benefits do you expect when using your loyalty card?
   a. Access to lounge areas
   b. Priority boarding
   c. Pickup-service to/from the airport
47) What difference makes travelling solo or with other people?
48) What criteria did you use to pick the destination?
   a. Connectivity
   b. Cost
   c. The destination per se
   d. Obligation
   e. Event (e.g., concert)
49) How do you combine your interest with those of your friends?
   a. Separate expectations/needs along the trip
50) How do plan your arrival at the airport when using multiple modes of transport?
51) How do you feel when you need to compute arrival/departure time for each of the transport modes in order to arrive at check-in on time?

52) What is most difficult when travelling alone as PRM?
    a. Moving around at the airport
    b. Moving around to and from the airport
    c. Getting assistance when boarding and disembarking the plane
    d. Finding suitable amenities
53) Have you ever travelled alone as a PRM?
54) What is the most reliable mode?
55) When do you book the plane tickets?
56) How much are you willing to pay for ease of mind transport?
57) What mode would you choose at an unknown destination?
58) Why would you choose this mode?
    a. Can't choose any other due to mobility restrictions
    b. Comfort
    c. Other factors (price, time, etc)
59) Would you search for information beforehand?
60) Would you book a ticket online or preferable when you arrive?
61) The airplane is having a delay and you are waiting, would you worry as you are far from the other passengers?
62) How will you find out about the airport facilities if it is the first time visiting this airport?
63) Do you ever travel alone as a PRM?
64) After leaving the airport, how do you get to your destination?
65) What factors are important to you when deciding to go to the airport by car?
    a. Travel cost (tolls, fuel)
    b. Time
    c. Walking distance
    d. Parking cost
66) Carrying luggage with me is important for deciding how I go to/from the airport
    a. Likert scale
67) When meeting with friends, is it important to know their location at all times?
    a. Yes
    b. No
68) Information for walking to the right platform
    a. Information signs along the way
    b. Indoor-navigation on my mobile
69) Would you choose a PT if the train/bus station was close to the airport?
70) Would you choose train/bus if you had a family discount ticket?
71) Would you choose to pay an extra fee in order to leave ?
72) your car in a special area close to your gate?
73) What is the fastest mode to reach your hotel at the destination?
74) When is the last moment to leave your work and not to be late on flight?
75) Why choosing taking the car and not public transport?
76) Why choosing a park around service and not parking at the airport?
77) Do you prefer booking everything online?
78) When do you plan your trip, how much time before the mMeeting?
79) WouldDo you change your mode choice every time that you visit the same destination?
80) Is the traffic conditions a decision factor for choosing your mode to go to the airport?
81) Are you facing trouble finding your car?
82) Would you prefer a code on your mobile or a paper ticket?
83) Do you prefer to check in
    a. online

b. in advance
c. At the airport

84) Would you like to have one single-ticket that combines all of your travel choices in advance?
85) When do you chose train instead of taxi?

Annex F Passenger Survey Questions

These are the questions of the passenger survey, which was disseminated to more than 2200 travellers across Europe.

Mobility Profile

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* 1) How **often** do you travel by plane (in regular conditions, before the COVID-19 pandemic)?

- I almost never travel by plane
- I rarely travel by plane
- I often travel by plane
- I frequently travel by plane
- *I have never travelled by plane*

* 2) What is your most common **purpose of travel**?

- Only for business (meetings, conferences, etc.)
- Mostly for business
- Mostly for leisure
- Only for leisure (vacation, visiting family, etc.)

* 3) Do you usually **print your boarding pass** when travelling?

- Yes, it's more convenient when in paper
- Yes, in case my phone stops working, I want to be sure that I have my boarding pass available
- No, I don't want to waste paper
- No, I prefer to have my boarding pass on my phone

* 4) Are you a member of a **frequent flyer program** (such as Miles&More, Flying Blue, IberiaPlus, MilleMiglia, Miles+Bonus, etc)?

- Yes
- No

* 5) Which **information** is the most relevant when you **decide to use public transport** (e.g., bus/train/metro) to travel to/from the airport:

- Availability of elevators and escalators
- Walking distance from home to the closest stop/station
- Walking distance from the stop/station to the airport
- Available schedules and routes

* 6) If travelling as a **group of 5+ people** (e.g., with 3 kids and your spouse, or with a group of friends), do you prefer to travel by public transport (e.g., bus, train, metro) or would you order 2 taxis?

By public transport (train, bus, metro)

By 2 taxis (or minivan)

* 7) If all of the following **transport modes** are available, which one would you choose to travel **to/from the airport**?

- Car (someone drops me off/picks me up)
- Car (park at/near the airport)
- Train
- Bus
- Metro
- Taxi (or ridesharing services like Uber or Lyft)
- Combination of modes (e.g., bus & train)
- Other

* 8) When going to the airport, does **traffic congestion** affect your mode choice? (e.g., choosing train, instead of car)

- Yes
- Somewhat
- No

* 9) When do you for the **first time search information** about your trip **from your home to the airport**?

- Before booking my plane tickets
- Right after booking my plane tickets
- A week in advance
- A day in advance
- A couple of hours before the trip

* 10) When do you for the **first time search information** about your trip **from the airport to your final destination** (e.g., hotel)?

- Before booking my plane tickets
- Right after booking my plane tickets
- A week in advance
- A day in advance
- A couple of hours before the trip

* 11) Imagine you are travelling **from the airport** towards your hotel **by train**, and then need to **change to taxi** for the last part of your trip. Which statement best describes your thoughts?

- It's fine, I knew that when I was booking the hotel
- It's fine, I found out after booking the hotel
- It's annoying, yet I knew that I needed to change two modes of transport to reach my hotel, but booked it anyway
- It's annoying, if I knew this earlier, I would have booked another hotel with better connectivity to the airport

* 12) What **type of luggage** do you usually have when travelling?

- Large luggage (over 10 kilos)
- Carry-on luggage (below 10 kilos)
- Small bag (e.g., backpack)

* 13) When travelling only with hand-luggage, do you **prefer** to **check-in** your luggage, or do you prefer to have it with you **on-board**?

- I prefer to have it with me on-board
- I prefer to check it in if possible

* 14) When **transferring to another mode** (e.g., from bus to train), which case do you find **most frustrating**?

- I need to issue a separate ticket
- There is a long walking distance between the two modes
- I do not find information about when the second mode is departing
- Transferring to another mode is not frustrating

* 15) **When** do you usually **arrive at the airport**?

- Aat least two hours before departure time
- Aat least one hour before departure time
- Wwithin an hour before departure time

16) Rate the following processes in terms of **how stressful** they are for you:

	Not stressful	Least stressful	Less stressful	More stressful	Most stressful
***Check-in**					
***Security check**					
***Passport control**					
***Walk to the gate**					

17) How much do the following factors influence your **choice of mode** when travelling to and from the airport:

	Not important	Less important	Important	More important	Most important
***Waiting Time** *(e.g., waiting for the train at the platform)*					
***Travel Time** *(e.g., time spend in the bus)*					
***Cost** *(e.g., total cost of a bus ticket)*					

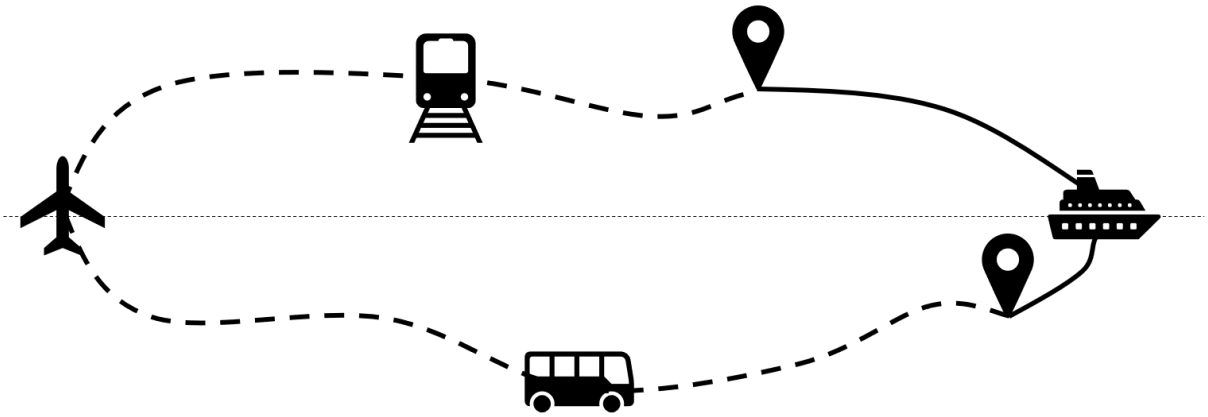
	Not important	Less important	Important	More important	Most important
***Reliability** *(e.g., whether your bus may be delayed or stuck in traffic)*					
***Security** *(e.g., the possibility of getting mugged)*					
***Weather** *(e.g., rainy or cold weather conditions)*					
***Crowdedness** *(e.g., a crowded bus or crowded train platform)*					
***Trip purpose** *(e.g., whether you are travelling for leisure or business)*					
***Familiarity of the city** *(e.g., whether it is your first time visiting a location, or if you are travelling within your own city)*					

Travel scenarios

In the following section, you will be presented with three different hypothetical scenarios. In each case, you will need to pick one of the two available modes of transport. Subsequently, you need to state the reason behind your choice.

