Innovative Mobility Solutions in Rural Areas with Case Studies

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ABSTRACT

Rural areas still have some disadvantages in comparison to urban areas. Access to jobs, education or health services provided for inhabitants in rural areas is limited. Another important topics is mobility, which is crucial to meet the travel expectations of inhabitants in rural areas. Finding new forms of mobility, capable of covering all areas and meeting the requirements of rural inhabitants is the most important challenge. This chapter deals with mobility in rural areas from the perspective of demographics, social change and accessibility to transport services. Moreover, this chapter offers various case studies dealing with innovative solutions for mobility in rural areas resulting from the RUMOBIL project.

Keywords: Mobility, Case Studies, Rural, Modality, Accessibility, Innovation, Public Transport, RUMOBIL project, Changes, Smart, Marian Gogola, Dana Sitanyiova, University of Žilina

INTRODUCTION

Living in urban areas has important advantages such as the close availability of various services ranging from health service, shopping, and education, to cultural and sports events. One of the consequences of the lack of such opportunities in rural areas is urban drift. In particular young people decide to move to bigger cities in the hope of greater opportunities for employment or better education. As a consequence, many cities become increasingly overcrowded putting pressure on different kinds of infrastructure and services. Moreover, the exodus to cities together with the negative natural growth has led to a population decline in many EU rural territories, generating substantial gaps between regions of the same country and Europe as a whole. The territorial dimension of economic weakness and social exclusion has been widely recognized in European regions by O'Donnell, O'Donovan, and Elmusharaf (2018).There are also considerable differences in regional demographic patterns across the European Union (EU) from overcrowded big cities with relatively young populations to more remote, peripheral rural regions that may have declining population numbers. Demographic changes in the EU including rural regions are likely to be of considerable importance in the coming years. Above all, the EU population will continue to age as a result of a consistently low level of fertility and extended life expectancy. The social and economic consequences associated with population ageing are likely to have profound implications across the EU, both nationally and regionally. Among other issues, there is the challenge of developing the rural areas to make them more attractive to young people in terms of employment prospects, education and training opportunities, health services, social life, etc.

As many European rural regions suffer from an ongoing population decline and dynamic ageing, so services of public interest retreat from these areas. This, however, brings enormous challenges for the

provision of public services, such as public transport (PT). Transport plays a key role in responding to the problems of rural social exclusion and out-migration of the young generation from these areas. On the one hand, population decrease and limited funds to finance PT result in reduced PT offers. On the other hand, mobility needs in regions where people are aging quicker than elsewhere change and even increase. The large distances between services and rural population centers often cause difficulties for people without access to private transport. In the light of these challenges, it is important, both at EU and national level, to review and adapt existing transport policies, because changes in demography also have an important impact on the future demand on all forms of transport.

Many scientific works deal with this problem. Among others, the study of Leibert and Golinski, (2017) focuses on problems of demographical changes such as depopulation and ageing in German rural regions, leading to a discussion about the future provision of services of general interest and equal living conditions in the context of the future spatial development of Germany. In their paper, they argue that the peripheralization approach (peripheralization is understood as the process of producing and reproducing peripheries) is a helpful tool to better understand how the interaction of out-migration, dependence, disconnection, and stigmatization shape the future of rural regions and lead to their gradual weakening.

The importance of mobility in rural areas was studied by Milbourne, and Kitchen, (2014). Their study highlights mobility as an important shaper of rural lifestyles and rural places. They draw on empirical materials from a recent community study in rural Wales to reveal the difficulties associated with practicing everyday mobility in rural settings. Some studies (Rogers, Dufty-Jones, Steele, 2015) examined the problems and role of housing in rural areas.

In recent years, in several countries (including Slovakia, Czech Republic, Hungary, and Poland) the increase of road transport has also resulted in the significant growth of negative impacts on the environment, increasing congestion in urban areas or increases in road accidents. In parallel, in passenger traffic, the growth of individual automobile transport is reflected by a significant decline in the performance of public passenger transport (rail, bus and public urban transport).

As said before, the significant demographic changes which mostly all the European countries have been experiencing in the last decade are affecting travel behavior. Moreover, this trend is not homogenous across different areas of Europe. For instance, the current demographic development in East European countries is a process similar to the one that took place in the developed Western and Northern Europe from the mid-60s to late 70s. There are also significant demographic changes such as age, gender, household composition or income of its members. This matter is emphasized in rural areas, where accessibility is not properly ensured. Accessibility can be defined as the proximity or facility for spatial interaction and so, more generally, as access to health care, education, work and other services (e.g., shopping centers). Hence, the importance of public transport supply (mainly for rural areas which highly depend on provided transport services or transport infrastructures) is increasing.

BACKGROUND – NEW DEMAND PATTERNS AND CHALLENGES FOR PUBLIC TRANSPORT

Bearing in mind that rural areas are characterized by low population density, large distance from city centers, spatial scarcity of facilities and very often undeveloped public transport network, residents of rural areas are transport-deprived and often dependent on passenger cars (Ranković Plazinić, Jović, 2013). The concerns of policymakers and transport planners now lie with the problems of how to maintain public transport, on which the mobility of many people depends, and how to increase its attractiveness to car users. A significant shift from car to public transport would reduce congestion and at the same time improve the efficiency of all road-based transport operations, as well bring important environmental benefits. A complex understanding of the determinants of public transport demand will help transport planners to ensure sustainable transport in the future.

