DT.1.2.9
ACCESSIBILITY OF AIRPORTS

Transnational Report of the mulimodal mobility system of the local FUAs airports

Version 1
11 2018

Written by WRS, 21.12.2018

Wirtschaftsförderung Region Stuttgart

1. Introduction

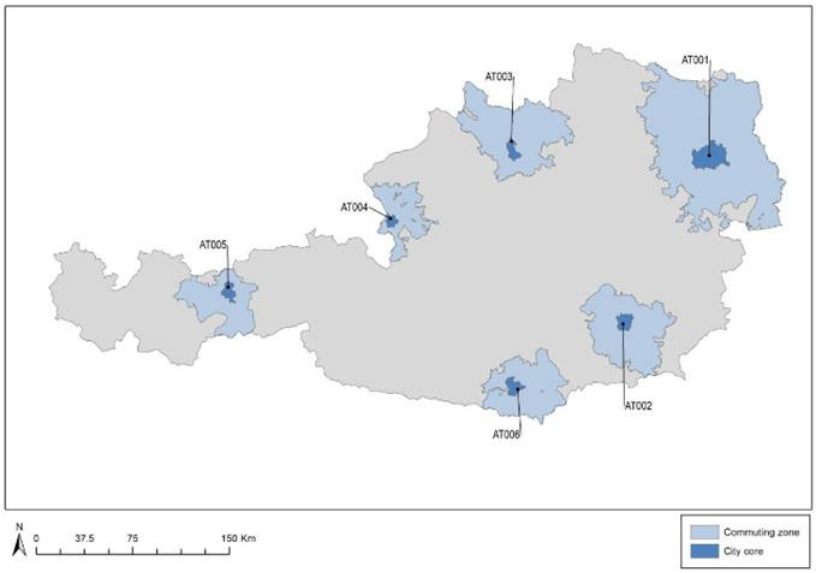
The resulting report sums up the A.T1.2 activities, delivering a detailed understanding of the Functional Urban Area (FUA) mobility services to integrate an accessibility system to the airport in a transnational perspective. It is necessary to clarify that the surface access of an Airport is much more than just the road and rail network. In the close future multimodal issues and information services become more and more important for the integration of an airport into its FUA. In order to compare the different FUAs there needs to be a common understanding of the FUAs and its airport surface access. In the following report, the airports and its mobility system will be compared and analysed, considering the road network, public transportation by road and rail, on-demand mobility services such as car-sharing, busses, on-call shuttles and cab services. The transport network can be served by various modes with different service qualities. Furthermore, airports parking capacities for those arriving by private car will be considered as well as mobility information systems. Many mobility options do exist, however, many mobility information systems only include information to a certain grade.

2. Airports and Functional Urban Areas (FUAs)

2.1. General description

Functional urban areas (FUAs) were originally defined for making different metropolitan areas comparable when it comes to their economic, social and environmental performances. In order to ensure the comparability of cities in terms of economic, social and environmental performance in cross-country aspect, a new definition of a city and its commuting zone the so called functional urban areas (FUA) was developed by the Organisation for Economic Co-operation and Development (OECD) and the European Commission in 2011. Therefore, this term is used for comparing different airport areas and its FUAs with each other in the LAirA project.

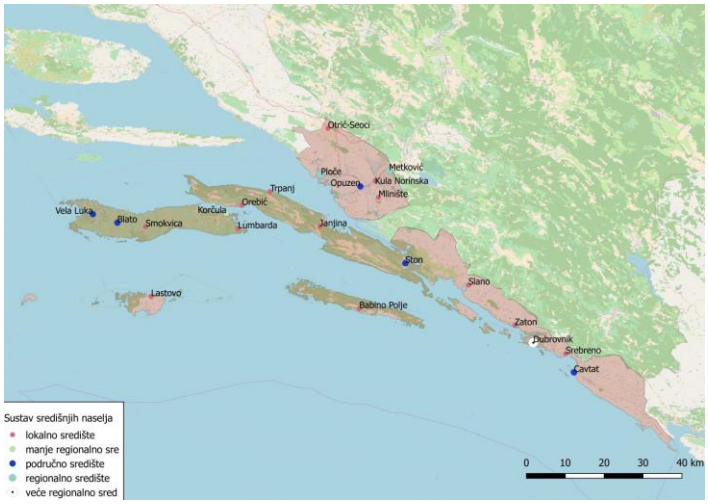
2.1.1. Location and size of the FUAs



1: FUAs in Austria

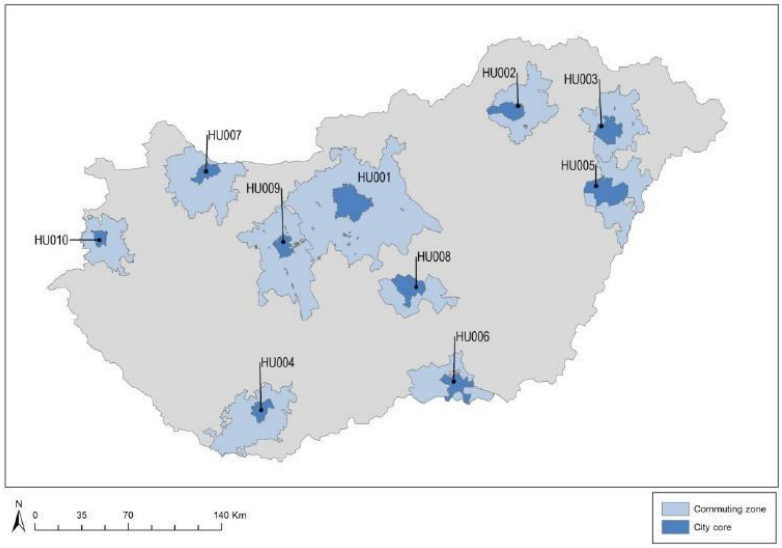
The FUA of Vienna based on the OECD definition comprises 313 municipalities in Austria. The total population of the Vienna FUA were 2,793,631 inhabitants in 2014. The City of Vienna has about 1.8 million inhabitants by 2017. As shown in Figure 1, the functional urban area of Vienna includes the city core as well as its commuting zones, where the airport of Vienna is located as well.

Administratively, the County (FUA Dubrovnik) is organized in 22 local government units, for example 5 towns and 17 municipalities. According to the 2011 population census, the DNC had 122.568 in 2011, which results in 2.86% of the total population of Croatia.



2: FUA Dubrovnik (brown)

The FUA Poznan is located in the Wielkopolskie Voivodeship and covers the urbanized area around Poznań with centers having well-developed functional ties in the social and economic areas, with developed transport infrastructure. These ties are particularly strong with Poznań – the capital of the region. The FUA is made up of 23 territorial units (Buk, Czerwonak, Dopiewo, Kleszczewo, Komorniki, Kostrzyn, Kórnik, Luboń, Mosina, Murowana Goślina, Oborniki, Pobiedziska, Poznański Poviat, Poznań, Puszczykowo, Rokietnica, Skoki, Stęszew, Suchy Las, Swarzędz, Szamotuły, Śrem, Tarnowo Podgórne), arranged in two rings surrounding the central city (Poznań). The FUA accounts for 11% of the Wielkopolskie Voivodeship and is inhabited by 1 million people, i.e. 30% of the population of Wielkopolska.



3: FUAs in Hungary

FUA Warsaw has over 3 million of inhabitants. The Warsaw Modlin Airport covers mostly the area of three municipalities: Nowy Dwór Mazowiecki, Zakroczym and Pomiechowek (approximately 46.000 inhabitants). However, it also includes Warsaw, due to the role played by Warsaw in the development of the functional urban area and Warsaw Modlin Airport itself.

According to the FUA definition, the FUA Budapest is considered the largest one in Hungary with nearly 3 million inhabitants including 7 medium-sized and 2 small urban areas. Whereas the city of Budapest has the population of approx. 1.8 million inhabitants.

Milano Linate and Milano Malpensa Airports are located in Lombardy region, which has over 10 million inhabitants and which is leader in the Italian economic system (21.8% of the Italian GDP). Linate and Malpensa Airports fall under two Functional Urban Areas (FUA) in the north-west of Lombardy region:

- Linate is in Milan FUA (IT002);
- Malpensa is in Varese FUA (IT043).

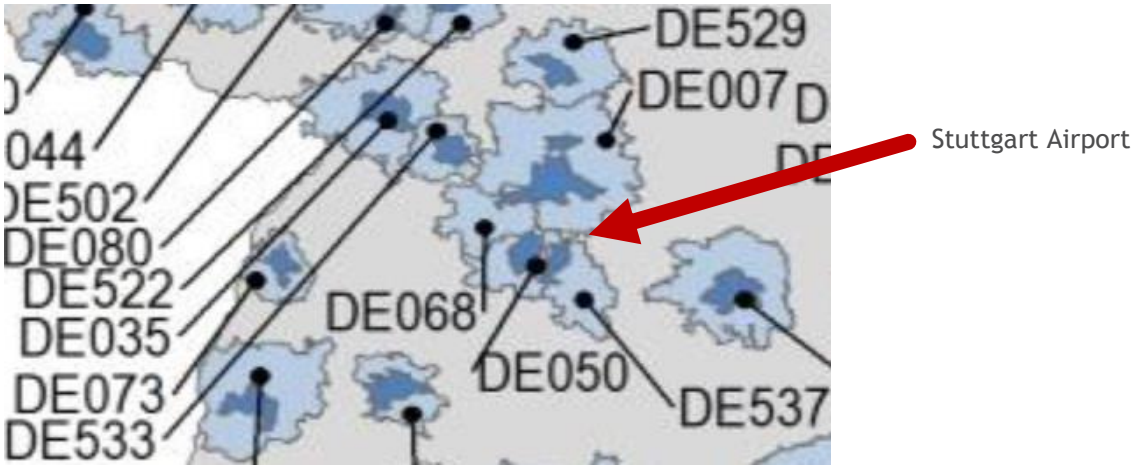
The two FUAs have a significant share of the regional population (41%, approximately 4.1 million). The core urban area for the two Airports is Milan Metropolitan Area (corresponding to Milan province and Milan FUA). In fact, this is a significant part of the Airports' catchment area in terms of number of passengers (45.9% for Malpensa and 63.7% for Linate).

The city of Stuttgart has a population of approximately 610.000 inhabitants by 2018. The functional urban area (FUA) of Stuttgart comprises 95 municipalities. The total population of FUA Stuttgart (DE007) were 1.965.942 inhabitants in 2014.

Other FUA's in the direct catchment area of the Stuttgart airport:

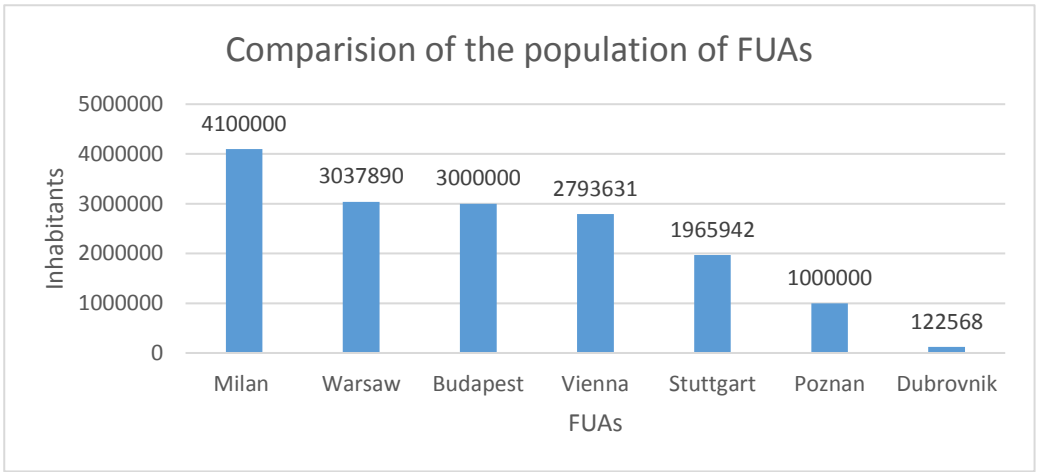
- FUA Sindelfingen (DE068) as a medium-sized urban area with 306.122 inhabitants.
- FUA Reutlingen (DE537) as a medium-sized urban area with 235.737 inhabitants.
- FUA Tübingen (DE050) as a small urban area with 189.252 inhabitants.
- FUA Heilbronn (DE529) as a medium-sized urban area with 372.093 inhabitants.
- FUA Pforzheim (DE533) as a medium-sized urban area with 243.262 inhabitants.

All these other FUAs are less than 60 minutes away from the Airport (by car). This five other FUAs combined with the FUA Stuttgart have a population of more than 3.3 million people. With an annual passenger volume of 10.5 Mio, which consists of 28 % national and 71 % international flights, the airport is an essential factor for the economy of the federal state of Baden-Württemberg. Up to 400 flights with over 100 destinations and about 55 Airlines are landing and taking off daily on the runway.



4: FUAs close to Stuttgart

After the OECD FUA definition of the project partners, the following chart presents a comparison of the population of the seven dissimilar FUAs.



5: Inhabitants of FUAs

As presented in the chart, FUA Milan is most populated with 4.1 million inhabitants, in comparison to FUA Dubrovnik, the least populated FUA with 122.568 inhabitants. This demonstrates the distinctions of the seven FUAs participating in the project. Due to the different FUAs, the several airports are also developed on different stages. Some airports are much more advanced in the application of public transportation, carbon free mobility and mobility information systems concerning surface access of airports then others.

2.2. Airport facts and figures

After the definition and characterisation of the FUAs, this sub-chapter deals with facts and figures of airports comparing and analysing airport location, size, as well as passenger and employee numbers.