Scenario A – Bus or train

Imagine that you just landed and you want to get to the port to get to take a ship. There is a bus and a train available, **at the same price**. - The bus is **frequent** and drops you **close to the port**, but **may be stuck in traffic** - The train leaves **every half hour**, drops you a bit **further away from the port**, but is **faster and more reliable**

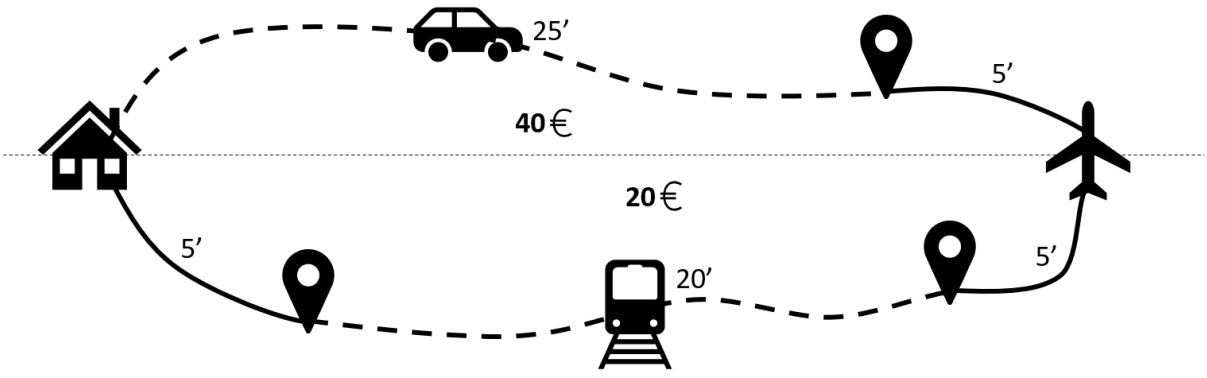


* A1) Which mode will you choose?

- Bus
- Train

Scenario B – Car or Train

You are heading **to the airport** for a weekend trip with your partner/spouse. You can get to the airport either by car, or train. In both cases the **total trip duration** to get to the airport is **30 minutes**. - By car, it takes **25 minutes** to get there, and **5 minutes to walk** from the parking lot - By train, it takes **5 minutes** to walk to the station, **20 minutes** on the train, then **5 minutes** to get from the station to the airport Regarding costs, **the car is two times more expensive**: - By **car**, the total cost is **40 euros** (gas + tolls + parking) - By **train**, the total cost is **20 euros** (2 round-trip tickets)

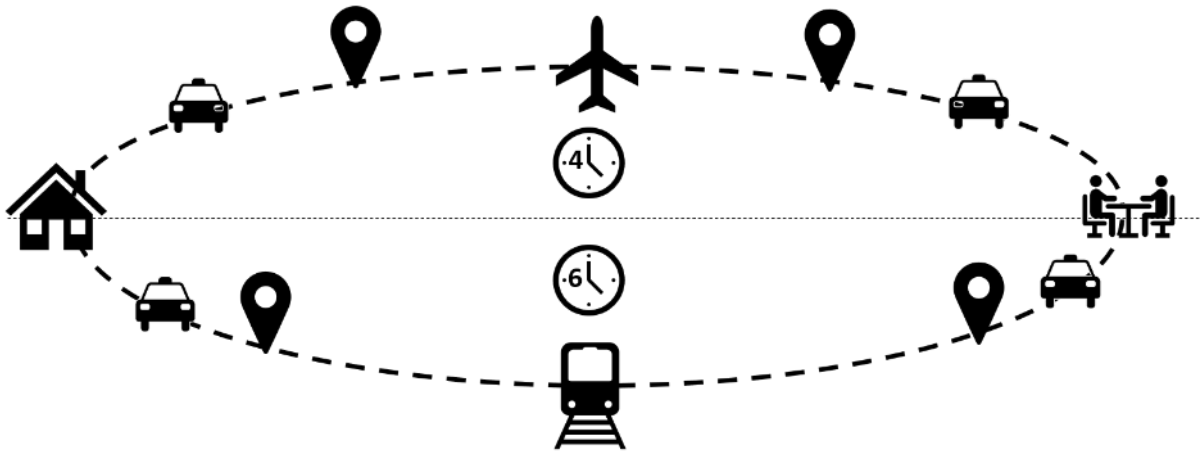


* B1) Which mode will you choose?

- Car
- Train

Scenario C – Train or Plane

You are travelling for business to a neighbouring country. You can either get there by train or plane. Travel cost is not an issue since the trip is compensated by your company. By plane, the door-to-door travel time is **4 hours** and includes: **Taxi** -> [Airport] -> **Plane** -> [Airport] -> **Taxi** - By train, the door-to-door travel time is **6 hours** and includes: **Taxi** -> [Station] -> **Intercity Train** -> [Station] -> **Taxi**



* C1) Which mode will you choose?

- Plane
- Train

Sociodemographic Profile

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* 18) What is the place of your **permanent residence**?

- Spain
- Greece
- Italy
- Serbia
- Other

* 19) Select your **gender**:

- Female
- Male
- Other
- Rather not say

20) Select your **age:**

- Scale 18 - 100

* 21) Do you have any disability that may affect your travel experience?

- Yes
- No

* 22) Select your **employment** status

- Employed (Public sector)
- Employed (Private sector)
- Student
- Retired
- Unemployed
- Other

* 23) Select your approximate **household income**:

- Low
- Average
- High
- Rather not say

* 24) Select your household size (number of people living together, including you)

Only values of at least 1 are allowed

- __ persons

* 25) How many cars does your household possess?

- 0
- 1
- 2
- more than 2

Annex G Survey results: Statistics per country

The following table presents the finding of the questionnaire. The results are aggregated by country, since the homogeneity test indicated that responses across countries are statistically not similar.

Table 9: Questions' description per country

Question	Answers	Spain	Greece	Italy	Serbia	Other
1) Frequency of travelling by plane	Almost never	5%	6%	7%	10%	1%
	Rarely	23%	41%	41%	30%	11%
	Often	39%	45%	42%	44%	57%
	Frequently	34%	8%	10%	15%	31%
2) Main purpose of travelling	Mostly Business	26%	13%	31%	41%	37%
	Mostly Leisure	43%	49%	43%	33%	40%
	Only Business	7%	1%	2%	6%	2%
	Only Leisure	24%	37%	24%	19%	21%
3) Printed boarding pass when travelling	No, I don't want to waste paper	30%	12%	16%	4%	14%
	No, boarding pass on my phone	26%	39%	20%	19%	41%
	Yes, I want to be sure that boarding pass is available	29%	35%	46%	33%	28%
	Yes, it's more convenient when in paper	14%	15%	18%	44%	17%
4) Member of frequent flyer program	Member	70%	46%	33%	39%	65%
	Non-Member	30%	54%	67%	61%	35%
5) Most relevant information when deciding to use public transport to travel to/from the airport:	Availability of elevators and escalators	7%	2%	3%	1%	3%
	Walking distance from home to the closest stop/station	21%	21%	14%	19%	17%
	Walking distance from the stop/station to the airport	15%	14%	16%	24%	18%
	Available schedules and routes	57%	64%	66%	56%	62%
6) Mode preference when travelling as a group of 5+ people	2 taxis	77%	46%	32%	64%	52%
	Public transport	23%	54%	68%	36%	48%
	Car (someone drops me off/picks me up)	15%	53%	34%	38%	38%

7) Mode preference for travelling to/from the airport if all modes are available	Car (park at/near the airport)	24%	25%	11%	7%	8%
	Train	7%	1%	12%	8%	13%
	Bus	9%	2%	4%	1%	2%
	Metro	24%	9%	21%	21%	18%
	Taxi (or ridesharing services)	18%	6%	8%	22%	14%
	Combination of modes	2%	4%	10%	2%	8%
	Other	0%	0%	0%	0%	0%
8) When going to the airport, does traffic congestion affect your mode choice?	Yes	55%	47%	48%	49%	55%
	Somewhat	36%	29%	35%	36%	31%
	No	9%	24%	17%	16%	15%
9) First time searching information about the trip from home to the airport	Before booking my plane tickets	15%	27%	39%	20%	24%
	Right after booking my plane tickets	16%	25%	26%	21%	20%
	A week in advance	19%	27%	17%	25%	24%
	A day in advance	28%	16%	13%	28%	24%
	A couple of hours before the trip	22%	5%	4%	6%	8%
10) First time searching information about the trip from the airport to the final destination	Before booking my plane tickets	23%	47%	54%	31%	37%
	Right after booking my plane tickets	23%	34%	30%	32%	29%
	A week in advance	16%	13%	11%	22%	20%
	A day in advance	23%	4%	4%	12%	11%
	A couple of hours before the trip	16%	1%	2%	2%	4%
11) Imagine you are travelling from the airport towards your hotel by train, and then need to change to taxi for the last part of your trip. Which statement best describes your thoughts?	It's fine, I knew that when I was booking the hotel	29%	35%	47%	44%	39%
	It's fine, I found out after booking the hotel	15%	9%	9%	7%	8%
	It's annoying, yet I knew that	41%	45%	22%	23%	30%
	It's annoying, if I knew this earlier, I would have booked another hotel with better connectivity to the airport	14%	11%	21%	26%	23%
12) Type of luggage when travelling	Large luggage	17%	31%	9%	47%	43%
	Carry-on luggage	65%	68%	84%	50%	51%
	Small bag	18%	1%	7%	3%	6%

