Smart and Mobile Work in Growth Regions

D4.1: Identification of success factors for the implementation of new mobility services

Work package No. and title: 4 Optimized Mobility as a Service - Planning	
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1 Introduction

1.1 Project

The Smart and Mobile Work in Growth Regions (Smart Commuting) project explores new ways of combining work and life with new intelligent transport system services and new concepts for supporting sustainable commuting. The mobility of workforce is increasing due to technology development, commuting and the nature of work. This has many consequences as long commuting may decrease the productivity of work and leave less time for relaxation. Cities also have to address commuting when planning technical solutions, developing services and calculating finance schemes. The first objective of this project is to identify the changing needs of mobile workers. The second objective is to increase the sustainability of mobility by supporting the implementation of sustainable and intelligent transportation services. The consortium will collect data by observations, surveys, interviews and workshops in Austria, Finland and Switzerland to evaluate how these new services meet the evolving needs of mobile workers. In addition, we will use simulations to provide decision support for stakeholders address urban planning and governance structures challenges. Implementations in large commuting areas are pivotal aspects of this project. Implementations in different areas help to scale up our partners' operations, get experiences about the needs of users and also discover some common ground for governance and city planning policies.

This project is a part of the ERA-NET Cofund Smart Cities and Communities (ENSCC), which was established by the Joint Programming Initiative (JPI) Urban Europe and the Smart Cities Member States Initiative (SC MSI).

The project started 1.4.2016 and is planned to last for two years.

1.2 Work Package and Task

The work package 4 is about an optimized Mobility as a Service (MaaS) planning. The optimization aims to support the implementation of new mobility services by the incorporation of mobility trends and data. The objective for the optimization is to incorporate mobility data, identify transportation modes and potential mobility hubs and simulate and evaluate MaaS and Sharing Concepts such as E-Car Sharing, Car-Pooling and Bike Sharing. This will lead to a decision support for regional and urban infrastructure planning and mobility service providers for the efficient use and disposition of resources in the field of mobility

Main objective is to develop a decision support for optimized MaaS. This general objective is subdivided into the following tasks:

- Task 4.1 Data acquisition, availability and mobility trends
- Task 4.2 Commuting as a Service, the problem definition
- Task 4.3 Configuration of the optimization framework

This report is about the first part of the work package to identify success factors based on Task 4.1 Data acquisition, availability and mobility trends and on the detailed case analysis of ISTmobil mobility service. Considering success factors in the design of an optimized Maas gives the possibility to obtain a guideline and avoids repeating mistakes. This helps to efficiently implement and transfer concepts for MaaS into new regions.

1.3 The report structure

The report summarizes the work done in Task 4.1 with the objective to identify success factors for the implementation of new mobility services or scaling up existing ones. Based on the project plan, this report is due to project month 9.

The state of the art will list relevant reference projects and mobility concepts. The following methodology chapter describes the performed steps and activities within the reporting period.

Mobility Trends
Commuting in general – the section includes definitions, who
Mobility Services in Austria
Discussion and Conclusion

The chapter results reports about data acquisition and illustrates some findings based on data analyzes.

2 Mobility Trends

As part of the Task 4.1, the literature regarding mobility trends and concepts was screened in order to get an overview about different aspects to be considered when designing mobility services. Subsequent some mobility trends but also changes in society which influence mobility are discussed.

2.1 The Role of Passenger cars

When talking about mobility trends, a crucial aspect is the role of cars. This role varies for different regions, user groups and time periods. While motorization in the last century has been seen as an indicator and a factor of economic growth, this (public) opinion has changed during last decades. Because of negative environmental and social impacts (see e.g. [6]), the role of the car in our society has been critically scrutinized and is an ongoing topic for research activities.

Steg with her colleagues [4[4] pointed out that the car is much more than just a means of transport. Car usage is driven by instrumental, social (or symbolic) and affective motives. Instrumental motives are more or less objective consequences of the car usage such as travel time, flexibility and costs. Whereas, social motives refer to the fact that people want to express themselves and their social position. The affective motives refer to emotions that are evoked by the car, i.e. driving a car will change people's mood and anticipate positive feelings. Sometimes social and affective motives are merged to social-emotional factors, which are in contrast to rational factors (or instrumental motives).

Dittmar [5] contends that in general material possessions, such as motor cars, represent instrumental values as well as by symbolic values. From this we can conclude that both rational and social-emotional factors are relevant for all kinds of transport modes including the possession of a vehicle (e.g. bicycle, motorbike, scooter, etc.). For instance, Goletz and colleagues [3] identified social-emotional factors to be most relevant reasons for the increase in the use of bicycles in Santiago, Chile. Two types of cyclists were described: One is a relatively low-income group that has traditionally cycled because it is the most cost effective transport mode. The other, new, higher-income group consists of young professionals living in relatively central areas in Santiago [3]. The authors claim that the latter group uses cycling as a method to express their status of income and education.

The negative effects of social-emotional factors on car ownership are visible In Singapore. Owning a car is very expensive. However, the high prices make car ownership even more desirable as it is considered as a symbol of success. Therefore, people tend to spend a large share of their earnings for a car.

In general, an increase of the car ownership and vehicle miles traveled per capita has been visible for most countries in the world since 1990. Between 1990 and 2005 people tended to drive more miles per capita year after year. However, since 2005 a demise of this trend is visible at least for urban regions. Millard-Ball et al. [8] investigated this trend for cities in eight different countries (Australia, Canada, Sweden, UK,U.S. and Japan). Based on their analysis, they conclude that travel activity has reached a plateau in all eight countries. Newmann [7] lists possible reasons for the saturation of car usage:

- Constant travel time budget: People willing to travel further but not longer. This means if the travel speed has reached an upper limit (e.g. due to safety or environmental reasons), the vehicle miles travels remains constant.
- Growth of public transport: Also due to environmental reasons, the development of public transport is an issue for every city. As a consequence, public transport is getting a competitive alternative to motorized individual traffic.
- Reversal of urban sprawl: Housing and population density fosters the use of active transport modes (walking /cycling) and hinders more bulky modes of transport. Therefore, density and car usage have interdependency.
- Ageing of cities: The average age of people living in cities is rising, and since people who are older tend to drive less. So, the amount of vehicle miles per capita decreases.
- Growth of a culture urbanism: Urbanization is constantly increasing and currently approximately half of the people live in urban regions. Because the car usage is more difficult (cost, space) and less necessary (public transport, walking/cycling distances) in urban regions, this trend leads to less vehicle miles travelled.
- Rise in fuel prices: Although the elasticity associated with fuel price is high, it has reached a limit where higher prices lead to a decrease of car use.