2.2.1. Airport location

The Vienna International Airport is located 20 kilometres of the City of Vienna in the province of Lower Austria. The immediate surrounding of the Vienna Airport region is characterized by agricultural areas, small- to medium-sized villages and industries (e.g. Austrian Mineral Oil Administration). The Vienna International Airport spreads out over an area of 10 square kilometres.

Dubrovnik Airport is situated in the Konavle municipality. The Konavle municipality, in turn, is situated in the south and borders with Bosnia and Herzegovina and Montenegro. The Konavle municipality centre is Cavtat. Dubrovnik Airport is located in two agglomerations: Čilipi and Močići. The Dubrovnik Airport is located about 20 km south of the old town of Dubrovnik. The nearest airport to the Dubrovnik Airport is the Tivat Airport, some 51 km away.

The international Henryk Wieniawski Poznań-Ławica Airport (IATA code: POZ, ICAO code: EPPO) is one of the oldest airports in Poland. The Ławica Airport is situated in the western part of the administrative territory of the City of Poznań, only 7 km from the city center.

The Warsaw Modlin Airport is located 42 km to the north-west of the centre of Warsaw and 6 km to the north-west of the centre of Nowy Dwór Mazowiecki.

Budapest Airport is located about 16 kilometres south-east of Budapest's city centre. It stretches along an area of 15.15 km^2.

Linate Airport is located in the nearest suburbs of Milan and is a city airport, located 9 km east of the centre of Milan and Malpensa airport is located in the province of Varese, 52 km south-west of Milan.

Stuttgart Airport is located about 13 kilometres south of the city of Stuttgart and is on the edge between the nearby municipalities of Leinfelden-Echterdingen, Filderstadt and Stuttgart. A highlight of the airport is its proximity to the state´s exhibition centre and the airport city. Due to its proximity to the airport, the fair is used by an international audience. Fair and airport benefit from each other. Many companies use the proximity to the international airport and settle in Airport City. The size of the airport campus is 400 hectares.

In the following, there is a table, which shows the distances in km from the different FUAs city centre to the airport or reverse.

FUA	Distance in km from airport to FUA city center
Milan - Malpensa	52
Warsaw - Modlin	42
Dubrovnik	20

Vienna	20
Budapest	16
Stuttgart	13
Milan - Linate	9
Poznan	6

6: Distance of the different FUAs to the airport

In regards of table 5, there certainly is a correlation between the distance traveling form a city centre to the airport and the size of its FUA and airport. For example, a FUA has much greater spacial development with more inhabitats, than a smaller FUA such as Poznan. On the one hand, airports tend to be build further away from the city centre, because airports need surface to rapidly expand their business operations. On the other hand, airports are further away from the city centre, because of noise and emission complaints of inhabitants. The greater the operations of the airport, the more noise and emission complaints a FUA has to overcome. However, most airports of large FUAs are connected to public transport systems, which results in overcoming the distance in almost no time.

2.2.2. Passengers

In 2016, a total of 23.35 million passengers were counted at the Vienna International Airport and 72 airlines were operating at the Vienna Airport.

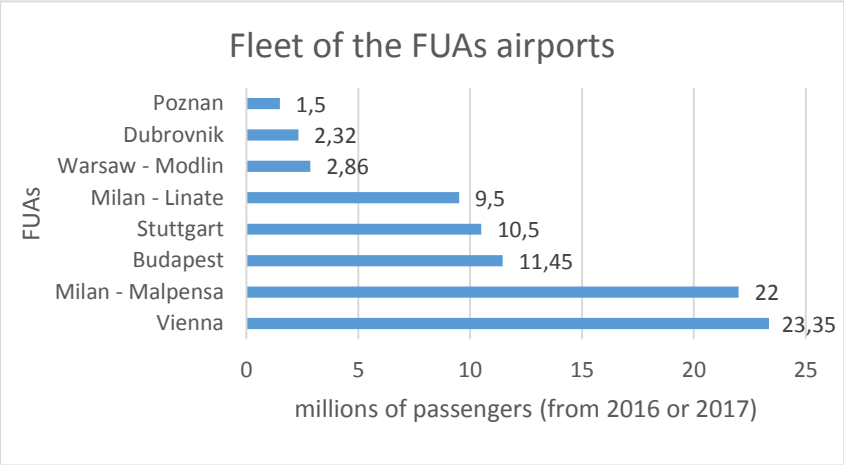
The number of passengers at the Dubrovnik Airport reached 2.32 million passengers and is operated by about 10 airlines in 2017. Dubrovnik is a tourist destination oriented towards luxury market supply. Over 50% of passengers of the Dubrovnik Airport travels for private purposes, i.e. as tourists. When analysing domestic passengers, they mostly travel on the Dubrovnik-Zagreb route, thus replacing a long bus ride from Dubrovnik to Zagreb.

Lawica Airport (Poznan) serves about 1.5 million passengers a year. Since 2012, the number of passengers at the Warsaw Modlin Airport is constantly increasing. In 2016, a total of 2.86 passengers were counted at the Warsaw Modlin Airport, as well as 17,543 aircraft movements.

Budapest Airport handled 11.45 million passengers, a record-breaking 112,143 tons of cargo with 96,141 aircraft movements in 2016. The total number of passenger airlines exceeds 40, while the number of cargo airlines is above 10.

Linate Airport registered 9.5 million passengers in 2017 and is operated by about 20 airlines. The airport has a balanced mix of national and international passenger traffics (52% and 48% respectively in the same year). The Airport registered a passenger growth between 2013 and 2017 (CAGR +1.4%), but it has a capacity cap preventing passenger traffic growth (the forecast is +0.3% between 2020 and 2030). Malpensa airport registered about 22 million passengers in 2017 and hosts 88 Airlines. It is the second Italian airport (after Rome Fiumicino) and it was the 28th busiest hub in Europe in terms of passenger traffic in 2017. In the same year it registered 86% of international (including intercontinental) traffic and 14% of national traffic. The Airport registered a passenger traffic growth between 2013 and 2017 (CAGR +5.4%). The forecasted traffic by 2030 is about 31.5 million passengers (CAGR +2.5% between 2020 and 2030).

With an annual passenger volume of 10.5 million, the Stuttgart Airport is an essential factor for the economy of the federal state of Baden-Württemberg. Up to 400 flights with over 100 destinations and about 55 Airlines are landing and taking off daily on the runway.



7: Passengers per airport in millions

According to this graph, Vienna Airport had the most passengers (23.35 million) in comparison to the other airports, however it did not have the most operating airlines (72). Instead, Malpensa Airport had the most airlines (88) operating with a passenger fleet of 22 million. Lawica Airport has the least passengers and can be most likely compared to Dubrovnik Airport and Warsaw Modlin Airport. Stuttgart, Linate and Budapest airports had similar passenger fleets from 9.5 to 11.5 million per year in 2016/2017.

In summary, the airports handle from 1.5 to 23.35 million passengers a year and are important economic drivers for the different FUAs. All seven reports stated a trend to steadily rising passenger numbers the past years. In general, the FUAs airports are one of the largest employers of the region and its employees come from all across the FUAs. This leads to an increased importance of surface access and the next chapter.

2.2.3. Employees

Not every project partner described of its airport (Lawica, Warsaw Modlin and Linate/Malpensa) the number of employees. Some airports reported numbers, others reported the surface access of its employees and the incentives, which are offered to use carbon free mobility.

In general, Flughafen Stuttgart GmbH has about 1,000 employees. Overall work at the airport hub round about 11,000 employees. At Dubrovnik Airport, the total number of employees was approximately 1,100 during peak months' in 2017. However, only 394 employees work permanently at the airport. On the premises of the Budapest Airport work approximately 12,000 employees at all companies.

The numbers show, that it is also important to support measures and incentives for employees concerning surface access of airports. For example, the Vienna Airport offers its employees a train connection (CAT) for free. Airport employees are able to use the CAT for free for travels to and from work. The CAT serves the route between the City Centre of Vienna ("Wien Mitte") and the airport and operates daily between 5:36 am (from the city centre) and 11:39 pm (from the airport) every 30 minutes.

The numbers illustrate the need for more incentives for airport employees to use carbon free mobility. According to the increasing number of employees, it would be helpful, if the following actions of the LAirA project would also consider the importance of employee mobility management at the airports.

2.3. Facts on environmental and social engagement

Only two FUAs reported on the environmental and social engagement of its airports. In the following are facts described by the Budapest Airport and the Stuttgart Airport.

2.3.1. Budapest Airport

Budapest Airport is the most significant economic player in the region therefore it aims at building a good relationship with the neighbouring settlements (Budapest District XVIII and XVII, Ecser, Vecsés and Üllő) and other settlements affected by its operation (Budapest District X, XIV and XVI), and to cooperate with local municipalities, political decision-makers and NGOs on a partnership basis.

Budapest Airport established the 'Budapest Airport Consultative Committee' in 2006, that is comprises mayors and deputy mayors from neighbouring settlements and representatives from the Budapest City Council, professional partners and tourism organizations. This information and discussion forum for municipalities, governmental stakeholders and business partners gives room to partners to receive first-hand information about the latest developments relating to the operation of the airport, and to regularly discuss hot topics in the name of good neighbourly cooperation including environmental issues or the development of public road access to the airport.

Budapest Airport strives to build good cooperation with all municipalities affected by its operation. The company has concluded three-year cooperation agreements with two of its most important partner settlements (Budapest District XVIII and Vecsés). The agreements, valid until 2012, recorded the details of Budapest Airport's voluntary noise insulation program, and the airport operator obliged itself to provide support, for the annual settlements in excess of 10 million HUF. The municipality is entitled to decide on the use of the support and it may include local foundations as beneficiaries or various events as a sponsor such as the Vecsés Cabbage fest or the Ecser Mayday event, or the September food-tasting event in the District XVIII.

Budapest Airport has established a strategic framework for its sustainability efforts by joining the "Committed to CSR Excellence" programme, which is building on a method of self-assessment to evaluate and develop CSR practices based on the organizational excellence model of the European Foundation for Quality Management. Three successful CSR projects paved the way to the intention to establish a working group and started drafting the 2012 CSR strategy for Budapest Airport.

Going beyond the legal requirements, Budapest Airport initiated its international carbon accreditation in 2010 by the Airports Council International Europe (ACI Europe) that certified the airport based on a detailed survey of its greenhouse gas emission. The airport recognized its own responsibility and committed itself to reduce its GHG emission and fight against climate change.

Budapest Airport has launched its Greenairport Program in 2015. This initiative aims at reducing the environmental impacts of the overall airport including companies operating at the premises. The companies are involved at a voluntary basis and they are committed to responsible corporate operation and environmental protection. The programme focuses on climate protection e.g. carbon accreditation and the necessary steps for the emission reduction including reducing energy consumption, using of renewable energy resources, developing electric mobility and introducing separated waste collection in the entire airport area.

2.3.2. Stuttgart Airport

Besides the economic success, sustainability is a big aim of the Flughafen Stuttgart GmbH (FSG). They are committed to positively influence the economy, society and the state of local and global environment. On that account they developed the fairport strategy, which is based on binding values and guidelines for all employees compiled in the fairport code. This code defines values and norms for the behaviour of all employees among each other as well as towards customers, competitors, business partners, public authorities and other stakeholder groups.

To reach the aim, becoming one of the highest-performing and most sustainable airports in Europe they defined steps to achieve on the way to fairport Stuttgart. One of these steps is the environmental policy. Running an airport has an impact on the environment. The airport operator contributes to reducing noise, greenhouse gases, energy consumption and waste as well as to protecting surrounding waters and biodiversity. To reduce its environmental impact to a minimum the Stuttgart airport intends to half its greenhouse gas emissions by 2030 as compared to 1990. By 2050 the airports operations are to be entirely carbon-neutral. To realize this ambitious plan they started efficiency and reduction projects. This means that the electric fleet will have to be increased. More energy will have to be produced from alternative sources and energy storages will have to be massively expanded. Therefore the FSG counts on technological innovations to be introduced in the coming 30 years such as a more efficient energy production in solar plants and better storage facilities. On the compound already exist a surface of 15.000 m^2 solar plants. On third of the produced energy is used by the airport itself and the remaining is fed into the public power supply system. Energy that is not produced at the airport is purchased to 100 percent from renewable sources.

More and more diesel vehicles are replaced by electric vehicles. Since the year 2018 the passengers and the luggage is transported by electric vehicles. Therefore, local emissions are reduced at the airport and less noise is caused. That has a positive impact on the environment and the conditions for the employees.

SCALE-UP! is a project, that realises the aim to reduce the CO^2-emission of the fleet by 80 % until the year 2020 as compared to 2009. Electric vehicles are particularly suitable at airports. On the one hand, the distances are short and on the other hand the breaks are long enough to recharge the battery consistently. Furthermore SCALE-UP! links to the already concluded project e-fleet. Through the major number of vehicles a wide amount of data admits specific statements about ecological and economical effects by electro mobility used on airports. The results are supposed to be assigned to all airports worldwide.

The project efleet was the beginning of the electrification at the Stuttgart Airport in 2013. In a period of 3 years the electrical vehicles dragged 12.000 airplanes, transported 1.5 Mio items of luggage and carried 300.000 passengers. The result was that electric vehicles are really suitable at airports.

Concurrently proceeded a similar project, which focused especially on decarbonised passenger transport at European airports, in order to prove if the entire passenger transport could be managed with electric buses. With the aid of the European Union fast chargers and an electrical infrastructure was built. As a result the electrical buses are as good as the diesel buses at passenger transport but with a 70 % higher energy efficiency.