13)Preference of checking-in the luggage or having it on-board, when travelling only with one-handed luggage	Have the luggage on board	69%	77%	93%	80%	81%
	Check-in the luggage	31%	23%	7%	20%	19%
14) Most frustrating case when transferring to another mode	I need to issue a separate ticket	26%	13%	17%	19%	19%
	There is a long walking distance between the two modes	28%	41%	34%	28%	31%
	I do not find information about when the second mode is departing	37%	34%	44%	27%	28%
	Transferring to another mode is not frustrating	10%	11%	6%	26%	22%
15) Time of arrival at the airport	At least two hours before departure time	39%	50%	31%	60%	56%
	At least one hour before departure time	45%	45%	57%	35%	38%
	Within an hour before departure time	16%	4%	12%	5%	6%
16a) Stressful rate when checking-in	Not stressful	5%	47%	34%	54%	56%
	Least stressful	12%	21%	16%	29%	21%
	Less stressful	25%	22%	33%	14%	15%
	More stressful	40%	7%	13%	3%	6%
	Most stressful	18%	3%	4%	1%	2%
16b) Stressful rate when passing the security check	Not stressful	2%	40%	23%	36%	33%
	Least stressful	5%	23%	12%	33%	24%
	Less stressful	21%	24%	36%	17%	24%
	More stressful	36%	11%	21%	10%	14%
	Most stressful	37%	2%	9%	3%	6%
16c) Stressful rate at the passport control	Not stressful	18%	59%	32%	55%	51%
	Least stressful	18%	19%	16%	28%	25%
	Less stressful	31%	16%	42%	13%	15%
	More stressful	23%	6%	9%	4%	8%
	Most stressful	10%	1%	2%	1%	1%
16d) Stressful rate when walking to the gate	Not stressful	8%	46%	42%	62%	64%
	Least stressful	10%	23%	18%	24%	21%
	Less stressful	26%	17%	30%	9%	10%
	More stressful	35%	10%	8%	4%	3%

	Most stressful	21%	3%	3%	1%	2%
17a) Importance of waiting time when deciding which mode to choose	Not important	2%	6%	4%	5%	9%
	Less important	14%	17%	18%	18%	20%
	important	47%	41%	46%	48%	47%
	More important	27%	14%	26%	23%	17%
	Most important	10%	21%	5%	6%	8%
17b) Importance of travel time when deciding which mode to choose	Not important	1%	3%	3%	4%	7%
	Less important	6%	14%	13%	18%	12%
	important	40%	41%	47%	41%	41%
	More important	30%	19%	30%	30%	25%
	Most important	23%	22%	7%	7%	15%
17c) Importance of cost when deciding which mode to choose	Not important	1%	7%	2%	6%	7%
	Less important	9%	18%	15%	27%	24%
	important	37%	37%	48%	39%	39%
	More important	30%	18%	25%	23%	21%
	Most important	23%	20%	9%	6%	10%
17d) Importance of reliability when deciding which mode to choose	Not important	1%	1%	0%	1%	1%
	Less important	4%	4%	2%	4%	6%
	important	34%	27%	27%	24%	24%
	More important	34%	22%	40%	46%	39%
	Most important	28%	46%	31%	25%	30%
17e) Importance of security when deciding which mode to choose	Not important	2%	4%	2%	6%	6%
	Less important	14%	14%	9%	14%	16%
	important	31%	31%	34%	26%	34%
	More important	34%	18%	35%	34%	23%
	Most important	19%	33%	19%	20%	22%
17f) Importance of weather when deciding which mode to choose	Not important	9%	6%	14%	16%	21%
	Less important	33%	24%	36%	37%	33%
	important	43%	33%	31%	30%	26%
	More important	13%	17%	14%	14%	13%
	Most important	2%	19%	5%	3%	7%
17g) Importance of crowdedness when deciding which mode to choose	Not important	2%	2%	4%	3%	6%
	Less important	13%	18%	20%	16%	24%
	important	44%	30%	41%	39%	35%
	More important	31%	23%	28%	34%	24%
	Most important	10%	27%	7%	8%	11%
	Not important	3%	20%	16%	19%	19%

17h) Importance of trip purpose when deciding which mode to choose	Less important	9%	23%	29%	28%	26%
	important	35%	31%	36%	32%	34%
	More important	25%	13%	14%	17%	14%
	Most important	28%	12%	5%	4%	7%
17i) Importance of familiarity of the city when deciding which mode to choose	Not important	1%	7%	11%	11%	12%
	Less important	12%	14%	23%	24%	22%
	important	47%	37%	42%	37%	39%
	More important	26%	20%	19%	24%	19%
	Most important	13%	21%	4%	4%	9%
A1) Which mode will you choose?	Chose Train	67%	73%	80%	79%	78%
A2) Why did you make the choice above?	Reliability	42%	60%	64%	64%	59%
	Frequency	25%	12%	10%	9%	9%
	Walking distance	14%	18%	10%	12%	15%
	Comfort	17%	9%	15%	14%	15%
	Other	3%	2%	1%	1%	3%
B1) Which mode will you choose?	Chose Train	52%	58%	75%	68%	74%
B2) Why did you make the choice above?	Reliability	28%	7%	18%	19%	18%
	Cost	20%	49%	42%	36%	39%
	Comfort	45%	41%	33%	37%	33%
	Other	6%	3%	7%	7%	10%
C1) Which mode will you choose?	Chose Plane	61%	83%	71%	71%	68%
C2) Why did you make the choice above?	Reliability	9%	3%	5%	4%	4%
	Time	29%	58%	54%	48%	45%
	Comfort	29%	28%	31%	35%	32%
	I do not like to travel by plane	9%	4%	4%	3%	3%
	I do not like to travel by train	6%	3%	1%	3%	2%
	Other	18%	4%	5%	7%	15%
19) Gender	Female	42%	81%	55%	33%	37%
	Male	54%	19%	44%	66%	61%
	Other	1%	0%	0%	0%	1%
	Rather not say	3%	0%	1%	0%	1%
20) Age	18-29	20%	35%	26%	13%	21%
	30-39	31%	41%	24%	24%	38%

	40-49	21%	17%	17%	40%	29%
	50-64	21%	5%	30%	20%	11%
21) Disability affecting travel experience	Disability	5%	1%	2%	2%	1%
21a) Kind of disability	Vision	0%	0%	0%	0%	0%
	Hearing	1%	0%	0%	0%	0%
	Mobility	3%	1%	0%	1%	0%
	Stamina	0%	1%	1%	0%	0%
	Other	1%	0%	1%	0%	0%
21b) Given the disability, what is most difficult when travelling alone?	Moving around at the airport	1%	0%	0%	0%	0%
	Moving to and from the airport	1%	0%	0%	1%	0%
	Getting assistance when boarding and disembarking the plane	1%	0%	0%	1%	0%
	Finding suitable amenities	1%	0%	0%	0%	0%
	I have never travelled by plane on my own	2%	0%	0%	0%	0%
22) Employment status	Employed (Public sector)	19%	13%	45%	37%	25%
	Employed (Private sector)	59%	64%	25%	50%	60%
	Student	11%	10%	20%	5%	7%
	Retired	5%	1%	2%	4%	1%
	Unemployed	4%	8%	2%	2%	2%
	Other	2%	4%	6%	3%	6%
23)Household income	Low	9%	19%	10%	1%	3%
	Average	72%	67%	73%	47%	49%
	High	15%	8%	8%	39%	41%
	Rather not say	4%	6%	9%	13%	8%
24) Household size	3 or less	65%	72%	58%	60%	69%
	more than 3	9%	28%	42%	40%	31%
25) Cars in household	0 cars	27%	11%	3%	11%	23%
	1 car	47%	46%	28%	50%	43%
	2 cars	24%	34%	55%	33%	28%
	more than 2 cars	2%	9%	14%	6%	7%

Annex H Survey results: Persona Mapping

The following table presents the findings of the survey aggregated per persona, based on the persona mapping that was presented in chapter 4.3.

Table 10: Questions' description per persona

Question	Answers	Axel	Berta	Nisha	Robert	Selma
1) Frequency of travelling by plane	Almost never	0%	3%	15%	7%	18%
	Rarely	14%	31%	41%	32%	38%
	Often	41%	50%	29%	46%	36%
	Frequently	45%	16%	15%	16%	8%
2) Main purpose of travelling	Mostly Business	83%	29%	5%	48%	0%
	Mostly Leisure	0%	47%	44%	34%	56%
	Only Business	17%	1%	5%	0%	0%
	Only Leisure	0%	23%	46%	19%	44%
3) Printed boarding pass when travelling	No, I don't want to waste paper	9%	15%	5%	10%	15%
	No, boarding pass on my phone	38%	27%	15%	25%	34%
	Yes, I want to be sure that boarding pass is available	27%	39%	32%	35%	41%
	Yes, it's more convenient when in paper	27%	19%	49%	30%	10%
4) Member of frequent flyer program	Member	72%	52%	24%	48%	15%
	Non-Member	28%	48%	76%	52%	85%
5) Most relevant information when deciding to use public transport to travel to/from the airport:	Availability of elevators and escalators	5%	2%	27%	2%	3%
	Walking distance from home to the closest stop/station	19%	19%	24%	19%	26%
	Walking distance from the stop/station to the airport	19%	15%	22%	18%	18%
	Available schedules and routes	58%	63%	27%	62%	52%
6) Mode preference when travelling as a group of 5+ people	2 taxis	30%	45%	34%	46%	100%
	Public transport	70%	55%	66%	54%	0%
7) Mode preference for travelling to/from the airport if all modes are available	Car (someone drops me off/picks me up)	33%	35%	46%	35%	48%
	Car (park at/near the airport)	14%	22%	17%	17%	11%