2.2 Urbanization

A trend of human settlement is visible in the continuous growth of urban regions. According to a UN-Report the share of people who live in cities has increased on each continent between 1995 and 2015 [10]. In Europe and North-America the urbanization is already on a high level (more than 60% live in urban areas) and therefore this growth is slower compared to Asia.

Urbanization has impacts on mobility for different reasons. Scarceness of private and public space influences car usage and advantages the spread of public transports, e.g. caused by a denser transport network and shorter walking distances to nearby stations. Costs for driving and parking (congestion and parking fees) are higher in many cities compared to rural regions. Therefore people tend to avoid car ownership and use other modes of transport.

Population is denser in cities and therefore trips are shorter compared to rural regions. Shorter trips are more likely to be made by an active mode of transport. Moreover urban citizens can better protect themselves from adverse weather in urban regions and can more easily combine their trips with other activities (shopping, leisure) compared to rural areas.

2.3 Work Environment

In western countries a shift in the economy from the secondary sector (manufacturing, industry), to the tertiary sector (services) is visible. Moreover, the primary sector (agriculture, livestock farming) plays only a subordinated role. Also the work environment is influenced by this change. While an isochronal and physical presence of workers is necessary for most industries (secondary sector), this is not the case in the same extent for companies active in the tertiary sector. Especially ICT supports employees in this third sector to be less independent of place and time for working. As a consequence flexible working times and home work are widely prevalent and effect mobility. The impacts are less commuting trips, less peak traffic and a trend to use travel time as working time.

2.4 E-Commerce and ICT

For e-commerce in at least a part of a business transaction ICT is involved. This effects mobility patterns of customer as well as transport demand of companies. Basically research showed a decrease of travel activity for the case of commuters ([12]). Recent findings suggest that this is only a short-term effect. Over a longer time period, travel distances are not observed to decrease ([11]). One explanation for this could be that savings in commuting travel times and costs to some extent convert into other or longer trips for non-work activities ([13]). Residential and employment location choices may change, which in turn affect travel demand, especially for commuters on a long-term ([12]). For example, a combination of e-shopping with teleworking may offer opportunities to choose a location in a more remote area. Living near a work or shopping location is less important.

Car ownership is another decision that can be affected by e-shopping. Owning a car is a good predictor of car use. For a car-free household (where no member owns a car) taking goods from shops back home can be a problem in everyday life ([14]). For these households, e-shopping may solve a problem and support the idea to resign on a car, which also impacts the mode of transport for commuting. But if e-commerce would affect the spatial distribution of conventional shops the average distance to the nearest store increases for households and it becomes more difficult to shop near the home. Hence, e-commerce may indirectly reduce opportunities for shopping with active transport modes (walking, cycling) and for living without a car.

2.5 Car-sharing

The concept of car sharing is an approach to mitigate transportation problems in urban areas. Motivations for participating or providing an own car for car sharing is an occasional need for a vehicle and financial savings. Car sharing impacts car ownership as well as mobility behavior.

Katzev found that in the U.S. 26% of car sharing user sold their personal vehicles and 53% were able to avoid an intended purchase ([16]). Also Nijland et al. claim in their study, conducted in the Netherlands a decrease of car owner ship caused by car sharing. Further they found that car sharers, on average, drove around 9,100 km before, and 7,500km per year after registering for car sharing. This decrease is mostly because owners who disposed of their privately owned car began to drive far less. Of the 7,500 km, 1,500 were driven by shared car. Before, these kilometers by shared car were either not made at all or other modes of transport were used.

Although car sharing has the potential to decrease car ownership and mileage, the question is whether it impacts travel behaviors of commuters. Since car sharing is mostly used for occasional trips, it is rather not suitable for daily commuting. On the other hand a decreased car ownership fosters usage of public transport, which in turn can be used for commuting.

2.6 Electric mobility

An intention of many countries worldwide is the electrification of mobility. This intention is driven by different objectives like reduce carbon emissions, ban tail pipe emissions from densely populated regions, decrease dependency from oil or increase energy efficiency of transport [17]. The adaption to electric mobility progresses at different paces in different countries (China, Norway, Austria, Germany, USA and India) and is affected by the individual factors.

- Policy Support
  Policy support is an inevitable measure to foster or even enable the widespread of battery electric vehicles and it is, as visible in Norway (cf. [19]) a very effective measure. Policy support can be divided into incentives and limitations

  - **Incentives** include monetary incentives e.g. subsidiaries for buying an electric vehicle, tax exemptions etc. or regulations regarding the usage of electric vehicles (e.g. usage of high occupancy lanes, parking areas). An important success factor for incentives is to adequately announce them in order to inform byers of electric vehicles.

- **Limitations** are less popular but may help to foster electric mobility. In contrast to create advantages for battery electric vehicle, limitations concern internal combustion engine vehicle, which should be substituted by electric vehicle. The limitation may concern different vehicle types (e.g. diesel vehicle) for specific zones or time periods. A drastic measure to spread electric mobility is to completely ban petrol powered vehicles, as it is planned for Norway ([20]).

- Status of electric mobility. Most buyers of a vehicle are already very familiar with a combustion engine, since this was/is the predominant engine technology for passenger cars. The situation is different in countries where penetration rate for passenger cars is still growing like China or India. In these countries most buyers of a vehicle are 'first-time buyers' and are not used to travel by car (e.g. their parents had no car). For this reason buyers show less prejudice and are more open minded for electric vehicles, which benefits the proliferation of electric mobility.