From 2015 to 2017, they tested an alternative energy storage beside the established lead acid batteries. Therefore, they extended the fleet by a lithium ion baggage tug. It was investigated if there are differences in durability and charge time. Additionally they developed a guideline to facilitate the conversion to electro mobility.

The Stuttgart Airport is also dedicated in economical waste management, water protection and the preservation of the biodiversity to reduce the ecological footprint. As far as practicable they avoid waste. The waste that is not avoidable is recycled in a valuable system with a utilization rate of 99 %. To protect the water they built a sophisticated dewatering system. For instance, they only use chemical de-icer, if ice and snow cannot be mechanically removed anymore.

The about 2 km^2 big green area is a habitat for about 70 plant species and numerous animals. Studies have proven that the biodiversity on the compound of the Stuttgart Airport is not burdened.

Besides the emissions and noise, an airport is also a burden for the environment. On the one hand for the habitat but also for neighbours and employees. In general, the noise must be decreased. The average noise pollution has been already decreased in Stuttgart over the last years, since the FSG encourages the airlines to use quiet airplanes with prices depending on the noise. Further to avoid nightly noise between

11.30 pm and 6 am civil airplanes with a jet engine are not allowed to land. To ensure soundproofing for the adjacent residents the FSG pays for physical alteration.

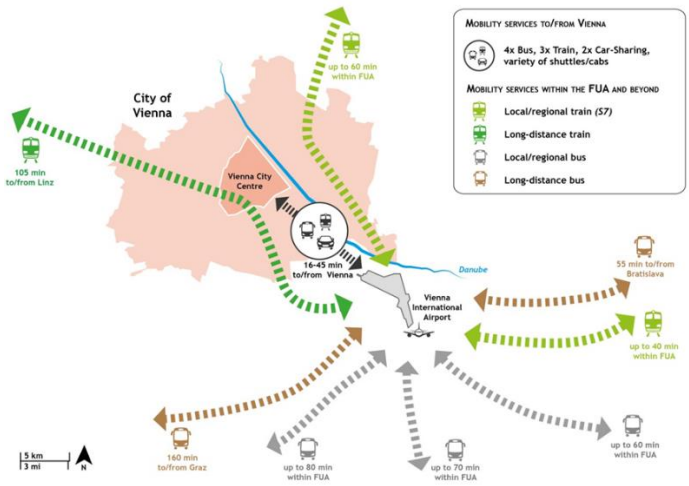
The FSG schedules a conjunction to the Central European pipeline system in order to make the aerial refuelling safer and more environmentally friendly. Yet about 6.500 trucks carry above 270.000 cubic meters of kerosene on a distance of about 70 km each way. The construction shall be concluded in 2019.

3. Mobility system

After providing a general overview of the airports towards its size and fleets, the following chapter will examine characteristics of the mobility system in which the seven airports are embedded. The description includes the existing modes of transport (infrastructure and vehicle related) and if considered, as relevant in the LAirA context, detailed information on available mobility and transport-related information services for employees and passengers.

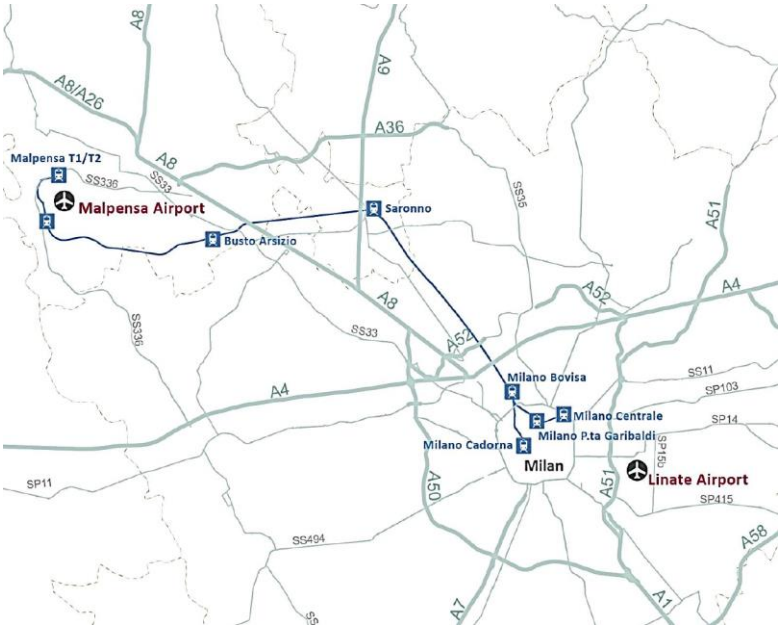
3.1. Characterization of the physical network access the airport

The Vienna Airport is very well connected to its surrounding area by road and railway with access for individual cars, busses, and car rental services, taxis, local and long-distance trains. Furthermore, active mobility options such as bicycle paths are available for reaching the airport area from Vienna as well as from municipalities in the immediate area. Accessibility, in the context of transport, is defined by the mobility options that are available at a specific location at a certain time. Therefore, available mobility options and services are qualitatively described for the Vienna FUA. Not just from the city centre but from all parts of the FUA it is possible to access the airport by road and rail with different modes of transport and types of vehicles such as private cars, shared cars, busses, bicycles, cabs via the highway “A4” or the federal road “B9” but are not explicitly shown in the graphic or local and long-distance trains. Figure 7 illustrates the accessibility of the airport form the centre of the City of Vienna and shows existing mobility services to the City of Vienna as well as to other parts of the FUA. The figure includes services that are directly connected respectively related to the airport.



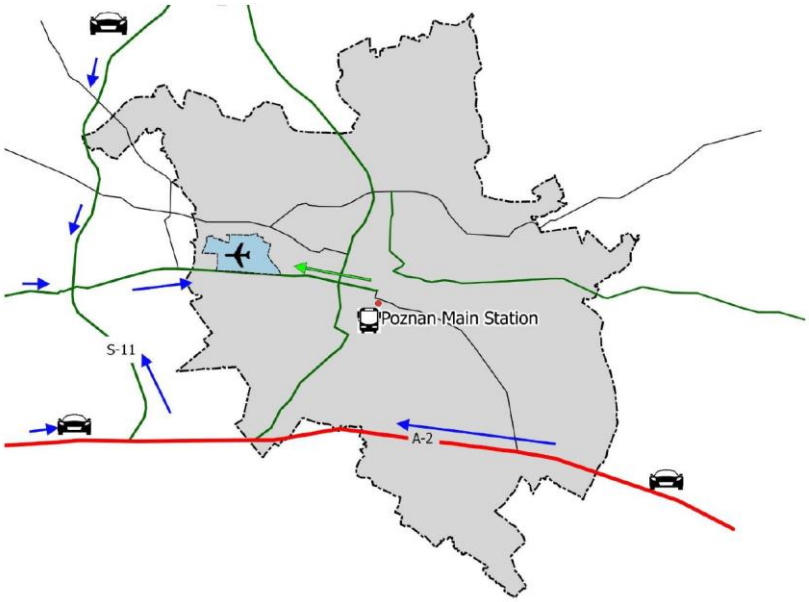
8: Schematic diagram with direct mobility services to/from the Vienna FUA

Linate and Malpensa Airports are integrated within a dense road and rail transport network connecting them to core regional, national and cross-border urban and economic areas. The following figure (8) presents the airports’ positioning within the main regional infrastructure system.



9: Surface access of Malpensa and Linate Airports

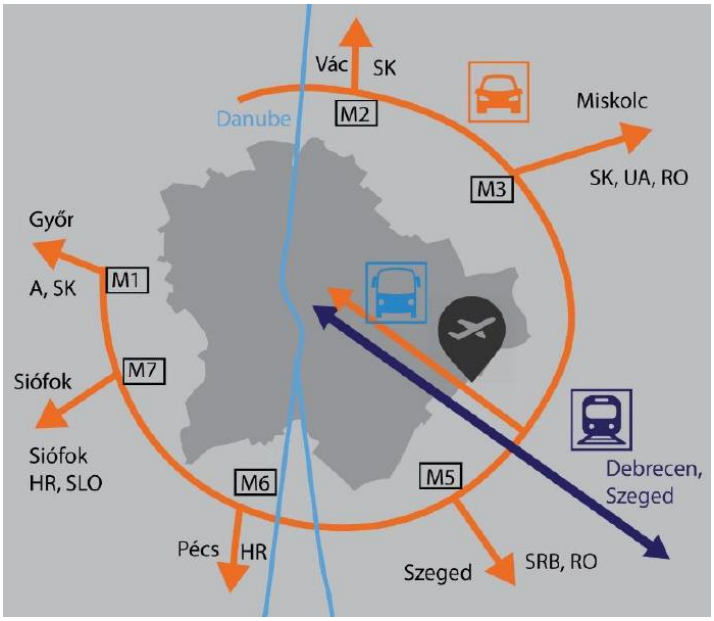
The Lawica Airport can be accessed only by road (using 307 voivodeship road – Bukowska Street). The entire airport is located within the administrative territory of the city of Poznań. Its location is presented in the figure 9 below.



10: Surface access of Lawica Airport

The Stuttgart Airport can be accessed via road, by private or rented cars, taxis and busses. However, due to rush hour traffic, it's faster to take public transport to the Stuttgart Airport. The airport is connected via railway from the city centre of Stuttgart to the airport.

The Warsaw Modlin Airport is integrated by road, by private or rented cars, taxi, busses and rail. However the airport cannot be directly accessed by rail. This involves a train connection combined with a direct bus line from the Modlin Station to the airport.



11: Schematic overview of the access to city centre and catchment of Budapest Airport

Dubrovnik Airport is only integrated in a road based network and can be accessed by private car, coach bus and taxi.

The Budapest airport is well connected to its surrounding area by road, offering and excellent access to individual motorized transport, taxis, urban buses and any other road transport vehicles. The train station is located within few kilometres from the terminals, which enables the integration of the airport via train as well. The outskirts of Budapest (part of the FUA) are well accessible, especially along the East-West axis with one change from train to bus using regional public transport. The North-South axis is mostly served by the individual motorized transport along M0 and other connecting road network, while public transport service not existing.

3.2. Characteristics of road network and services

The following sub-chapters provide a detailed description of the characteristics of the different FUAs transport network. One similarity is already clear. All airports are easy accessible by car, nevertheless passengers have to take into account the high parking fees at the airports and traffic congestion during rush and peak hours. As well as the aspect, that every car boosts air pollution and produces CO_2. One important thematic area of the LAirA project is the green mobility aspect, for example the promotion of carbon free mobility such as e-mobility or public transport systems. In that perspective, there is a need of publicity of carbon free mobility options and the development of incentives to finally use them.

3.2.1. Vienna Airport

The Vienna Airport and its FUA are connected via the motorway “A4” as well as the federal road “B9”. The city centre of Vienna is reachable within 15-20 Minutes by car in case of normal traffic volume. At peak times and depending on construction sites along the motorway (which are not unusual), a longer travel time must be assumed. The motorway A4 is well connected to the higher-raking transport network and therefore the airport is also very attractive for passengers coming from the Czech Republic, Hungary and Slovakia.

On a smaller scale the airport can easily be reached from its immediate surrounding municipalities by country roads and another highway called “S1” which also connects the airport area with the southern and western part of Austria. However, there is an interchange between the S1 and the A4 which means, the S1 does not directly access the airport. Considering these road-side connections it is obvious that the catchment area of the Vienna international airport is fairly extended across the Austrian borders. Via road, private cars, taxis, car rental services and busses can access the airport.

A lot of space at the Vienna Airport area is reserved for short-term and long-term car parking options. In total 11,038 covered parking spaces are available and 10,214 spaces are available outdoor. Two covered parking areas and three short-term parking lots area located next to the terminal buildings and two more

(long-term) parking lots are situated in the outer area of the Vienna Airport. It is also possible to book a parking space online in advance. Depending on the walking distance from the parking lot to the terminal buildings prices vary for e.g. two days of parking between €79.90 (closer parking lots) and €44.90. On the website of the Vienna Airport individual fares can be calculated.

Two charging stations for electric vehicles are available at the airport. Charging stations are available in the parking lot "4" as well as on the parking space "C", both served by "TANKE Wien Energie". Due to their locations it can be assumed that one is mainly addressing passengers and the other one addressing employees. For using the charging stations at parking lot 4 and parking space C a specific member card is needed in advance. Another high-speed e-charging station located at the parking lot of the grocery store "BILLA" which is located in direction of the highway and easily accessible by car. The charging station at the BILLA parking lot is operated by the company SMATRICS. For using the SMATRICS charging station, also a specific member card and/or a user account is needed in order to commence and pay the charging process.

3.2.2. Stuttgart Airport

The Stuttgart Airport and its FUA are connected via the motorway "A8" and the national road "B27". The city centre of Stuttgart can be reached within 15-20 Minutes by car in case of normal traffic. Nevertheless, often a longer ride must be assumed, especially during rush hours. The motorway A8 runs from Luxembourg at Schengen via Karlsruhe, Stuttgart, Ulm, Augsburg and Munich to the Austrian border near Salzburg. Travellers from Ulm (FUA DE532) need approximately 60 minutes (with good traffic conditions) to the airport. Taking the car from Karlsruhe (FUA DE035) takes the same time. The national road "B27" connects the FUA Stuttgart with the airport. To the south the "B27" connects the FUA Tübingen (DE050) and FUA Reutlingen (DE537) to the airport in less than 30 minutes by car (with good traffic conditions).