Question	Answers	Axel	Berta	Nisha	Robert	Selma
	Train	5%	6%	2%	8%	7%
	Bus	0%	3%	0%	2%	8%
	Metro	17%	19%	12%	18%	20%
	Taxi (or ridesharing services)	30%	9%	7%	15%	2%
	Combination of modes	2%	5%	12%	5%	5%
	Other	0%	1%	2%	0%	0%
8) When going to the airport, does traffic congestion affect your mode choice?	Yes	55%	52%	44%	50%	46%
	Somewhat	31%	29%	34%	33%	43%
	No	14%	19%	22%	17%	11%
9) First time searching information about the trip from home to the airport	Before booking my plane tickets	27%	26%	32%	21%	34%
	Right after booking my plane tickets	16%	23%	27%	27%	21%
	A week in advance	17%	25%	29%	21%	26%
	A day in advance	28%	19%	7%	25%	15%
	A couple of hours before the trip	13%	7%	5%	7%	3%
10) First time searching information about the trip from the airport to the final destination	Before booking my plane tickets	36%	39%	49%	35%	48%
	Right after booking my plane tickets	25%	32%	22%	33%	28%
	A week in advance	22%	16%	22%	16%	16%
	A day in advance	13%	10%	2%	12%	7%
	A couple of hours before the trip	5%	3%	5%	3%	2%
11) Imagine you are travelling from the airport towards your hotel by train, and then need to change to taxi for the last part of your trip. Which statement best describes your thoughts?	It's fine, I knew that when I was booking the hotel	45%	37%	34%	40%	30%
	It's fine, I found out after booking the hotel	8%	13%	5%	9%	7%
	It's annoying, yet I knew that	20%	34%	41%	31%	44%
	It's annoying, if I knew this earlier, I would have booked another hotel with better connectivity to the airport	27%	16%	20%	21%	20%
12) Type of luggage when travelling	Large luggage	0%	28%	44%	37%	13%
	Carry-on luggage	81%	68%	51%	60%	82%
	Small bag	19%	3%	5%	4%	5%

Question	Answers	Axel	Berta	Nisha	Robert	Selma
13)Preference of checking-in the luggage or having it on-board, when travelling only with one-handed luggage	Have the luggage on board	80%	79%	71%	83%	87%
	Check-in the luggage	20%	21%	29%	17%	13%
14) Most frustrating case when transferring to another mode	I need to issue a separate ticket	33%	19%	10%	18%	13%
	There is a long walking distance between the two modes	23%	38%	54%	31%	36%
	I do not find information about when the second mode is departing	27%	30%	24%	33%	36%
	Transferring to another mode is not frustrating	17%	13%	12%	17%	15%
15) Time of arrival at the airport	At least two hours before departure time	42%	45%	68%	44%	54%
	At least one hour before departure time	42%	45%	32%	47%	41%
	Within an hour before departure time	16%	10%	0%	9%	5%
16a) Stressful rate when checking-in	Not stressful	59%	40%	41%	44%	30%
	Least stressful	19%	19%	10%	23%	30%
	Less stressful	16%	26%	24%	20%	26%
	More stressful	6%	11%	20%	9%	10%
	Most stressful	0%	3%	5%	4%	5%
16b) Stressful rate when passing the security check	Not stressful	36%	28%	24%	32%	21%
	Least stressful	19%	21%	24%	22%	23%
	Less stressful	25%	25%	20%	24%	31%
	More stressful	16%	18%	22%	14%	13%
	Most stressful	5%	8%	10%	8%	11%
16c) Stressful rate at the passport control	Not stressful	55%	45%	39%	45%	41%
	Least stressful	22%	22%	17%	24%	21%
	Less stressful	16%	24%	24%	23%	26%
	More stressful	8%	7%	12%	7%	10%
	Most stressful	0%	2%	7%	2%	2%
16d) Stressful rate when walking to the gate	Not stressful	48%	44%	41%	55%	34%
	Least stressful	25%	21%	20%	19%	21%
	Less stressful	13%	18%	10%	17%	31%
	More stressful	13%	13%	20%	7%	10%

Question	Answers	Axel	Berta	Nisha	Robert	Selma
	Most stressful	2%	5%	10%	3%	3%
17a) Importance of waiting time when deciding which mode to choose	Not important	8%	4%	5%	7%	7%
	Less important	22%	16%	12%	17%	25%
	important	41%	45%	46%	45%	39%
	More important	22%	21%	22%	22%	20%
	Most important	8%	14%	15%	10%	10%
17b) Importance of travel time when deciding which mode to choose	Not important	5%	2%	7%	4%	5%
	Less important	16%	11%	10%	13%	21%
	important	34%	45%	41%	46%	30%
	More important	34%	22%	20%	28%	34%
	Most important	11%	19%	22%	10%	10%
17c) Importance of cost when deciding which mode to choose	Not important	13%	2%	12%	5%	2%
	Less important	36%	19%	15%	25%	8%
	important	22%	45%	32%	40%	33%
	More important	23%	24%	24%	21%	36%
	Most important	6%	11%	17%	8%	21%
17d) Importance of reliability when deciding which mode to choose	Not important	5%	0%	0%	0%	2%
	Less important	2%	3%	12%	5%	7%
	important	16%	24%	24%	24%	33%
	More important	48%	32%	27%	42%	20%
	Most important	30%	41%	37%	28%	39%
17e) Importance of security when deciding which mode to choose	Not important	9%	3%	2%	5%	2%
	Less important	19%	12%	12%	16%	16%
	important	25%	32%	24%	28%	33%
	More important	28%	27%	27%	30%	31%
	Most important	19%	26%	34%	21%	18%
17f) Importance of weather when deciding which mode to choose	Not important	17%	9%	17%	14%	8%
	Less important	28%	31%	22%	34%	43%
	important	31%	33%	32%	31%	33%
	More important	17%	16%	20%	15%	10%
	Most important	6%	11%	10%	7%	7%
17g) Importance of crowdedness when deciding which mode to choose	Not important	8%	2%	7%	2%	3%
	Less important	14%	18%	12%	18%	33%
	important	28%	39%	29%	38%	30%
	More important	42%	23%	27%	31%	15%
	Most important	8%	18%	24%	11%	20%

Question	Answers	Axel	Berta	Nisha	Robert	Selma
17h) Importance of trip purpose when deciding which mode to choose	Not important	22%	16%	17%	15%	23%
	Less important	17%	30%	15%	23%	23%
	important	17%	31%	34%	36%	31%
	More important	33%	14%	20%	17%	16%
	Most important	11%	10%	15%	8%	7%
17i) Importance of familiarity of the city when deciding which mode to choose	Not important	13%	5%	10%	9%	3%
	Less important	22%	19%	20%	21%	18%
	important	25%	45%	34%	42%	39%
	More important	30%	20%	27%	22%	23%
	Most important	11%	12%	10%	6%	16%
A1) Which mode will you choose?	Chose Train	81%	77%	85%	78%	69%
A2) Why did you make the choice above?	Reliability	72%	66%	51%	61%	51%
	Frequency	6%	12%	10%	10%	20%
	Walking distance	11%	13%	12%	14%	11%
	Comfort	11%	8%	24%	12%	18%
	Other	0%	2%	2%	2%	0%
B1) Which mode will you choose?	Chose Train	63%	60%	51%	64%	79%
B2) Why did you make the choice above?	Reliability	19%	14%	17%	19%	0%
	Cost	20%	41%	37%	33%	67%
	Comfort	50%	39%	41%	41%	28%
	Other	11%	7%	5%	6%	5%
C1) Which mode will you choose?	Chose Plane	73%	71%	76%	69%	82%
C2) Why did you make the choice above?	Reliability	11%	3%	5%	4%	0%
	Time	44%	50%	51%	48%	62%
	Comfort	33%	33%	34%	32%	23%
	I do not like to travel by plane	2%	5%	5%	6%	5%
	I do not like to travel by train	3%	2%	2%	2%	3%
	Other	8%	7%	2%	8%	7%
18) Country	Spain	6%	12%	22%	10%	7%
	Greece	14%	40%	17%	21%	51%
	Italy	3%	23%	17%	21%	36%
	Serbia	58%	16%	34%	34%	2%
	Other	19%	10%	10%	14%	5%
19) Gender	Female	16%	62%	61%	44%	70%

Question	Answers	Axel	Berta	Nisha	Robert	Selma
	Male	84%	38%	32%	56%	25%
	Other	0%	0%	2%	0%	0%
	Rather not say	0%	0%	5%	0%	5%
20) Age	18-29	14%	0%	22%	0%	100%
	30-39	28%	57%	10%	31%	0%
	40-49	36%	24%	22%	41%	0%
	50-64	19%	16%	17%	28%	0%
21) Disability affecting travel experience	Disability	0%	0%	100%	0%	0%
21a) Kind of disability	Vision	0%	0%	10%	0%	0%
	Hearing	0%	0%	10%	0%	0%
	Mobility	0%	0%	49%	0%	0%
	Stamina	0%	0%	27%	0%	0%
	Other	0%	0%	22%	0%	0%
21b) Given the disability, what is most difficult when travelling alone?	Moving around at the airport	0%	0%	5%	0%	0%
	Moving to and from the airport	0%	0%	27%	0%	0%
	Getting assistance when boarding and disembarking the plane	0%	0%	24%	0%	0%
	Finding suitable amenities	0%	0%	15%	0%	0%
	I have never travelled by plane on my own	0%	0%	22%	0%	0%
22) Employment status	Employed (Public sector)	0%	37%	22%	45%	0%
	Employed (Private sector)	100%	63%	22%	55%	0%
	Student	0%	0%	10%	0%	79%
	Retired	0%	0%	39%	0%	0%
	Unemployed	0%	0%	7%	0%	16%
	Other	0%	0%	0%	0%	5%
23)Household income	Low	0%	0%	12%	0%	69%
	Average	0%	100%	68%	63%	0%
	High	100%	0%	10%	29%	0%
	Rather not say	0%	0%	10%	8%	31%
24) Household size	Less than 3	100%	100%	100%	0%	100%
	3 or more	0%	0%	0%	100%	0%
25) Cars in household	0 cars	9%	11%	15%	4%	21%

Question	Answers	Axel	Berta	Nisha	Robert	Selma
	1 car	42%	50%	49%	31%	38%
	2 cars	42%	37%	29%	53%	30%
	more than 2 cars	6%	2%	7%	11%	11%

Annex I Correlation analysis

The following correlation analysis is provided by POLIBA, and was used for identifying the trade-offs of passengers regarding mode choice.