- Attitude: There is an increasing aware of ecological aspects related to transport. For instance, trips and transport modes are evaluated regarding their carbon emission. Moreover public and active mode of transports are not only chosen because of economic reasons, also because of consciously choosing an environmental friendly and sustainable mode of transport

2.7 Autonomous driving

The trend of autonomous driving is cleary visible on the fact that nearly every auto manufacturer is currently working on prototypes for autonomous vehicles and plans to introduce market ready solutions within the next few years ([21]). Based on the level of autonomy vehicles are categorized into low, medium and high autonomy.
Low autonomy means those vehicles are travelling on predefined routes only and are applied in logistical areas but also in public transport routes. Medium autonomy means, that still an area for travelling is define, but vehicles are able to change their route within this are. Finally, full autonomous vehicles are equipped with highly intelligent sensor systems and instruments and are able to use the whole transport network and may deal with all kind of traffic situations and incidents.
In general autonomous vehicles may have following impacts:

- Decrease number of road accidents
- Harmonize traffic flow and increase traffic density
- Reduce car ownership causing less congestion and more relaxed parking space situation
- Enables mobility for all citizens (Children, elderly and physically challenged people) in regions with poor public transport.

Despite of all advantages of autonomous vehicles, as it might become much more convenient to go by (automated) car and therefore increase the transport volumes.

2.8 General Aspects

For policy makers it's relevant to know how a specific which measure will impact the different motives of each transportation mode. Impacts on mobility trends can be considered from different perspectives:

- Psychology of traffic:
  Since traffic participants are human individuals the psychological aspect is strongly related to traffic. E.g. the choice for a specific transport mode is affected by rational and social-emotional factors. E.g. these factors are considered for mode choice modelling. Aspect of health: Active (walking, cycling) vs. passive transport modes (costs, status, health, convenience, rational and socio-emotional factors)

- Requirements on mobility
  Apart from psychological aspects of traffic, a transportation system has to satisfy (objective and subjective) user needs. Caused by changes in society, settlement structures, working conditions etc., these objectives are shifting as well.
  Since the number and complexity of user trips is constantly growing, a transportation system has to enable a **more intertwined mobility behavior**. For instance the pricing of public transport has to be designed in way to enable users a large diversity of trips (different destinations, etc.). To keep pace with this development the transport association for eastern Austria (VOR – Verkehrsverbund) has changed its pricing from fixed zones to user specific transport fees. Moreover seasonal tickets can be used for a personalized subnet of the public transport system.

3 Commuting

3.1 Definitions

To increase common understanding, Table 1 provides the definitions of the key terms in this project.

Table 1- Terminology and definitions for the project

Name	Definition
Commuter	Commuting is a periodically recurring travel between one's place of residence and place **of work, or study**, and in doing so **exceeds the boundary of their residential community**. It sometimes refers to any regular or often repeated traveling between locations, even when not work-related. A distinction is also often made between commuters who commute daily or weekly between their residence to workplace, and are therefore considered respectively local or long-distance commuters. [Wikipedia] “In technical literature, commuting has been called **the journey to work and does not include trips conducted as part of work activities** such as a bus driver’s work day or an executive’s business trip to attend a meeting.”[2] Roughly one out of every six American workers commutes more than forty-five minutes, each way.

	The highest share of commuter outflows In Europe was recorded for the capital city region of the United Kingdom, London, where almost half (48.6 %) of the workforce commuted to work in another region. (Eurostat regional yearbook 2016 edition) The number of commuters who travel ninety minutes or more each way - known to the Census Bureau as “extreme commuters” - has reached 3.5 million, almost double the number in 1990 (in USA).
In-commuter	From the perspective of the workplace, commuters are in-commuter.
Out-commuter	From the perspective of the residence, commuters are out-commuter.
Mobile worker	An employee who is using digital utilities to accomplish a part of his work outside of his regular place of work. “Recent research by the Association for Information and Image Management (AIIM) and Workshare revealed that more than four out of five workers (81 percent) now access work documents on the move.”[1] „The rise in mobile working has also resulted in a significant adoption of Bring Your Own Device (BYOD) strategies across the enterprise. In Workshare’s survey of 5,895 IT professionals worldwide, 62 percent of employees are already using their personal devices in the workplace – be it a phone, tablet, or laptop.“ [1]
e-Nomad	This is name for a new kind of worker in a work environment full of new devices, apps, services, communication networks, machines. E-Nomad is the “b” side of the massive establishment of information and communication technologies in the world of work. Properly used, technology makes things easier, but taken to an extreme; it may have counter-productive effects at both occupational safety and health and productive levels. E-Nomad belongs to this second case that in which his/her life and work were invaded by technology. Working time has no established start and end, since task can be accomplished at any place and anytime. The number of technologies used is manifold and is rather a burden than assistance. In most extreme cases personal relations are substituted by virtual contacts and life-work balance is impossible to distinguish because both aspects are mixed.This description regarding users of ICT is clearly excessive, but is summarizes negative impacts of ICT. When introducing new mobility services relying on ICT, these effects may be taken into mind.

Commuters travel between different types of regions, i.e. commuter flows can be classified according as shown in Figure 1 [2]. The assumtion is that each city contains a central city and suburbs and commuters may travel between these regions as well as between different cities.

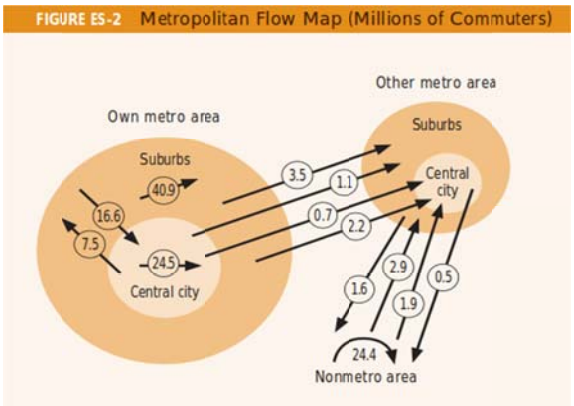

Figure 1: Types of Commuting [2]

Different impact factors on commuting are shown in Figure 2 [2]. The factors are categorized regarding land use, micro (or individual) variable, macro and psychology of the commuter variables. Factors for **land use** describe the regional structure on an aggregated level. Information about these factors are content of census data. **Micro or individual variables** are disaggregated data related to specific individuals. Information about these factors can be obtained by interviews (questionnaires). **Macroscopic factors** are obtained for larger regions and are properties related to the whole population i.e. different kinds of commuters. **Psychological variables** describe same as individual variables individual commuters. Modelling the impact of psychological factors on commuting requires detailed information about the users, and a distinction between stated and revealed preferences.