The following chart shows the approximately traveling times of the surrounding FUAs (with good traffic conditions) to the airport by car:

CITY	TRAVELLING TIME	DISTANCE
STUTTGART	20 minutes	13 kilometres
SINDELFINGEN	20 minutes	17 kilometres
TÜBINGEN	25 minutes	33 kilometres
REUTLINGEN	20 minutes	28 kilometres
HEILBRONN	50 minutes	70 kilometres
PFORZHEIM	35 minutes	48 kilometres
KARLSRUHE	50 minutes	77 kilometres
ULM	60 minutes	79 kilometres

12: Time and distance to the Stuttgart Airport from other close FUAs

Stuttgart Airport can be reached for about eight million people within 90 minutes by car. In total, employees and airport visitors have around 280 m² of parking space in car parks and in front of buildings. At the airport there are offered up to 11.000 parking lots. As well as special parking spaces (extra wide parking bays) and space for guests with handicap. For electric vehicles in the public area, 48 electric charging points are offered. All parking lots are fee required. The price range is between 23 and 35 euros per day and between 53 and 125 euros for the first week.

3.2.3. Linate and Malpensa Airport

Linate Airport is only accessible by road, but it is well integrated into the road transport network. The main access road axes include: highways A51 (Tangenziale Est Milano), A52 (Tangenziale Nord Milano) and A58 (Tangenziale Esterna Est Milano); state road (Strada Statale) Padana Superiore SS11; provincial roads (Strade Provinciali) Cassanese SP103, Rivoltana SP14, Paullese SP415 and Via Mondadori SP15b.

Other road axes to access the Airport are Viale Forlanini, which connects the Airport to Milan ring road system (Tangenziale) and the city centre, and Via Circonvallazione Idroscalo (north-east of the Airport).

Malpensa Airport is directly connected to the main road axes, in particular via: highway A8 from Milan to Busto Arsizio – Milano Malpensa exit and then State Road SS336 to Gallarate – Milano Malpensa; highways A8 and A9 respectively from Como and Varese; highway A4 from Turin and Venice, to Marcallo Mesero exit and then State Road SS336 to Malpensa; and highway Pedemontana A36.

Malpensa Airport has a wide parking offer, both indoor and outdoor (10,700 parking slots). The capacity of the Linate Airport consists of 4,866 parking slots.

3.2.4. Lawica Airport

The airport can be accessed easily by car using the modernized Bukowska Street. The most convenient way to get to the Airport from the east and south leads through Poznań A2 motorway. Taking A2 motorway towards Świecko, turn right at road interchange Poznań-Zachód and, driving along S-11 express road, get to 307 national road (exit: Poznań-Ławica) which will lead you directly to the Ławica Airport. This way is also the most convenient if you want to get to the airport from the west. If you are coming in from the north, take S-11 express road and then, at Poznań-Ławica interchange, turn left to 307 national road, which will lead you directly to the airport.

3.2.5. Dubrovnik Airport

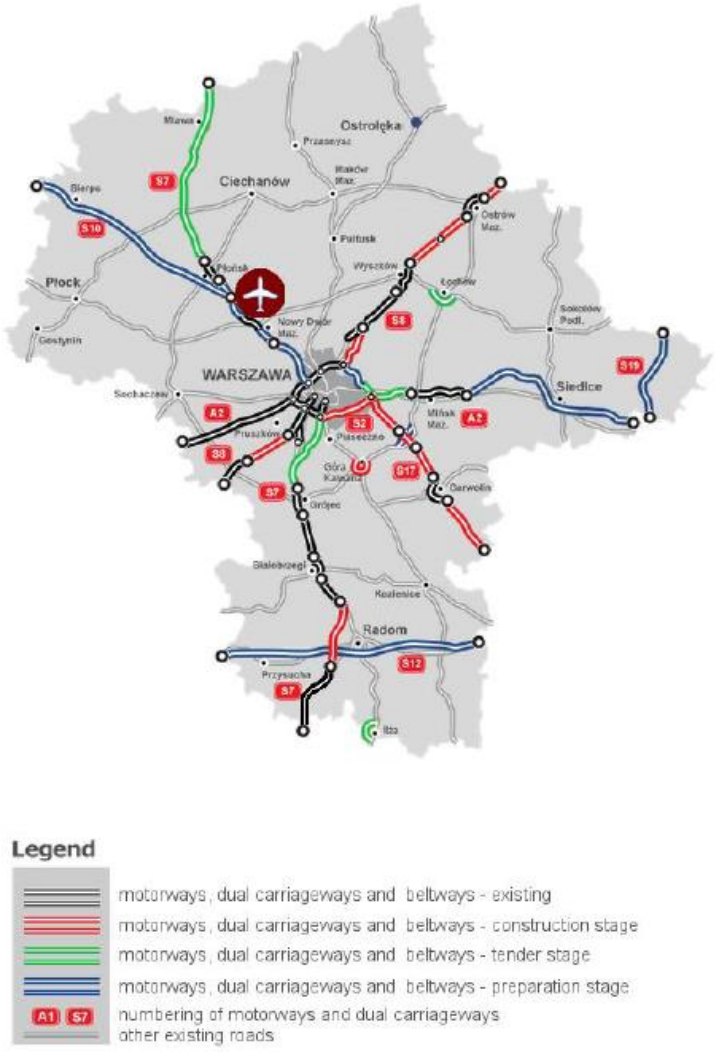
The County's road network includes 2 motorways, 16 state roads, 33 county roads and 78 local roads. In all, the road network is not up to expectations. Roads passing through settlements are not sufficiently solved, especially in the Neretva River valley, City of Dubrovnik and Župa Dubrovačka municipality. Most local and county roads are in bad condition, mostly used for local, intra-county connection and under the responsibility of the County Road Administration.

Dubrovnik Airport has also a wide parking offer of 638 parking spots.

EV charging stations are installed at nine locations in the Dubrovnik-Neretva County. All inspected charging stations except the one at the Dubrovnik Airport, have two AC sockets, rated output 22 kW (32A), output voltage 400V for fast charging. The charging station at the Dubrovnik Airport has three sockets with higher rated power Table, equal voltage and is free of charge. The EV charging station at the Dubrovnik Airport was installed towards the end of 2017 and is still used for commercial and promotion purposes. This is why information on its use is not available. Out of the nine EV charging stations, five are free of charge and for four the data is not available.

3.2.6. Warsaw Modlin Airport

The Warsaw Modlin Airport is located 42 km to the north-west of the centre of Warsaw and 6 km to the north-west of the centre of Nowy Dwór Mazowiecki. Three important roads run in the immediate vicinity of the airport: the S7 dual carriageway linking Kraków and Gdańsk, the S10 road linking Szczecin with Płońsk and Warsaw, and national road No. 62 (Strzelno - Włocławek - Płock - Wyszków - Sokołów Podlaski - Siemiatycze). The airport does not have a direct connection to a motorway, but the implementation of the planned road connections will facilitate future journeys to the A2 motorway.



Source: General Directorate for National Roads and Highways

13: Current national road system and planned investments

The map (figure 11) shows the current national road system providing access to the Warsaw Modlin Airport as well as planned investments. As can be seen on the map, the main road linking the airport with the centre of Warsaw does not currently provide adequate standard. The off-peak travel time to the airport from the centre of Warsaw amounts to approximately 45 mins. However, due to significant traffic to and from Warsaw on this route, the travel time to the airport is very unpredictable and in peak hours can rise significantly above 60 mins. A high speed connection from the airport to the centre of Warsaw requires the construction of a dual carriageway between the existing dual carriageways: S8 in Warsaw and the S7 in the vicinity of Czosnów (south of Nowy Dwór Mazowiecki).

Road connections between the airport and other municipalities of the functional area are provided by national road No. 62, local roads and the road system around the airport. The road access map from the functional urban area to the airport is presented below. The short distances and location of the municipalities along national road No. 62 result in very short travel times to the airport.

Source: own analysis, Google Maps

14: Road access from the functional urban area to the airport

3.2.7. Budapest Airport

15: Fast road network around Budapest

The Budapest Airport is located approximately 21 km by road from the city centre along the Eastern border of Budapest. Depending on the traffic, it can be reached in 20-60 minutes along the "High-Speed Road", the section of main road 4 within Budapest. The airport is located along M0 motorway ring road around Budapest that connects all motorways (M1-M7-M6-M5- M3-M2) heading to the capital in Hungary. Thereby M0 provides easy and fast road access to further parts of the country and extending the outreach of the airport to the neighbouring countries such as Austria, Slovakia, Ukraine, Romania, Serbia, Croatia and Slovenia. At a smaller scale, main road 4 is providing a West-East connection to the airport area, whereas the North-South connection is served by motorway M0 and subordinate roads 3101 and 4602.

Budapest Airport has approximately 3050 open-air long-term car parking spots and approximately 900 open-air short-term parking spots. The parking prices vary according the length of stay in both cases as well as the location (walking distance from the terminal building) e.g. a one-day parking ranges from 3000 HUF (10 EUR) to 30000 HUF (100 EUR) depending on the car park. The short-term parking spots are up-to 5 minutes free. Prices significantly differ from the booking through the online system at https://parkolo.bud.hu/. Bookings can be done at least 12 hours prior to the planned time of departure.

In the neighbourhood of the airport other private companies offer their long-term parking service with or without a shuttle service to the terminal.

3.3. Public transport by road

In summary, all airports are easy accessible by car. The number of parking spots are ranging from 638 to 10,700. The next sub-chapter, takes into consideration the public transportation option by road from each FUA. The main aspect to focus on, is that bus operator's don´t only offer bus lines just from the city centre to the airport, but from all parts of the FUAs to the airport. Another aspect will be analysed, if there is offered a seamless connection to the airside transportation or if passengers and employees will have several changes from their location to the airport.

3.3.1. Stuttgart Airport

The Stuttgart Airport Busterminal (SAB) is located in front of Terminal 4 of Stuttgart Airport. The three lanes include a total of 18 bus platforms, with platforms 1 to 3 serving regional transport. National and international long-distance bus services leave from platforms 4 to 18.

Several local bus lines are leading to Stuttgart Airport. From the South the Line 828 called "Airport Sprinter" connects Tübingen and other municipalities on the track to the airport. Depending on the travelling route, the traveling time is between 50 and 60 minutes from End to End. The bus line 828 operates from Monday to Friday between 4 am and 12 pm twice an hour, except between 4 to 5 am and 10 and 12 pm with only one bus per hour in every direction. On weekend there is a reduced schedule. The ticket costs up to 6.20 € for an adult.

Another bus line from the south is the "eXpresso X3" which operates between Reutlingen and the airport in a travelling time of 50 minutes. The bus line operates from Monday to Friday between 4 am and 12 pm once an hour. On weekends the schedule is reduced. One ticket for an adult costs 5.95 €. There is no connection to the airport during the night between 0 am and 4 am.

Another provider, the "VVS – Verkehrs- und Tarifverbund Stuttgart" operates with several bus lines. Most of the city trains called "S-Bahn" are aligned to Stuttgart's main station as centre of the FUA. The "Relex" buses "X10" and "X60" operate tangential between bigger cities and other important destinations like the university, airport and fair. Thus, these bus lines create direct connections, without going via the main station. The bus lines 122 and 806 operate between the airport and surrounding municipalities.

Besides the local bus transport, also long-distance bus services are connected to the Stuttgart Airport. Providers like Flixbus, Eurolines, ÖBB-Postbus, Deinbus and 60 other companies connect the airport with destinations all over Germany and Europe. There are around 20 domestic destinations and 50 destinations in other European countries offered.

3.3.2. Linate and Malpensa Airport

From and to the Linate/ Malpensa Airport are multiple bus connections and coach busses offered.

3.3.2.1. Malpensa Airport

Three main companies operate between Milano Centrale railway station and Malpensa Airport.

Service	Origin	Operator	Daily return rides (n.)	Travel time	Fare	Vehicle capacity
Coach	FS Milano Centrale (railway station)	Air Pullman	106 workdays 107 Sunday / public holidays	50 min	€10.00	54
Coach	FS Milano Centrale (railway station)	Autostradale	110	55 min	€8.00	54
Coach	FS Milano Centrale (railway station)	Terravision	80	55 min	€8.00	Up to 64

16: Bus and coach connections between the metropolitan and central Milan area and Malpensa Airport

Provinces outside Milan Metropolitan area are connected to Malpensa Airport both by regular and seasonal or on-demand services (on-demand services need advanced book and run based on demand). Services are operated by local public buses (from the province of Varese – Gallarate and Somma Lombardo - in which Malpensa Airport is located), or by coach services (regularly from Genoa, Novara, Turin, Rome, and seasonal or on-demand from Aosta and Domodossola).

Coach services from several operators extend to Malpensa Airport catchment area but also to central Italy. The following Table reports the service details. The fleet capacity is 50 passengers per vehicle for all the listed regular services.

Service	Origin	Operator	Daily return rides (n.)	Travel time	Fare
Local public bus	Gallarate FS (Varese)	S.A.C.O.	Variable	15 min	€1.40 - €1.80
Local public bus	Somma Lombardo (Varese)	S.A.C.O.	22	27 min	€1.30 - €1.50
On-demand coach	Domodossola	COMAZZI	14	80 min	€15.00
Winter-time coach	Aosta bus station	Sadem-Sauda	6 Workdays 4 Weekends and Holidays	160 min	€25.00
Coach	Genoa	VOLPI	2	180 min	€25.00
Coach	Novara	STN	16	60 min	€3.00 - 9.00
Coach	Turin	SADEM-Autostradale	30	115 min	€22.00
Coach	Rome	Flixbus	4 Monday, Friday, Sunday 1 Tuesday, Thursday	600 min	€25.00

17: Local public bus and coach services between of Malpensa Airport and other provinces except the province of Milan

Provinces outside Milan Metropolitan area connected to Malpensa Airport both by regular and seasonal demand service. Services are operated by local public buses from the province of Varese – Gallarate and Somma Lombardo - in which Malpensa Airport is located. The busses take 15 and 27 minutes and one ticket costs between 1.30 to 1.80 €.