1. Procedure

Report includes correlations between significant variables of the SYN+AIR passenger survey.

1.1. The transformation of string into numerical variables

For obtaining exploratory information between all observed variables, we used the mathematical formulation of Pearson Correlation. The Pearson's correlation coefficient is the covariance of the two variables divided by the product of their standard deviations as reported by Everitt and Skrondal[5] in Eq (1). In general, it is a measure of the linear association between two variables, that takes a value between -1 and 1. The value -1 indicates a perfectly negative correlation between two variables, while 0 indicates no correlation between two variables. On the other side, value 1 indicates a perfectly positive correlation between two variables. In this case, the further away the coefficient is from zero, the stronger is the relationship between the two variables.

$$r_{xy} = \frac{\sum_{i=1}^{n}(x_i-\bar{x})(y_i-\bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i-\bar{x})^2}\sqrt{\sum_{i=1}^{n}(y_i-\bar{y})^2}} \quad (1)$$

where:

$x_i, y_i =$ *i* element of the variables X, Y

$n =$ sample's size

$\bar{x}, \bar{y} =$ mean of X, Y

Since different answers to each multiple-choice question were (usually) independent, each answer was transformed in a new binary variable for finding more precise relations. The Pearson correlation coefficient estimated for two binary variables will return the Phi coefficient given in Eq. 2) where two binary variables are positively associated if a major part of observations belong to the main diagonal in the contingency table (see Table 1.)[6].

Table 1. Contingency table

Contingency table	$Y = 1$	$Y = 0$	*Tot.*
$X = 1$	n_{11}	n_{10}	n_{1y}
$X = 0$	n_{01}	n_{00}	n_{0y}

[5] Everitt, B. S., Skrondal, A. (2010). The Cambridge dictionary of statistics. Available at: http://www.stewartschultz.com/statistics/books/Cambridge%20Dictionary%20Statistics%204th.pdf

[6] Davenport, E.C., El-Sanhurry, N.A. (1991). Phi/Phimax: Review and Synthesis. Educ. Psychol. Meas. 51, 821–828. https://doi.org/10.1177/001316449105100403

Tot.	n_{x1}	n_{x0}	n

$$\Phi = \frac{n_{11}n_{00} - n_{10}n_{01}}{\sqrt{n_{1y}\, n_{0y}\, n_{x1}\, n_{x0}}} \quad (2)$$

where:

n_{xy} corresponds to the crossed count of observations between the X and Y

According to the results of the survey, a total of 44 initial variables were observed as follows:

- 22 nominal string variables (more than 2 answers' choices)
- 13 numeric (likert) variables
- 7 binary variables
- 2 continuous/scale

Therefore, for transforming string into numerical variables we considered a total of 145 variables, as follows:

- 22 nominal NUMERIC variables (more than 2 answers' choices);
- 13 numeric (likert) variables;
- 7 binary NUMERIC variables;
- 2 continuous/scale;
- +101 binary numeric variables, considering each reply to the multiple-choice questions.

According to Eq (2), a positive correlation coefficient indicates the presence of high number of common answers between the two binary variables, underlining that a positive association considers the overall variable (both affirmative and negative answers). If two binary variables are positively correlated by Phi, it could mean that they have a great number of negative answers in common, or a great number of affirmative ones, or both negative and affirmative referring to the total number of paired answers.

1.2. Results of the correlation

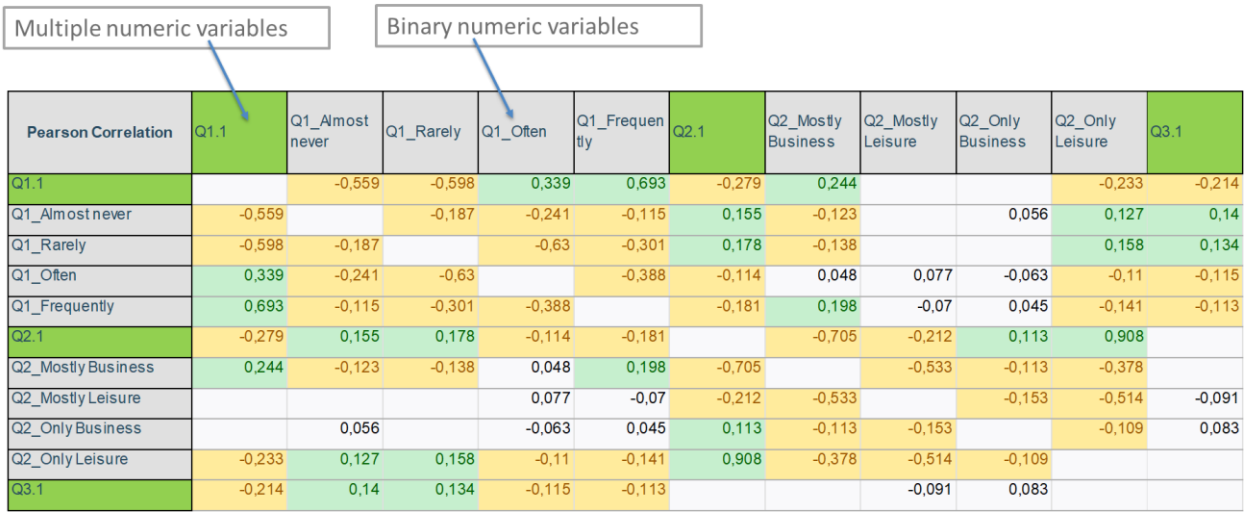
For presenting the results of the Pearson correlation, we considered only the significant correlations, where the Pearson's coefficients values are greater than 0.1 are defined as positive correlation and the values lower than -0.1 are defined as negative correlation. The Pearson Correlation analysis is performed considering the sample of the total 2199 number of pairs, where correlations are considered significant at the 0.05 level. Accordingly, in Fig. 1, for sake of room, we reported a small part of the obtained correlation matrix, where:

- Non highlighted cells indicate a weak significant correlation (-0,1<coeff. <0,1)
- The light green cells indicate a significant positive correlation (coeff. >0,1)
- The yellow cells indicate a significant negative correlation (coeff. <-0,1)
- Empty cells indicate non-significant correlation.

Later on, we are reporting the results of the correlations between binary numeric variables of the Syn+Air survey, focusing on:

- Question 20 related to age and correlations among age groups
- Question 19 related to gender

However, in the following description we neglected the multiple numeric variables correlations since their interpretation is more imprecise.



Pearson Correlation	Q1.1	Q1_Almost never	Q1_Rarely	Q1_Often	Q1_Frequently	Q2.1	Q2_Mostly Business	Q2_Mostly Leisure	Q2_Only Business	Q2_Only Leisure	Q3.1
Q1.1		-0,559	-0,598	0,339	0,693	-0,279	0,244			-0,233	-0,214
Q1_Almost never	-0,559		-0,187	-0,241	-0,115	0,155	-0,123		0,056	0,127	0,14
Q1_Rarely	-0,598	-0,187		-0,63	-0,301	0,178	-0,138			0,158	0,134
Q1_Often	0,339	-0,241	-0,63		-0,388	-0,114	0,048	0,077	-0,063	-0,11	-0,115
Q1_Frequently	0,693	-0,115	-0,301	-0,388		-0,181	0,198	-0,07	0,045	-0,141	-0,113
Q2.1	-0,279	0,155	0,178	-0,114	-0,181		-0,705	-0,212	0,113	0,908	
Q2_Mostly Business	0,244	-0,123	-0,138	0,048	0,198	-0,705		-0,533	-0,113	-0,378	
Q2_Mostly Leisure				0,077	-0,07	-0,212	-0,533		-0,153	-0,514	-0,091
Q2_Only Business		0,056		-0,063	0,045	0,113	-0,113	-0,153		-0,109	0,083
Q2_Only Leisure	-0,233	0,127	0,158	-0,11	-0,141	0,908	-0,378	-0,514	-0,109		
Q3.1	-0,214	0,14	0,134	-0,115	-0,113			-0,091	0,083		

Fig. 1. Portion of the obtained correlation matrix

1.2.1. Results of the correlations in the Question 20 - Age

In Table 2,. we reported the result of the Pearson correlation analysis considering significant negative and positive correlations of the continuous variable “Age”. Then, we report the results of the continuous variable Age according to the four age groups that match the previously defined personas.