Below, the most important socio-economic aspects concerning demand patterns for PT in the future have been identified.

Age – There are big differences in the travel behavior of children, young people, adults, and older people, due to the different types of activities they are interested in. Children are primarily interested in educational and play activities, young people mainly in educational and social activities, adults in work-related activities and pensioners are primarily interested in social and leisure activities. These activities also influence the distance of their travel. This tends to be shorter for children and old people, while it can be considerably longer for young people and adults. The ageing of the population will change household structures (smaller family units) so social institutions will be required more and more to replace family care. More resources will be needed for structures and services dedicated to aged people: their specific needs will have to be addressed in urban planning, infrastructures, and services design.

Income and car ownership – People with a higher income, are not only *able* to travel more and longer but often they are *required* to travel (e.g. to work). This is very often linked to car ownership. Those who can count on a higher income often prefer to travel by a private car, while those who cannot afford it are forced to use public transport services, whose presence and quality becomes even more essential in rural areas (where services like car-sharing are very uncommon). On the one hand, the possibility of moving by car positively affects the development of the economy, employment and influences the way people live, increasing social inclusion, but on the other hand it has a very negative impact on the environment and traffic congestion, matters already very serious in urban or suburban areas.

Traffic congestion is something that the population of cities and commuters around the world have to face every day, costing enormous amounts of both time and money. **The processes of urbanization, disurbanisation, and suburbanization** play a central role. Urbanization is defined as the movement of the population from rural to urban settlements and from smaller settlements to larger ones, while disurbanisation is the movement from inner cities to their suburbs or surrounding communities. Both these processes should be seen not only as a change in population distribution and spatial structure but also as a change in the way of life.

What has emerged from the study conducted in RUMOBIL is that there is a difference between trends in Western European countries (Germany and Italy) and Eastern European countries (Slovakia, Czech Republic, Hungary, Poland). While in Eastern countries, apart from a few cases of urbanization, the overall trend is suburbanization due to economic reasons, in Western ones urbanization prevails, although to a lesser degree. It can be said that the Eastern countries are experiencing a process that Western ones have already lived in the last thirty years, after a massive urbanization process. It must also be said that the big cities of the Western countries already have enough developed suburban areas so that any change in the trend is slower and lighter.

Approximately half of the population of Germany lives in the 30 major urban German agglomerations, such as Berlin, Hamburg, Munich, and Cologne, but also in smaller cities including Münster, Freiburg, Leipzig, and Dresden. The research work by Henning (2018) helps to understand the demographic processes and development that occurred there in recent years, revealing some distinct trends of re-urbanization in some of the most densely populated areas. Examination of the average annual change in the populations of the selected urban agglomerations highlights the regional differences in these trends. Contrary to the national population decline, which is predicted to continue, 26 out of the 30 major agglomerations show population growth between 2008 and 2013. In 25 of these areas, population growth in the city center is even higher than in its suburban area. This can be seen as evidence of a very recent trend of re-urbanization in these places.

Suburbanization is generally seen as a negative phenomenon, although it brings some positive aspects. On the one hand, it is true that if part of the population moves to the metropolitan areas, it means that these sites will require investment, infrastructure, facilities that increase social inclusion. On the other hand, it means longer and more expensive trips for commuters and high effects on traffic congestion, air pollution, and noise (if there is no efficient alternative to a private car). Furthermore, there are negative

impacts on the protection of natural habitats and on quality of life (social issues, such as emptying the inner city, unequal distribution of jobs and people's homes).

Providing public transport in low-density rural areas is usually cost-inefficient, although necessary in a lot of cases, and it has been a challenge for many governments all over the world. Nowadays, several cities have multiple modal choices at their disposal, most often offered in a combination (conventional or automated metro, light rail or tramway, bus or BRT, or waterborne) plus other less conventional modes (cable car, tram-train or monorail). Cities with long-established public transport systems have problems particularly with ageing rail infrastructure and rolling stock and now need rehabilitation and automation to improve their operational efficiency and capacity. Besides challenges linked to quantitative growth, public transport must make significant qualitative improvements in order to become more attractive. The notion of quality in public transport should also be created through operational excellence, which includes enhanced frequency, punctuality and reliability of the service thanks to optimized network design and service performance. Likewise, smart ticketing and integrated travel information contribute to making public transport customer/user-friendly, while facilitating accessibility for all citizens. As far as rural areas are concerned, we can see some different needs and user types that lead to different demand patterns, like the following:

- inhabitants in rural areas without ownership of individual means of transport (i.e. cars)
- inhabitants with specific mobility needs (disabled, etc.)
- inhabitants in low densely populated areas which need to commute daily (school children students, commuters, etc.)
- inhabitants who travel irregularly (pensioners, etc.)
- tourists who consider particular rural areas interesting for any reason.

These groups refer to low populated areas where people are not able to provide adequate demand for regular public transport operation. To solve this, we can see various approaches. The first one consists of the development of regular operations based on short and regular intervals supported by integrated public transport organization. This is mainly for rural areas where the population is increasing. The population in these rural areas can take advantage of the proximity of economically strong cities.

The second approach is suitable for less populated areas and is based on the creation of good conditions for development of either public transport service on demand (so-called Demand Responsive Transport - DRT) or a combination of individual transport (cars, bikes) and PT.