There is also a connection between Linate and Malpensa airport by the operator air Pullman, 10 rides/day with the duration of 90 minutes and it costs 13,00€ per ride (with stops at Rogoredo and Cascina Gobba) and to Orio al Serio Airport by a coach service which needs advanced booking and runs based on demand.

3.3.2.2. Linate Airport

The central Milan area is connected to Linate Airport by local public bus and coach services; services differ in terms of origin, operators, number of daily rides, travel time, fares and vehicle capacity. We present them in the following table 17.

Service	Origin	Operator	Daily return rides (n.)	Travel time	Fare	Vehicle capacity (n. passengers)
Coach	FS Milano Centrale (railway station)	ATM	70	45 min	€5.00	12 - 50
Coach	FS Milano Centrale (railway station)	STARFLY	54	25 min	€5.00	
Local public bus - Urban line 73	Milano Duomo	ATM	246 Monday to Friday 170 Saturday 192 Sunday / public holidays	40 min	€1.50	Up to 95
Local public - Urban line 183[23]	Milan	ATM	N/A	N/A	€1.50	N/A

18: Local public bus and coach services between the central Milan area and Linate Airport

Milan Metropolitan area (that is to say Milan province either than the central area) is connected to Linate Airport by two local public transport bus services: line 923 originating in Segrate and line Z409 originating in Rodano.

Service	Origin	Operator	Daily return rides (n.)	Travel time	Fare	Vehicle capacity
Local public bus - Urban line 923	H. S. Raffaele (Hospital)	ATM	78 Monday to Friday 23 Saturday 23 Sunday / public holidays	55 min	€1.50	9 - 19
Local public bus - Urban line Z409	Rodano	Autoguidovie	10 Monday to Friday 8 Saturday	35 min	€2.30 - €4.00	50

19: Local public bus and coach services between Milan Metropolitan area and Linate Airport

Linate Airport has regular coach connections (11 rides/day) with Monza (30 min, 8.00€) and Pavia (45 min, 15,00€) and on-demand connections to Brescia.

In general, Linate Airports lacks regular direct connections to Switzerland; however, some private operators offer on-demand services from Switzerland. The vehicles type depends on the number of bookings.

3.3.3. Vienna Airport

The Vienna International Airport is serviced by four bus lines (Vienna Airport Line 1-3, AirLiner) directly connecting it with the City of Vienna. The intervals of the busses vary depending on the day of the week and time of the day. The AirLiner, for example, runs daily between 5am and 10pm 14 times per day (every 60 minutes) for a price of €5 for a single ticket and €9 for a return ticket.

Another provider, the Vienna Airport Lines (VAL) operates with three different bus lines (VAL1, VAL2, VAL3) between the airport and different stations in the western ("Wien Westbahnhof"), northern ("Donauzentrum") and central ("Wien Schwedenplatz") part of Vienna. The operating hours and frequency of the three VAL bus lines again vary from the day of the week and the time of the day. E.g. the busses VAL1 and VAL3 run between 5:15am respectively 5:58am and 11:40pm respectively 6:58pm every 60 minutes, whereas the bus line VAL2 operates daily between 4:30am ad 11.30pm every 60 minutes and irregularly between 11.30pm and 4.30am. Rides with the Vienna Airport Lines cost €8 for a single and €13 for a return ride.

The bus lines 221, 222 and 273 operate between the airport and surrounding municipalities and cater for mobility needs of the employees at the airport and citizens within the catchment area. The lines 222 and 273 are connected to train stations of the regional railway network, i.e. the stations of Fischamend, Gramatneusiedl and Ebreichsdorf. However, the intervals of these regional and local bus lines, operated by ÖBB-Postbus AG, operate at a lower frequency and one ride between the origin and destination station (in all cases the connected railway station) takes at least an hour. The intervals vary between 30 and 350 minutes depending on the day of the week and time of day.

On the airport site an "Airport Shuttle" operates between the on-site companies and airport-related infrastructure (e.g. terminals, parking lots, train station). The airport shuttle operates in a defined course starting at 5:30 am and ending at 11:30 pm. The bus line serves the stations every 15 minutes from 5:30 to 8:30 am and 2 pm to 4 pm and the stations get served every 30 minutes from 8:30 am to 2 pm and 4 pm to 11:30 pm. During nights, meaning the time window between midnight and 5:20 am, the bus operates every 20 minutes. Prices vary depending on the type of ticket, starting at € 0.75 for a single ride up to € 200 for a full year.

Besides the local and airport-specific bus lines, also long-distance busses are connected with the Vienna Airport. Companies such as Postbus, Flixbus, Regiojet, Eurobus and Leo Express connect the airport with cities in Slovakia (Bratislava, Prešov, Košice), Hungary (Budapest, Györ), the Czech Republic (Brno, Znojmo, Prag), Poland (Wroclaw), Romania (Miercurea Ciuc, Sibiu, Timisoara) and Slovenia (Ljubljana). The busses connecting the Vienna Airport to its FUA directly stop at the terminal buildings and enable a seamless connection to the airside transportation.

3.3.4. Lawica Airport

The Ławica Airport is well-connected with the city center by public transport. There are bus stops right in front of the passenger terminal and in its immediate vicinity. At present, there are four bus connections between the Airport and the city center - the shortest and fastest one – Line 59 - connects the Airport with Poznań Główny Railway Station in 22 minutes, and depending on the time of the day – shuttles every 15 – 20 minutes.

Equally fast but more comfortable transport services are rendered by taxis.

In order to accelerate travel between the Airport and the city center, special facilities for buses and taxis have been arranged along Bukowska Street, for example, bus-only lanes and right-of-way at intersections.

3.3.5. Dubrovnik Airport

The Dubrovnik Airport is linked with the DNC and the FUA by means of regular bus lines, shuttle bus lines, inter-city bus lines and taxi services. Bus transport seems to be the dominant transport mode. Atlas shuttle busses operate after arrival of every regular flight, for a price of 40 HRK (one-way ticket), public transport operator Libertas lines connect Dubrovnik and neighbouring municipalities. There are regular departures of the carrier Autotrans/Dalmacija bus, at a price of 40.00 HRK + 5% discount for online

ticketing. The company Korkyra also offers shuttle bus services, connecting the Dubrovnik Airport with the whole DNC, but only during the tourist season.

Taxi services are available as well, there are 106 licensed taxi drivers, members of the Konavle Taxi Drivers Association operating in the Dubrovnik Airport area.

3.3.6. Warsaw Modlin Airport

The regional train operator, Koleje Mazowieckie, provides a bus connection from the Modlin train station to the Warsaw Modlin Airport. The bus leaves 10 minutes after the arrival of a train from Warsaw. The capacity of the bus is 102 persons in total, with 34 seats and it is enough to carry all requested passengers (based on experience so far). A summary of details for this connection is provided in the table (figure 19) below.

Route	Travel time	Time available for change	Frequency	Ticket price	Means of transport
Warsaw Central - Warsaw Modlin Airport	ca. 60 mins	ca. 10 mins.	31 connections (22by KM; 9 by other operators) per working day; 30 connections (21by KM; 9 by other operators) per non-working day	19,00 PLN* (255 PLN for monthly ticket)	Train on the Warsaw Modlin route, bus on the Modlin-airport route
Nowy Dwór Mazowiecki - Warsaw Modlin Airport	Ca. 25 mins	Ca. 5 mins	63 connections (55 by KM; 8 by other operators) per working day; 55 connections (47 by KM; 8 by other operators) per non-working day	9,70 PLN (128 PLN for monthly ticket)	Train on the N. Dwór Mazowiecki-Modlin route, bus on the Modlin-airport route
Pomiechówek - Warsaw Modlin Airport	ca. 25 mins	Ca. 5 mins.	33 connections by KM per working day; 22 connections by KM per non-working day	9,70 PLN (128 PLN monthly for ticket)	Train on the Pomiechówek-Modlin route, bus on the Modlin-airport route

20: Details of the combined regional train-bus connections to/from the Warsaw Modlin Airport

However, the driving time on the Pomiechówek - Warsaw Modlin Airport route is very short (approximately 8 min.). Due to travel time the available combined train-bus connection on this route is not attractive to travelers. The same applies to the Nowy Dwór Mazowiecki - Warsaw Modlin Airport route. Time of travel by train is not competitive in comparison with the car.

Only one bus service operates between Warsaw and the Warsaw Modlin Airport. Modlin Bus (www.modlinbus.pl) offers direct connections from the Warsaw city centre (Defilady Square) and from the Chopin Airport in Warsaw.

Tickets can be purchased via the Internet, from the drivers, at ticket counters at the airport, in the Palace of Culture in the center of Warsaw, and at affiliated retailers (mostly travel offices). The standard price is 39 PLN, but when booking earlier online, the prices start from 9 PLN.

Passengers travelling to/from the Warsaw Modlin Airport may, on the Warsaw centre – Warsaw Modlin Airport route, benefit from a special combined ticket: "airport ticket". The ticket includes a Koleje Mazowieckie train journey form Warsaw to Modlin and a Koleje Mazowieckie bus journey from Modlin to the Warsaw Modlin Airport. All railway stations are located within the City of Warsaw. Additionally, the ticket enables free of charge use of public transport within Warsaw on the day the ticket is valid for a period of 75 minutes.

3.3.7. Airport Budapest

Budapest Airport is connected to the city centre by two urban public transport bus lines. 100E provides a fast and direct connection to the city centre, whereas the 200E gives a quick connection to the Metro 3 (blue line) to suburban areas. Single ticket for a person costs 350 HUF/way (1.20 EUR/way) for each transport mode, however buying the ticket at the driver costs 450 HUF/way (1.50 EUR/way)

Even though Budapest Transport Centre (BKK) operates the 100E, a special ticket must be bought for each ride. A single ticket for a person for the 100E costs 900 HUF/way (3.00 EUR/way). For all public transport rides, a separate single ticket must be validated. Otherwise 24 and 72-hour, weekly and monthly travel passes for Budapest public transport are also valid for all other public transport rides such as 200E and M3.

The airport is accessible from the city centre on all weekdays by 100E and 200E leaving at a regular basis between 4:00 and 23:30, while downtown is accessible an all weekday by 100E and 200E from 5:00 to 0:30. The airport and the downtown can be reached during the night, but with one or two changes by the night buses 900 and 950/950A.

Even though the regional bus operator (Volánbusz Zrt.) has a relatively good route network, it does not serve the passenger transport of the airport, but the airport employees. The regional buses (575, 576, 577, 580, 581) stop at the entrances of the airport where most employees enter the airport area. There is only a single early morning bus (840) stopping the terminal 2 building at 5:20. BKK 24 and 72-hour, weekly and monthly travel passes are valid within the boundaries of Budapest, otherwise the tickets can be bought at the driver.

Local and international bus lines and shuttles connect the airport with the FUA and the catchment of the airport. International buslines (Flixbus, Orangeways), other smaller bus operators and shuttles provide connection to more distant Hungarian cities as well as to neighbouring countries such as Serbia, Romania, Ukraine, and Slovakia.

In summary, airports in Vienna, Stuttgart, Mailand and Budapest provide a seamless connection from local busses and coaches to the airside transportation. However, most airports only consider the connection from city centre to the airport and back, but not the destinations in the different FUAs of an airport. For Dubrovnik Airport is the bus transport the dominant mode, as well as to Lawica Airport in the FUA Poznan. On the other hand, Warsaw Modlin Airport offers a train/bus connection, which is not attractive to most citizens due to long travel times and the change of transport mode.

In conclusion, the surface access of public transport by road still needs to be improved by developing seamless bus connections (no change) and multiple better connections to the different urban destinations in the FUAs. Such recommendations can be addressed further in the LAirA project.

3.4. Characterisation of rail network and services

3.4.1. Stuttgart Airport

At the moment there is a city train station of the “S-Bahn” in the underground of the airport with direct access to the entrance hall. The city train lines “S2” and “S3” are operating the whole week between 5 am and 1 am of the next day with four drives per hour. On Saturdays and Sundays also at night (1am - 5am) with one drive per hour. The city train needs 27 minutes to/from Stuttgart main station. A one-way ticket costs 4.20 € for an adult. At the main station there is a large offer of city trains, which connect the municipalities of the FUA. As well as regional trains with destinations all over Baden-Württemberg and the long-distance traffic.

Currently the airport isn´t yet connected directly to regional- and long-distance traffic by train. At the moment the German railway company “Deutsche Bahn” runs a railway and urban development project in Stuttgart, called “Stuttgart 21” or “Bahnprojekt Stuttgart-Ulm”. One part of this project is the connection of the Stuttgart Airport to the ICE high-speed track between Stuttgart and Ulm. For these ICE Trains and for other regional trains a new station called “Filderbahnhof” will be built in the next few years. With the high-speed track it will be possible to reach the main station in 8 minutes or Ulm in 29 minutes. This project will increase the airport´s catchment area and improves the surface access of Stuttgart Airport. Also there will be a final destination of the streetcar “U6” at the airport/fair. Together with the existing city train station and the bus terminal between airport and fair, there will be an important interchange of the public transport, connecting air, rail and road. With these improvements, the operator expects up to 1.2 million additional passengers per year.

3.4.2. Vienna Airport

The Vienna International Airport is connected to the regional and the long-distance railway network. The railway network (considering the airport connection) is served by trains from the Austrian Federal Railways Association (“Österreichische Bundesbahnen - ÖBB”) and the City Airport Train (CAT) which operates independently but is owned by the Vienna International Airport (share of 50,1%) and the ÖBB (49,9%).

