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LAirA

LAirA project handbook

Multimodal and sustainable low carbon mobility integration of airports and their catchment areas

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Preface

This educational model handbook presents the multimodal and sustainable low carbon mobility integration of seven different airports in the transport systems of their functional urban areas (FUAs).

Functional urban areas (FUAs) were originally defined in order to make different metropolitan areas comparable when it comes to their economic, social and environmental performances. The project is looking for answers on how to tackle changes in the aviation transport business by implementing actions which **integrate airports into the FUAs multimodal sustainable mobility systems.**

The handbook briefly introduces the objectives of the project in the Introduction section, as well as the main challenges and expected impacts.

The project's comprehensive approach integrates seven key thematic areas:

- **Electric mobility**
- **Air-Rail links**
- **Walking and cycling**
- **Shared mobility**
- **Information Technology Systems**
- **Wayfinding**
- **Road Public Transport**

At the beginning of each chapter the background of the area and its relationship with the airports are presented, and the characteristics of the airports participating in the project are analysed.
Finally, some examples of best-practices from non-partner airports are given. At the end of each mobility section, summary questions and tasks support the learning process. At the end of the handbook, the conclusion gives a comprehensive view of the airport low carbon mobility content.

The handbook relies on primary data collected through **on-line surveys**, in-person **interviews and professional materials** (action plans, best practices, case studies, reports) with airport employees and passengers. These interviews were prepared by the participating airports. Last but not least, the handbook and the associated low carbon mobility presentation are part of the completed tutorial material.

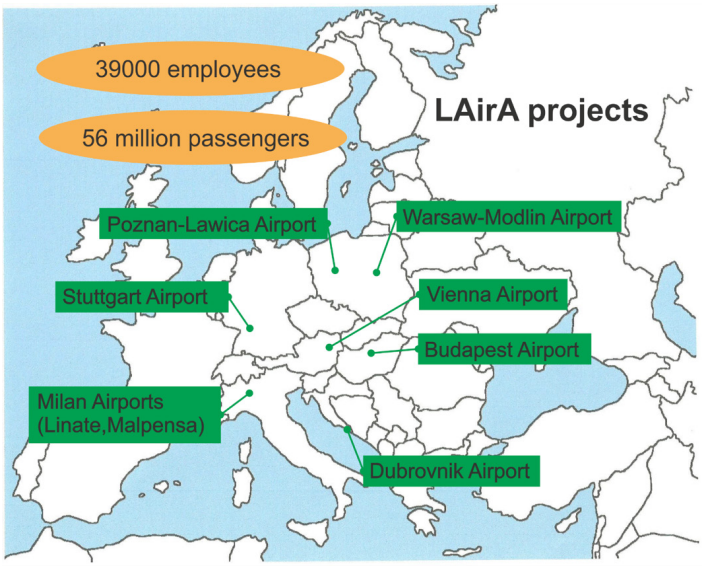
The educational training would cover **public authorities**, such as public servants and transport providers, as well as airport employees to improve their skills in the development of low carbon mobility services at the airport and its catchment area. It is very important **to understand the sustainable airport connectivity procedures**, so that the right solutions to the problems that arise in the mobility sector of the FUA can be found.

The pictures in this manual originate from the websites of the airports participating in the project or from the illustrations of the professional material which has been produced in the project.

Introduction

Airports are assets and transnational transport gateways for citizen traffic and commercial activities. **LAirA (Landside Airport Accessibility)** addresses the **multimodal, smart and low carbon mobility integration of airports** in the mobility systems of functional urban areas (FUAs). The project is supported by the Interreg Central Europe cooperation programme and includes Eastern and Southern regions of the EU and affects about **56 million passengers** and **39 000 employees** of the FUAs of Budapest, Dubrovnik, Milan, Modlin (Warsaw), Poznan, Stuttgart, and Vienna.

The main subject of the LAirA project addresses the improving capacities for mobility planning in FUAs to reduce CO_2 emissions.



Project objective

The objective of the Interreg Central Europe funded project LAirA **is to change the mobility behaviours of airport passengers and employees**, by respecting the FUAs continuous **energy reduction**, by the introduction of **smart technologies** and by observing environmental mobility impacts. It is important to develop **a common new low carbon mobility strategy** by involving local authorities, other organizations and stakeholders. Transportation is now one of the largest sources of carbon emissions in the European Union. The main objective is **to reduce the carbon footprint** of transport activities related to the airports' landside connectivity in FUAs – develop strategies and capacities for transport planning.

Challenge of the project

The most important factors in reducing CO_2 at airports and their FUAs would be the easing of the growing congestion as well as managing the traffic and transportation flow. The unlimited development creates the loss of the natural habitat, increases air and noise pollution and leads to high distress growth on the local population. The major challenge of the analysed airports and their FUAs is **to find a sustainable strategic way** of balancing the negative airport traffic with the well being of the affected population.

LAirA project impact

In order to build a lasting impact in airports mobility, the project needs to enhance the planning capacities – especially at municipal level via learning experience, i.e. how to understand the specific FUAs mobility situation and ways of designing and implementing sustainable strategies. Electric mobility, growing air-rail links, shared and soft mobility and public transport present **new directions of CO_2 reduction**. Comprehensive IT systems, up to date technologies, the use of artificial intelligence as well as creative wayfinding will generate new mobility solutions.

Presentation of the airports

FUAs and airports are very different from each other. All seven airports and their FUAs have different sizes in terms of area, number of inhabitants, airport landside accessibility and culture. The FUA of **Milan** is the most populated, with 4.1 million inhabitants, in comparison to FUA **Dubrovnik**, which is the least populated FUA with 122.568 inhabitants.

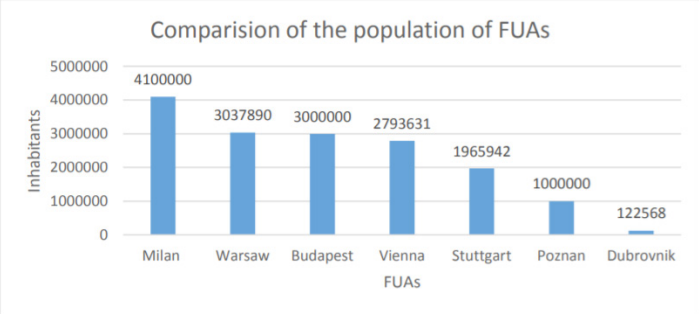


Figure 1. Comparison of the population of FUAs

There is also a significant difference between the airport catchment area and the city centre of the FUA. The minimum distance is 7 km in the case of **Poznan Airport**; however, **Malpensa Airport** is located in the province of Varese, 52 km south-west of Milan, which is the maximum distance among the seven surveyed airports.

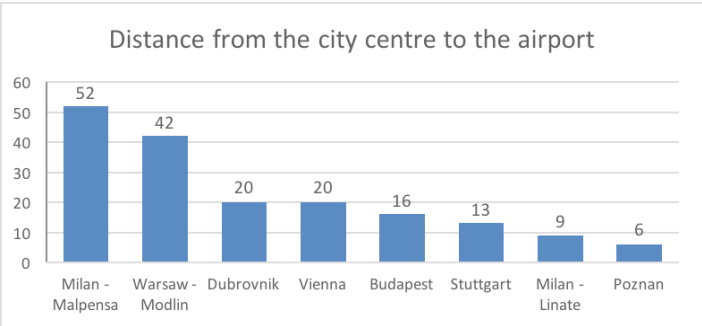


Figure 2. Distance from the city centre to the airport

In regards to figure 2, there is a certain correlation between the distance travelling from a city centre to the airport and the size of its FUA. For example, a FUA has a much greater special development potential with more inhabitants, than a smaller FUA, like Poznan.

Most airports of large FUAs are connected to public transport systems, which results in overcoming the distance between the city centre to the airport in short time.

Mobility system

Vienna Airport is well connected to its catchment area by road and railway with access to it by individual cars, busses, car rental services, taxis, local and long-distance trains. Not just from the city centre but from all parts of the FUA it is possible to access Vienna 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.

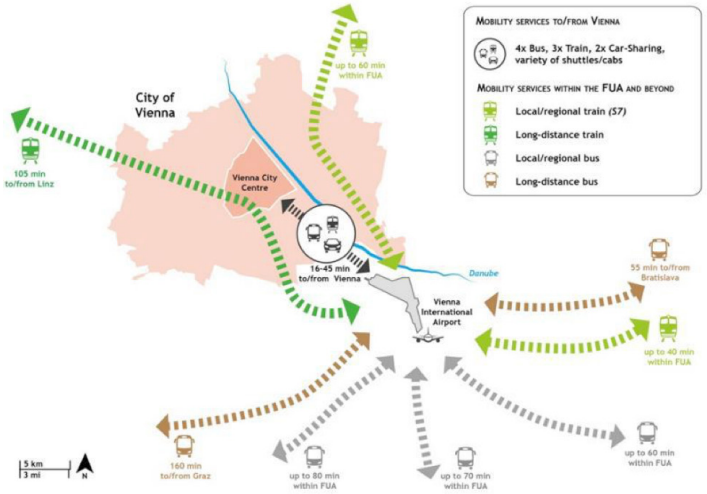


Figure 3. Schematic diagram with direct mobility services to/from the Vienna FUA

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 Ławica Airport (Poznan) can only be accessed by road and the entire airport is located within the administrative territory of the city of Poznan.

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

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

Budapest Airport is well connected to its catchment area by road, offering an excellent access to individual motorized transport, taxis, urban buses and other road transport vehicles. The train station is located within few kilometers from the terminals, which enables the integration of the airport via rail link as well. The outskirts of Budapest (part of the FUA) are well accessible, especially along the East-West axis with one change from the train to a regional bus. Figure 4 shows that the North-South axis is basically served by the individual motorized transport along M0 and other connecting road network, while public transport service is not existing.

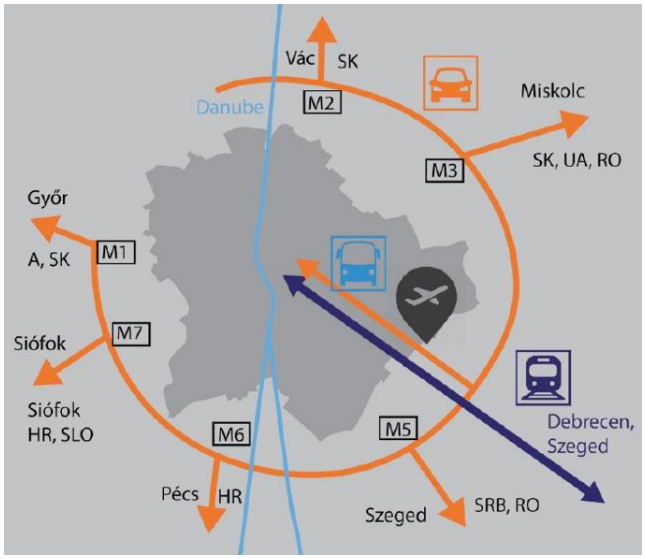


Figure 4. Schematic overview of the access to city centre and catchment of Budapest Airport

Dubrovnik Airport is integrated in a road-based network and it can only be accessed by private cars, coach buses and regular taxis.

Passenger traffic

Figure 5 shows that there are also significant differences in the passenger traffic of the seven airports (1.5-23.5 million people). The biggest is **Vienna Airport** with 23.35 million passengers and operates with 72 airlines.

The number of passengers at **Dubrovnik Airport** reached 2.32 million passengers from ten airlines in 2017. Dubrovnik is mainly a tourist destination oriented towards the luxury market supply.

Ławica Airport (Poznan) serves about 1.5 million passengers a year.

Since the opening in 2012, the number of passengers at the Warsaw/Modlin Airport is constantly increasing reaching 3 million passengers in 2018.

Budapest Airport handled 15 million passengers in 2018, 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.

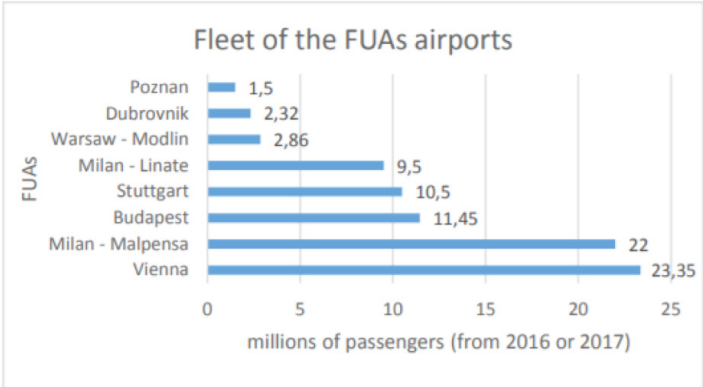


Figure 5. Fleet of the FUAs airports

Linate Airport registered 9.5 million passengers in 2017 from some 20 airlines. The airport has a balanced mix of national and international passenger traffic (52% and 48% respectively in the same year). **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.

With an annual passenger volume of 10.5 million, **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.

According to Figure 5, **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. 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** in 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.

Summary

The analysed airports are very different from each other. All of them have unique catchment areas with various sizes and special landside accessibility. They attract a divergent population that uses their services.

There is a big difference regarding the passenger traffic, the distance between airport and city centre as well as the different procedures from departure till arrival.