Apart from new innovative forms of demand-based public transport service or combination of individual transport and public transport, the lack of efficient passenger information systems should not be underestimated. This may strongly reduce the use of public transport (where it is present) and increase car ownership. The provision of accurate, current information on arrival and departure times and stations can pose a challenge. Passengers from suburban, rural and remote areas need more reliable and sophisticated travel information compared to the urban area, because, unlike in urban areas, passengers in rural areas are provided with very limited transport facilities and alternatives, and generally make longer journeys.

Mobility and its quality are key elements of assessment standards in the countries of the European Union (EU). In general, transport is one of the basic sectors that significantly affect socio-economic development and growth. In passenger transport, quality depends largely on satisfying the everyday needs of citizens, including the level of access to work, schools, shops, accessibility to social care and leisure activities. The main objective of this chapter is to point out and discuss various approaches to enhancing public transport services in rural areas based on case study experiences.

Based on regional EU statistics findings, in 2016 in inland Europe the majority of trips were made by passenger car (83%)[1]. The study of Wolny (2019) confirmed this and explains car dependency in suburban regions in Poland. In general, transport services in rural areas have their own specification: the accessibility to services or budget. Smith, Hirsch, and Davis (2012) proposed minimum transport needs with an emphasis on household costs in rural areas. Operation and provision of g public transport in rural areas, usually on a cost-inefficient basis, has been a challenge for many governmental authorities all over the world. For some groups of passengers public transport is crucial because of lack of car ownership. It is necessary to find the right approach for authorities to combine many aspects within a transport system. Each low-density area can have its own optimal combination, depending on the wishes of the stakeholders and the circumstances of the system. Therefore, three ingredients are crucial for success: the presence of financial means from the perspective of the authority providing public transport, cooperation between stakeholders and flexible supply of scheduled and on-demand transports.

The study of Velaga et. al (2012) discovered that rural communities face a range of challenges associated with accessibility and connectivity which apply in both the physical and virtual sphere. Constraints in rural transport infrastructure and services are often caused by limitations in the development and resilience of technological infrastructures. In this context, there is a significant disparity between urban and rural communities. McDonagh, (2006) explains the transport policy instruments and transport-related social exclusion in rural areas of Ireland.

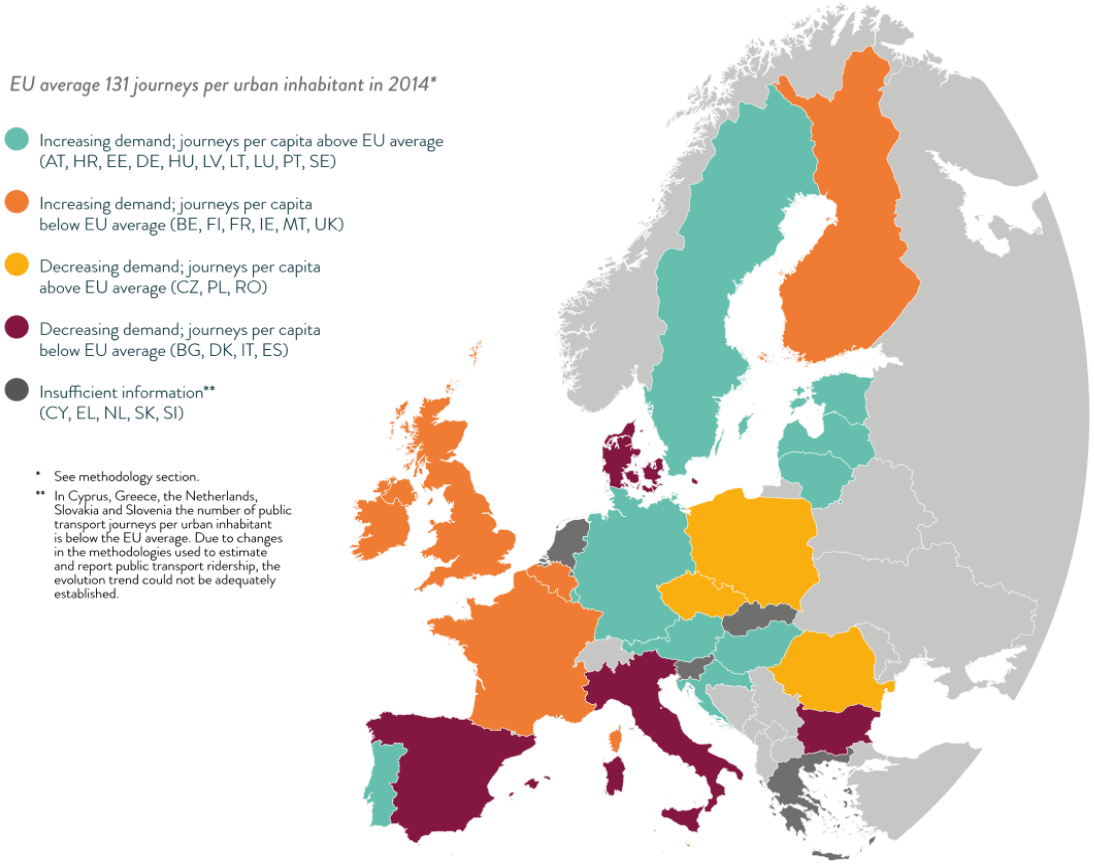

Figure 1. EU-28 Public transport journeys by bus, tram and metro per urban inhabitant in 2014 and evolution trend in the previous 5 years. Source: UITP, 2016