Table 2. Pearson correlation related to the Question 20 (Age)

Pearson Correlation	Q20
Q2.1	-0.234
Q2_Mostly Business	0.276
Q2_Mostly Leisure	-0.116
Q2_Only Leisure	-0.171
Q3.1	0.236
Q3_No, I prefer to have my boarding pass on my phone	-0.156
Q3_Yes, it's more convenient when in paper	0.23
Q6.1_PT=1	-0.122
Q7.1	0.145
Q7_Car (someone drops me off/picks me up)	-0.165
Q17a	-0.187
B2_Reliability	0.166
B2_Cost	-0.172
C1.2Plane1	-0.139
C2_Time	-0.109
C2_Comfort	0.103
Q18.1	0.13
Q18_Greece	-0.275
Q18_Serbia	0.183
Q19.1	0.136
Q19_Female	-0.171

Q19_Male	0.184
Q21.1 Disability=1	0.115
Q22.1	-0.133
Q22_Employed (Public sector)	0.275
Q22_Student	-0.438
Q22_Retired	0.326
Q23.1	0.142
Q23_Low	-0.179
Q23_High	0.123
Q25_0	-0.133
Q25_2	0.122

- **Age group (18-29)**

Table 3 shows the results of the investigation about the significant negative and positive correlation considering the age group from 18 to 29 years. Referring to the Question Q2 (What is your most common purpose of travel?), respondents in this group resulted to be negatively correlated with traveling mostly for business and, as expected, the significant positive correlation was indicated for the respondents that travel for leisure. As observed from Question Q3 (Do you usually print your boarding pass when travelling?), the respondents in this age group do not consider convenient to print the boarding pass (negative correlation). Also, the age group is negatively correlated with the frequent flyer program memberships in Question Q4 (Are you a member of frequent flyer program?) and positively correlated with the preference of using PT when travelling as a group of five or more people (i.e., Question Q6: "Do you prefer to travel by public transport (e.g., bus, train, metro) or would you order 2 taxis?"). Regarding to Question Q7 (If all of the following transport modes are available, which one would you choose to travel to/from the airport?), such group of users is positively correlated to the use of car (as passenger). Moreover, the cost factor (Q17) resulted to be important about the transport mode choice when traveling to and from the airport. Concerning the Scenario B (Car or Train), the respondents are negatively correlated with "reliability", and positively with "cost" when choosing the travel mode. Regarding Scenario C (Train or Plane) there is a positive correlation with the option "plane". Considering Question Q18 (What is the place of your permanent resident), the respondents resulted to be positively associated with Greek residence, and negatively with Serbian residence, while according to Question 19 (Gender), respondents having age ranging from 18 to 29 years are mostly female. Other significant results were obtained for the question Q22 (Select your employment status), where the considered age group are mostly students (high positive correlation 0,547), while negative correlation resulted employees in public and private sector.

Table 3. Pearson correlation related to the age group from 18 to 29 years

Pearson Correlation	Age_18_29
Q1.1	-0,11
Q2.1	0,219
Q2_Mostly Business	-0,248
Q2_Only Leisure	0,168
Q3.1	-0,116
Q3_Yes, it's more convenient when in paper	-0,119
Q4.1 Member	-0,121
Q6.1_PT	0,109
Q7.1	-0,113

Q7_Car (someone drops me off/picks me up)	0,141
Q17 cost	0,12
B2_Reliability	-0,102
B2_Cost	0,115
C1 Plane	0,126
Q18.1	-0,127
Q18_Greece	0,173
Q18_Serbia	-0,159
Q19_Female	0,127
Q19_Male	-0,143
Q22.1	0,179
Q22_Employed (Public sector)	-0,215
Q22_Employed (Private sector)	-0,114
Q22_Student	0,547
Q23.1	-0,129
Q23_Low	0,179
Q23_High	-0,129
Q25_more than 2	0,136

- **Age group (30-39)**

The results of the significant correlations with age group from 30 to 39 years are reported in Table 4. As observed from Question 3 (Do you usually print your boarding pass when travelling?), the respondents do not prefer to have a paper boarding pass when traveling by airplane. However, for this age group the cost factor (Q17) resulted to be important for deciding which mode to choose when traveling to and from the airport (significant positive correlation 0,107). As far as for the Question Q18 (What is the place of your permanent residents?) concerns, the investigated age group resulted to be positively associated to Greek residence, and negatively with Serbian residence. Considering the question Q22 (Select your employment status), the respondents were positively correlated with the employment status in the private sector and negatively with student status. Finally, from the results of the Questions 24 and 25, it is observed that most of the respondents live in the small household with lower number of owned cars.

Table 4. Pearson correlation related to the age group from 30 to 39 years

Pearson Correlation	Age_30_39
Q3.1	-0,127
Q3_Yes, it's more convenient when in paper	-0,117
Q17 cost	0,107
Q18_Greece	0,139
Q18_Serbia	-0,105
Q22_Employed (Private sector)	0,215
Q22_Student	-0,191
Q24.1	-0,148
Q25.1	-0,139

- **Age group (40-49)**

In Table 5 are reported the significant correlation relevant to the age group from 40 to 49 years. Considering the Question 2 (What is your most common purpose of travel?), respondents in this group resulted to be positively correlated with traveling mostly for business. On the other side, for the Question 16 (Rate the following processes in terms of how stressful they are for you), process "walking to the gate" resulted to be negatively correlated with the considered age group. Also, for the cost factor in Question 17, resulted to be negatively correlated when selecting the travel mode to and from the airport. Regarding the Question Q18 (What is the place of your permanent residents?), the respondents resulted to be positively associated with Serbian residence, and negatively with Greek residence, while according to Question 19 (Gender), the respondents are mostly male. Whit respect to the Question Q22 (Select your employment status), the respondents were positively correlated to the employment status in the public sector and negatively with student status. According to Question (23) related to the income, this age group is positively correlated with high income (0,124).

Table 5. Pearson correlation related to the age group from 40 to 49 years

Pearson Correlation	Age_40_49
Q2.1	-0,137
Q2_Mostly Business	0,174
Q16 walking to the gate	-0,116
Q17 cost	-0,134
Q18.1	0,158
Q18_Greece	-0,123
Q18_Serbia	0,208
Q19_Female	-0,105
Q19_Male	0,107
Q22_Employed (Public sector)	0,115
Q22_Student	-0,193
Q23.1	0,125
Q23_Low	-0,115
Q23_High	0,124

- **Age group (50-64)**

The Pearson correlation related to the age group from 50 to 64 years are reported in Table 6. Similarly to the previous age group, also in the case of the Question 2 (What is your most common purpose of travel?), respondents resulted to be positively correlated with traveling mostly for business, and negatively correlated with traveling only for leisure. However, as observed from Question Q3 (Do you usually print your boarding pass when travelling?), the respondents are positively correlated with having a paper ticket when traveling by airplane. According to the results of the Scenario B (Car or Train), the respondents are positively correlated with "reliability", and negatively with "cost" factor when choosing the mode of travel. Regarding the Question Q18 (What is the place of your permanent residents?), the respondents resulted to be positively associated with Italian residence, and negatively with Greek residence, while according to Question 19 (Gender), the respondents are mostly male. In the case of the Question Q22 (Select your employment status) the respondents were positively correlated with the employment status in the public sector and negatively with employment in private sector and student status. According to Question Q23 related to the income, this age group is negatively correlated with low income, while Question Q25 resulted to be positively associated with the higher number of owned cars.

Table 6. Pearson correlation related to the age group from 50 to 64 years

Pearson Correlation	Age_50_64
Q2.1	-0,138
Q2_Mostly Business	0,148
Q2_Only Leisure	-0,109
Q3.1	0,153
Q3_No, I prefer to have my boarding pass on my phone	-0,113
Q3_Yes, it's more convenient when in paper	0,142
B2_Reliability	0,133
B2_Cost	-0,103
Q18_Greece	-0,204
Q18_Italy	0,185
Q19_Male	0,103
Q22.1	-0,104
Q22_Employed (Public sector)	0,23
Q22_Employed (Private sector)	-0,126
Q22_Student	-0,151
Q23_Low	-0,104
Q25.1	0,119

1.2.2. Results of the correlations in the Question 19 - Gender

The results of the significant positive and negative correlations for Question 19 are reported in Table 7. In the case of the female gender for Question 2 ("What is your most common purpose of travel?"), it resulted to be positive for respondents that travel mostly for business, only for business, while it is negatively correlated for respondents that travel mostly for leisure and only for leisure. Also, the female gender is negatively correlated with the frequent flyer program in Question 4. Regarding Question 7 (If all of the following transport modes are available, which one would you choose to travel to/from the airport), the female gender is positively correlated with car as passenger, and negatively with train mode choice. Considering Question 14 (When transferring to another mode (e.g., from bus to train), which case do you find most frustrating?), the female gender is negatively correlated with the frustration associated with the necessity of issuing a separate ticket and in general for transferring to another mode, while they are frustrated with a long walking distance between the two modes. Also, the female gender is positively correlated with the factors such as "Weather" and "Familiarity of the city" when deciding which mode to choose when travelling to and from the airport. Regarding Scenario B (Car or Train), the female respondents are positively correlated with "cost", and negatively with "reliability" factor when choosing the travel mode. However, for Scenario C (Train or Plane) the female respondents are positively correlated with choosing "plane" for the "sake of time" considering that in the Scenario C, the D2D travel time by train is 6 hours, by the airplane is 4 hours. Regarding the Question Q18 (What is the place of your permanent residents?), the female gender resulted to be positively associated with Greek residence, and negatively with Serbian and other residence, while according to Question 23 related to the income, the female gender is negatively correlated with high income. Additionally, for the previously mentioned questions, the results of the significant negative and positive correlations for the male gender are opposite to female gender. However, according to Question 20 (i.e., age), female respondents are positively correlated with the age group from 18 to 29 years, and negatively from 40 to 49 years, while the male respondents are negatively correlated with the age group from 18 to 29 years, and positively from 40 to 49 years, and from 50