There are airports (for example Vienna, Linate, Malpensa, Stuttgart and Modlin airports) that can be reached by varied means of transport (train, bus, car, taxi, etc.). For some airports, however, only the road approach is currently available (Dubrovnik, Budapest and Ławica Airport). There are also significant differences in the number of passengers.

Vienna Airport (from 2016 or 2017) with 23.35 million passengers has 15 times more passenger traffic than Ławica Airport (1.5 million passengers).

The knowledge of these data is very important, as passenger numbers and access procedures can affect significantly the ecological footprint of the different airports and the possibilities of reducing their CO_2 emissions.

Questions and tasks

- Name which is the smallest and largest FUA of the analysed airports.
- Specify which airports have the largest and smallest distance to their city centre.
- Which airports have the most transport access opportunities?
- Which airport can only be reached by road?
- Describe the way to get to Vienna Airport. Which is the most environmentally friendly access option to the airport? Why?
- Pair the named airports and the number of passengers (based on 2016 or 2017 data).

Vienna Airport	1.5 million
Budapest Airport	10.5 million
Dubrovnik Airport	2.86 million
Ławica Airport (Poznan)	23.35 million
Warsaw/Modlin Airport	2.32 million
Linate Airport	22 million
Stuttgart Airport	9.5 million
Malpensa Airport	11.45 million

- List some indicators which differentiate a significant way the analysed airports.

Seven key thematic areas

Theme 1: Electric vehicles

Electric vehicles are becoming increasingly practical in terms of their range, availability, cost and specification. Provision for these vehicles in terms of **charging infrastructure** is increasingly common at airports for convenience for customers and to **support the low carbon travel**.

Theme 2: Air-Rail Links

Easy access to a fast-frequent rail link to the local city centre is **an attractive alternative** to road-based transport to / from airports. Often faster services compete with cheaper slower rail or bus services so Air-Rail services need to be frequent, fast, high quality and well promoted.

Theme 3: Active Travel (Walking & cycling)

To encourage cycling to the airport, particularly **for airport employees**, good supporting facilities and incentives are required. This includes good connectivity to cycle routes in the wider area, on-site facilities such as secure parking and showers, and incentives such as promotions and events.

Theme 4: Car Pooling and Car sharing

Car pooling and car sharing **offer alternatives to taxi, hire car and single occupancy car trips**. Car sharing can be more economical than taxi or traditional car hire, depending on the timescale of use. The shared cars themselves are often low emission models, including electric options. Car pooling is particularly useful to reduce single occupancy commute trips.

Theme 5: Intelligent Transport Systems

Worldwide, 63 percent of the population is estimated to have a **smart phone and applications**. Apps are now a key method of accessing information on travel. Traditionally, airport apps have focused on parking and air-side information; however, modern best practice examples provide detailed information for passengers on landside transport options. Apps can also assist airport staff to provide high quality customer services to passengers by providing travel information, particularly at times of disruption.

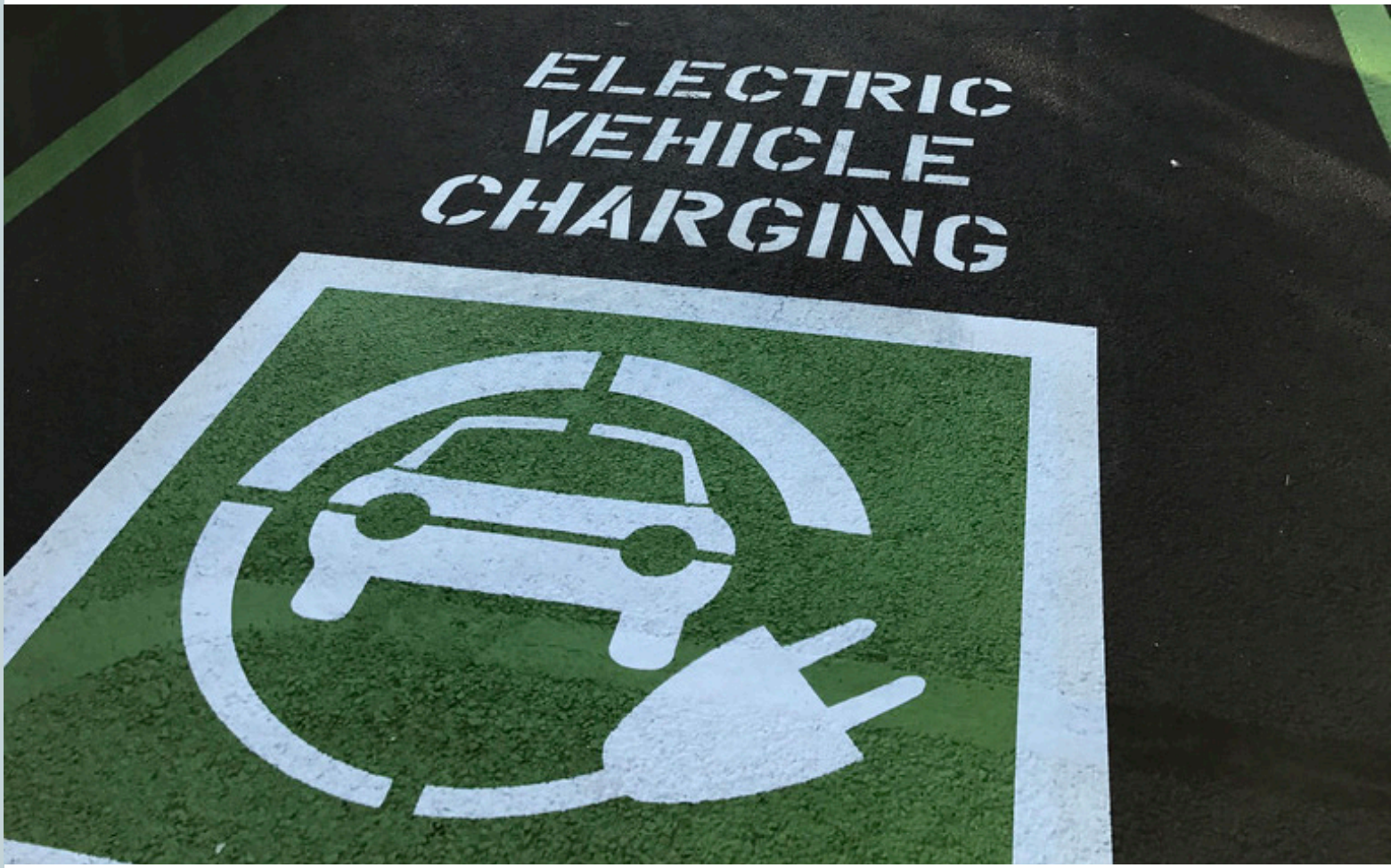
Theme 6: Wayfinding

Airport terminals are complex buildings, often on multiple layers. Airport with multiple options for landside travel can have the associated issue of providing information in a way which is **intuitive to an international and transient audience**. Clear wayfinding to onward transport connections is vital to ensure that these options are as easy to use as possible.

Theme 7: Road Based Public Transport

Bus and coach services often provide opportunities for low cost, convenient links to a wider range of destinations than rail services may provide. **Special airport coaches**, other coach operators and **local bus services** can provide excellent levels of accessibility. Local bus services also provide an important option for airport staff. Ensuring attractive and easy to use ticketing options and information is important for both passengers and staff.

Introduction to sustainable transport mobility systems



Theme 1: Electric Vehicles

Background

There are immediate opportunities within the automotive sector to transition to alternatively fueled vehicles (AFVs) in order **to decarbonize the sector and reduce the environmental impact**. A key option identified by the transport sector and policy makers is transport electrification.

Electric vehicles are **powered in part or in full by an electric battery** that is charged by dedicated charging infrastructure from the major electricity supply. The term electric vehicles encompass a range of vehicles including, pure electric vehicles (PEV), plug-in hybrid electric vehicles (PHEV) and extended-range electric vehicles (E-REV).

There are benefits of efficiency of electric drivetrain compared to the internal combustion engine (ICE), as well as further benefits of energy security by **diversifying the transport sectors energy sources**. However, there are challenges in transitioning to electric vehicles due to extensive sunk technological costs in ICE engines and entrenched behaviours and cultures surrounding the automobile.

In order to overcome these challenges and increase the take up of EVs, many countries have introduced grants and incentives for purchasing electric vehicles and installing charging infrastructure.

Electric Vehicles and Airports

Airport access and exit by car for customers and staff, be it as a driver parking at the airport or pick up/drop off by family member, friend or taxi, is a key mode of travel for airport accessibility. In many cases the **car is the most convenient option**, particularly for those travelling from locations not directly connected by public transport or at times when public transport may be less frequent.

The continued development and increasing availability of electric vehicles has allowed some airports to consider opportunities to use this technology to maintain the flexibility of car and taxi travel but with a **lower level of CO_2, NOx** and particulate emissions than those associated with traditional fuelled vehicles.

Equally there are financial advantages for the adoption of EVs due to the low operating costs and consequently competitive total cost of ownership. This is particularly important for fleet procurement to assess the direct and indirect costs and create benchmarks for vehicle replacement.

Specification of the airports involved in the project

The project did not include a detailed study or questionnaire survey on the use of EVs and their share regarding ICE vehicles. However, research has shown that a significant proportion of airport passengers and employees are accessing or leaving the airport by car. Figure 6. shows that **40-80% of the passengers** of the airports participating in the project use a car to approach the airports (car, car sharing, taxi, rent-a-car, call-a-car). In case of **employees**, the proportion of people using the vehicles is even higher, between **53-92%**.

Studies show that private car use is still the most common way among the passengers to reach airports. Research suggests that journey time and cost, journey distance and ease of baggage handling are key factors in travel mode choice. Passengers favour the use of private cars because of the perceived **comfort, availability, flexibility, reliability, low marginal costs**, ease of transporting heavy luggage and the short **door-to-door journey** time they provide.

Since there is a high proportion of ICE in almost all airports, it is absolutely necessary to increase the proportion of EVs within the used vehicle target, which directly contributes to the reduction of CO_2 emissions (on the condition that electricity comes from renewable energy sources).

It can be seen that **employee preferences** in traveling to the workplace clearly favour the car at the moment. The demand for mobility of employees is very different from the one of the passengers for different reasons:

- Trips are done on a regular (daily) basis
- Trips are done all day (day and night) and the offered transport services should be flexible, frequent and available, cheap, and tailored to the need of employees. In contrast, passengers heading to (or leaving) the airport are just connected with a one-off flight.

In addition to the objective factor that determine the mobility choices of the airport employees, there are many other elements that are subjective and cannot really be quantified or ranked. These could relate to **habit or preferences**, inside perception or just mobility culture.

Analysis of data shows, for example that distance of the airport from the city centre is not per-se a determinant factor for mobility choice: Dubrovnik and Budapest city centres are both located ca. 20 km away from their airports, but the employees' modal transport choice is completely different. Dubrovnik employees are only car users. Availability of direct connections is not per-se a decisive factor: Poznan employees could take advantage of the direct 20 minute bus connection, but only 34% do. Over 40% of Budapest employees use public transport in spite of the lack of (regular) direct connections.

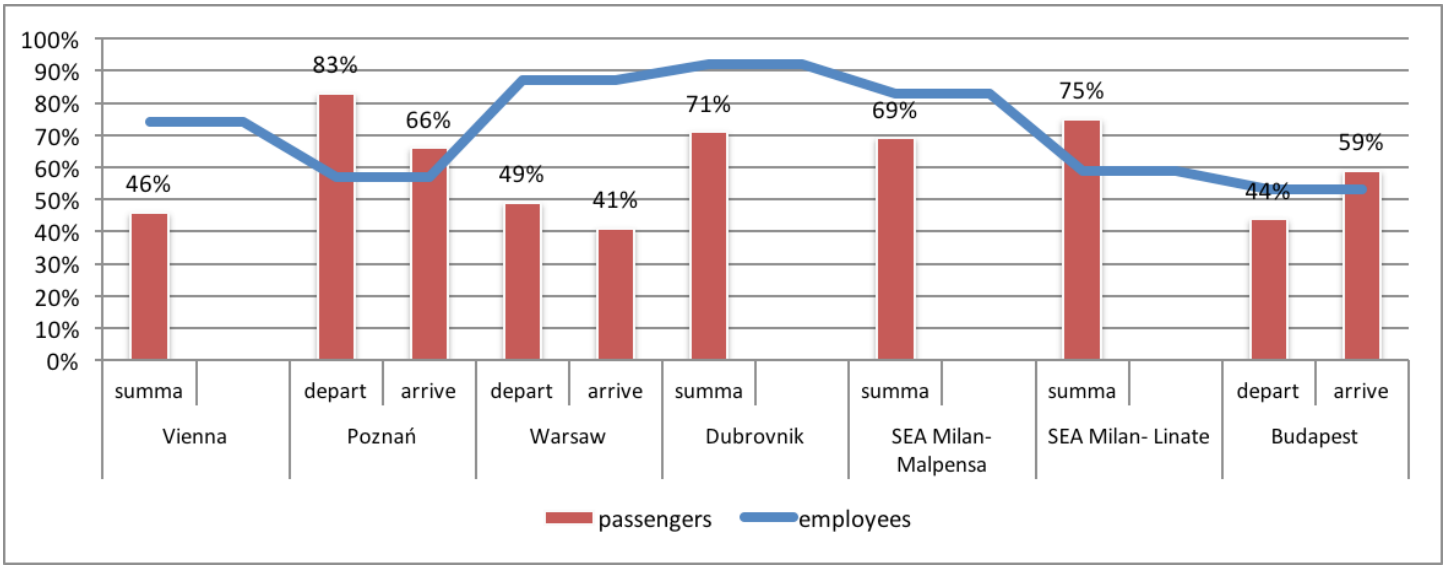


Figure 6. Use of private cars in the different airports by passengers and employees

Customer acceptance is a major driver in e-mobility development. If customers accept the new technology, and they consider electric vehicles to be similar or even better than other transportation options, they will move gradually to electric vehicles in their choices. Furthermore, the most relevant issues from the customer's point of view are the following: cost, lifetime, cruising range, access to charging infrastructure, environmental attitudes, safety, reliability and comfort.