[1] https://ec.europa.eu/eurostat/web/products-eurostat-news/-/EDN-20180917-1

Certainly, there is a bigger difference between urban and rural or suburban areas. However, we can see there is still a lack of sufficient statistical data on public transport in such areas. The use of public transport in the EU reached its highest level since 2000, with a total of 57.9 billion journeys made in 2014 according to UITP's new Statistics Brief, 'Local public transport in the European Union' (2016). But we can say it is mainly in and around the urban areas. 2014 was the first year of distinct growth in demand for public transport after years of stable demand following the start of the economic crisis in 2008. The highest total demand in 2014 for bus, tram, metro and suburban rail was recorded in Germany (10.9bn journeys), UK (7.7bn) and France (7.6bn). Between 2013 and 2014, 'growth leaders' France, Italy, Poland, and the UK had a combined increase of 600 million journeys, driving up the total EU figure, see Figure 1.

Of the 57.9 billion public transport journeys made in 2014, 55.8 % were by bus, 16.1 % by metro, 14.5 % by tram and 13.6 % by suburban rail. The developments mask significant national variations, however, which are quite closely linked to national employment figures. 17 EU countries saw higher ridership in 2014 compared to 2010 but only seven had sustained growth: Austria, France, Germany, Lithuania, Malta, Sweden, and the UK. Bulgaria was the only country where ridership dropped every year since 2000. Encouragingly, countries such as Spain, Ireland, and Italy that have been impacted by the crisis, saw a return to growth in 2014. In EU capital cities, the average annual percentage growth in demand (2010-2014) was highest in Brussels; demand per capita is approximately 2.5 times higher in capital cities than the national average.

In general, there are various approaches to public transport organization. In many countries, local or regional public transport is organized by municipalities or their companies, and by regional or county government which subsidizes the service. The advanced system of public transport organization is represented by integrated public transport systems where all regional and urban transport systems are organized by one so-called integrator (e.g. in Germany or Austria there are the public transport unions, so-called Verkehrsverbunds).

Most regions in the Czech Republic have a similar organization . In Slovakia, meanwhile, there are only 2, although others are in the preparation phase. However, what is important from the legislative framework is the recommendation to have a Public Transport Service Plan according to Act Nr.56/2012 in Collection of acts on road transport in Slovakia[2]. In Slovakia, it is obligatory for each town, city or region. This plan determines the requirements of public transport supply based on transport demand respecting changing socio-demographic characteristics.

There also is a similar approach in Germany. For instance, in the Public Transport Plan for Saxony-Anhalt for 2010 -2025 (2018)[3] the level of and target for public transport service considering the future forecast is also stated. The public transport timetable is planned on the headway interval (so-called Taktplan). The plan also states the goals in updating the transport infrastructure and maximum travel time to reach important towns and cities to get to work or to schools and points out different approaches needed in various regions.

In economically strong countries like Germany, Switzerland, Austria or Netherlands, high-frequency public transport can also be provided in suburban or rural areas which are profiting from the proximity of big urban areas, or high population density. The problem occurs in economically weak regions or rural areas which do not have enough finance to support high-frequency public transport. In these areas, the population without a car is dependent on PT service.

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[2] https://www.slov-lex.sk/pravne-predpisy/SK/ZZ/2012/56/ Act also determines the basic conditions and rules for public bus transport organization in Slovakia.

[3] https://mlv.sachsen-anhalt.de/themen/nahverkehr/plan-fuer-den-oeffentlichen-personennahverkehr-des-landes-sachsen-anhalt-2020-2030/

New challenges of public transport

Public transport is facing many challenges and opportunities that result from changes occurring within the sector itself, as well as from external trends affecting its wider socio-economic environment. Growing urbanization leads to an increasing demand for transport, which requires a corresponding increase in mass transit supply to absorb it. The study by Wollner (2015) already described some new concepts of mobility in rural areas, in the CASI project they investigated a large collection of sustainable innovations from all over Europe illustrating well the future of sustainable mobility in rural areas.

Moreover, new mobility services are offered to solve problems with public transport demand and supply. Besides challenges linked to quantitative growth, public transport must make significant qualitative improvements to become more attractive. Passengers expect the same level of quality services and connectivity from public transport vehicles and stations as they already have in their environment and living space. Such services build on basic requirements, which include comfort, security, and cleanliness. The notion of quality in public transport should also be created through operational excellence, which includes enhanced frequency, punctuality and reliability of the service thanks to optimized network design and service performance. Likewise, smart ticketing and integrated travel information contribute to making public transport customer/user-friendly, while facilitating accessibility for all citizens. All these tools offer a huge potential to attract new public transport customers and consequently increase revenues.

The world is changing fast and urban areas are springing up everywhere, driven by the growth of cities of all sizes. Combined with rapid economic growth and the emergence of a large middle class in emerging countries, these trends are shifting the world's center of gravity to the South-East. Globally, some 1,000 cities of more than 500,000 inhabitants are already facing major mobility problems, due to the near impossibility of providing adequate infrastructure to keep pace with the ever-increasing popularity of the private car. In the meantime, in Western countries, car use seems to have reached a ceiling. Young people according to the UITP Public Transport Trends Report (2015) are now more interested in all the latest mobility solutions than in car ownership. In urban and rural areas, this is leading to new mobility behavior. Concerning rural areas, the statistics show different trends there, so we would like to present some good examples that can be taken for inspiration.