Each category contains several factors which influence the commuting behavior. Moreover, some factors show interdependency. E.g. personal income is related to commuting and whether he/she owns or rents a house/apartment. The latter also impacts the commuting behavior directly.

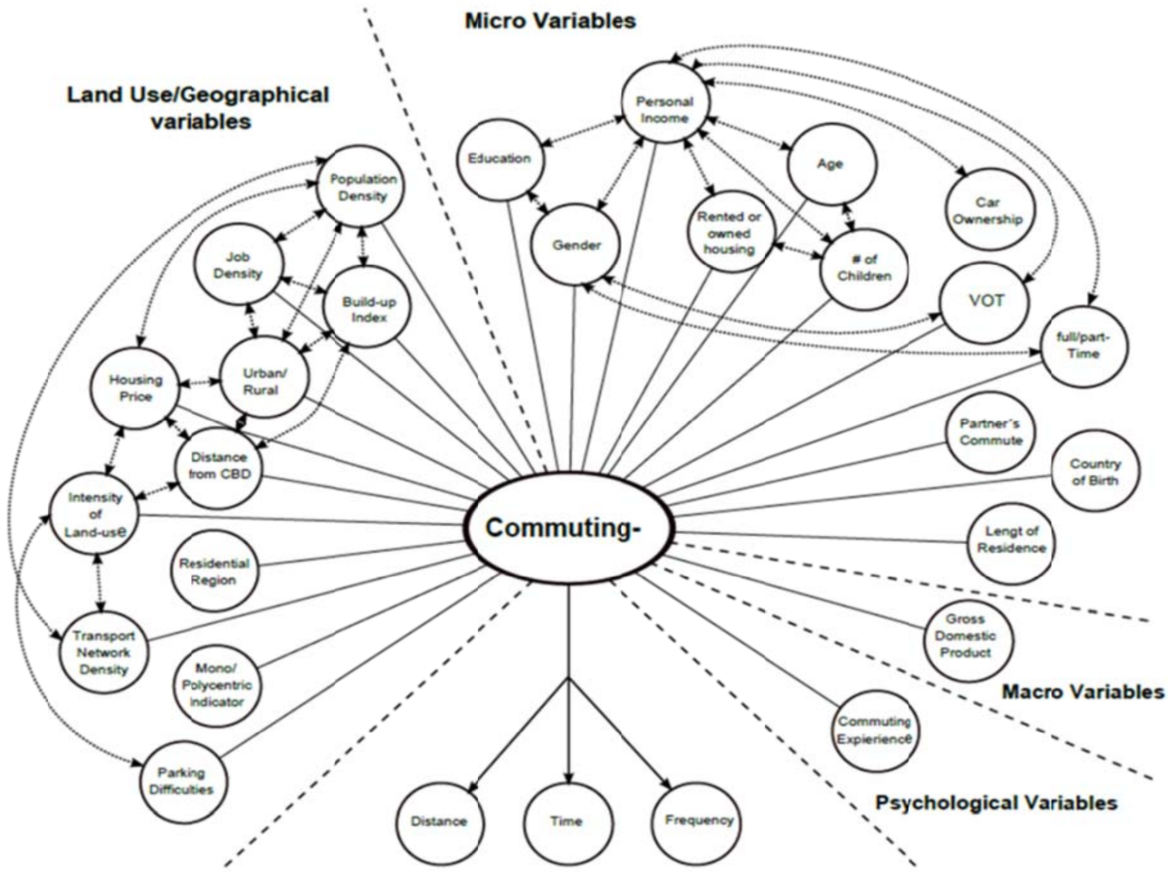

Figure 2: Variables influencing commuting behavior [2]

4 Mobility Services, Commuting in Austria

4.1 Introduction

In this section we summarize information regarding mobility of commuters in the investigated case are. The analysis is based on different data sources as described in Section 4.2. The service of a mobility provider operating in the case area is described in Section 4.3. Recorded data are analyses and different statistics about mobility behavior are presented.

4.2 Data and methods

Data used for our investigations should provide insight into commuting behavior in the investigated case are. Therefore different data sources exits with varying aggregation level, accessibility and completeness. The methodology to identify key aspects of mobility services is based on the incorporation of mobility data. In order to collect data sources, for information about content and availability a structured data list was defined as shown in Table 2.

Table 2- Sources for mobility data used in for this study

Data Source Acronym	Region / geographical coverage	Data provider	Data provider URI	Ownership	Data source description
Pendlerstatistik (Commuterstatistic)	*Österreich*	*Statistik Austria*	*http://www.statistik.at/web_de/statistiken/index.html*	*Public*	Relation between place of residence and working place is determined based on register data
BRAWISIMO (Region BRAtislava WIen: StudIe zum Mobilitätsverhalten)	Eastern part of Austria (eastern Niederösterreich, northern Burgenland and Vienna) and Western part of Slovakia (Bratislava and Trnava districts)	bmvit; Austrian Ministry for Transport, Innovation and Technology (lead partner)	*http://www.ivv.tuwien.ac.at/forschung/projekte/international-projects/brawisimo-at/*	*Public*	Household survey consisting of 3 linked data layers: households/persons/trips (trip records of all persons (>= 6 years) in the household) collecting transport and mobility data as well as household data
Österreich unterwegs'	all Austria	bmvit; Austrian Ministry for Transport, Innovation and Technology (client)	*http://www.oesterreich-unterwegs.at/*	*tba*	Household survey consisting of 3 linked data layers: households/persons/trips (trip records of all persons (>= 6 years) in the household) collecting transport and mobility data as well as household data

Analysis

The data source template was filled with relevant mobility data sources, including provider information and data details. The project context includes appreciations for data usage in Smart Commuting and refers to experts within the project team. The STATCube powered by Statistik Austria (http://statcube.com/statistik.at/ext/statcube/jsf/terms.xhtml) enables requests for commuter flows for the years 2009 to 2013 on municipality level. Therefore a subscription is required (92 days and 1.5 m values: Euro 250 or 366 days and 6 m values: Euro 800). Request can be stratified by gender and education and origin as well as destination can be chosen individually. Additionally an interactive map, including a table provides a description of commuter flows on municipality level (e.g. **Fehler! Verweisquelle konnte nicht gefunden werden.**) for the years 2011 and 2013.