Customers are mostly interested in the **purchase prices and operating costs**: although currently electric vehicle prices are higher than conventional ones, in the longer term, the price surplus could be offset by savings on operating costs. With the current price differences, customers need to use the EV extensively otherwise the payback period of the car investment increases over the acceptable timeframe (10 years). There are also uncertainties in the customer's mind about affordability, efficiency over the long term, durability and warranty, as well as the residual value of the used car. As such, it is hard to estimate the customer's final choice and the aspects that leads to these decisions.

Budapest Airport

At the end of 2015, two so called **electric quick chargers** were installed in the Car Parking Terminal (Terminal 2). These two electric fast chargers have been available for all passenger electric cars arriving to the airport. The modern DC or AC fast power chargers can charge two cars at the same time. The airport does not charge any additional costs for the electric current availability, only the parking fee. Moreover, more than a thousand vehicles (some of them already EV powered) are used at the airport. They are serving the aircraft technical management, towing passenger luggages, driving the passenger service staff and the airport authorities. All these airport vehicles are circulating in a traffic closed area with a radius of less than ten kilometers.

Dubrovnik Airport

EV charging stations are installed at nine locations in the Dubrovnik-Neretva County. 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.

Milan – Malpensa and Linate Airports

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 recharging stations** for E-Vai electric cars. The E-Vai electric car-sharing operator provides also services at Malpensa Airport. It has five parking slots at Terminal 1 and two charging stations.

Poznan – Ławica Airport

No data are available regarding EV airport diffusion. As far as other electric mobility aspects are concerned, thanks to cooperation with Blinkee, the City of Poznan offers electric scooters, which can be rented per minute using a mobile application.

Stuttgart Airport

More and more diesel vehicles are replaced by electric vehicles at the airport. Since the year 2018 **airport passengers and luggage are transported by electric vehicles**. Therefore, local emissions are significantly reduced at the airport and less noise is caused. All these have positive impact on the environment and employees working conditions.

From 2015 to 2017, Stuttgart Airport tested alternative energy storage capacities beside the established lead acid batteries. Therefore, the airport extended the fleet with **a lithium ion baggage tug**. It was investigated if there are differences in durability and charging time. Additionally, a guideline has been developed to facilitate the conversion to electro mobility.

By 2020, Stuttgart Airport wants to reduce CO_2 emissions from the handling plant by 80% compared to 2009. To achieve this goal, the airport's existing e-fleet will be expanded by 40 additional units within three years (scale-up project). A first phase of the project started in 2013 with only six electric vehicles (Erfleet project).

Vienna Airport

By the date of this report, **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.

Best practices

Vancouver

Vancouver Airport currently has 19 accessible electric vehicle charging bays for public, employee and fleet use. The first electric vehicle charging points were introduced in 2013. The parking incurs a fee; however, **the electric vehicle charging is free**. Within the multi-story car park, if the space is used for more than four hours, drivers must inform the cashier upon exiting that they parked in the multi-story to access an electrical charging station.

The airport also runs a **Taxi Incentive Programme** which allows discounted license fees to taxi drivers who operate fuel efficient vehicles. The Taxi Incentive Programme was launched in 2004.

Objectives and actions

Vancouver Airport has a Master Plan which is a 20-year strategy which aims to support sustainable growth of the airport, and an Environmental Management Plan which sets targets for 2020. The airport produces an annual sustainability report.

Introduction and expansion of electric vehicle charging forms part of the approach to improving ground access and reducing emissions.

Impacts and challenges

In 2016, Vancouver Airport recorded 1.836 charges from their public and employee charging stations, an increase of 79 per cent over 2015.
Ensuring that the correct mix of charging infrastructure is provided is a challenge and balancing this with parking demands from traditionally fuelled vehicles.

Recommendations

- Provide adequate mix of charging types for different parking needs.
- Provide Taxi Incentive Programme to encourage low emission taxis.
- Provide attractive incentives for public landside access by EVs vs traditional fueled vehicles e.g. paid parking but free charging.

Summary

The EU and national policies and strategies are clearly stating that transport has to use less and cleaner energy, better exploit a modern infrastructure and reduce its negative impact on the environment and key natural assets like water, land and ecosystems, **by reducing the use of petrol and diesel cars** in cities by half by 2030, phasing them out completely by 2050 and achieve CO_2-free city mobility by 2030.

Therefore, new transport patterns must emerge, according to which larger volumes of freight and greater numbers of travellers are carried jointly to their destination by the most efficient modes. Individual transport is preferably used for the final miles of the journey and performed with clean vehicles. Information technology provides for simpler and more reliable transfers. All these point to the **need of using electric/clean vehicles**.

The rise of electric cars in the following period will be a trend that every market player has to adjust to. Market forecasts also predict that more and more EVs will be encountered on the roads. All these processes will be reinforced by regulatory changes and even more stringent environmental standards than ever before.

In parallel, the annual passenger traffic of airports is growing steadily, **and the most popular approach to airports is still the car**. As a result, it is particularly important for the airports to adopt the challenges from e-mobility. The airports need to respond to the increased demand for services soon, and they need to develop a strategy that goes beyond charging needs. Airports have to realize that they are in an exceptional position where they can experiment with solutions to e-mobility.

E-mobility development has two different approaches: the **internal-driven airport development** and the **external-driven customer related developments**. It is recommended that airports gradually replace their own fleet with EVs, or as a temporary alternative, with other alternative fuelled vehicles. On the other hand, **they must provide the charging infrastructure**, so that customers can use electric cars during their journey. It is also important that charging services should be adapted to the needs of users. During all these processes, airports should be in close cooperation with their partners, and measure the customers' attitudes in each phase of the process.

Since there is a high proportion of ICE in almost all airports, it is absolutely necessary to increase the proportion of EVs within the used vehicle target, which **directly contributes to the reduction of CO_2 emissions**.

Questions and tasks

- In your opinion, which factors contribute to the fact that most airport passengers and employees are using car travel?
- Compare the car usage ratio of employees and passengers in Figure 6 (page 11).
- What general tendencies do you see?
- What can be explained by the fact that in many cases airport employees are using cars at a higher rate than passengers to travel to/from the airport?
- Visit the Vienna Airport website to check where and how it is possible to charge an electric car (*https://www.viennaairport.com/en/passengers/arrival__parking/parking_services*).
- Fast EV power chargers are used in many airports. Why is it important?
- Could you define the Taxi Incentive Programme in Vancouver? What are the benefits of this programme for the airport?

Theme 2: Air-Rail links

Background

In 2016, rail had a 7.7% mode share of trips across the EU. Mode share ranged by country from 12.1% in Austria to 1% in Lithuania and Greece. Rail services generally **provide fast connections** (particularly at peak time, especially when passengers are affected by road-based congestion), over long distances to key destinations.

Slower, basic commuter services complement longer distance express services which often have a wider range of facilities on board such as Wi-Fi, dining, and at seat entertainment. In some cases, express rail services compete for comparable short distance with air travel, with rail often having an advantage of taking customers to a city centre location near their ultimate destination.

Air-Rail link and Airports

Where available, rail links provide the opportunity for fast, efficient and attractive links to key destinations such as city centre sites. Research shows how introduction of direct air-rail services can dramatically impact mode share away from the private car. At a European level, rail mode share for access to airports does not appear to be publicly available though research indicates an average rail mode share of around 16%. Oslo Airport has been able to achieve an overall public transport share of 68%, the highest in all Europe, 70% of which is attributed to the “Flytoget” air-rail link. Many airports have **direct air-rail links**, with the rail station either being constructed within the terminal building, within short travel distance of the main terminal building or within a short bus journey way. Rail connections (both in terms of the rail station and rail services) that are of good quality, **provide an attractive potential to road-based alternatives**, particularly at congested times on the road network. Airports may rely on standard rail services, either serving the local commuter market, national or international services serving a much wider catchment and/or dedicated express services.

Specification of the airports involved in the project

The project did not include a detailed study or questionnaire survey on the sharing of public rail transport regarding the use of passengers and airport employees. Based on the given data the following graph (figure 7) could be compiled. It can be seen, that the use of public transport preferences of the employees are different from those of the passengers. Some airport FUAs have developed advanced multimodal air-rail accessibility (Vienna, Warsaw, etc.) which are basically used by passengers.

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.
It takes 22-25 minutes from the downtown to reach the Ferihegy railway stop. The Ferihegy railway stop is about 12 minutes away from the Terminal 2 by bus 200E (Figure 8.), or six kilometers by taxi. As a result of the abundance of trains 4-6 trains stop at Ferihegy every hour in each direction.

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. Works for the extension of the railway to reach the airport are ongoing and could substantially improve the already good landside mobility performance of Budapest.

Figure 8. The railway link of Ferihegy train stop and the connecting bus line 200E to Budapest Airport

The consideration for Budapest is to decide if a new train line between the airport and the city centre or an extension from the existing train lines connecting the airport terminals and the national rail networks needs to be built. In the first case the airport needs to have enough passenger traffic to sustain a dedicated airport rail line or a regular financial support from the state to sustain such line. An extension from national rail network has the benefit of integration with other rail lines which would enhance the general accessibility of the airport FUA. This also seems more financially feasible.

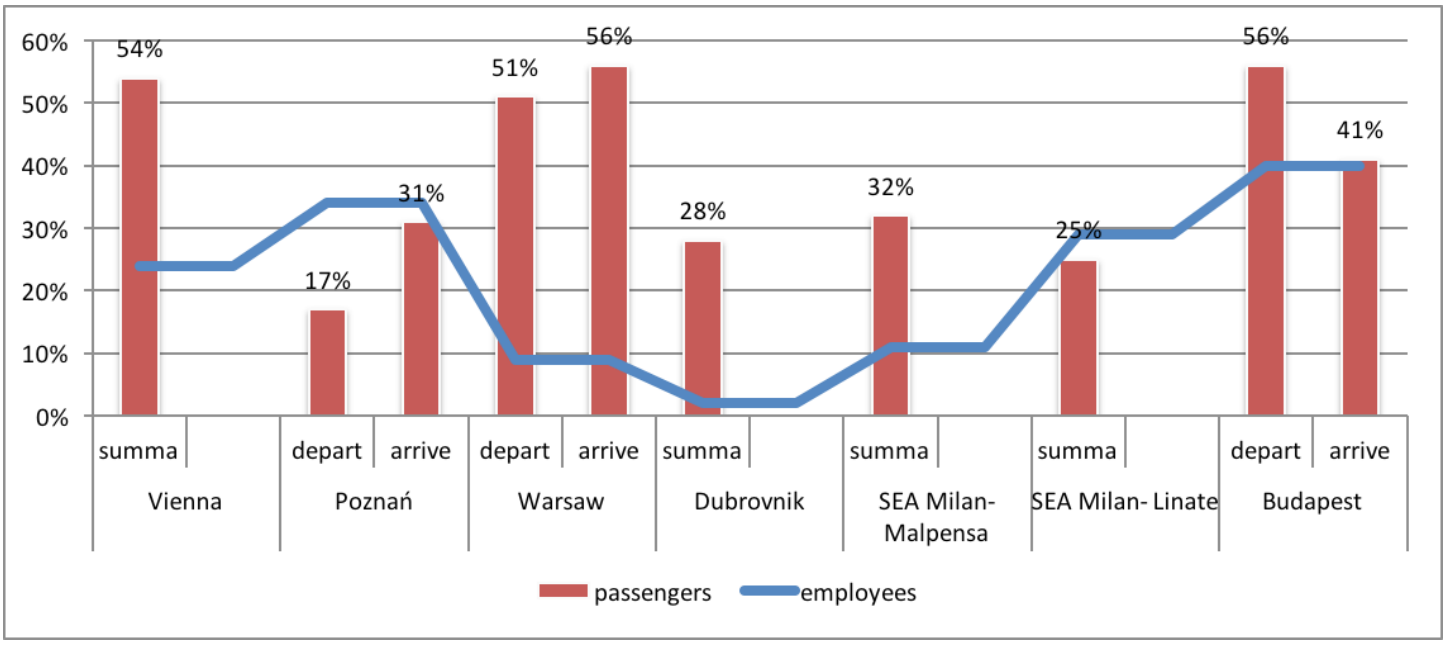


Figure 7. Share of public transport users among passengers and employees

Dubrovnik Airport

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

Mazovia - 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 (ca. six kilometers from the airport). The regional train operator, Koleje Mazowieckie (KM), 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. This train station is used by passengers arriving at/departing from the airport using rail transport.

Time of travel by train is so far not competitive for employees in comparison with the car. About 30% of employees surveyed reported they would be convinced to stop commuting to the airport by car if there was a train station at the airport.
Most of the passengers decided not to travel by train mainly due to the low comfort of travel (34%). Passengers assessed in the most negative manner the availability and frequency of trains.