South-Moravian region

Interesting results are provided by the study by Stastna et al. (2015) focused on integrated public transport in South-Moravia ensured by the Integrated Transport System of the South Moravian Region. This joint venture company involves 21 state-owned, communal and private companies in unified tariffs and schedules, operated from one place with mutual interconnection of various public transport systems. It covers 672 of 673 communes in the region (both urban and rural) and an additional 55 communes in neighboring regions including small overlaps to Slovakia and Austria. It operates over an area of 8,117 km2 with 1,221,212 inhabitants (2010), including villages with small populations and out-migration trends. The system is under permanent monitoring and the routes, schedules, and other characteristics are adapted according to the needs of inhabitants. The system consists of 331 public transport lines, including 25 railway lines, 11 tramway lines, 13 trolleybus lines, 79 bus lines of urban transport in 10 cities and towns (including Brno) and 193 regional bus lines altogether with about 3500 stops. Railway and tramway lines outbalance in radial directions, whereas buses mostly on the tangential ones. The system generates more than 20,000 daily connections. It operates with 1300 vehicles. The average number of public transport connections according to the study is 27. The reachability analysis (analysis of total travel time required to get from the origin village or small town to the destination urban center in minutes) showed that all villages or towns are a maximum of 40 minutes from the closest urban center. The output from this case study shows that rural areas can profit from a PT offer which is based on the integration of PT services or other services related to mobility.

Mittelthüringen

Another interesting example is related to Public Transport Union Mittelthüringen. The Verkehrsverbund Mittelthüringen - VMT (2018) is a consortium of 13 transport companies which offer regional local transport as a simple, environmentally friendly and inexpensive mobility solution. The territory of the VMT includes the cities of Erfurt, Weimar, Jena, and Gera as well as the counties of Gotha, Weimarer Land, and the Saale-Holzland-Kreis. In this case, passengers from rural areas also benefit from a single public transport system. The system covers urban as well as rural areas with frequent public transport service.

But based on the evidence from UITP, rural inhabitants are more likely to use and need cars. This is mainly caused by the lower accessibility of other forms of transport mode. The statistic of the Association of German Transport Companies (2016) shows and confirms the data about modal split in various types of settlements, see Figure 2. It provides interesting information about the relationship between urban-rural typology and changes in demand for transport.

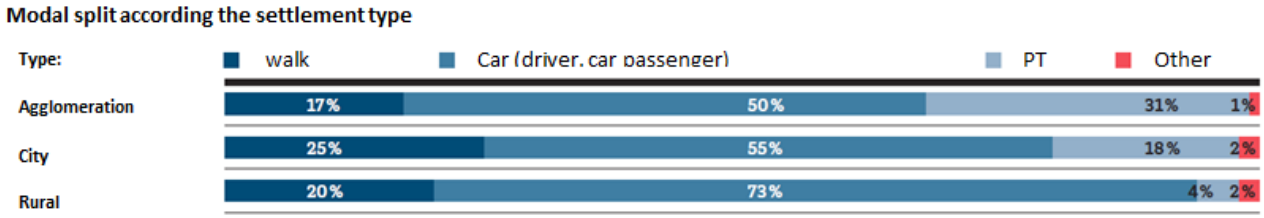

Figure 2. The modal split according to the settlement type, Source: The Association of German Transport Companies, 2016

Based on UITP, there is a correlation between the modal split in well-served urban areas and public transport service provided (Figure 2). Demand for PT in rural areas is very low. Due to this fact, low density rural areas cannot be fully supplied by common public transport services, and new approaches are sought.

New approaches and forms of public transport

Rural areas are facing problems with everyday mobility. Analysis of the current status in particular countries clearly indicates that rural areas are facing changes, especially in travel demand. However, various mobility solutions have already been testing new ways of supplying public transport services in many countries. These methods respond better to uncertain travel demand. The role that taxis or other demand-responsive transport services could have, alongside conventional public transport, in meeting the transport needs of rural dwellers were examined.

Two principal approaches prevail. The first one is the development of regular operation based on short and regular intervals supported by integrated public transport organization. This is suitable mainly for rural areas where the population is increasing, or in the case when these rural areas can benefit from the proximity of economically strong cities. But what if the rural area is represented by low-density population and small settlements distributed in the area? In this case, it is recommended to establish the minimum public transport frequency service which will guarantee the minimum number of connections to or from cities to the rural area. This can be ensured by the implementation of standard quality criteria in the contracts between operators and governments or municipalities.

The second approach is suitable for less populated areas. It is based on the creation of good conditions for the development of a combination of an on-demand and conventional public transport, promising improved mobility and increased service coverage. Some studies, for instance (Wang et. al, 2015) already tested the propensity of such transport in a rural area. There are many examples of such a service as Dial a

bus in Belgium[4], Germany[5] or the UK[6]. Even if DRT services are not an innovation, new recent technologies enable their large scale involvement. Nowadays, new solutions based on the concept of Mobility as a Service (MaaS) are emerging. This includes the development of smartphone apps which help to manage, monitor or order transport services for customers. Various forms of mobility combining different modes of transport including non-motorized supporting the multimodality including bike-sharing, carsharing, carpooling, Bike+Ride, Park+Ride, e-scooter-sharing, etc. are also suitable for rural areas with low transport demand.