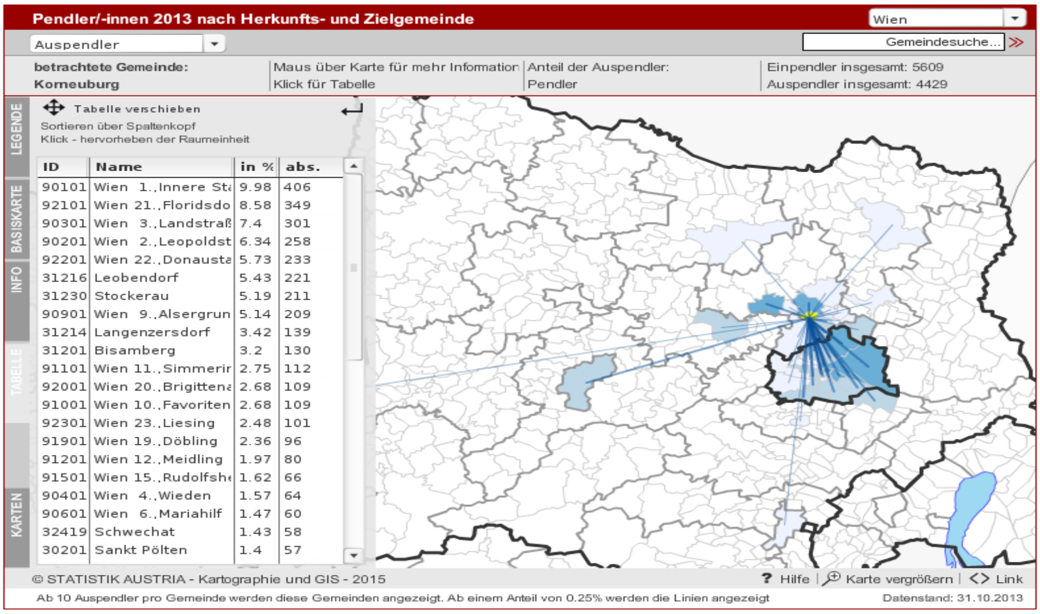

Figure 3: Out-commuter Korneuburg 2013

All data are determined by a register-based census and contain only working commuters (‘Erwerbspendler’), i.e. not students are included. The data is contained in the “normal” census carried out in 2001. For this project, the in- and out commuters for the investigated region were selected on a community level.

4.3 Case IST-Mobil

IST-mobil developed and operates a shared taxi system in Austria. The system is flexible in terms of the pick-up location and time. Moreover trips are ordered up to one week in advance by telephone or online. All vehicles of the system are equipped with a positioning system, which enables the tracking of taxis in real time.

In this project on smart commuting, we use recorded tracking data to estimate the potential and benefits of sharing taxi trips when relaxing other constraints as pick-up or delivery time. In Figure 4 all origins and destinations of customer trips are visualized.

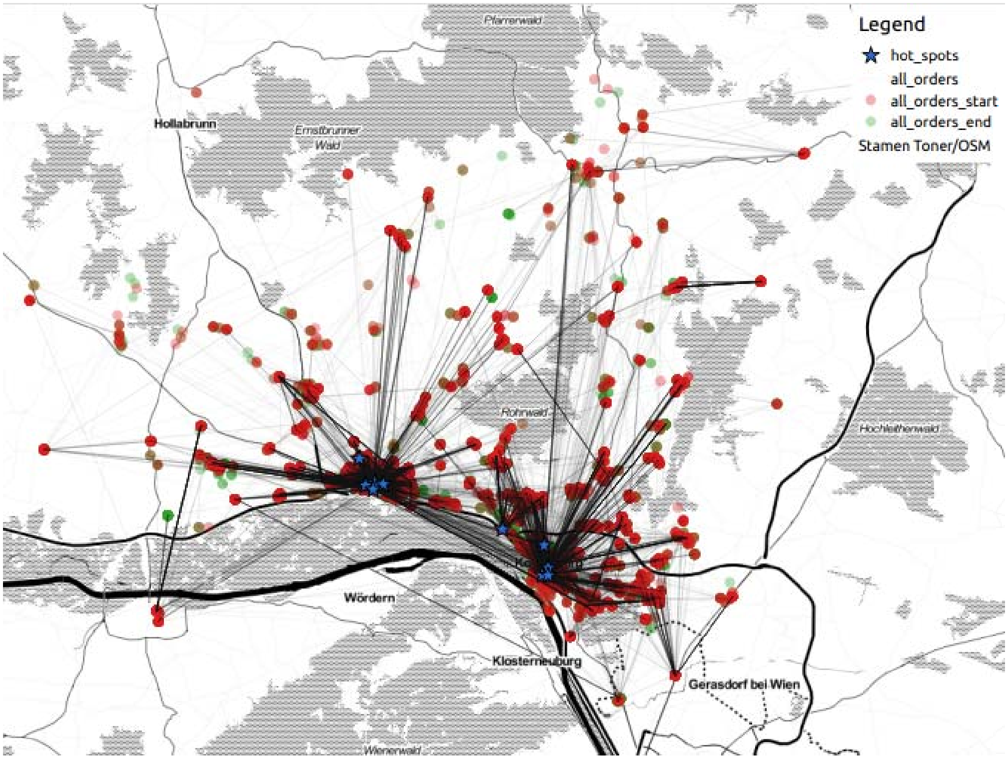

Figure 4: Origins and destinations of customer trips. Please note that many destinations (green dots) are shadowed by the origins (red dots). Blue stars are very frequent origins or destinations of trips.