In terms of shaping the strategic railway system, a plan envisages the construction of a Modlin-Płock railway line which would provide a quick connection from the regional centre of Płock to Warsaw and from the northwestern part of the region to the Mazovia - Warsaw/Modlin Airport. At first stage, the expansion of a railway link from the Modlin railway station to the Airport and the construction of a train/bus station at the airport are being prepared. In the second phase of the project it is expected to extend the railway connection to Płock.

Milan – Malpensa and Linate Airport

Linate Airport does not have a rail connection. Malpensa Airport has connections without changes to the city of Milan and to Switzerland.

Among the airports investigated, Malpensa Terminal 2 is one of those that offers (almost) exclusively low-cost companies. The Malpensa Terminal 2 it is not very close, though well connected by train and by airline transfers and coaches to Milan and the neighboring cities. The thoroughly informative and detailed dedicated page lists all possible options and makes it very easy to reach the destination effortlessly, without own car. However, the use of private car, as driver or passenger, is still prevailing, with percentages that largely exceed 50%.

The Malpensa Express service runs from Milano Centrale and Milano Cadorna railway stations to Malpensa Airport. There is an additional train, same direction and same cost. Connections to Switzerland are operated by the rail company TILO, which provides the S40 service from Canton Ticino to Malpensa Airport.

SEA Milan has forecasted the doubling of the demand for public transport (coach, bus, plus rail for Malpensa) by 2030, and a consequent decrease in the use of own cars and third-party cars and slight decrease in car-sharing and car-rental.

Poznan – Ławica Airport

At present, the Ławica Airport is **not connected to public railway transport.** Conceptual work in this respect was commissioned by the Marshal Office in 2007 and by the Poznan City Hall in 2012.

A railway connection between the Ławica Airport and the Poznan 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 by car, which is the main reason for congestion of the city's transport routes.

About 62% of employees surveyed said that if a rail link was built from Poznan city centre to the airport, they would be open to using it to commute.
The Poznan Metropolitan Railway would provide high-frequency connections to further afield areas of the region which currently have poor public transport options to the airport.

The plan is a strategic document that outlines the soundness of construction of the Poznan Metropolitan Railway especially connecting the airport with the Central Station. In addition, the plan determines as a priority the improvement of quality of passenger transfers through a consolidation of stops aimed at reducing waste of time for changing the means of transport.

Stuttgart Airport

The airport is **connected via railway from the city centre of Stuttgart to the airport**. Due to rush hour traffic, it is faster to take public transport to the Stuttgart Airport, which takes 27 minutes from the city centre to the 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.

One of the aims of S21 is the improvement of long distance and regional traffic to the airport. The project consists of building a new underground train station at Stuttgart Airport. It is located on the opposite of the main building of the airport and is close to the already existing terminal station. Most important is, that the departure hall of the airport can be reached in a few steps.

Also, there is a new "Stuttgart-Wendlingen" line planned to connect the main station via the airport with Ulm. It will only take 30 minutes from Ulm to the Stuttgart Airport instead of taking 1h35min and it will only take eight minutes from the city centre to the Stuttgart Airport instead of 27 minutes. Therefore, the new line will significantly increase the landside airport accessibility from FUA Stuttgart in the future.

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.

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.

Public transport and especially the low emission transport are big part of the LAirA project, furthermore it was interesting to analyse those passengers accessing the Vienna Airport by train in detail. The three most chosen transport modes for accessing the Vienna Airport were analysed per country (EU 28 states). What is remarkable is that the "suburban train" is under the top three in each country and in the majority of the countries the mode is mentioned by more than 20%. Also, the "CAT" is mentioned quite often.

A quite high percentage of passengers (15%-30%) from four countries (including other EU 28 states) indicated the "CAT" as one of the top three chosen transport modes for accessing the airport.

Comparing the choice of transport mode in relation to the distance travelling to the airport, there are differences to be recognized. What is significant, is that passengers accessing the airport from destinations less than 25 km away, the largest share in transport mode usage makes the "train" with 52% (nonetheless more than 30% travelling by cars or taxis).

Certain airport employees are able to use the CAT for free for travels to and from work.

Another train connection between Vienna and the airport is serviced by the suburban train line S7, a so-called "S-Bahn". The S7 enables interchanges with various underground stations in Vienna as well as busses and other suburban train lines. The ÖBB operates long-distance trains. With these long-distance connections the airport hqs enhanced its importance as an Eastern-European hub.

According to the newest data from passenger surveys at the airport of Vienna, 44,60 % were travelling to the airport by railway in the second calendar quarter of 2017. In comparison to that, 18,4 % of employees used the train for commuting to and from the Airport of Vienna in 2013.

Best practice

Oslo Airport

The air-rail link consists in a high-speed railway (maximum speed: 210 km/h) connecting the airport southwards with the Oslo Central Station through the "Flytoget" service. The link is integrated in the national railway network so that also long-distance direct services to other Norwegian cities are operated from the airport.

The “Flytoget” service covers the almost 50 km distance between Oslo Central Station and airport in only 19 minutes, with a frequency of one train every ten minutes. The service continues beyond Oslo Central Station and serves nine further stops within Greater Oslo and takes up to 60 minutes.

Impacts

Oslo Airport has been able to achieve a public transport share of 68%, the highest in all Europe, 70% of which thanks to the contribution of the “Flytoget” air-rail link.
The objective was to endure that 50% of travel to and from Oslo Airport would be made by public transport and that trains would provide the most important mode. Both targets have been achieved a long time ago and the current Local Plan for Oslo Airport set an even more ambitious public transport target for travelling to and from the airport at 75%, to be reached by 2020.

Challenges

The main challenge encountered was the extensive leakage during the construction of the Romeriksporten tunnel, which caused the works to be delayed and additional costs amounting to 1.3 billion NOK. In general, during the construction of new ambitious infrastructure projects it is not unlikely that unforeseen events occur, which can make construction time and costs increase. In 2002 a government commission made it clear that the new line could not be run at a commercial profit as foreseen in 1992: the infrastructure was therefore transferred to the National Rail Administration and the Flytoget AS was set up as a separate public corporation under the auspices of the Norwegian Ministry of Transport and Communication.

Summary

Airport rail link projects, whether it is **a new connection or a modernisation project**, involve many stakeholders and are capital heavy. Building strong and sustainable relations with the many stakeholders is key in ensuring the success of the project. LAirA project partners highlight the **political and local support** as one of the main challenges in delivering airport rail link projects. The political support can be strengthened if the local community is behind the project and is actively advocating for it. A dedicated airport-city centre rail link might not appeal to local communities as it will bypass their settlements, but it could help ease the road congestion in the area and reduce emissions from cars. A clear, open and reliable communication strategy is recommended to engage the stakeholders from the very start of the project development to secure their support.

One of the key barriers for airport rail link development is the lack of global best practice studies available for airports and airport regions to support their own projects. Beyond that, the data available might not be comparable as there is no global standard for airports to analyse public/private transport mode share changes and how different infrastructure projects affect passenger behaviour.

However, the overall trend is to consider rail connection as an environmentally friendly, reliable, frequent, fast and affordable public transport option for a growing airport. All LAirA project partners agree that an airport rail link connection will help reduce road congestion, increase airport catchment area, provide an alternative transportation mode for local communities and support airport growth.

Despite the listed benefits, it can be seen that the use of public transport (bus, railway, metro) is not yet loved by passengers and employees. At the same time, it would be important for the public transport to **play a greater role in order to reduce CO_2 emissions.**

Questions and tasks

- What is the biggest advantage of the railway in reaching the airport compared to other means of transport?
- Which of the analysed airports is not accessible by rail?
- Which is the airport that has a direct railway from the city centre?
- Check out the Stuttgart Airport website to find out what the BahnCard and BahnBonus represent? *https://www.flughafen-stuttgart.de/an-abreise-und-parken/anreise-mit-bus-und-bahn/*
- The public transport share is 68% in Oslo. What are the reasons for this result?

Theme 3. Walking and cycling (active travel)

Background

Physical activity is an important part of a **healthy lifestyle**. Insufficient physical exercise is the second biggest health risk factor after tobacco and 30% of Europeans do not practice a regular and proper activity in their daily life. Soft mobility can help people **reduce stress** and their risk for chronic diseases, such as heart disease, diabetes, and some cancers, just with 30 minutes of activity five times a week.

Walking and cycling (active travel) and airports

Private vehicles play an important role in landside accessibility, with all its related negative externalities in terms of congestion, pollution, noise. Apart from sustainable alternatives, as public transport, rail or sharing mobility, some airports, thanks to their layouts and locations, can reduce transport impacts by **cycling or walking** alternative modes.

These **soft mobility solutions** are generally addressed with reference to mobility management of employees. Where it is possible, these slow modes of transport need to be encouraged by the airports and territorial interventions and plans, to produce benefits for both employees and passengers.

Reasons for addressing soft mobility management and intervention are:

- optimization of parking spaces,
- reduction of budget allocated for renting and maintenance of parking spaces,
- improving employee wellness and travel experience,
- rationalize the use of private vehicles,
- contribute to solve environmental issues.

The project did not include a detailed study or questionnaire survey on the use of Walking & cycling regarding the share of employees. The available employee data in figure 9. reflects the share of the airport employees in the different FUAs. Based on the available data it is clear, that in general the average Active travel share does not exceed more than 2 percent per FUAs. With the exception of Milan and Poznan FUAs, where employees use bicycles at a higher rate.

Budapest Airport

There is **little pedestrian and proper cycling infrastructure**, creating a perception that cycling to the airport is unsafe.

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. This has lead to the planning of a gradually evolving bike road system in all FUAs in the near future.

Most respondents do not regard walking and cycling as suitable alternatives, either due to the distance or lack of infrastructure and dressing rooms at the airport, deficit of safe bike parking places was mentioned such as the lack of information about the potential bike routes. It was several times highlighted, that it is almost impossible to access the Terminal 2 on foot or by bike. In fact, around 24% of employees commute within ten km to the airport. This presents an opportunity for fostering soft mobility if suitable cycling infrastructure and facilities were created.

Dubrovnik Airport

The terrain around the airport is not flat, making cycling challenging. There is also a lack of safe cycling infrastructure, such as cycle paths parallel to roads.

Mazovia – Warsaw/ Modlin Airport

A large proportion of surveyed employees live close to the airport, representing an opportunity for fostering soft mobility. 32% of employees commute within ten km to the airport.

There are **almost no proper infrastructure/cycling paths available** for cyclists along ways from key locations of the FUA. There are new bicycle stands at the airport and bicycle path to Nowy Dwór Mazowiecki (the city where the airport is located) and there is a lack of convenient paths in other directions.

Milan – Malpensa and Linate Airport

Linate Airport is seven km from Milan city centre and the Municipality of Milan is an important area for trip origins; this is an opportunity to foster soft mobility (in particular cycling). Employee campaigns and discounts (such as discounted bicycles or equipment) could encourage mode shift from car to cycling.

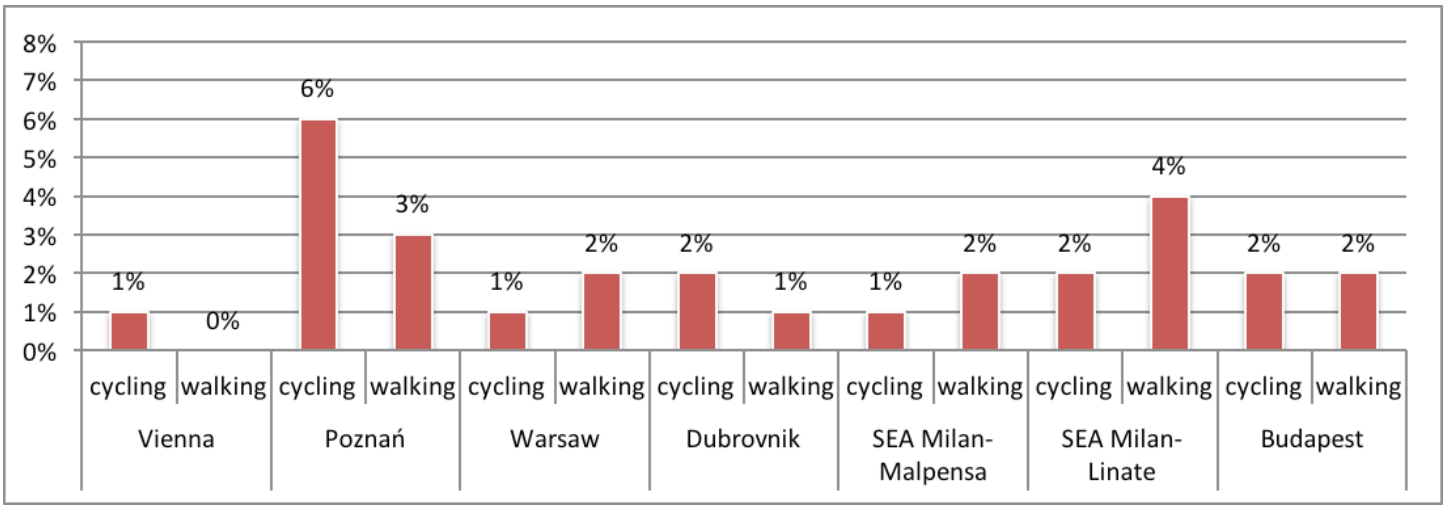
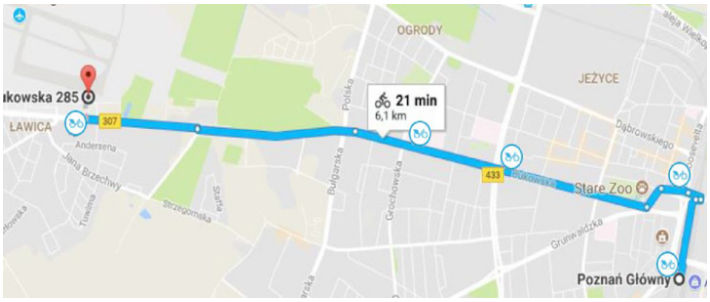


Figure 9. Share of Walking and cycling (Active travel) by employees in the analysed airports

Poznan - Ławica Airport

Ławica Airport is accessible also for cyclists. Around the railway station there is bicycle infrastructure enabling people to get around using bicycles. The city centre 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 favourable, the travel time is about 21 minutes, and this is an opportunity to foster soft mobility including bicycle.