Figure 3 presents the basic concept for an innovative solution in rural mobility. Conventional modes such as trains or buses are still represented, but it is necessary to also add individual modes and apply the new MaaS services. This can be converted in the new framework called the SMART RURAL MOBILITY, Figure 3.

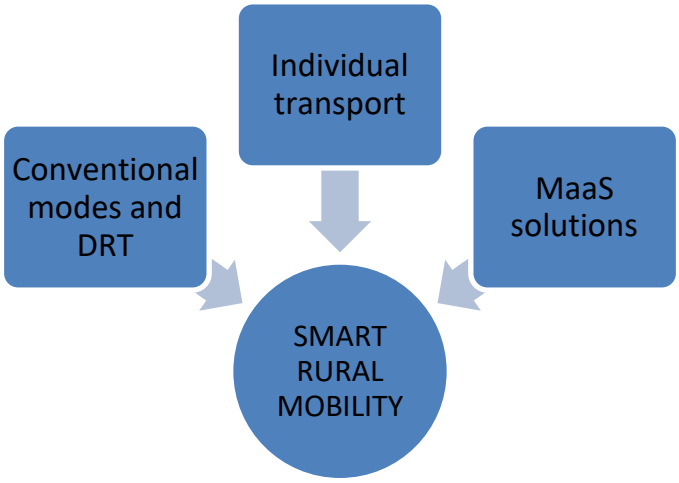

Figure 3. The right mix for solving mobility in rural areas

Mobility as a service in rural areas

As mentioned above, rural areas have specific characteristics that need to be properly addressed towards guaranteeing and adjusted mobility to its population transport demand. According to the study provided by Barreto, Amaral and Baltazar (2018), MaaS - a key component of any future mobility system - will play an important role in enhancing social inclusion in rural areas. Creating the opportunity to integrate various transport modes and functionalities, this system will allow access to information, in a personalized way. As they presented in the pilot cases, MaaS can integrate various transport modes, allowing the rural population to increase their quality of life.

Eckhardta, et al. (2018) presented a paper providing characteristics of rural areas for MaaS development in Finland based on a project co-funded by the Ministry of Agriculture and Forestry of Finland. The paper presents rural mobility SWOT analysis and challenges, as well as goals and vision. Solutions for MaaS services in terms of collaboration, services & markets, planning & decision-making, and technology & information are proposed. The next steps to be taken in rural MaaS development in Finland are examined there too.

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[4] https://www.delijn.be/de/belbus/

[5] https://www.landbusunterland.at/anrufbus/

[6] https://www.nidirect.gov.uk/articles/dial-a-lift

In our chapter we would like to describe some of the case studies with the pilots of new mobility services in various regions of Europe during the RUMOBIL project. The RUMOBIL consortium demonstrated a roadmap – RUMOBIL strategy towards smart rural mobility including MaaS concept elements divided into three fields of concern:

1. New approaches and transport services to link rural areas to national and EU transport;
2. Improvement of access points to public transport networks to render offered services more attractive;
3. Enhancement of passenger information to promote the use of public transport in rural areas.

CASE STUDIES: RUMOBIL PROJECT

Alternative transport services and new innovative solutions may play a key role in keeping rural people engaged in mainstream society. The main objective of the RUMOBIL project (supported by the Interreg Central Europe program in the period April 2016 – May 2019) was to improve public transport in nine rural areas by better connecting those areas to the national and European transport networks. The project provided answers to the core-periphery dichotomy in the CENTRAL EUROPE area. Thanks to the project, the gap between peripheral and less accessible regions and the area's well-connected centers could be reduced.

Quicker and more comfortable access to public transport positively contributes to the quality of life in rural areas and supports business activities there. To meet that aim, a set of evidence-based policy recommendations was elaborated at the end of the project to improve the capacities of local and regional decision-makers responsible for the design and coordination of public passenger transport in Central European regions affected by demographic change. These recommendations were presented in the form of the RUMOBIL Model, a strategy which provides insights into already proven good practices and novel solutions. This means that new public transport solutions, new transport planning knowledge, and new strategic recommendations were transferred to decision-makers, public officials and transport professionals.

Eight pilot actions, performed in rural regions of some Central European countries (Germany, Italy, Croatia, Czech Republic, Poland, Hungary and Slovakia), allowed the testing of a number of innovative applications during the period 2017-2019 in order to determine how sparsely populated peripheral areas can be better linked to a primary, secondary or tertiary transport node (access to European and national passenger transport networks). These pilots were experimental trials, small-scale, short-term projects, which helped partners learn how a large-scale project might work in practice in the future in the region. The pilot projects provided a platform for the partner organizations to test measure, prove value and reveal deficiencies before spending a significant amount of time, energy or money on a larger-scale project. All pilot projects began with a proposal listing the objectives of the action.

A set of monitoring indicators was defined to measure outputs against the goals of the pilots and RUMOBIL project as well. In total 51 indicators were examined. All partners gathered data from their pilot regions with the aim of giving an overview of the functional features of the existing transportation system and baseline situation in the region before and after pilot implementation. Data were used to prepare a transport demand prognosis for the future in mid-term and long-term horizon, measure user satisfaction with the pilot measure, and measure project impact in the future. Partners selected their set of indicators, choosing a mixture of different types of indicator suitable for individual pilot projects and providing data for all purposes mentioned above. Because there were various types of pilots, the common comparable set of indicators was defined. While some indicators were unique or tailored to a specific pilot project context, some common indicators were required, too, with the aim of comparing results among partners. That data was used for evaluation of pilot performance (ex-post evaluation), assessing the value for money of the pilot, valuation of user acceptance and satisfaction, and for transport demand prognosis. Indicators were quantitative and qualitative and divided into five groups: Geographical, Socio-

demographical, Operational, Economical and Qualitative. Some result indicators are reviewed in this chapter.