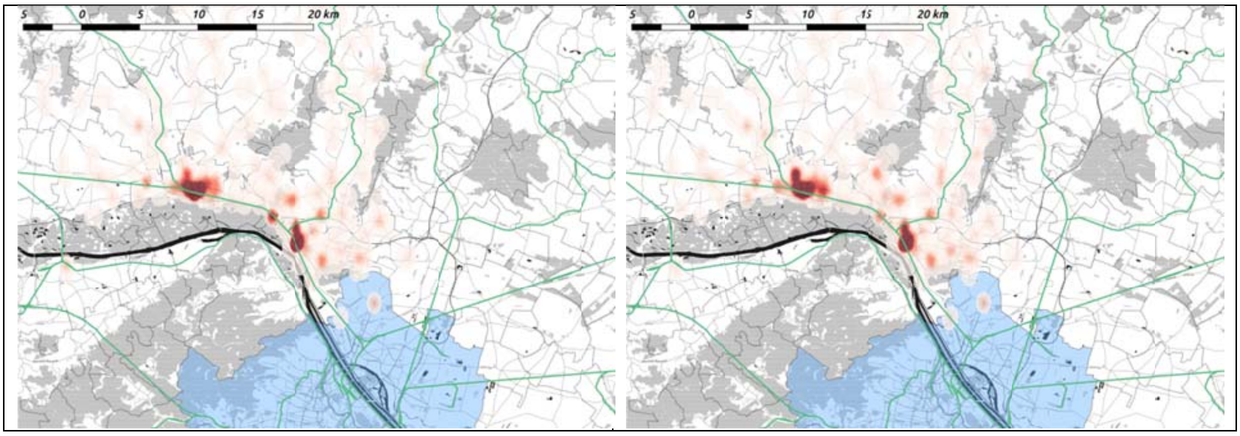

Figure 5: Heatmap for origins (left) and destinations (right) of trips. Red indicates a higher number of trips in the corresponding region. Green lines indicate railroads.

Table 3: Summary information about commuters

Description	Value	Source
Number of observed days	412	IST-mobil
Number of working days	294	IST-mobil
Number of trips	20605	IST-mobil
Number of trips inside on community	11355	IST-mobil

Number of trips between different communities	9250	IST-mobil
Trips to Korneuburg	20140	IST-mobil
Trips to Vienna	262	IST-mobil
Trips to elsewhere	203	IST-mobil
Trips to a railway station	2945	IST-mobil
Trips from a railway station	4886	IST-mobil
Commuters from Korneuburg	24460	Statistik Austria
Commuters to Korneuburg	6376	Statistik Austria
Commuters to Vienna	15911	Statistik Austria
Commuters elsewhere	2173	Statistik Austria

~10 people travel to railway station per day. If we assume that all trips ending at a railway station are multimodal commuters to Vienna, then this would be a share of 0.06%.

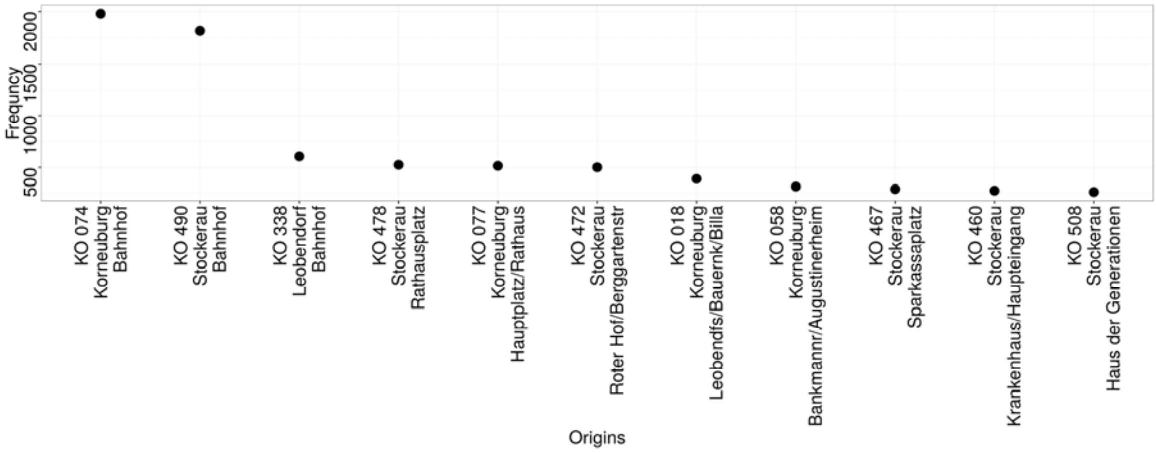

Figure 6: Most frequent origins of IST-mobil trips.

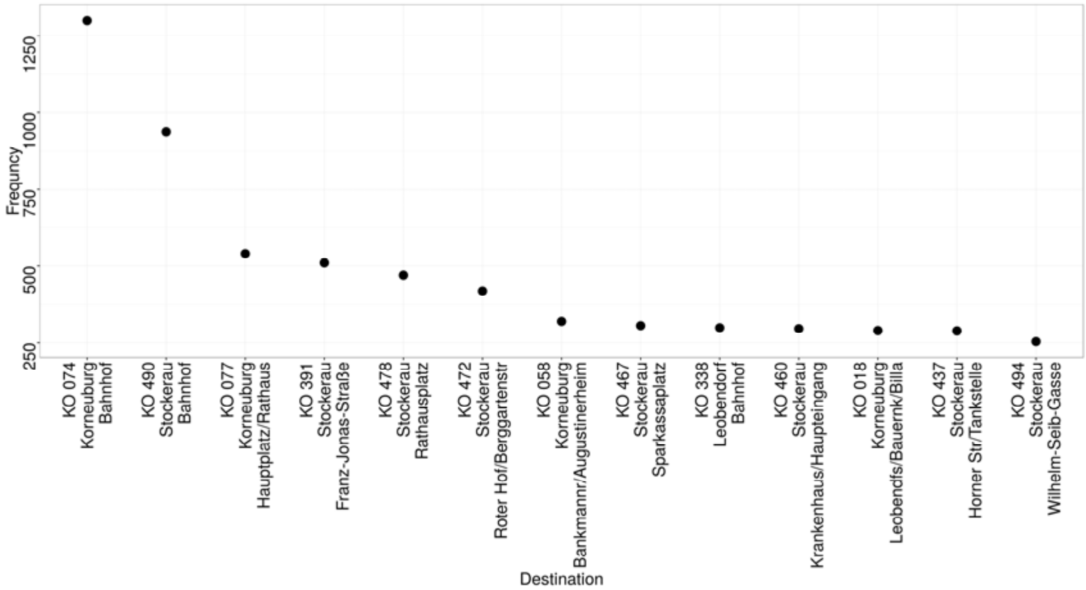

Figure 7: Most frequent destinations of IST-mobil trips.