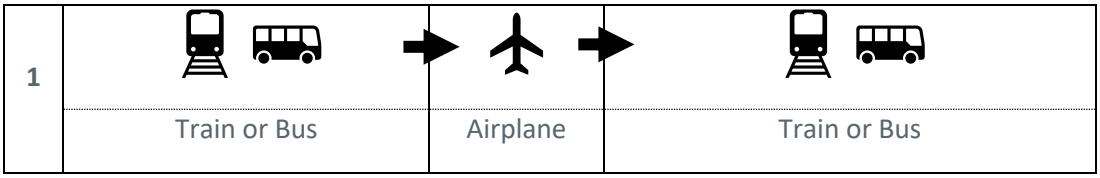
to 64 years. Also, the stressful process “walking to the gate” resulted to be negatively correlated with the male respondents in Question 16. Moreover, male respondents resulted to be negatively correlated with the unemployed status in Question 22.

Table 7. Pearson correlation related to the female gender

Pearson Correlation	Q19_Female
Q1.1	-0.114
Q1_Frequently	-0.126
Q2.1	0.245
Q2_Mostly Business	-0.27
Q2_Mostly Leisure	0.106
Q2_Only Business	-0.113
Q2_Only Leisure	0.201
Q4.1 Member	-0.122
Q7.1	-0.163
Q7_Car (someone drops me off/picks me up)	0.182
Q7_Train	-0.126
Q10.1	-0.122
Q14_I need to issue a separate ticket	-0.101
Q14_There is a long walking distance between the two modes	0.152
Q14_Transferring to another mode is not frustrating	-0.129
Q17_Weather	0.22
Q17_Familiarity of the city	0.117
B2_Reliability	-0.132
B2_Cost	0.12
C1 Plane	0.139
C2_Time	0.11
Q18.1	-0.273
Q18_Greece	0.369
Q18_Serbia	-0.247
Q18_Other	-0.135
Q19.1	-0.944
Q19_Male	-0.979
Q20	-0.171
Age_18_29	0.127
Age_40_49	-0.105
Q23.1	-0.221
Q23_Low	0.14
Q23_Average	0.14
Q23_High	-0.237

Annex J Validated Customer Journeys

This is the final collection of the validated customer journeys, that is the result of the tentative journeys that were created, merged and corrected by the findings of the survey from the real-world respondents, according to how the identified personas responded to the various questions.



Selma | Budget Traveller	To the airport	At the airport	From the airport
Journey			
Actions	• Goes to the bus stop early to wait for the bus since she doesn't know the timetable • Uses her student discount to buy a ticket on her mobile app	• She has printed her ticket in advance (41%) • She is carrying carry-on luggage (82%) • She is not a member of frequent flyer program (85%)	• Asks information about which bus to take • She doesn't like that she cant find information for the bus (36%) and that the bus stop is far (36%) • Issues a paper ticket while on the bus
Needs & Emotions	• Travels for mostly for leisure (56%) • Prefers a cheap solution	• Needs to meet up with her friends • Anxious, since her friends are taking the subway, she cannot call them and she does not know whether they are arriving soon	• Needs to get to their hostel to leave their luggage, so they don't want to walk a long distance • Feels insecure, because she is travelling to that destination for the first time

Robert | Family Traveller	To the airport	At the airport	From the airport
Journey			

Actions	• Going to the train station • Checking the timetable of the train through the mobile app	• Arriving earlier at the airport • Checks the flight information and the number of gate • Check-in the luggage • Long walking to the gate	• Checks the timetable of train on the info kiosk • Chooses the fastest travel mode • Paying the ticket at the ticket machine for the entire family
Needs & Emotions	• The price of the trip is not the main concern • Needs real-time traveling information • Reliability	• Needs good airport connectivity • Paying attention to the kids	• Good connectivity to the hotel destination • No walking longer than 5 min

2	Bus or MaaS	Airplane	Bus or MaaS

Berta | Short Break Traveller			**SYN+AIR Customer Journey 2.1**
	To the airport	**At the airport**	**From the airport**
Journey			
Actions	• Order Uber or taxi for husband and herself	• Carries only hand luggage • Spend minimal required time at the airport, probably visiting shops to buy some cosmetics because she didn't have time to do it earlier	• She consider both MaaS and bus because they are at the destination • She will decide to take a taxi in order to be at the hotel sooner. But if the bus going directly to her destination is available at the moment (in front of the airport) she would take it also
Needs & Emotions	• Need to have reliable transport to airport because she doesn't have time buffers. Value her time more that money.	• Last minute shopping	

Selma | Budget Traveller	To the airport	At the airport	From the airport
Journey			
Actions	• Book ticket online • Plan journey in advance (check availability) • Search for discounts	• Does not check in her luggage • Has already checked in • Flies with budget airlines • Finds the airport processes to be somewhat stressful	• Takes an Uber to the destination • Walks to the boarding location • Searches for WiFi
Needs & Emotions	• Low price • High availability	• More on-board luggage space • Fast check-in • Meeting Points • Free WiFi	• Free WiFi • Meeting points • Information on changes of transport • Weather information

SYN+AIR Customer Journey 2.2

3			
	Train or MaaS	Airplane	Train or MaaS

Axel | Business Traveller	To the airport	At the airport	From the airport
Journey			
Actions	• Make the reservation through the mobile app • Using business card	• He is using his mobile phone for boarding the plane	• Downloads a new app and orders a ride • Uber doesn't operate in this city, so he needs to download another app for finding a ride, or he will have to wait outside in the queue for a taxi
Needs & Emotions	• Prefers the fastest trip mode • Money is not the issue	• He has no luggage and is already checked-in	• Anxious that he may be late for his meeting

SYN+AIR Customer Journey 3.1

	• Trip comfort – wants to work on the way to the airport • Anxiety regarding the on-time arrival		

Robert | Family Traveller	To the airport	At the airport	From the airport
Journey			
Actions	• When travelling in big groups of 5+ people, Robert prefers to travel by public transport instead of taxi (54%)	• Want to be there earlier, yet arrives one hour before departure (47%) • Does not want to walk long distances due to large baggage and ski equipment	• Use MaaS, have planned everything in advanced • Use technology for planning the trip
Needs & Emotions	• Values security for choosing a mode (30%) • Want to have everything under control, may be stressed	• Looking for something interesting for the kids, to keep their attention and to keep them entertained	• Need a large vehicle to accept large family • Reliable driver (weather conditions in ski resorts)

SYN+AIR Customer Journey 3.2

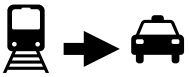
4				
	Train or MaaS	Airplane	Train	MaaS

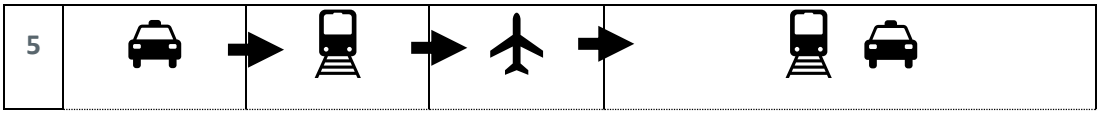
Nisha | PRM Traveller	To the airport	At the airport	From the airport
Journey			
Actions	• Since she is familiar with trains in her town she takes the one with special place for PRM traveller	• She rarely travels by plane (41%) • She needs more time at the airport • If available she would pay more for some	• She takes train to the MaaS and she needs special type of cars that can transport her wheelchair. She made reservations from her home

SYN+AIR Customer Journey 4.1

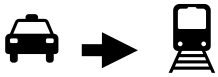
	• Since she lives close to train station she goes there by herself • She arrives at least two hours in advance to the airport (68%)	additional services at check in • She has already printed her ticket since she finds it be more convenient (49%) • She is a member of a frequent flyer program to have access to extra amenities (76%) • She is only carrying carry-on luggage with her	• She finds it annoying that she has to change modes, yet she is in terms as she knew this in advance (41%)
Needs & Emotions	• Needs to have a special access to the coach for PRM travellers • The most stressful part of the journey is getting to and from the airport (27%)	• Worried how her wheelchair will be transported and also will the flight be late because she has taxi waiting for her at the airport	• she needs special type of cars that can transport her wheelchair

Axel | Business Traveller — **SYN+AIR Customer Journey 4.2**

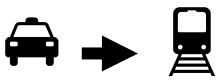
	To the airport	At the airport	From the airport
Journey			
Actions	• Issues a paper ticket on the vending machine in order to get a receipt • Boards the train, but cannot find a seat to sit at, as it was not possible to reserve a seat in advance	• Already checked-in on his phone, he heads straight to the security check and his gate	• He rides a train, since it is the fastest option • He wants to book a taxi • He then transfers to a taxi for the last mile, since it's too far to walk
Needs & Emotions	• Cannot afford to get caught in traffic, therefore he chooses to travel by train • Needs to get a receipt for all trip segments • He finds trains to be much more reliable than other modes	• Needs to squeeze the time of all processes as he has a long day ahead	• He would like to reserve a taxi while in the train but he doesn't know which application to use



	MaaS	Train	Airplane	Train or MaaS

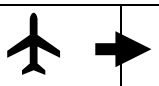
Berta | Short Break Traveller	To the airport	At the airport	From the airport
Journey			
Actions	• Checks the plane boarding time, and looks into train timetable to find a ride which will transport her and her husband to the airport, but still give then enough time for check-in. • Based on the train departure time they schedule a ride	• Goes to the check-in but prefers to have their carry-on baggage with them on-board (71%) • Passes security check and walks to the boarding gate.	• Schedules a ride using mobile app • Walks to taxi pickup point
Needs & Emotions	• Does not want walk too much with their luggage • It's not a problem that they need to change modes, they knew that already while planning the trip (37%) • They want sit next to each other. • They also need to compute departure and arrival time for each mode of transport.	• Want to shop for souvenirs for their loved ones.	