There is a **lack of segregated safe cycling infrastructure** leading to the airport, putting commuters off from cycling even if they live less than five km from the airport. A large proportion of employees surveyed live close to the airport. 21% live within five km, a total of 56% live within ten km.



This adds to the viability of bicycle and public transport as commuting options. Only 15% of employees surveyed have used the Poznan City Bike bike-share scheme. A bicycle can be rented using a mobile application and a bicycle can be used free of charge for up to 20 minites.

Vienna Airport

Also, the local plan Transport Concept Schwechat 2030 aims to achieve a shift from motorized individual transport to transport modes that are more sustainable such as **walking, biking and public transport**. 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.

Only some of the investigated airports have focused on the employees' demand for cycling to work. A major example that is worth mentioning is the Radroute of the airport of Vienna Schwechat that connects the airport to the surrounding region and other primary and secondary routes in the region, where over 20.000 employees work, allowing them to opt for bicycle as an alternative for the car, if they wish so.

A big achievement was the implementation of t**he 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. Airport employees suggested safe cycling routes would increase the viability to commute using a bicycle. Employees also suggested an electric bicycle sharing scheme could be successful.

Best practices

Vancouver (Canada)

The airport is located on Sea Island which has a network of cycling routes mostly comprised of on-street bicycle lanes and paved shoulders. The airport has its own **cycling map** and the airport's website provides links to local and regional cycling information. Bicycles are allowed on Canada Line trains and most TransLink buses are outfitted with front-mounted bicycle racks. Public and employee cycle parking are provided at the airport. Vancouver Airport sponsored two one-day cycling commuter station events and organized a cycling tour to promote Bike to Work Week. In September 2017, the airport launched its Fleet Bicycle Programme, which provides six common-use bikes for all Airport Authority employees to use for business trips.

Geneva (Switzerland)

Located four km far from the city centre, **Geneva Airport is at the centre of a cycle and pedestrian network**. In order to promote active travel, Geneva Airport was developed in such a way so that the majority of services are accessible by foot (restaurants, post office, etc.).

Good **bicycle-friendly paths**, mostly dedicated, enable fast, flexible and safe travel by bike in the local area.

Many bicycle parking facilities are installed near the main entrances of the airport.

- The airport fosters active travel for longer and steeper journeys by providing recharging points for e-bikes.
- The airport also provides discounts for staff for bicycle and e-bikes sale and repair.
- The airport undertakes awareness activity including "Bike to Work" and an awards system for staff who cycle.

Summary

Higher share of **soft mobility modes** in the modal split has a clear limitation, but also a great potential too within certain framework conditions. At transnational level it is challenging to generalize, as each airport, every location has its specificities. However, in general walking, cycling and other **human-powered transport modes have their limitations**, that can determine the set of possible solutions too.

Walking and cycling have an optimal range in daily commuting deriving from the average speed. Depending on the lifestyle, attitude of an employee, the range of walking is up to 2-3 km, but in extreme cases it might reach the five km. Residential areas are rarely located in the close vicinity of airports, therefore the pedestrian infrastructure even if cannot be neglected, it has limited impact on the increase of sustainable mobility modes.

Cycling is a swifter mode of soft mobility, this way it has a larger range. Especially in denser urban environment, cycling is very competitive with individual motorized transport and this can replace the under five km long, unnecessary urban short trips by car. Beyond the five km range, cycling has a typical range of 0-25 km range for commuting depending on the individuals and the type of bike they use. With the spreading of pedelec and e-bikes, this range is closer to the 25 km or sometimes it may exceed that.

It would be important for the airports **to support the construction of cycling infrastructure for sustainability reasons**, motivating those employees who live nearby to use their bicycles. Therefore, the share of soft mobility could be increased among employees, although this would not be an alternative for passengers.

Questions and Tasks

- How many active travel options have the airports analysed?
- Why has soft mobility not yet been taken seriously into account for accessing airports?
- Who can be most affected by active travel issues?
- What is the maximum distance for commuting to the airport in terms of cycling?
- What changes are the most important to make more people interested in using soft mobility?
- What does the airport provide to the active travellers in Geneva?
- Find the Nextbike programme at the Vienna Airport website and briefly describe the service.

Theme 4. Car Pooling and Car sharing

Background

Car sharing (where a vehicle can be used on a **pay-as-you-go basis**) or car pooling (where an individual may **share their own vehicle with others** to make a specific journey) can be effective ways of reducing carbon emissions for landside access.

Car sharing is increasingly common in cities across the world, with a number of providers often operating in the same city. Methods of operation include fixed bays, where users can access a vehicle at a designated location but must return it to a specific car share bay elsewhere; and free-floating schemes, where the car can be left anywhere within a designated geographical location. Increasingly, car share operators provide a range of vehicle types for different purposes. Lower emission vehicles are the norm, and electric vehicles now a common option.

Car pooling arrangements are common measures within employer strategies to manage travel demand. Effective car pooling programmes can reduce pressure on limited car parking resources, reduce carbon emissions from commuting journeys, and reduce the cost of commuting for car pool groups. An additional benefit can be to improve access for those who do not have access to transport, when someone local is able to provide a lift.

Car Pooling/Car Sharing and Airports

Car share services complement more traditional car rental companies and taxis by providing a **cost effective and convenient option** for those who require access to a vehicle for more than one single journey (where a taxi may be most convenient) but do not require long term car hire.

Car pooling within an airport context can be challenging due to a range of staff work shift patterns, which may limit the potential for matching with other staff. However, car sharing can also support access for those working shifts where alternative transport options are not available e.g. nightshifts or where public transport provision is poor. Car pooling services now increasingly offer more dynamic matching options for more ad-hoc journeys.

Specificity of the airports involved in the project

Based on Figure 10. the car sharing system is not very popular among passengers and employees at the investigated airports. The main reasons could be from the passengers' side the different destinations, and from the employees that they start the workdays at different times. On the chart the car sharing usage is less than 10% at all airports.

In fact, about 44% of surveyed airport employees have flexible working hours, 30% are shift workers. This is a challenge to develop car-pool schemes, unless they are based on dynamic systems.

Based on employees' suggestions, a car sharing service would be popular in airport FUAs. About 34% of the surveyed employees said they would use a car sharing service, and a further 42% said they might use it.

Budapest Airport

FUA Budapest has also multiple car sharing options, however none of them are operating 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.

Above 25% of the surveyed employees stop on their way to the airport; 50% of employees have a variable time in ending work and approximately 30% in starting work; this makes in **principle a car pooling system more complex**, unless a dynamic system is set-up.

The surveyed employees identified shared taxi services and car-sharing as a viable alternative if suitable services were available. A more detailed analysis of car-pool opportunities could be delivered, taking into account that time is a critical success factor in employees' travel mode choice and that affording car use was a critical element.

Dubrovnik Airport

No data are available regarding car sharing services. Rent-a-car service is used by passengers not only because it is the simplest form of transportation, but also because of the savings in travel time, financial viability and distance. A rent-a-car service would increase the shared mobility services.

Milan – Malpensa and Linate Airport

Four operators provide car-sharing services at Linate Airport. CAR2GO offers 20 parking slots, ENJOY – 14 parking slots; DRIVENOW - ten parking slots and E-Vai offers four electric parking slots. There are two recharging stations for E-Vai electric cars. The E-Vai electric car-sharing operator provides also services at Malpensa Airport. It has five 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.

About 95% of surveyed employees drove to Malpensa Airport and 91% of surveyed employees drove to Linate Airport commute alone. About 30% of surveyed employees travelling by car in peak hours have detours or stops along the journey, which is in principle not facilitating a car-pool scheme.

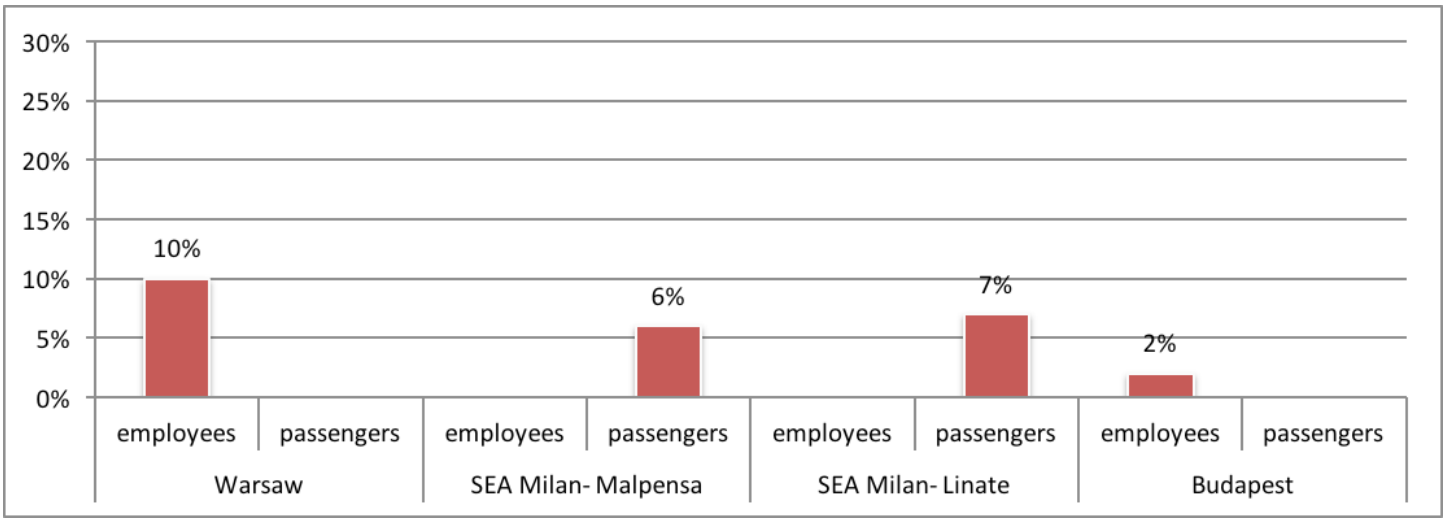


Figure 10. Car sharing use in the different airports by passengers and employees

About 42% of surveyed employees at Malpensa airport and 38% of surveyed employees at Linate airport expressed interest in joining a car-pooling service. This is a major opportunity, given that the airports host over 20.000 employees. The provision of an Emergency Ride Home option would be recommended to reduce anxiety from potential car pool members. SEA could introduce priority car parking spaces for those who car pool.

Poznan – Ławica Airport

The city of Poznan 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, offers a fleet of 150 cars.

Arriving at Ławica Airport 66% of the passengers use Uber/ Carpooling and 31% of the passenger use car sharing to the airport. Departing from Ławica Airport 61% of the passengers use Uber/Carpooling and 28% of the passenger use car sharing to the airport.

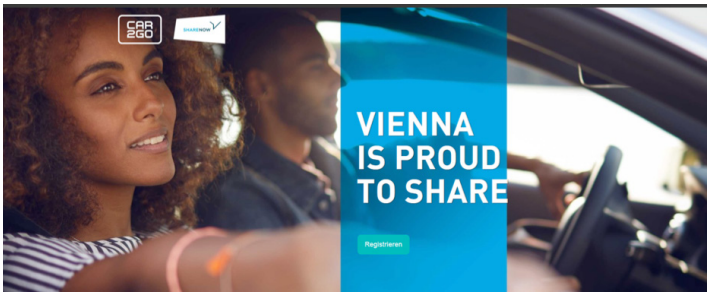
Stuttgart Airport

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. Stuttgart Airport has developed a self-organised ride-sharing platform for its employees on the intranet for pairing ride sharing.

Vienna Airport

Two different car-sharing companies serve Vienna International Airport, namely car2go and DriveNow. However, this offer is solely provided between the operating area of Vienna and the airport area. 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.

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 who have 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 Vienna Airport. An additional fee of €10 is required for parking a DriveNow car at the airport. 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 foreign passengers.

Vienna International Airport has also 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 with a 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. However, the network is not intended to be specifically used by passengers travelling to or from the airport.

Best practice

Brussels Airport has an objective of reducing dependence on fossil fuels, postponing depletion of oil reserves and greening its energy policy. Car sharing facilities are provided via **two providers**, DriveNow (Share Now) and Poppy, at Brussels Airport. Both schemes offer parking in a specifically designated area in the P1 Parking Fast Access area, which is easy to reach from the main termainl. Poppy has a fleet composed of electric VW Golf vehicles, as well as CNG-powerd Audi cars.