In Figure 6 and Figure 7 the descending order of origins and destinations of trips are presented. The two most frequent locations for both, origins and destinations are the railway stations of the two largest cities in the district ("Bahnhof" means railway station German). Therefore, the assumption is that the IST-mobil service is very often used in combination with other transport modes that is a train.
Since the train is the predominant public transport mode in the investigated district, all trips starting and ending at any railway station are selected. Only these trips are considered as combined trips while all other trips are assumed to be single mode trips.

The IST-mobil system is mainly used during the day and on working days. This is visible from Figure 8, where the trips have been categorized according following time periods:

- Morning: 6am – 9am
- Day: 9am – 4pm
- Evening: 4pm - 7pm
- Night: 7pm – 6am

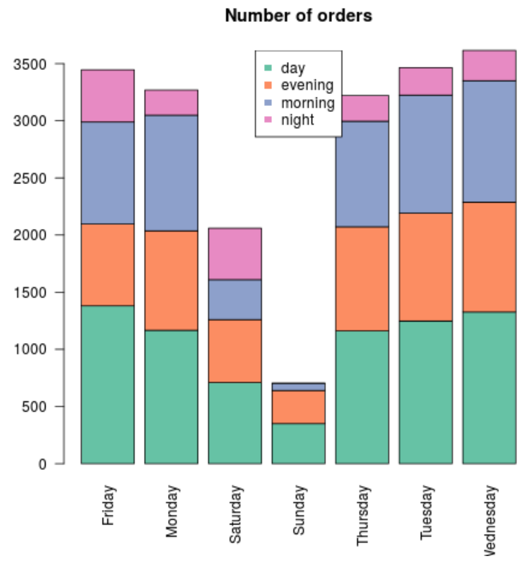

Figure 8: Temporal distribution of trips

Trips of customers using the IST-mobil service are in 95% of the cases below 15km or last for less than 20 Minutes. Half of the trips are even below 5km and last for less than 10 Minutes. From this we conclude that the service is rather used for short distances.

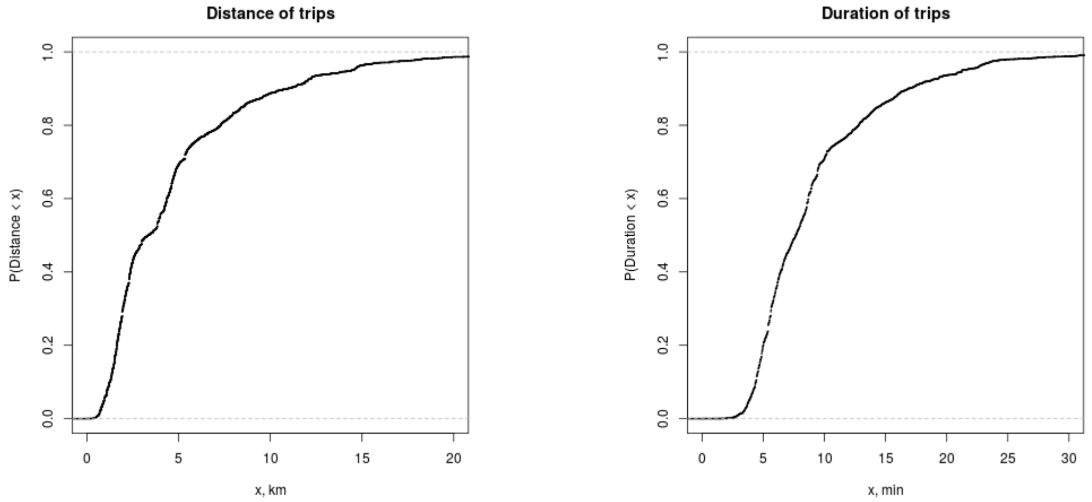

Figure 9: Empirical cumulative distribution of trip distance (left) and duration (right)

4.4 Summary

In the previous sections we investigated different data regarding commuters in the case and the mobility behavior of users of a taxi service in the area. The service was designed to substitute public transport in the region and is supported by the municipality of the case area.
The analysis of IST Mobil data show, that the share of commuters using the service is actually very small (0.06%). As census data indicate a large number of commuters in the investigated region, there is a considerable potential to increase the number of passengers using the service.
Moreover, the analysis shows a concentration of trips on the two major cities (population approx. 15tsd each) in the region. This is also visible in the distribution of trip length and duration, which is rather small compared to the extent of the whole case area.
Another observation of mobility data is that many trips have a common destination and/or origin, which is mainly a railway station. In the case area a large number of commuters travel by train, although it is unclear how they reach the railway station. Since in both cities large park and ride facilities are installed, we assume that a significant number of commuters change travel by car to the railway stations.
These results and considerations lead us to the assumption that although the share of commuters using the IST-Mobil service currently, there is potential to extend the service and combine or share routes, which would make trips cheaper and thus more attractive. The investigation of possibilities for sharing IST-Mobil trips is topic for succeeding deliverables of this project.

5 Discussion and conclusions

The identification of success factors is based on the previous describes trends, knowledge from mobility projects and analysis of mobility data. Furthermore experts and stakeholder inputs were used to outline criteria's for successful mobility solutions.

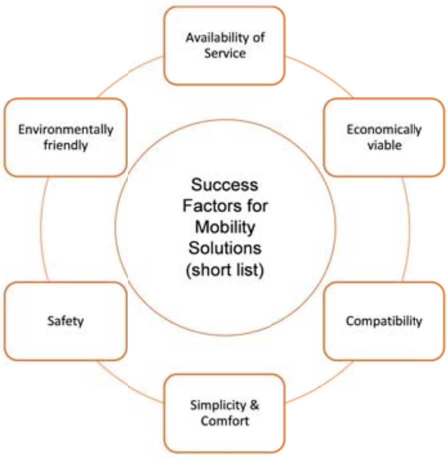

Figure 10: Potential success factors for mobility solutions (short list)

From the point of view of customers a mobility solution needs to fulfill their main transportation need, the trip from A to B. This includes the first domain of essential factors in for mobility solutions Figure *10*: the **availability** of transportation service.