SYN+AIR Customer Journey 5.1

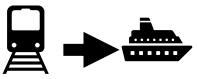
Nisha | PRM Traveller	To the airport	At the airport	From the airport
Journey			
Actions	• Gets to the station, uses the elevator to get to the platform	• She uses the PRM restroom • Notifies the airport that she needs	• She finds a place in the train where she can also have space to work on,

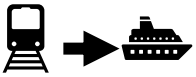
SYN+AIR Customer Journey 5.2

	• Issues a ticket from the vending machine, since she needs the receipt as well	assistance to board the plane	on her way to her conference
Needs & Emotions	• She needs to be sure that she can reach the airport from the train easily and without barriers	• Requires assistance to get on and off the plane	• She considers security the most important factor when selecting mode of transport (34%) and also reliability (37%) • Since the train trip to the conference hall is more than half an hour away, she requires a quiet and comfortable place to work on some final slides of her presentation • Worried that she may not find a suitable space in the train

6				
	Train or Bus	Airplane	Train or Bus	Ship

Berta | Short Break Traveller — **SYN+AIR Customer Journey 6.1**

	To the airport	At the airport	From the airport
Journey			
Actions	• Well prepared for the travel; prefers trains due to the better comfort; goes to the train station on time; uses smartphone for timetable update	• Carries only hand baggage that can be taken into a cabin • Does not come at airport too early	• Takes the train to get to the ship (77%) • She prefers to get their by train due to reliability (66%)
Needs & Emotions	• Expects reliable service without delays and available service staff to help and assist her	• Prefers fast check-in service, do not like to wait in long queues; appreciates organization	

Axel | Business Traveller	To the airport	At the airport	From the airport
Journey			
Actions	• Axel is used to this journey, hence he needs little preparation time. • Axel already booked the tickets in advance	• Axel knows the airport and procedure and can move quickly through the airport to get to his gate. • Axel doesn't have to check any luggage; he travels light.	• Takes the train to get to the ship (81%)
Needs & Emotions	• Axel prefers a time reliable solution (72%) • Axel takes the opportunity to answer some emails and send text messages while on board	• Axel needs to have real time information to optimize his time. • Axel needs to work on a report during his trip	

SYN+AIR Customer Journey 6.2

7			
	Car	Airplane	Train or Bus or MaaS

Selma | Budget Traveller	To the airport	At the airport	From the airport
Journey			
Actions	• Gets picked up by a friend (48%) • They park in the cheapest parking near the airport • Avoids tolls	• Parks far away, needs time to get to the airport • Does not check in luggage • Flies with budget airlines (problems with on-board luggage)	• Checks destination • Books the ticket online • Goes to the platform/stop • Buys a ticket • Notify AirBnB host of arrival time

SYN+AIR Customer Journey 7.1

Needs & Emotions	• Information on parking • Information on traffic	• More on-board luggage space • Fast check-in (she also printed her ticket to always have her boarding pass available – 41%) • Meeting Points • Travel Information (e.g., bus stop)	• Needs free WiFi on bus • Meetings points • Information on changes of transport • Is not affected by weather conditions (43%) nor crowdedness (33%) • She is however considering reliability to be the most important element for choosing mode (39%)

Robert | Family Traveller — **SYN+AIR Customer Journey 7.2**

	To the airport	At the airport	From the airport
Journey			
Actions	• Going to the airport with his private car and he will leave it in the parking lot. • He will walk with his 4 kids to the gate so he wants to park near the entrance. • He will arrive earlier in the airport	• He finds none of the airport operations to be stressful	• They will claim their luggage and they will go straight to the exit to take their already booked mini van • They will travel by train since Robert prefers to travel by public transport when in big groups (54%)
Needs & Emotions	• He is anxious because he doesn't want to be late and he doesn't want to stuck in the traffic (traffic affects his mode choice decision, yes: 50%, somewhat: 33%)		• He wants to be always with his family and he will avoid walking that much

Berta | Short Break Traveller — **SYN+AIR Customer Journey 7.3**

	To the airport	At the airport	From the airport
Journey			

Actions	• Her husband picks her after work (35%) and they go directly to the airport where they will leave a car during the weekend. She made a reservation at airport's parking	• Takes coffee before check in or if she has enough time goes to restaurant • Berta flies often (50%) and therefore does not find any airport operation to be stressful	• Since it is her first time at the destination (45%) she decides to take a taxi
Needs & Emotions	• She need to be able to find reserved parking place easy and she would like to have application to show her how to reach that place		• She is tired and she wants to reach hotel as soon as possible

8	Train or Bus or MaaS	Airplane	Car

Selma | Budget Traveller			**SYN+AIR Customer Journey 8.1**
	To the airport	**At the airport**	**From the airport**
Journey			
Actions	• Her friends plan their trip to the airport separately • She takes the bus to reach the airport since she is entitled to student discount	• Arrange a meeting point at the airport as not the same mean of transport is the best alternative for everyone	• Find car hiring company with the cheapest fee
Needs & Emotions	• To orchestrate their arrival time at the airport and meet they designate someone to lead the group	• Make sure that everyone is at the gate after security none is left behind • Arrange/share things if one person has an overload.	• Need to have more than one driver and experience in driving • Need to rent a car that has a room for at least 4 backpacks • Split the fees

Berta | Short Break Traveller			**SYN+AIR Customer Journey 8.2**
	To the airport	**At the airport**	**From the airport**

Journey			
Actions	• They bought the tickets at the train station	• They are going straight to the gate because they are already checked-in and they are only carrying hand luggage (68%)	• They are walking to the parking lot and paying the reservation upon their arrival • They are trying to find their paper ticket in order to pay the parking
Needs & Emotions	• They chose the train because it's more comfortable and more reliable than the bus and the taxi (traffic)		• They are going straight to the gate because they are already checked-in and they are only carrying hand luggage

9			
	MaaS or Bus	Train	MaaS or Bus

Nisha | PRM Traveller — **SYN+AIR Customer Journey 9.1**

Journey			
	To the airport	**At the train station**	**From the airport**
Actions	• Nisha takes the bus to get to the train station • She is facing mobility issues (49%) • The most difficult part of travelling is getting to and from the airport (27%) and boarding the plane (24%). That is why she chose to travel by train instead	• She chooses to travel by train instead of plane (49%) • She states that comfort is the primary drive of that choice (41%) • The secondary factor behind her choice is cost (37%)	• She arranges for a taxi to pick her up at the destination, since she travels to that destination for the first time and considers familiarity with the city to be an important factor (70%) when choosing mode

10				
	Car	Airplane	Train of Bus	Ship

Berta | Short break Traveller — SYN+AIR Customer Journey 10.1

	To the airport	At the airport	From the airport
Journey			
Actions	• Arrives at the airport by car. Her sister dropped her off (35%)	• Arrives at the destination airport and consider whether to choose train or bus. She considers reliability to be an important factor when choosing mode (97%). She therefore chooses to take the train	• Prefers to travel by train over bus (77%)

Axel | Business Traveller — SYN+AIR Customer Journey 10.2

	To the airport	At the airport	From the airport
Journey			
Actions	• Arrives at the airport by car (14%)		• Prefers to travel by train over bus (81%)

Selma | Budget Traveller — SYN+AIR Customer Journey 10.3

	To the airport	At the airport	From the airport
Journey			
Actions	• Arrives at the airport by car. Her parents drop her off (48%)	• She has already researched in advance the travel options that are available at the destination airport (48%)	• She chooses to take the bus to get to the port (31%) • The reason behind her choice is to have a smaller walking distance from the bus stop to the ship (85%)

11	Train or MaaS	Ship	Train or MaaS

Robert | Family Traveller	To the port	At the port	From the port
Journey			
Actions	• Robert travels to the port by train (78%) • He finds the train to be more reliable than other modes (61%)	• All family member board the ship • The ship reaches the destination and they disembark	• They travel by train again, since Robert prefers to travel by public transport when in big groups (54%)

SYN+AIR Customer Journey 11.1

12	Bus	Train or MaaS

Berta | Short break Traveller	On the bus	At the station	On the train
Journey			
Actions	• Traffic congestion is important for choosing mode (yes: 52%, somewhat: 29%) • Berta chooses to take the bus since cost is an important factor (Important: 45%, More important: 24%, Most important: 11%)	• She needs to transfer to a train • She doesn't like that there is a long walking distance between the two modes (38%) • She doesn't like that she cannot find information about when the second mode is departing (30%)	• She prefers to travel by train, as she considers it to be more reliable (66%)

SYN+AIR Customer Journey 12.1