Both schemes operate as **free-floating car share schemes**, where users can end their journey at any location in the DriveNow or Poppy zone of operation in Brussels, as opposed to a requirement for a designated car share parking bay.

Impacts and challenges

In 2010, Brussels Airport set an ambitious target: to reduce its CO_2 emissions by 20% by 2020. By 2017, it had already reduced its emissions by 34%. Brussels Airport’s wider green mobility project is a key element in this process.

There is a challenge for car sharing when accommodating peaks in demand. This may result in car share vehicles being unavailable for potential users at the time they are needed. Modern car sharing schemes are effective at catering for demand and approaches to this are improving.

Critical success factors - Opportunities

- Availability of vehicles that meet users needs;
- Demand for use from passengers;
- Ease of booking and use;
- Location of car club vehicles at airport terminal;
- Availability of parking at destinations.

Recommendations

- Ensuring car share vehicles can meet the needs of airport passengers e.g. room for luggage, free-floating parking at the final destination;
- Ensure car share operator is able to provide a high-quality service, and able to meet the needs of passengers in terms of vehicle availability and type.
- Consider potential for inclusion of electric vehicles in the vehicle offer dependent on how advanced electric vehicle charging is within the airport's catchment area

Summary

Within the LAirA project, the topic of Shared Mobility covers the comprehensive use of vehicles and rides – both motorized and non-motorized. **Shared mobility** represents the highest profile of new airport mobility services that have proliferated in the past decade, thanks to increased connectivity. In the field of motorized private transport, commercial and privately organized car-sharing exist, which in fact predates the advent of connectivity, and is the most mature way of the shared airport mobility offerings. Car-sharing is organized and operated by e.g. a fleet manager or a car company (like MOL Limo in Hungary) or by associations that operate a platform for matching joint rides. As shared mobility and connectivity trends converge with the move toward zero-emission vehicles, a range of new commercial mobility options become possible. Commercial car sharing can either be organized free-floating or station based.

The above-mentioned car sharing options have the potential **to create carbon effective**, more diverse, and more individually tailored airport transportation services.

Today, various business models combine different elements, that includes car-sharing and hence, simplify its usage and generate higher acceptance by its users. The overall mobility market for car-sharing services is giving way to new growth potential in more and more airports.

Within the LAirA project, commercial car-sharing services (e.g. DriveNow, Car2Go) that serve the airport are subject to be used. Furthermore, peer-to-peer ride-sharing that is enabled through platforms are also subject to be used at airports. The objective of Sharing Mobility for LAirA airports is not only important in the field of education, but it also in supporting decision-makers to promote **low carbon mobility planning** for airports and their catchment areas.

Within this field, and especially addressing **CO_2 footprint reductions**, LAirA aims to improve sharing mobility to reduce the amount of single-person travelled motorized vehicle kilometers in the analyzed airports and their FUAs.

LAirA Sharing Mobility Action Plan delivers some specific key objectives listed below:

- Increase the share of employees and passengers using shared mobility offers
- Increase of travelled kilometres in vehicles occupied with less than one person
- Expand commercial car-sharing parking spaces at the airport when/where needed
- Engage employees for pairing up for commuting to/from the airport.

Questions and tasks

- What are the features of Shared mobility? List some of them.
- What do you think is the biggest obstacle to the airport implementation on this topic?
- What is the biggest difficulty for passengers?
- From your point of view, what could be the disadvantages of car sharing?
- Refer to the best car sharing solutions in different airports. Explain.
- What is Brussels Airport's ambitious target by 2020?
- Please find out from the website of Stuttgart Airport webpage the tools and initiatives of electric mobility (Fairport): *https://www.stuttgart-airport.com/?cl=en*

Theme 5. Intelligent Transport Systems (e.g. apps)

Background

In 2019 around 67% of the world population owns a mobile phone. People are relying **more and more on digital channels** when they need to gather information about a product. In addition, the spread of smartphones and other mobile devices is increasing the number of contacts between brands and consumers, by giving consumers **new opportunities to connect to media content** wherever they are, at any time of day. Some of these contacts take the form of paid advertising in third party content, but mobile technology is also enabling broader brand experiences, such as branded content and social media engagement. The development of good quality apps is therefore of crucial importance when it comes to conveying customers' real-time information. In addition to that, they also offer marketing and advertising opportunities.

Intelligent Transport Systems and Airports

Airport apps allow travellers to have real-time information about flights (gate, delays or cancellations), shopping opportunities, car parking and accessibility via public transport, car or taxi on their smart phone.

Specificity of the airports involved in the project

Budapest Airport

Budapest Airport has an official application for iOS and Android which provides passengers with practical information that ensures a pleasant visit to Budapest Liszt Ferenc International Airport.

Users can receive real-time flight information about flights arriving / departing within the last four hours and in the next 24 hours.

One arriving and three departing flights can be selected as favourites and every status change is notified by a push message. The application also contains **useful information about flying**, e.g. **luggage information**, help points for passengers with reduced mobility, **useful information on parking and shopping and special offers**. The application terminal also includes a map that makes airport navigation easy.

Milan – Malpensa and Linate Airport

The website of Milan Airport and App35 provides several information to passengers concerning flights, directions and parking, shopping and 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.

The app makes it easier for passengers travelling by car to find **road directions, parking service information** and the possibility **to book parking online**. This app service provides Google real-time traffic and report on road congestions. Bus, taxi and railway passengers can find bus services, operators, schedules, fares, etc. as well as up-dated taxi and railway information. This website application provides also **car-rental and car sharing functional options**.

Milan Airport is not only engaged in providing information to passengers but also in collecting feedback. In particular, during 2017, it 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, there is no other 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.

Mazovia - Warsaw/Modlin Airport

Warsaw/Modlin Airport does not have an app but taking into account numerous travel planning apps available in Warsaw FUA there is no need for such (some difficulties for airport users could result from the lack of a unified name for Warsaw/Modlin Airport in various travel planning applications). According to the results of the passengers' survey there is moderate interest in using a mobile application dedicated to the airport.

Poznan – Ławica Airport

The national transport development strategy determines in its directions the activity concerning airports in the intermodal transport and logistics department as: development of multimodal functions of airports and sea ports in the TEN-T network through their connection with road and railway transport.

One of the elementary tasks for an increase in competitiveness of Polish regions until 2020 will be a significant advance of the process of creation of high-quality transport connections with an intelligent outline of use of high-speed rail and air connections.

Expansion and modernization of main international airports in the TEN-T network and regional airports are also important. Regarding Ławica Airport, based on the new intelligent application, it is possible **to book a car in advance**, shown on the map. With the mobile application, the user can also find a scooter on a map, which is parked nearby and is able to reserve it.

Stuttgart Airport

In the FUA Stuttgart different intelligent public transport applications exist, such as the official Stuttgart Airport app, which give travellers accurate personal flight information. Passengers can receive **the very latest flight information** and regular status on flight updates on their smartphones. The apps provide them with all necessary data on arrivals and departures at a single glance, i.e. check-ins and other official contact details. The app is also a comfortable solution for flight search. "My Flights" helps to find immediately the passenger' flight-time and delays, the flight status, the terminal, gate and check in numbers. My Flights inform also the travellers on any other notifications about Stuttgart flight activities.

Vienna Airport

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. All aforementioned programmes/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.** As far as Vienna Airport apps are concerned, a modern application system developed by the airport serves all passengers at a high level. However, there are areas where further improvements are definitely needed, like the development of an interchange information system between public transport lines and the on-site airport shuttle. The already existing DRIVE2VIE integrated mobility information system may need further extension, since private and company mobility options are missing.

As far as the employees are concerned, a change of their attitudes is necessary, to convince them to change from car to public transport, but this process requires regular airport night transport opportunities.

Best practices

ITS – London Gatwick

London Gatwick's has a customer facing app and one for staff. The current Gatwick app was introduced in winter 2017/18 and most recently updated in summer 2018.
The **customer facing app** supports landside access in the following ways:

- Direct links to Google's journey planner.
- Links to public transport timetable information.
- Live train times.
- Airport announcements (these include updates about landside transport issues).

The **staff app** was developed by Airport Labs and provides a mechanism for all airport staff to be able to be kept up to date on airport issues, including any disruption to landside access such rail service interruptions.

Impacts

Information is limited on the impact of apps on travel patterns and how these apps support reductions in carbon emissions from landside access. The app itself seems well received with a rating of 3.9 out of 5 on the App Store.

Critical success factors

- Dynamic information connected to real-time journey information.
- Linkage with Google maps journey planning facility.
- Well designed, intuitive app.

Opportunities

Improving awareness and usage of the Airport Labs app to support staff provide customer service advice relating to landside transport especially during times of disruption.

Recommendations

- Ensure airport app incorporates landside journey planning options.
- Ensure the landside travel information is consistent across all media e.g. airport app, airport website, operator information and other key journey planning options.
- Invest efforts to integrate airport apps more fully with key landside travel information and/or journey planning apps.

Summary

Intelligent transport systems (ITS) are considered as transport-related development that increases safety as well as network efficiency and mitigates negative environmental effects. Information and communication technologies form the backbone of ITS. Considering efficient ITS mobility for (Central) Europe, activities need to be coordinated properly. The deployment of ITS developments proceeds differently, always depending on the technological and economic progress in a region or country. Applications that belong to ITS mobility are for example toll systems, automated and connected driving, management of stationary and flowing traffic and multimodal travel information. The accessibility of airports can be described by listing road or rail infrastructure, but also by having information and communication technology that enables or simplifies a journey through providing **relevant travel information**. In the LAirA context, ITS mobility focuses on multimodal travel information and reliability in terms of landside accessibility by road and rail.

Airport apps allow travelers to have real-time information about **flights** (gate, delays or cancellations), **shopping opportunities, car parking and accessibility via public transport, car or taxi** on their smart phone.

Within this field, and especially addressing CO_2 footprint reductions, LAirA aims at promoting ITS mobility for addressing priority fields such as efficiency and environment particularly with the overall goal of achieving climate protection targets.

According to the project's and programme's objectives, more specified objectives as well as actions and measures are recommended within the LAirA field of ITS mobility for airports.

Objectives	Actions
Availability of comprehensive landside-access-related travel data for passengers and employees.	Cooperation with local/regional/national transport providers and establishment of a comprehensive travel data platform/storage. Provision of an interface that enables travel data sharing for user-centered front-ends (e.g. map/ route planning applications).
Mitigation of negative environmental effects by better using ITS applications.	Cooperation with other ITS relevant stakeholders (e.g. road/rail infrastructure providers) and ('smart') cities or regions.
Effective on-site transport management within an airport's responsibility.	Deployment or enhancing of ITS infrastructure and services at airports.

Questions and Tasks

- Define what functions belong/should belong to the Intelligent Transport System (ITS)?
- Discuss with your group mate / bench-partner
  - what apps have you ever met during your travels?
  - what do you think can be introduced at airports in Europe?
- How can you personally help the environmentally conscious transport in your agglomeration with ITS?
- Select one of the actions for the ITS defined by the project which you consider as the most effective option and explain why?
- On the website of one of the participating airports, use the mobile application to look for a restaurant that suits your taste.

Theme 6. Wayfinding

Background

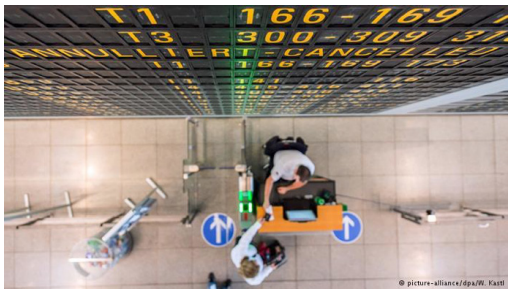
Wayfinding is more than just signs; **it is a physical extension of a brand; a reflection of a destination's physical character; and an information system**. It is important to understand that there are a number of factors that influence how users interact with a wayfinding system. These factors can be broadly grouped into three different types: people; environmental; and information factors.

Effective wayfinding and information design will: better connect users to destinations; use consistent nomenclature; maintain a safe movement; be predictable; disclose information progressively; help users learn; keep information simple; and be accessible.

Wayfinding and Airports

The provision of effective wayfinding and intuitive information design for users forms a fundamental part of the airport user experience. It provides passengers with **more control over their journey** and this in turn results in direct benefits not just for the passenger themselves, but also for the airport. For the traveller, simply **knowing where they are**, where they need to be and how to get there gives them more control over their journey and **reduces stress**. For the airport, having a passenger who is in control of their journey leads **to increased satisfaction levels**, an important benchmark for airport efficiency.

Passengers' journey does not stop once they exit the airport, on-ward and post journey information are important elements of the user journey and should be considered part of the responsibility of the airport operator. It is essential to consider the importance of a user's journey on approach to the airport, and the ease of access to and ability to use information allowing passengers to complete their journeys.



Best practices

Catania

The intervention included the optimization of both internal and landside wayfinding and signage systems to improve passengers experience and vehicular flow within airport areas.

The project provided **design guidelines and technical maps** with details on signage's locations, dimensions and contents for pedestrian and vehicular viability.
The project aimed at optimizing viability and passenger's awareness during airport surface transits.