The CAT serves the route between the City Centre of Vienna (“Wien Mitte”) and the airport and operates daily between 5:36 am (from the city centre) and 11:39 pm (from the airport) every 30 minutes. One journey between the city centre and the airport takes 16 minutes and costs €11 one-way and €19 return. Airport employees are able to use the CAT for free for travels to and from work.

Another train connection between Vienna (and beyond its immediate borders) and the airport is serviced by the suburban train line S7, a so-called “S-Bahn”, operating daily between 4am and 10pm in an interval of 30-60 minutes. The line S7 connects the district of Mistelbach, located in Lower Austria, northern of Vienna and close to the Czech border, with the airport. Furthermore, the line S7 closes the gap between the region “Bruck an der Leitha” which is also located in Lower Austria but east of Vienna and close to the Slovakian border. The journey from both directions to the airport takes around 45-60 minutes. The S7 enables interchanges with various underground stations in Vienna as well as busses and other suburban train lines. The regular fare for one ride between the city centre of Vienna and the airport is €3.90 (e.g. owners of a railway-related bonus card pay €1.20 for the same ride) and takes approximately 23 minutes.

The ÖBB operates long-distance trains that connect the airport with St.Pölten (the capital city of Lower Austria), Linz (the capital city of Upper Austria), Salzburg, Innsbruck (the capital city of Tyrol), Graz (the capital city of Styria) and Klagenfurt (the capital city of Carinthia) as well as Brno, Prague (both Czech Republic) and Györ and Budapest (both Hungary). With these long-distance connections the airport enhanced its importance as an Eastern-European hub.

Another project that is yet not implemented nor planned in detail is the so-called “Flughafenspange” which is a rail-interlink between the S7 (from the train station of the Airport of Vienna) and the “Ostbahn” (the eastern railway-link connecting Vienna with Hungary). By June 2017 the strategic impact assessment for the planned infrastructure project was completed and the proposed railway path was approved for possibly being used as high-performance railway track.

3.4.3. Malpensa Airport

Linate Airport doesn´t have a rail connection. Instead, Malpensa Airport has connections without changes to the city of Milan and to Switzerland.

The Malpensa Express service runs from Milano Centrale and Milano Cadorna railway stations to Malpensa Airport. Trains departing from Milano Centrale run through the following route (stops en-route can vary): Milano Centrale – Milano Porta Garibaldi – Milano Bovisa – Saronno – Rescaldina – Castellanza – Busto Arsizio Nord – Ferno-Lonate Pozzolo – Malpensa Terminal 1 – Malpensa Terminal 2. Trains departing from Milano Cadorna do not stop at every station, as most trains from Centrale do, but they follow the same route: Milano Cadorna – Milano Bovisa – Saronno – Busto Arsizio Nord – Malpensa Terminal 1 – Malpensa Terminal 2. This connection consist of 68 rides a day in between 51 and 58 minutes and a costs of 13,00 €. There is an additional train, same direction and same cost, offering 79 rides a day with the duration of 37 to 43 minutes.

Connections to Switzerland are operated by the rail company TILO, which provides the S40 service from Canton Ticino to Malpensa Airport. The service starts at the Italian municipalities of Albate-Camerlata and Como San Giovanni and then to Chiasso – Balerna – Mendrisio – Stabio – Cantello Gaggiolo – Arcisate – Induno-Olona – Varese – Gallarate – Busto Arsizio FS – Busto Arsizio FN – Ferno – Malpensa Terminal 1 – Malpensa Terminal 2. This connection consists of 30 train rides and 56 bus rides a day for 135 minutes and a cost of CHF 6.50 to 20.

3.4.4. Poznan Airport

At present, the Ławica Airport is not connected to public railway transport (tram or train). Conceptual work in this respect was commissioned by the Marshal Office in 2007 and by the Poznań City Hall in 2012. Both concepts assumed that such a connection should be fast, reliable (punctual), attractive, aesthetic, cost-effective and feasible. A railway connection between the Ławica Airport and the Poznań Główny Railway Station was taken into account. Performed analyses were aimed at accomplishing the above objectives so as to develop a solution that would be competitive with other means of transport, especially the car, which is the main reason for congestion of the city’s transport routes.

3.4.5. Dubrovnik Airport

The Dubrovnik Airport has no surface access by rail. However, 80 percent of the passenger agree that the airport needs a rail connection to the city of Dubrovnik.

3.4.6. Warsaw Modlin Airport

There is currently no infrastructure enabling direct rail access to the Warsaw Modlin Airport. The nearest train station is located in Modlin (a part of Nowy Dwór Mazowiecki, ca. 6 kilometres from the airport). This train station is used by passengers arriving at/departing from the airport using rail transport.

3.4.7. Budapest Airport

The Budapest Airport has no direct connection to the city railway. Yet, it has a good location; two major East-West railway corridors (100a, 120a) run along its borders. The 'Ferihegy' railway stop was built along the 100a railway corridor in 2007 and since all regional, domestic and international trains stop there. 120a is only accessible via few complicated changes to urban and regional buses. This connection is not even considered.

It takes 22-25 minutes from the downtown (Nyugati train station) to reach the Ferihegy railway stop. 24 and 72-hour, weekly and monthly travel passes are valid for regional trains (S20, S50, S51) without any supplementary ticket within the boundaries of Budapest including Ferihegy train stop. For intercity or fast trains supplementary tickets are mandatory. The change to bus 200E at Ferihegy train stop is included in the price of the travel pass. Without any travel pass, a regular adult single train ticket from the downtown to Ferihegy costs about 370 HUF/person (1.25 EUR/pers.). By showing the valid train ticket to the bus driver of 200E a reduced price single bus ticket can be bought for 300 HUF/person (1EUR/person). The Ferihegy railway stop is about 12 minutes away from the Terminal 2 by bus 200E, or 6 kilometres by taxi.

21: The railway link of Ferihegy train stop and the connecting bus line 200E to Budapest Airport

The MÁV-START operates regional and domestic trains departing from Nyugati train station. Regional trains operate between Budapest Nyugati train station and Monor (journey time: 13-20 min) as well as Cegléd (48 min) and follow each other every 20-30-60 minutes frequency depending on the time and day of the week. As a result of the abundance of trains 4-6 trains stop at Ferihegy every hour in each direction.

Domestic normal, fast and Intercity trains follow each other at one- or two-hourly frequency and leaving from Ferihegy directly for Kecskemét (60 min), Szolnok (55 min), Szeged (120 min), Debrecen (120 min), Nyíregyháza (170 min), Záhony (300min). Other Hungarian can be reached with one change such as Székesfehérvár (90 min), Békéscsaba (150 min), Miskolc (160 min) or major cities outside Hungary Oradea (260 min), Cluj Napoca (360 min), and Timisoara (350 min) etc.

In the last decades several solutions were brought up how to improve the accessibility of Budapest Airport by train by offering a seamless transport from a wider catchment area. The Hungarian government has decided to improve the accessibility by building the 100d train corridor with a train station under Budapest Airport Terminal 2. The planning process is under way.

In summary, the Stuttgart Airport has a direct connection to the city centre by city railway every 15 minutes and the offer will be improved in the future with an additional long-distance train from several FUAs to the airport by the end of 2025, when the "Bahnprojekt S21" is finalized. In comparison, the public transportation offer by railway to/from Vienna Airport is much better. Especially because the airport is connected to the regional and long-distance railway network. The train takes the passengers and employees from the airport to the city centre of Vienna within only 16 minutes. However, most trains only run every 30 minutes. Malpensa Airport has not just a railway connection to the city centre of Milan, but multiple connections by railway to the different residential areas.

In conclusion, Linate Airport, as well as Lawica, Dubrovnik, Budapest and Warsaw Modlin Airport do not have surface access by rail. In this case, LAirA project can be a great asset for the named airports and FUAs to collect and exchange knowledge and develop strategies considering the more advanced airports in planning its own railway development further.

There is also still room for improvement concerning surface access at the more advanced airports Stuttgart and Vienna. For example, there is a lack in a more peripheral connection by rail from the airport to rural areas in the FUA. However, other public transport modes, such as busses already connect airport with the rural residential areas of the FUAs. Also, the Vienna Airport could improve it´s timing of the trains, running every 15 minutes instead of every 30 minutes.

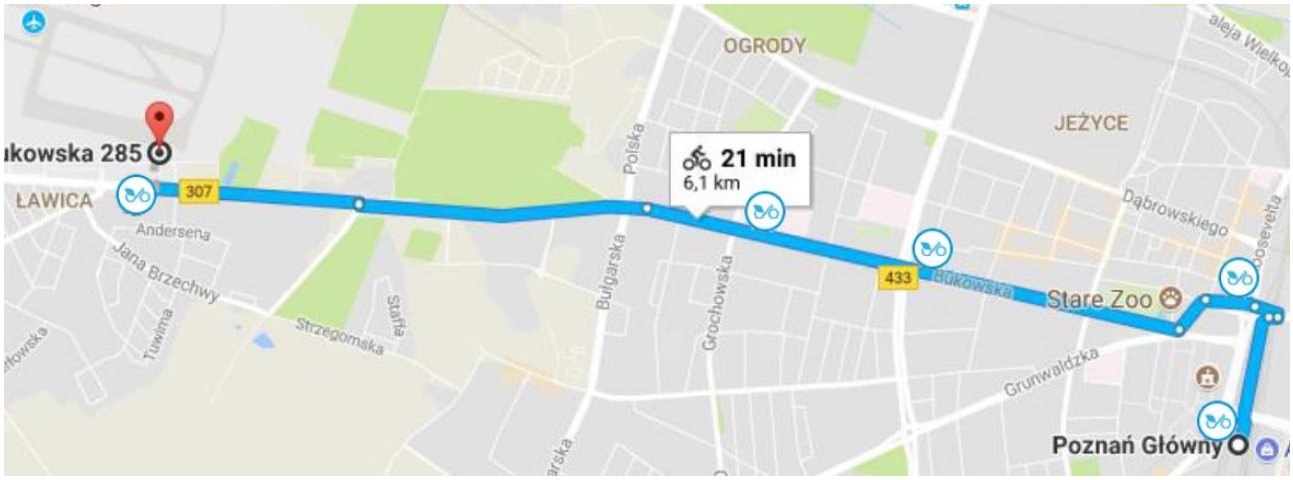
3.5. Characteristics of the cycling network and services

In general, there is almost no optimal infrastructure for cyclists to or from the airports of the FUAs. Some FUAs, as described in the following, have surface access by bicycle, however the cycling network needs to be improved by all project partners in the near future.

3.5.1. Lawica Airport

The Ławica Airport is accessible also for cyclists. Around the railway station there is bicycle infrastructure enabling people to get around using bicycles. The city center is connected with the Airport by a bicycle lane with a total length of 6.1 km, running mainly along Bukowska Street. When weather and traffic conditions are favorable, the travel time is about 21 minutes.

Poznań operates Poznań Public Bike System (Poznański Rower Miejski - RPM) used by an increasing number of users. The number of PRM stations and bicycles keeps increasing as well. The nearest PRM station is located 500 meters from the Airport (on Brzechwy Street). A bicycle can be rented using a mobile application and up to 20 minutes, a bicycle can be rented free of charge. It is possible to get from the railway station to the airport free of charge as there are 3 PRM stations along the route.



22: Surface access to the Lawica Airport by bicycle

3.5.2. Warsaw Modlin Airport

Warsaw Modlin Airport has no optimal infrastructure for cyclists to access the airport. The cycling routes from the centers of municipalities in the functional urban area to the Warsaw Modlin Airport run mainly along national road No. 62 and municipal roads. Due to sub optimal infrastructure dedicated to cyclists

and significant car traffic on national road No. 62 & 85, the current cycling routes to the airport do not provide adequate levels of comfort and safety. There is no proper infrastructure/ cycling paths available for cyclists along the most ways from key locations of the FUA.

3.5.3. Budapest Airport

Budapest has a slowly, but gradually evolving bicycle road system, but most of the developments are focused in the central areas of the capital. Terminal 2 can be reached via a 25 km bike trip from the city centre on various quality of road, street, bike road, bike lane etc. However, Budapest Airport has no direct bicycle access to the airport terminal on the last mile, only on a dirt road.

The other partners' didn´t characterized the cycling network and services in their own reports, due to not existing cycling paths to the airport. This leads to the planning of a gradually evolving bike road system in all FUAs in the near future. There is also a potential in the LAirA project to address and stress such carbon free mobility modes and its infrastructure even more.

3.6. Characterisation of pedestrian road network

The characterisation of pedestrian road network wasn´t addressed in the reports of the FUAs, probably due to not existing pedestrian roads to the different airports. Most airports are located further away from the city centre, but only few kilometres away from residential areas. There is a potential in connecting close residential areas by pedestrian road networks to the airport, since many employees are living close to the airport. The construction of a pedestrian road network would improve the airport accessibility at least for employees. This mode of transportation will be addressed further in the LAirA project to improve the understanding of such a potential.

4. On-demand mobility services

In addition to the mobility offers already described, there are also on-demand mobility services available at the airport. Beyond conventional transport modes, on demand mobility services are also available at different airports. The following chapters provide a detailed description of the characteristics of different FUAs on-demand mobility services. There are car-/ ride-sharing initiatives, taxis and other shuttle services. At present the development of mobility services improves rapidly, but the development of such services varies extremely.

4.1. Car-sharing

Besides the travellers, car sharing is an interesting alternative for those who can´t buy or don´t want their own car in order to save the environment. The principle of car sharing is simple. You reserve a car of your choice by phone, by app or on the internet, pick it up at a certain place, drive it and return it to a nearby parking space. It is usually billed by the kilometre travelled. One shared car can substitute up to 19 private ones.