As shown in Figure *2* the influences on trip behavior and commuting are based on main variables, like distance, time and frequency of travelling. Additionally there are influencing individual (microscopic) variables, like car-ownership and geographic (macroscopic) factors, like availability and distance to public transport stations.

Construction and maintenance of transportation infrastructure and services are cost-intensive and need proper business models. With mostly high investments and high operational costs for mobility services the **economic viability** is high in rank. This domain covers all cost related aspects, like funding, sponsoring, pricing policy, ticketing and more.

Transportation in urban environments is specified by different mode of transports and design of transportation network, stations and ticketing. The concept of “Mobility as a Service” is to provide integrated mobility packages based on customer needs. Integrated mobility mostly with public transport as a backbone complemented by other modes such as car-sharing, bike-sharing or on-demand services needs high **compatibility** in mobility solutions. Offering mobility solutions based on customer needs means to provide services with simple searching, booking and ticketing for reliable, comfortable and safe transportation. Based on the slogan “Information-Booking-Payment-Use” the Austrian project SMILE has developed an integrated mobility platform. For trips from A to B the mobility platform offers different individual options and combinations. These can be sorted by mean of transport, time, price and CO2 – this allows the user to specific search for **environmental friendly** mobility services.

With the European Standard EN 13816 the quality criteria for public transportation services are described. This European Standard specifies the requirement to define, target and measure quality of service in public passenger transport (PPT), and provides guidance for the selection of related measurement methods. It is intended to be used by service providers in the presentation and monitoring of their services but is also recommended for use by authorities and agencies responsible for the procurement of PPT services in the preparation of invitations to tender. Its use promotes the translation of customer expectations and perceptions of quality into viable, measurable, and manageable quality parameters. According to the standard, there are 8 criteria to measure the overall quality of service:[1]

- Availability
- Accessibility
- Information
- Time
- Comfort
- Security
- Environmental impact
- Customer care

This definition of quality criteria matches the factors described before. With focus on on-demand services, like *IST Mobil* operated in Korneuburg (Austria) further aspects and benefits are listed in Figure *11*.

[1] https://ec.europa.eu/eip/ageing/standards/city/transportation/en-138162002_en, EN13816,visited Feb. 2017

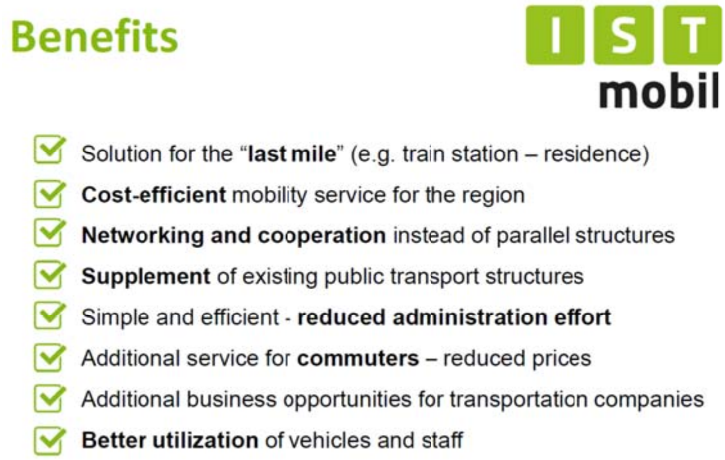

Figure 11- Benefits of on-demand services based on the example of IST Mobile, Austria

The objective of this Micro-PT System is to supplement existing public transport structures. Cooperation with taxi fleet operators and the use of public transport stations allows benefiting from synergy effects - main aspects for operating such microtransit systems.
As microtransit evolves, it promises to have important implications for public transportation, including in areas such as[2]:

<u>*Dynamic Routing Technology*</u>

Microtransit providers adjust routes and stops in real time by aggregating demand to provide the most efficient possible service. Each day, these companies work to build and refine the complex algorithms that make those rides possible. While they're currently focused on serving dense urban areas, many in the industry have speculated on the value of adapting the dynamic routing model to better serve suburban communities and other low-density areas where demand is elastic, and that are difficult to serve efficiently using traditional fixed route service. Once they have perfected their technology, today's microtransit providers may be able to expand their profits by licensing their algorithms to public transit agencies that serve disbursed populations.

<u>*Public Private Partnerships*</u>

Instead of licensing their technology, microtransit providers may also choose to work hand-in-hand with the public sector to serve riders directly. These operators could provide dynamically routed bus service or offer more efficient alternatives for paratransit, "dial-a-ride" transport and other important but inefficient forms of public transportation.

<u>*First and Last-Mile Connections*</u>

In addition to offering near door-to-door service, microtransit can also provide commuters with first/last mile connections to existing transit systems. Using new, more efficient ways to connect with transit for long-haul trips will help better sustain our cities' legacy transportation systems.

<u>*Providing More Options*</u>

Studies suggest new dynamic ridesharing services like microtransit have the potential to reduce single occupancy vehicle trips and decrease congestion in cities – all with relatively low overhead costs and high customer satisfaction.

In combination with other services, the flexibility of microtransit may play a key role in helping people live well without owning a car.

[2] http://sharedusemobilitycenter.org/ "Four Ways Microtransit Can Influence the Future of Public Transportation", visited Feb. 2017

6 Dissemination

The work and findings in WP4, especially for this deliverable will be disseminated at:

- ISPIM Conference in Vienna
  The XXVIII ISPIM Innovation Conference – Composing the Innovation Symphony – will be held in Vienna, Austria on 18-21 June 2017. *Abstract was submitted by project team: "Cross-Border Transfer of a Systemic MaaS Innovation"*

- Presentation in next GA
  The next General Assembly will be held in March 2017. As part of the program, findings and results of the project's first year will be presented, including parts of this report.

- Presentation in Growth Corridor Finland together with the results of WP 1 and 3 (M13)

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