The base situation in regions

Spatial and socio-demographic characteristics

All partner regions are rural areas, however with different **spatial** or **socio-demographic characteristics**. The size of **area** covered by pilot measures (area where the PT service is accessible) in partner regions ranges from the biggest one 5,339 km^2 – region in North-Western Mazovia (PL) located around the two railway lines Nasielsk – Sierpc, and Sierpc – Kutno and the smallest one covering area 71 km^2 – Microregion of Kaplice (CZ), a part of South Bohemia region.

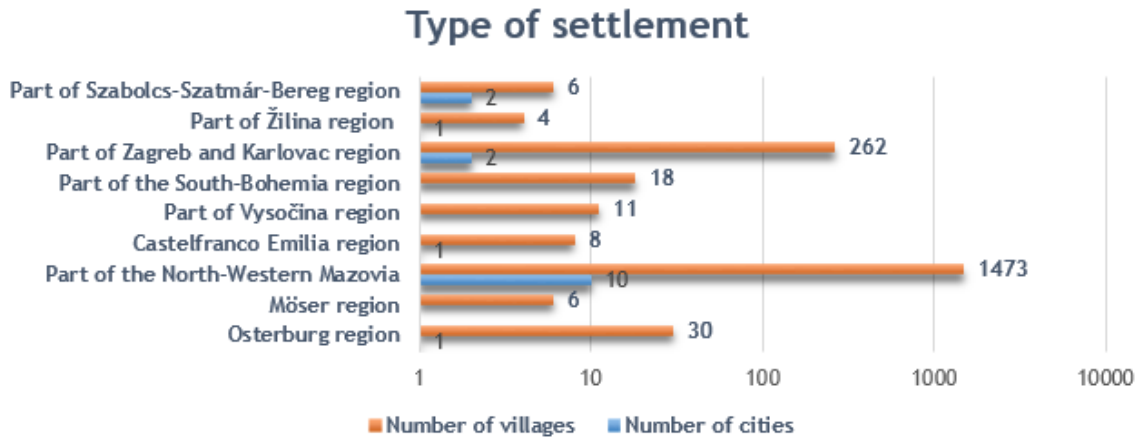


Figure 4. Typology of settlements in partners' regions, Source: RUMOBIL, D.T2.6.2 Quantitative evaluation, 2019

Population density varies between 44 inh/km^2 in Osterburg region (D) and 321 inh/km^2 in Castelfranco Emilia (I). Most partner regions are predominantly rural; regions, where the rural population live in settlements under 5,000 inhabitants account for 50 % or more of the total population and villages represent the main type of settlements, Figure 4.

However, some of the regions are very close to big cities (Zagreb, Bologna, Modena), which explains why they were assigned as urban/rural or intermediate regions. The information about **the spatial distribution of settlements** was useful to understand spatial implications and relationship between urban and rural environment. Concerning demographic patterns, the biggest population lives in the Mazovia region – 365,657 inh. (2017), which represents 60 % of the RUMOBIL target group, while the least populated area is a part of South-Bohemia region – 3,263 inh. (2017), representing 1 % of the RUMOBIL target group.

South-Bohemia, Vysočina (CZ) or Szatmár-Bereg region (HU) represent low-density rural areas with poor public transport service. For example, Vysočina Region situated in the center of the Czech Republic differs from neighboring regions by its dissected territory, higher altitude, and low residential density. Disintegrated residential structures very often cause people, especially young and qualified inhabitants to move away from smaller municipalities. Economic performance of this Region in comparison with other regions of the Czech Republic is below the average. Then there are rural areas which are near smaller cities as the Mazovia region, Žilina region and Ozalj (Karlovac) region (HR) benefiting from their position. Another case is represented by CastelFranco Emilia region, which in fact lies between the suburban area of Modena and Bologna.

Most of the partner regions suffer from **population decline**. An exception is Castelfranco, where the population growth rate was +1.11 %/year (in period 2011-2014). The town Castelfranco Emilia in Modena Province, the site of the pilot project, is located about 13km east of Modena; it has a population of 32,174 inhabitants (2014). The town is situated on the main regional and national rail network that allows easy connections to the main cities of the region, and from there, particularly from Bologna (25 km distant from Castelfranco Emilia), it is possible to enter trains to many Italian and European destinations. The territory of the municipality is quite extensive and includes eight minor villages that consist of predominantly rural areas and no relevant production or industrial facilities are present in the territory. The proximity to two important towns such as Modena and Bologna, the lower cost of housing than in the main cities, the presence of public services and in particular the good train service, have fostered a strong demographic growth in the last 25 years accompanied by significant growth in commuting. The increase of population was initially in the small villages around Castelfranco Emilia and this, some years ago, has created a kind of repopulation of rural-agricultural areas that were more attractive than the main city. This attractiveness has created new needs, principally for people that are getting older, to access the main services located in the central town and cities.