4.1.1. Stuttgart Airport

In Stuttgart there are four car-sharing providers: car2go, Flinkster, Stadtmobil carsharing and drivy, a platform, where car owners can lend their vehicle for a certain time. But only car2go offers its car-sharing option at the airport. With a total of 550 electric vehicles of the brands smart (500 cars) and Mercedes-Benz B-Class Electric Drive (50 cars) car2go operates the largest fully electric, free-floating car-sharing fleet in the world. But this service is only provided between the “home area Stuttgart” (operating area of car2go) and the airport area.

4.1.2. Linate/Malpensa Airport

Four operators provide car-sharing services at Linate Airport. CAR2GO offers 20 parking slots, ENJOY - 14 parking slots; DRIVENOW - 10 parking slots and E-Vai offers 4 electric parking slots. There are two re-charging stations for E-Vai electric cars.

The E-Vai electric car-sharing operator provides also services at Malpensa Airport. It has 5 parking slots at Terminal 1 and two charging stations. The car-sharing offer is limited compared to Linate Airport, due to the further distance of Malpensa Airport to Milan.

4.1.3. Vienna Airport

As already mentioned, two different car-sharing companies serve the Vienna International Airport, namely car2go and DriveNow. However, these offers solely are provided between the operating area of Vienna and the airport area (specifically, certain parking spaces). Both pick-up/drop-off stations are located in a car park next to Terminal 3 and reachable by a weatherproof connecting passage from the main terminal buildings.

Using a car2go to and from the airport requires an additional fee of €12. It is possible to reserve an available car2go 30 minutes in advance. In case no car is available at the requested time, so-called “radar” can be activated which the user via push-notifications about the availability. Speaking in use cases this would mean a person could hop into a car2go in the City of Vienna and drop it off at a certain parking space at the airport with an additional fee. However, users have to be registered and validated in advance

for using a car2go. Car2go users that registered their account in another country are able to reserve a car in Austria as well.

DriveNow provides BMW or MINI cars for driving to or from the Vienna Airport. An additional fee of €10 is required for parking the DriveNow car at the airport, although this fee is 50 % lower on Tuesdays and Wednesdays. It is also possible to reserve a car for free 15 minutes in advance.

Both car-sharing options show similar characteristics and enable (domestic) flight passengers (employees would not use it regularly due to economic reasons such as high cost) to take a car instead of public transport respectively saving parking fees (compared to using their own car). Also the fact that hardly any information about these mobility offers is available in English shows that they do not seem to address international passengers.

4.1.4. Poznan Airport

The city of Poznań has developed a car-sharing concept providing for self-service pay-per-minute car rentals. It is assumed that hybrid cars will be deployed first, to be followed by electric ones. At present, Traficar, offering a fleet of 150 cars. The cost of renting a car for about 10 km is approximately PLN 8. With the application, it is possible to book a car in advance, shown on the map. All cars in the Traficar's offer meet the Euro 6 standard which, compared to Euro 1, reduces dust emissions by more than 96% and those of nitric oxides and hydrocarbons – by 85%.

Furthermore, thanks to cooperation with Blinkee, the City of Poznań offers electric scooters, which can be rented per minute using a mobile application. With the mobile application, the user can find a scooter on a map, which is parked nearby and is able to reserve it. Depending on the selected package, a scooter can be rented even for as little as PLN 0.11 per minute in the case of a 3-month subscription. In the case of standard recharging, the cost of renting a vehicle is PLN 0.69 per minute. Students pay PLN 0.43.

4.1.5. Budapest Airport

FUA Budapest has also multiple car-sharing options, however none of them are operatiing at the airport. For example, the Avalon 'caresharing' is offering pick-up and drop-off points in the downtown area of Budapest. Another private company, the GreenGo offering e-mobility covering mostly the downtown area, even though the range of the service was extended in 2017, it still has not reached the airport area. A new player, Mol-Limo is expected to enter the car-sharing market from 2018, but it is unclear, whether the service will cover the airport area or not.

4.1.6. Dubrovnik Airport

At this time there are no car-sharing services available or operating in the DNC area or on the Dubrovnik Airport area, but there are some indicators that this service could be established by 2020. The company Avantcar, a rent-a-car company, operating at the Dubrovnik Airport, will start a car-sharing pilot programme with an electrical vehicle (EV) fleet. Therefore new EV charging stations are planned at the Dubrovnik Airport terminal building area.

The report of Warsaw Modlin Airport didn´t mention any car-sharing options. Most airports have at least one car-sharing provider, but the service is quiet costly due to an additional fee (car2go, drivenow) the user gets charged by entering the airport area. Another barrier for passenger to use car-sharing as a mobility option is, that hardly any information about these mobility offers is available in English. This shows that car-sharing providers do not seem to address international passengers.

4.2. Ride-sharing

The Vienna International Airport launched the online ridesharing-network “Drive2VIE”, hosted by the German company “flinc” together with Austrian Airlines, Gebrüder Heinemann, Celebi and NIKI Luftverkehr. The intention was to create a company respectively location specific network for quickly matching requested and available rides from or to the airport of Vienna. The principle is easy: Drivers can enter either their driving schedule or be ready for short-term requests while driving. Car passengers enter their requests and are matched with possible drivers. The network can serve both long-term and short-term ridesharing requests. Though the network is not intended to be used by passengers traveling to or from the airport.

As ride-sharing platform to or from the Lawica Airport the BlaBlaCar web portal can be used, through which drivers can offer a seat in their cars, while passengers can find journeys offered by drivers. Each user of the ride-sharing system decides with whom they want to travel and how the cost of the journey will be shared. After the ride, BlaBlaCar users may also rate each other. The system can be used for both long- and short-distance journeys, and its flexibility allows for travelling both to and from the Airport.

There are two large private carpooling organizers on the Hungarian market: oszkar.com and blablacar.hu both offering rides from/to Budapest Airport, predominantly to domestic and international destinations. The rides are organized online with registered drivers and passengers.

In general, multiple FUAs have BlaBlaCar as a mobility option, but this mode of transportation is barely used by passengers to go to/from the airport. In the case of employees, they most likely find their own ride-sharing cooperation with colleagues. For example, the Stuttgart Airport has developed a self-organized ride-sharing platform for its employees on the intranet for paring ride sharing up.

Other mobility services such as taxi services, airport shuttles and car rental companies are mentioned by all airports as an additional and mostly very popular mobility option. However, these services are usually not considered as sustainable or carbon free mobility services. Such services could be improved by either offering rides with e-Taxis or car rental companies with electric vehicles.

5. Mobility information system

In general, different transport information systems/services exist at airports. Some are developed for regional use others as a national information system. In the following, will be described the different mobility information systems and later on the identification of potentials and gaps of such solutions.

5.1. Describtion of existing mobility information systems

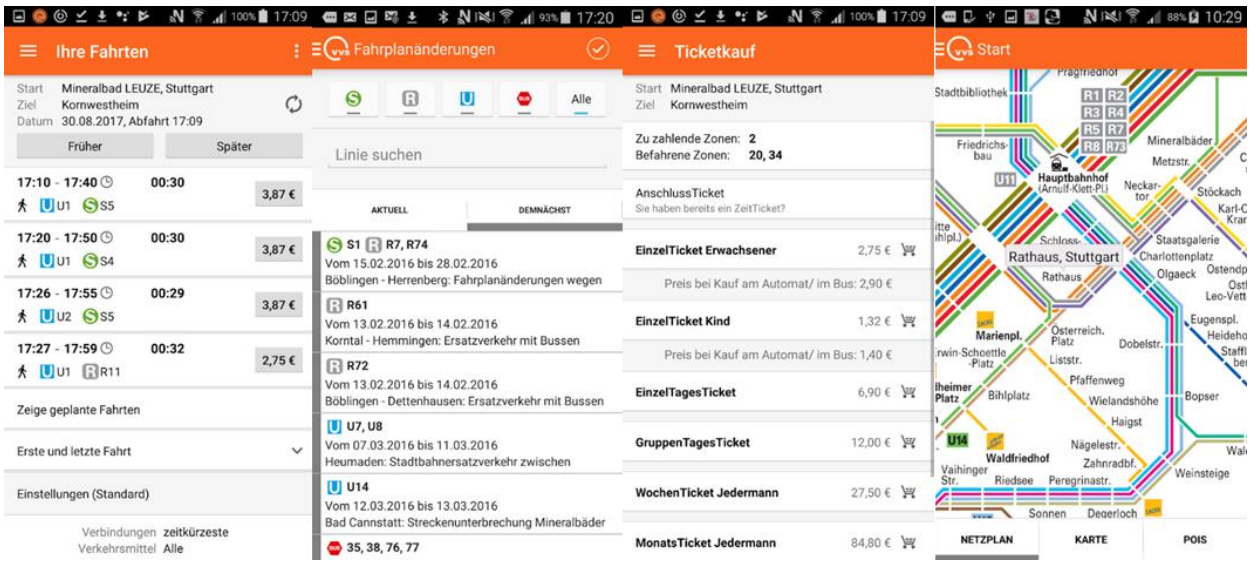
Many people also use Google Maps as international mobility information system. It shows the shortest way to the destination including footways and the route of the train. It shows different possibilities and as soon you have chosen one it also shows the link to the homepages of the mobility provider to get detailed information. An advantage is, that almost every traveller has access to Google. You can´t pay directly on Google Maps, but the user gets redirected to the purchasing site.

The following chapter includes a brief analysis of passenger mobility information systems at the FUAs airports. Since the goal of LAirA is to develop, test and implement an innovative ITS-tool that provides passengers and employees with relevant (pre-trip and on-trip) travel information, only digital services (i.e. applications for digital devices) are considered in this state of the art description.

5.1.1. FUA Stuttgart

In the FUA Stuttgart exist different public transport apps. Some of them can be used all over Germany and some of them only in the region.

The “VVS” mobile application is a system restricted to the region of Stuttgart. This is the operating area of VVS (Verkehrs- und Tarifverbund Stuttgart), the local public transport provider. VVS is running the city train called “S-Bahn”, the streetcars, busses and other mobility services. The app provides all information about the public transport in the region. You can plan and book your travel via the app. The app plans your travel to the exact address, means it shows also the way to walk on a map. Also you can get live information about single connections like the delay time or cancelled rides. If you book your travel via the app, you get a reduced ticket price. Once you have bought a ticket, it appears as a QR-Code in the app. Figure 22 shows pictures of the just describes VVS-application.



23: Screenshots VVS mobil App, Source: https://play.google.com/store/apps/details?id=com.mdv.VVSMobil

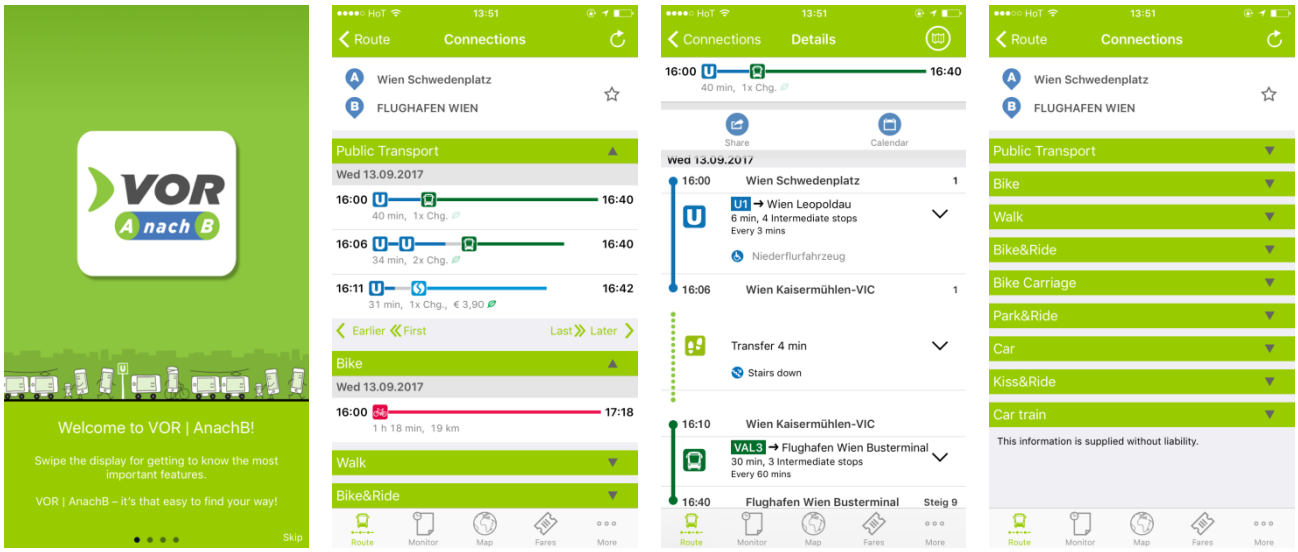
The application “DB Navigator” is similar to the “VVS mobil-APP” but on a national level. It already offers a variety of different services around rail travel, like mobile booking, real time information with current departure and arrival times or the opportunity to set a delay alert. Every day are about 4 Mio. travel information provided and in 2017, 15 Mio. tickets were sold via the application. The “DB Navigator” provides also regional offers. The route planner shows the navigation for footways as well as lines of S-Bahn and underground, trams and busses. Meanwhile it is one of the most used applications in Germany.

5.1.2. FUA Vienna

Various digital mobility information systems exist in Austria, such as “AnachB”, “Quando”, “Wien mobil” or “Wegfinder”, offering different functions (planning, booking, etc.), content and address different target groups . Recent developments also enabled the availability of the timetables of the Wiener Linien (the main public transport provider in Vienna) on Google Maps, which makes the travels to and from the airport for visitors easier than before. All aforementioned (and in general most popular) programs/applications for digital devices (e.g. smartphones, tablets or computers) include the access to the airport of Vienna, i.e. the planning, booking and/or paying of trips to and from the airport.