Both internal and landside wayfinding and signage systems were developed according the following tasks:

- Pedestrian and vehicle flow analysis.
- Detection of decision points.

A clear and recognizable airport brand enables the creation of long-term relationships with passengers and commercial clients. A brand applies to all contact points between the brand and users, understanding how users interact with the infrastructure and services, and how branding influences their behaviours and choices.

Toronto Pearson

Travel information was presented in a poster that included information for all four of transit agencies providing bus services to Pearson (TTC, GO, MiWay and Brampton Transit). Information primarily covered trip planning and fare payment. **The poster also included secondary information on schedule and stop location**.

A number of improvements such as updated bus stop poster cases (agency specific) and multiple transit info screens were being implemented in the area and complemented the poster.

The successful implementation of the transit information poster could lead into the development of a fully integrated 'transit hub' at the airport as well as potential digital application for journey planning. In a majority of airports onward travel options are often not presented to passengers as an unified offer, the emphasis is placed on the passenger to do the work. An integrated 'transit hub' operated by the airport authority could lead to increased passenger satisfaction levels.

New York JFK

The three airports of John F. Kennedy, Newark Liberty, and LaGuardia operate separately and have over time developed separate, inconsistent styles for wayfinding. Initial programming and implementation were developed and applied to JFK Terminal 4 resulting in an approach that provided all information necessary to travel smoothly through the airport – from curb to plane and back.
The challenge was to develop one master system that could be applied to all airport terminals, roadways, and parking facilities, and which had the sophistication to direct passengers from all over the world within an environment of hundreds of possible destinations. The outcome of the process was a **manual providing guidance on pedestrian wayfinding and signage**.

Within the airport itself the emphasis needs to be on providing clear wayfinding for users to access all of the transit providers, with equal presence given to each transit service.

Summary

Enhancing the efficiency of communicating spatial ideas to passengers is an important issue in all airports. **Wayfinding is a system designed for passengers to get better, faster information across the airport**. Travellers are using wayfinding services, which not only help them finding the right way, scheduling their flight, helping the airport staff to make passengers satisfied, but also to increase the passenger self confidence, which is an important factor to decrease stress before flying. Based of international rules, some of these spatial ideas indicators are regularly changing, to meet the new sustainable challenges of the airports.

Questions and Tasks

- What could be the reason why most airports did not send detailed information about their wayfinding report? Share your opinions with your fellow teammates.
- Why is wayfinding at the airport especially important?
- Give an example based on a learned best practice, how it affects the right wayfinding?
- What is the biggest problem for you as a passenger as far as your information need is concerned?
- Why could be Toronto or New York be a best practice in wayfinding theme?

Theme 7. Road public transport

Background

Road based transport forms **the core public transport mode** for cities around the world. Mode share for bus use varies across Europe. Average mode share for bus across the EU was 9.4% in 2016. Though buses provide a lower carbon alternative to private car travel, many cities have experienced issues with pollution resulting from concentrations of bus services and associate particulate and Nitrogen Dioxide emissions from diesel engines. However, technological progress has resulted in cleaner diesel engines and hybrid and electric buses becoming more mainstream.

Road Based Public Transport and Airports

Road based public transportation can provide **direct connections** between an airport and surrounding destinations. **Local buses**, dedicated airport links and bus/coach services serving hotels and tourist markets provide connection to city centres. **Coach** services provide options from locations further afield.

Road based mode share for access to airports do not appear to be compiled at the European level though research indicates an average European mode share of around 17%. Road based mode share varies from airport to airport. Dedicated bus services often provide a high level of quality, with service frequencies high, vehicles being modern, spacious with ample luggage space, services running across a 24-hour period, Wi-Fi, and easy to purchase ticket options. Increasingly these can be purchased via apps in advance.

Local services provide an important travel option for commuters also. Often road-based transport competes with rail services covering similar routes though road-based transport options are usually lower cost. Where bus services share road space with private cars, congestion can be challenging particularly at peak times when routes from city centres to airports may suffer from congestion.

Specificity of the airports involved in the project

The results of the questionnaire surveys carried out within the framework of the project are shown in figure 11. About 17-56% of the surveyed passengers use **public transport** to access and exit the airport. By comparison, the airport employees appreciated less the Public Transport (2-40%) than the passengers.

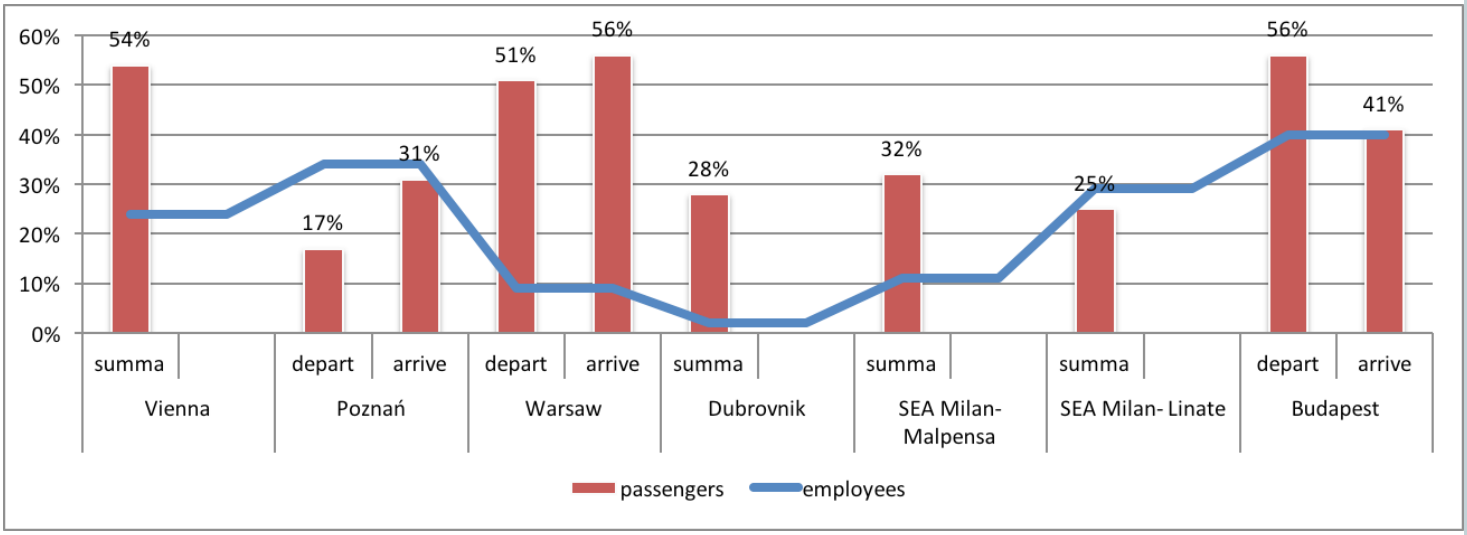


Figure 11. Sharing Public Transport by passengers and employees

Public Transport includes bus and train, coach, regional, international and airline transfer buses. The figure 11. shows what is the proportion of the Road Public Transport within all public transports. For some airports, the two values are the same because no train connections exist (e.g. Dubrovnik).

There is a significant difference at other airports because the rail-link plays a prominent role in the public transport (e.g: in Vienna the bus transport is only 11% out of the total public transport share of 54%). The data on bus transport sharing (Figure 12.) demonstrates the passengers' bus utilization. The highest rate is in Warsaw and the lowest in Vienna.

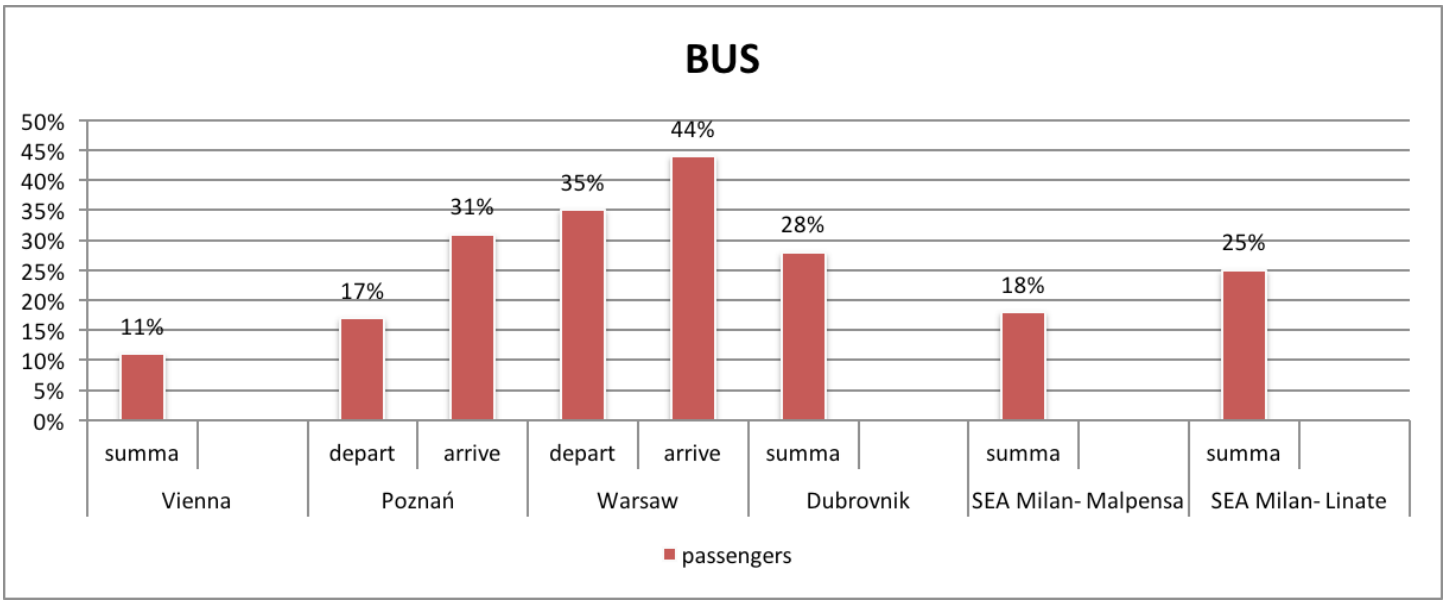
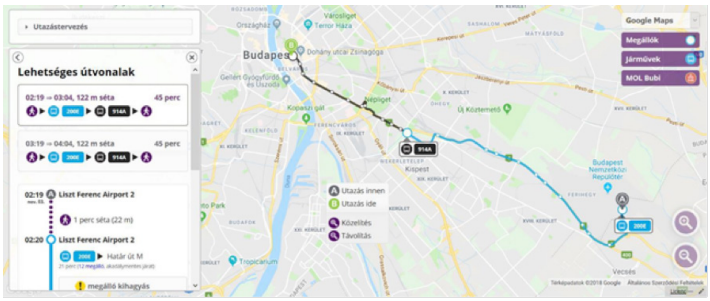


Figure 12. Sharing Bus Transport by passengers

Budapest Airport

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. 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. Even though the regional bus operator has a relatively good route network, it does not serve the passenger transport of the airport, but only the airport employees. The **regional buses stop** is located at the entrances of the airport where most employees enter the airport area. **Local and international bus lines** and shuttles connect the airport with the FUA and the catchment of the airport. International bus lines, other smaller bus operators and shuttles provide connection to more distant Hungarian cities as well as to neighbouring countries.



About 40% of the employees surveyed use public transport to commute. Employees who took private cars said that public transport was uncompetitive on travel time, comfort, and flexibility. To this category we can add the character of flexibility that has been voted among the three most important characteristics by the employees of Budapest airport. Though one of the safest and more reliable public transport services in this respect is provided by BKK, waiting one hour for a bus might be acceptable for a traveler but cannot be considered a suitable solution for a worker who has to do it on a daily basis.

Budapest Airport employees complain about Public Transport as too many changes are needed, no direct connections and too high prices. According to the airport' passengers, the public transport has the largest share (40%) including the different alternatives of urban bus, combined with rail or metro services. The data about the departing passengers is more reliable, as the declared information is based on daily events. About 54% of the respondents arrived to the airport by public transport.

The very good public passenger performance of the airport of Budapest in terms of number of passengers choosing to reach it via public transport is achieved in spite of the >20km distance from the city centre and the lack of direct connections by train.

In summary Budapest provide a seamless connection from local busses and coaches to the airside transportation, consider the connection from city centre to the airport and back, but there is a lack of other transport destinations.

Dubrovnik Airport

Whereas the transport to Dubrovnik airport is organized by bus, taxi or car, bigger airports have established accessibility through public transportation. The airport is not adequately integrated into the regional transport system. Not only is the modernization of the Dubrovnik Airport one of the main priorities of the air transport sector, it shall also be directed towards improved accessibility to airports, especially by public transport means.

Dubrovnik is **connected to the city and the region via three bus companies**, according to the information collected on the website.

The survey shows the ways by means of transport as the passengers arrived at the airport of Dubrovnik. From the view it is evident that the largest number of airport users comes by private car as a passenger (46.92%). In the surveyed area, 12.18% of the passengers to the airport arrived with the Charter bus. Of the more representative transport there are shuttle buses, taxi transport and passengers arriving by private car. The least represented forms of transportation are interurban, regional, international bus service and city liner transport.

The main motivation for passengers chosing public transportation for going to the Dubrovnik Airport has been respectively the more frequent bus departures, the stations close to the place of residence and the cheaper carriers. For other reasons, passengers prefer shorter travel time and like using travel planning application for timetable information.