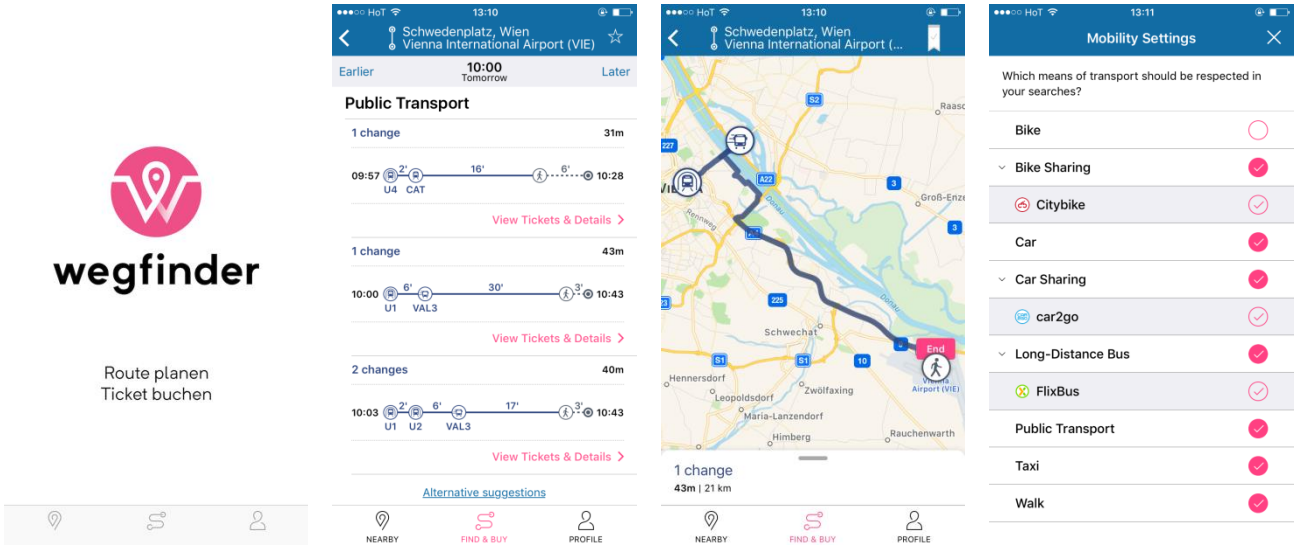
An already well-established smartphone app for journey/route planning in Austria is “AnachB” which is provided by the public transport association “VOR” (see Figure 23). In contrary to “Wegfinder”, the app AnachB provides route planning information, including all kind of passenger transport modes and various

intermodal interchange possibilities, however, ticketing is not available. The app requires no login or account registration for retrieving relevant information. These apps are usually also available in English.



24: Screenshots AnachB App, Source: Verkehrsverbund Ost-Region (VOR) Gesellschaft m.b.H., 2017

A fairly new app is "Wegfinder", provided by the iMobility GmbH, an Austrian start-up that is supported by the ÖBB. By using the Wegfinder app it is possible to plan routes from A to B by considering intermodal mobility options. The main intention of the app is to reduce the complexity of the representation of mobility offers and make suitable mobility options more feasible for transport users. By implementing the app, individual, flexible and ecological transport decisions (in terms of mode and route choice) should be promoted. As shown in Figure 24 the Wegfinder smartphone app includes route planning, booking/ticketing for certain services, activation and deactivation of transport modes and personal settings in case of account registration/login.



25: Screenshots Wegfinder App, Source: iMobility GmbH, 2017

5.1.3. Linate and Malpensa Airports

Milan Airports' website and App35 provides several information to passengers concerning flights, directions and parking, shopping & food, and Airports' services and facilities. The web site and App functionalities on "directions and parking" provide information on the Airports' accessibility according to the preferred travel mode:

- Passengers travelling by car find road directions, parking services information and the possibility to book parking on-line. The section also provides real-time traffic data through Google Maps and web-streaming from 6 video cameras that shows the level of congestion on the main roads to the Airports.
- Passengers travelling by bus can find information on the main services, operators, schedules and fares.
- Passengers travelling by taxi find companies' phone numbers, as well as information on limousine services.
- Concerning car-rental the website and App provides a list of operators, phone numbers and websites.
- The website and app functionality also concerns car-sharing options describes the service and cars' location in detail.
- Finally, passengers can find information on rail services and schedules, including real-time updates.

SEA is not only engaged in providing information to passengers but also in collecting feedback. In particular during 2017, SEA has surveyed passenger satisfaction through dedicated multimedia displays at the Airports. The survey concerned different aspects of the Airports' service, including satisfaction on the quality of information provided and on modal integration at Airports.

Although there are various other route planning apps for mobile devices, however there is no application that specifically addresses the needs of airport employees or passengers for travelling to and from the airport or between company buildings and airport infrastructure on site. This will be discussed further in the LAirA project by establishing a pilot ITS-tool for the FUAs airports.

5.2. Potentials and gaps of mobility information services

5.2.1. Vienna Airport

The following aspects could be identified as current gaps and possible potentials for future enhancements:

- Lack of information on interchanges between public transport lines and the on-site Airport Shuttle
- Lack of integration of DRIVE2VIE in existing mobility information systems
- Lack of incentives for employees to use other modes than the private car
- Lack of available public transport for those working on nightshifts or having irregular working hours
- Lack of integration of surrounding municipalities in the public transport system and public transport options for employees coming from the province of Burgenland
- Private or company-related mobility services/options are not part of (commercial) mobility information systems

- Difficulties in finding information about private or company-related transport offers
- Availability of fixed tariff models that make services unattractive for some user groups
- Certain regulations for cab drivers and therefore empty runs between the airport and Vienna (there is a law that restricts pick-ups of passengers from another province unless it is pre-ordered)

5.2.2. Stuttgart Airport

The following aspects might be present gaps, but they can also be potentials for the future:

- There are many mobility apps on the market, but every app has its pros and cons. For example, the app of “Deutsche Bahn” (german railway company) works in whole Germany, but if you want to buy a ticket, only connections with trains running by DB can be booked. What is missing is a unified solution.
- To increase the attractivity of public transport a reward program could be evolved, e.g. bonus miles for using public transport like frequent flier miles.
- On possible potential for the future could be an on-flight information panel, where you can look for connections at the plane.
- Lack of availability of public transport during the night times for those employees who begin to work at night time (0 am to 4 am).
- Long travelling times into southern FUAs (will get better in future).
- Car-sharing isn´t yet available for every user group (due to its sophisticated registration process)

Only two FUAs identified the potentials and gaps of its own mobility information system. The other partners either didn´t address mobility information systems in their individual reports (Poznan, Warsaw, Dubrovnik and Budapest) or just don´t have their own. In the end, the following chapter will summarize and conclude the findings in this transnational report.

6. Conclusions and recommendations

First of all, the report presented and compared the different FUAs and its airports. FUA Milan is most populated with 4.1 million inhabitants, in comparison to FUA Dubrovnik, the least populated FUA with 122.568 inhabitants. The indifference of the numbers of inhabitants demonstrates the distinctions of the seven FUAs participating in the project. Due to the different FUAs, the several airports are also developed on different stages. Some airports are much more advanced in the application of public transportation, carbon free mobility and mobility information systems concerning surface access of airports then others.

In general, the airports handle from 1.5 to 23.35 million passengers a year and are important economic drivers for the different FUAs. All seven reports stated a trend to steadily rising passenger numbers the past years. In general, the FUAs airports are one of the largest employers of the region and its employees come from all across the FUAs. This leads to an increased importance of surface access and the next chapter. Not every FUA presented its total number of employees, nevertheless the numbers of Stuttgart and Vienna Airport illustrated the need for more incentives for airport employees to use carbon free mobility.

Not every FUA presented its total number of employees, however the numbers of Stuttgart and Vienna Airports illustrated the need for more employee incentives to use carbon free mobility. According to the increasing number of employees, it would be helpful, if the upcoming actions of the LAirA project would also consider the importance of employee mobility management at FUAs airports.

The Offices of employees are not always located in immediate distance to the train or bus station of an airport. Therefore an on-site airport shuttle could be organized to improve the access by public transportation for employees. For example, exists such a shuttle at the Vienna Airport. However, this shuttle bus is not included in any digital or online mobility information system.

Only two FUAs reported on the environmental and social engagement of its airports. In the future, there needs to be developed a detailed overview of the planned or already taken measures of all seven airports considering environmental and social engagement.

In summary, all airports are easy accessible by car. When speaking of immediate surrounding areas or the municipalities located close to the airports, the access by car is the most convenient and probably even the most reasonable way of accessing the airport for employees as well as for passengers. The number of parking spots are ranging from 638 to 10,700 depending on the size of the airport.

The airports of Vienna, Stuttgart, Mailand and Budapest provide a seamless connection by local busses and coaches to the airside transportation. However, most airports only consider the connection from city centre to the airport and back, but not the destinations in the different FUAs of an airport. The dominant transportation mode of Dubrovnik and Lawica Airport is by shuttle bus. On the other hand, Warsaw Modlin Airport offers a train/bus connection, which is not attractive to most citizens due to long travel times and the change of transport mode. Overall, the surface access of public transport by road still needs to be improved by developing seamless bus connections (no change) and multiple better connections to the different urban destinations in the FUAs.

Stuttgart Airport has a direct connection to the city centre by city railway every 15 minutes and the offer will be improved in the future with an additional long-distance train from several FUAs to the airport by the end of 2025, when the “Bahnprojekt S21” is finalized. In comparison, the public transportation offer by railway to/from Vienna Airport is much better. Especially because the airport is connected to the regional and long-distance railway network. The train takes the passengers and employees from the airport to the city centre of Vienna within only 16 minutes. However, most trains only run every 30 minutes. Malpensa Airport has not just a railway connection to the city centre of Milan, but multiple connections by railway to the different residential areas. On the other side, Linate, Lawica, Dubrovnik, Budapest and Warsaw Modlin Airport do not have surface access by rail. In this case, LAirA project can be

a great asset for the named airports and FUAs to collect and exchange knowledge and develop strategies considering the more advanced airports in planning its own railway development further.

There is also still room for improvement concerning surface access at the more advanced airports Stuttgart and Vienna. For example, there is a lack in a more peripheral connection by rail from the airport to rural areas in the FUA. However, other public transport modes, such as busses already connect airport with the rural residential areas of the FUAs. Also, the Vienna Airport could improve it´s timing of the trains, running every 15 minutes instead of every 30 minutes.

In summary, there is almost no optimal infrastructure for cyclists to or from the airports of the FUAs. Some partners' didn´t characterized the cycling network and services in their own reports, due to not existing cycling paths to the airport. Other airports have surface access by bicycle, such as Vienna Airport. A big achievement was the implementation of the bicycle path between Vienna and the airport. Although, due to the location and weather conditions in this area (characterized by strong winds) and a total duration of around 75 minutes for one direction it can be assumed that this mode of transport is not chosen very often; especially not by passengers. For the future, the cycling network needs to be improved severely by all project partners. This leads to the planning of a gradually evolving bike road system considering the best practice of Vienna Airport. There is also a potential in the LAirA project to address and stress such carbon free mobility modes and its infrastructure development. Project partners can get to know specific cases of bike systems.

The characterisation of pedestrian road network wasn´t addressed in the reports of the FUAs, probably due to not existing pedestrian roads to the different airports. Most airports are located further away from the city centre, but only few kilometres away from residential areas. There is a potential in connecting close residential areas by pedestrian road networks to the airport, since many employees are living close to the airport. The construction of a pedestrian road network would improve the airport accessibility at least for employees. This mode of transportation needs to be addressed further in the LAirA project especially to improve the understanding of such a potential.

Besides private cars and public transport services, also car-sharing companies and usual taxis are available alternative for commuting to and from the airport. Most airports have at least one car-sharing provider, but the service is quiet costly due to an additional fee (car2go, drivenow) the user gets charged by entering the airport area. Another barrier for passenger to use car-sharing as a mobility option is, that hardly any information about these mobility offers is available directly at the airport. A lack appears when it comes to the car- and ride-sharing options, when different isolated solutions/applications exist but are not integrated in existing information systems. For the future, passengers need to see preferably with one view collected in one information systems, which mobility options are provided and to what conditions offered.

Other mobility services such as taxi services, airport shuttles and car rental companies are mentioned by all airports as an additional and mostly very popular mobility option. However, these services are usually not considered as sustainable or carbon free mobility services. Such services could be improved by either offering rides with e-taxis or car rental companies operate with electric vehicles.

Only three project partners described in their reports their airports mobility information system. The other partners either didn´t address mobility information systems in their individual reports (Poznan, Warsaw, Dubrovnik and Budapest) or just don´t have their own. Nevertheless, in the following the project will provide a report analysing and identifying the potentials and lacks of all different information systems of the FUAs airports.

In general, there is still room for improvement at all airports concerning sustainable surface access. For example, there is a lack in a more peripheral connection by rail from the airport to rural areas in the FUAs. Especially those regions that are in the immediate surrounding area of the airport are not very well reachable by public transport. In conclusion, the surface access of airports still needs to be improved by

developing seamless bus and rail connections (no change) from the city centre for some FUAs as well as from different urban destinations.

In summary, the Airport of Vienna is well accessible by road, rail and sustainable transport modes. Especially during peak hours the frequency of local trains serving the airport with passengers and employees is high. All the other FUAs airports can learn from the best practice example. Vienna Airport can be used as example for other project partners to exchange knowledge and best practices. In this case, LAirA project can be a great asset for the named airports and FUAs to collect and exchange knowledge and develop strategies considering the more advanced airports in planning its own surface access development further.