In summary, 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.

Mazovia - Warsaw/Modlin Airport

The existing road network provides good connections to the airport. An important barrier, however, is the lack of access from the north side of the airport and the low capacity of the national road No. 62. The regional train operator provides a bus connection from the Modlin train station to the Warsaw/Modlin Airport. Only one bus service operates between Warsaw and the Warsaw/Modlin Airport.

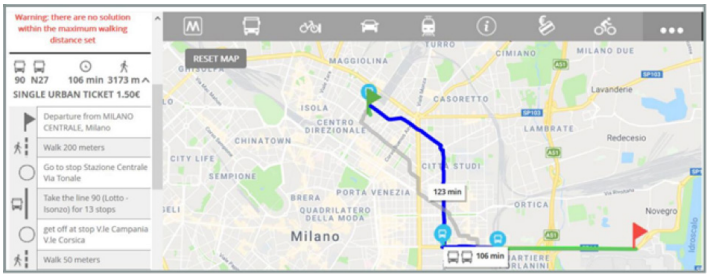
Only 9% of the employees (bus (2,5%) and train (6,5%) in total) use public transport to go to work. 41% of surveyed employees using the bus reported accessibility regarding frequency as "very bad".

The passenger factors indicated in the scope of travel by public transport concerned mainly the cost and availability. On the other hand, price was the main reason why passengers give up buses (bus is more expensive than train - 39 to 19 zlotys). It should be noted that the ecology-related factors of means of transport were not taken into account, with the highest share of answers concerning this aspect noted in the case of travel by train and bus, although the said share was very low (below 2%).

Aspects which got the highest marks in the passenger's survey regarding buses, were the road marking and signs to the airport and the punctuality of buses (83%, respectively for the sum of 8-10), while the worst assessed were the availability and frequency of buses. At the beginning of the previous paragraph, it is mentioned that around 40% of passengers use bus to go to or from the airport.

Milan – Linate and Malpensa Airport

From and to the Linate/Malpensa Airport **multiple bus connections and coach busses** are offered. Provinces outside Milan Metropolitan area are connected to Malpensa Airport both by regular and seasonal or on-demand services. Services are operated by local public buses, or by coach services. Coach services from several operators extend to Malpensa Airport catchment area but also to central Italy. There is also a connection between Linate and Malpensa 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. Milan Metropolitan area (that is to say Milan province rather than the central area) is connected to Linate Airport by two local public transport bus services.

Linate is a city airport, close to the urban centre, and 28% of the surveyed **employees** commute by train, bus and metro. The access to night connections for airport employees is particularly difficult, since public transport is not available according to the time table at night. There is also a risk of having to walk at night for those employees who do night shifts, as the bus stop is three km away from the airport entrance.

As far as young adult **passengers** (18-24 years) is concerned, they usually choose local public transport to access both airports, since it is the cheapest travelling mode.

Linate and Malpensa Airports differ in terms of modes of access as a railway connection is available only to Malpensa, while local public buses (plus other means of local transport) arrive exclusively at Linate.

Proximity is also a determinant factor in the choice of alternatives to the car. At Milan Linate – located seven km from the main train station – the use of public transport is facilitated by being located close to the city centre, though differences can be measured compared to train and direct bus traffic.

SEA Milan has forecasted the doubling of the demand for public transport (coach, bus, plus rail for Malpensa) by 2030, and a consequent decrease in the use of own cars and third-party cars and slight decrease in car-sharing and car-rental.

Poznan – Ławica Airport

The Ławica Airport is **well-connected with the city centre 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 centre.

About 34% of surveyed **employees** use public transport for at least one leg of their commuting journey to the airport. This is a relatively a high figure. For employees who live within the boundaries of the city of Poznan, this figure rises to 47%. There is a lack of dedicated bus lanes all the way from Poznan city centre to the airport, leading to slow bus journey times.

Suggestions and complaints from airport employees with regards to the existing mobility offer:

- Buses do not always operate according to the timetable.
- The timetable is not adjusted for morning departures, and night-time bus service is not adapted to working hours.
- More employees suggest reestablishing the fast bus line and direct bus connections to the surrounding settlements.

Passengers' opinions were also voiced – that the airport should be reached by more than one bus line to allow direct access to other parts of the city. It was also mentioned that information regarding the possibilities of travelling by public transport is insufficient.

The discrepancy is big, and passengers complained that Poznań is surrounded by other settlements, from which it is not clear how to reach the airport.
A significant number of respondents stated that the Ławica Airport could use a railway or a tram connection with the Poznań Główny railway station to enhance faster travelling.

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.

Furthermore, "fairport STR" mentions that from the Stuttgart Airport Bus Terminal (SAB) long-distance buses are departing to around 20 domestic destinations and about 50 international destinations in Europe.

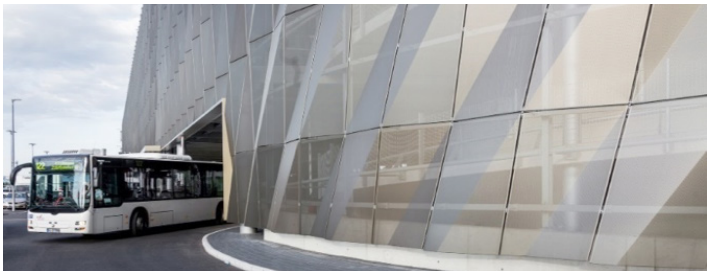
According to the "fairport STR"-strategy, FSG is developing a service and office location in the northern area of the airport, between the terminal facilities and the convention centre. Thanks to this project the future landside accessibility of the Stuttgart Airport is even more significant.

Best practice

Paris Charles De Gaulle

Paris Charles de Gaulle is served by bus and coach services for a total of eight lines that connect directly the airport terminals to Paris city centre and other main destinations (Disneyland Paris and Paris-Orly airport). The airport also provides six **on-demand** bus services, known as Filéo, which complements other traditional bus routes to provide 24 hr access to the airport. Routes are shown on a map. Filéo, formerly Allobus, began operating at the airport in 1998.

The reliability and versatility of the Allobus service attracted 1/3 of passengers from car users.



These services allow employees who work shifts better access to the airport at the times they need to travel and also improves accessibility for those living in an area which have traditionally been less well served by public transport.

Objectives and actions

The objective of Filéo is to provide a demand responsive service which improves accessibility both for existing staff living in its area of operation, as well as opening up employment opportunities for others who may not have been able to work the required shift patterns.

The low cost and demand responsive nature of the service also encourages switching to lower emission travel from car drivers.

Critical success factors and risks

- Use of small capacity vehicles allow the service to operate efficiently and access narrow streets.
- On-demand services rely on financial support. Cuts in the level of financial support would impact on the service.
- Complexity of the airport layout might represent an issue for efficient services.

Challenges and opportunities

Charles de Gaulle Airport is underdoing expansion increasing passenger numbers and staff. This is may result in increasing levels of demand for these services and a need to service new communities. Continuing to respond to these changes, potentially with new on-demand services, will be challenging.
The technology used to operate on-demand services is changing rapidly. The Allobus/Filéo scheme itself has modernized and is bookable by phone, app and web.
These app-based on demand bus services indicate opportunities for further development of demand responsive travel.

Recommendations

- Consider application of emerging best practices with app-based on-demand bus services;
- Consider need for on-demand services to improve access for employees to the airport site in locations or at times when traditional services are unavailable.

Summary

Though buses provide **a lower carbon alternative** to private car travel, many cities have experienced issues with pollution resulting from concentrations of bus services and associate particulate and nitrogen dioxide emissions from diesel engines. However, technological progress has resulted in cleaner **diesel engines and hybrid and electric buses** becoming more mainstream.

Road based public transportation can provide **direct connections between an airport and surrounding destinations**. Local buses, dedicated airport links and bus/ coach services serving hotels and tourist markets provide connection to city centres. Coach services provide options from locations further afield.

Dedicated bus services often provide a high level of quality, with service frequencies high, vehicles being modern, spacious with ample luggage space, services running across a 24 hr period, Wi-Fi, and easy to purchase ticket options.

Despite numerous positive features, studies show that road public transport can compete in a relatively small number of places with the use of auto / taxi strongly preferred by passengers and employees. In the case of the investigated airports, the employees also indicated that they are not able to use public transport in many cases, because it does not adapt to their time table, they need to connect to other buses and sometimes these buses are full. Passengers are not taking the public transport opportunities regularly, so they are less sensitive to the problems reported by the employees. Most of the airports use applications to help the passengers to choose the best public transport opportunities. The price sensitivity of many passengers is stronger than their comfort and door-to-door transportation convenience, so they choose public transport.

Questions and tasks

- Describe the advantages and disadvantages of public transport for passengers.
- In your opinion, what are the benefits and disadvantages of public transport for environmental reasons?
- Refer to Figure 11 (page 35) and name airports where passengers and employees use public transport in a similar way. What do you think, what should be the reason for this?
- Refer to Figure 11 (page 35) to identify airports where passengers and employees use public transport in a very different way. What do you think, what is the reason for this?
- Summarize the benefits of bus services at Paris Charles De Gaulle, based on the best practices.
- How do you get unlimitid public transport in Milan? Find the tool/service on the Malpensa Airport website!
- In your opinion, what are the challenges of the airports to increase passenger traffic in terms of public transport? What are your suggestions for solutions?

Conclusions

The handbook deals with all areas of the **carbon free airport mobility**. Based on the surveyed data some airports are much more advanced in the application of public transportation, sustainable mobility and mobility information systems concerning surface access of airports, than 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 airports stated a trend to steadily **rising passenger numbers** during the past period. The airport FUAs are one of the **largest employers** of their regions and commonly most of the employees come from all across those FUAs.

The studied airports can be accessed in a variety of ways, so both passengers and employees had different opportunities to keep track of their schedules. In summary, all airports are **accessible by car**, which seems to be the most **convenient, reliable and comfortable** - but definitely not carbon free - way of reaching the airport for employees as well as for passengers. With increasing traffic, most of the analysed airports will have to count with **parking problems** in the near future.

The airports of Vienna, Stuttgart, Milan and Budapest provide a seamless connection by local busses and coaches to the airside transportation. The surface access of **public transport by road** needs to be improved by developing direct bus connections and a better bus network to the different FUA destinations. Connecting **railways or subways** coming from the city centres to the airports is an important element of the sustainable organization of an effective carbon free airport mobility. Linate, Ławica, Dubrovnik, Budapest and Warsaw/Modlin Airport do not have direct surface access by rail. There is also still room for improvement concerning rail mobility at the more advanced airports of Stuttgart and Vienna.

Public transport plays an important role in **reducing urban CO_2 emissions**. Replacing gas-powered buses with electric drives is one of the main objectives of almost all participants.

As far as **the soft mobility** is concerned, there is no optimal infrastructure for cyclists to or from the airports of the FUAs in general. Some airports have surface access by bicycle, such as Vienna Airport, where a big achievement was the implementation of the bicycle path between the city centre and the airport. For the future, the cycling network needs to be improved significantly by all the studied airports.

Besides private cars and public transport services, **car-sharing** companies and regular taxis are also available options for commuting to and from the airport. Most airports have at least one car-sharing provider, but this service is recent and quite costly. There is also a lack of information regarding car-sharing mobility to the public.

Car pooling or car-sharing offer an effective transport alternative instead of using personal cars, which is feasible not only by the transformation of the carbon free perception of the employees, but by the setting up of identical working hours. After the survey, the green expectations and related tasks can also be studied by the employers.

Taxi services, airport shuttles and car rental companies are well advertised in all airports, however they certainly could not be considered as carbon free mobility alternatives. These services could be improved by using **e-taxis** or car rental companies operating with **electric vehicles**. Only three airports provide **intelligent mobility information systems** to the public. **Wayfinding** did not receive proper feedback, which means that this area did not meet passengers and employees' expectations or that it was not sufficiently represented.

So far, the CO_2 reduction programmes implemented by the airports have focused almost exclusively on the management and operational emissions. However, it is increasingly recognised that **the carbon footprint** embodied in the airport access mobility is a very significant part of the airport and its FUA carbon impact.

Innovative non carbon mobility services will continue to evolve, and airport facilities will need to react quickly to the new challenges. The modern technology-enabled services are likely to continue transforming the passengers' future mobility access and the airports with their catchment areas will need to cooperate closely to ensure that the outcomes of these **sustainable developments** are in general public interest.

The LairA project draws the attention to that innovative non carbon mobility services will continue to evolve, and airport facilities will need to react quickly to the new sustainable challenges. **However, the most important task of the project was the elaboration of a joint plan and the implementation of various low carbon mobility solutions integrating the seven key thematic areas**.

Project partners

Municipality of 18th District of Budapest, Lead Partner, Hungary

SEA Milan Airports, Italy

Stuttgart Region Economic Development Corporation, Germany

City of Dubrovnik Development Agency, Croatia

Austriatech LTD – Federal Agency for Technological Measures, Austria

Budapest Airport LTD, Hungary

Regional Government of the Mazowieckie Voivodeship, Poland

Dubrovnik Airport LTD, Croatia

Airport Regions Conference, Communication Partner, Belgium

City of Poznan, Poland

Associated partners

Stuttgart Region, Germany

Flughafen Wien AG, Austria

BKK Centre For Budapest Transport, Hungary

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