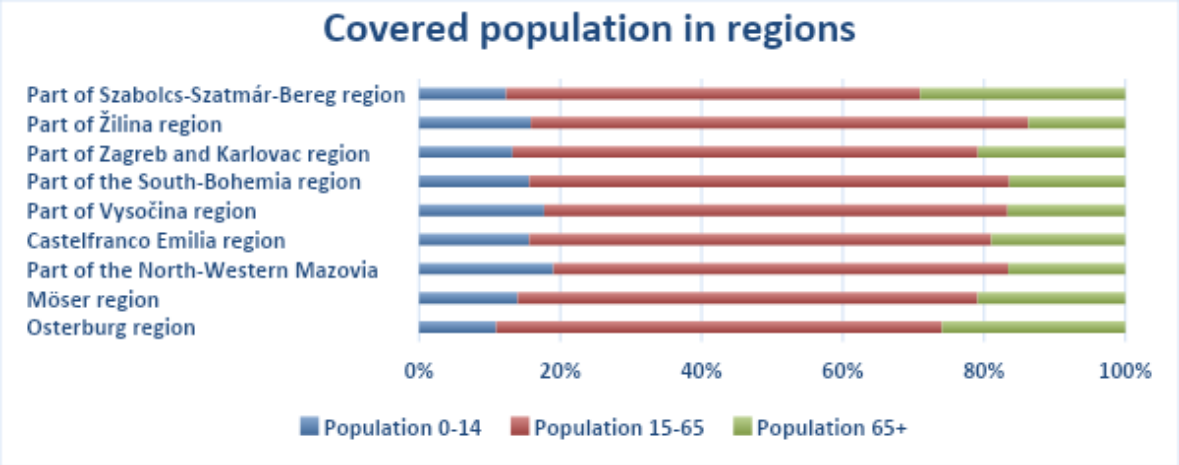


Figure 5. Populations by age groups in partners' regions, Source: RUMOBIL, D.T2.6.2 – Quantitative evaluation, 2019

Ageing is a problem in all the RUMOBIL partner regions. Especially in Szabolcs-Szatmár-Bereg County, where people in the group 65+ represent 29 % of the total population, Figure 5.

One of the indicators of population ageing is the **ageing index**, or the elder child ratio, defined as the ratio of elders (individuals 65+) to children (youths under the age of 15). Populations with ageing index scores of 15 or less are described as young, whereas populations with aging index scores of 30 or greater are considered old. Populations in all partners' countries are old. When we compare the ageing indices in the partner regions with the ageing indices in the relevant countries we see that the worst situation is in Osterburg and Szatmár-Bereg region and the best situation in Castelfranco Emilia region, Figure 6.

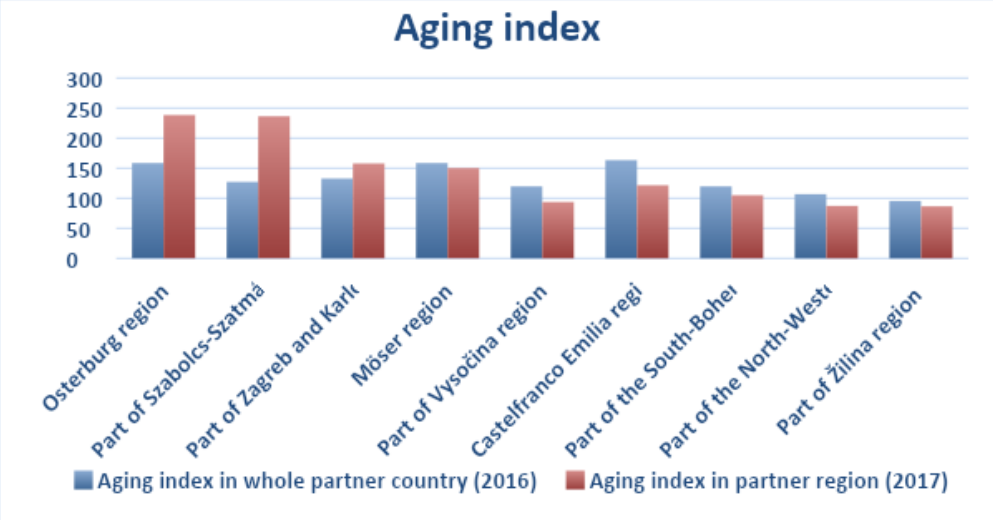


Figure 6. Ageing index in partners' regions and countries, Source: RUMOBIL, D.T2.6.2 – Quantitative evaluation, 2019

Consistently low birth rates and higher life expectancy will transform the shape of the age pyramid in partners' regions; probably the most important change will be the transition towards a much older population structure, a development which is already apparent in the many EU Member States.

Demographic and social factors are very influential in public transport demand. Population growth, as a leading factor, and population characteristics (e.g., age structure, the declining proportion of young people, ageing) have a big impact on the use of public transport in rural regions. Without understanding the transport system dynamics and more importantly, the behavior of public transport travelers, it would be difficult to make accurate transport demand forecasts, which are necessary for marketing, service planning and fare policy purposes for regions.

Operational or performance indicators are widely used in transport planning and evaluation purposes. Performance measurement can support public transport planning in rural areas in many ways. Respecting the aims of the RUMOBIL project, selected operational indicators allowed the determination of whether resources were used efficiently and equitably, identification of potential problems and wins, and verification of whether a particular pilot achieved its predicted targets. They were also used for comparison among partners, even if there were different types of pilots. Some pilots intended to launch new services (Saxony-Anhalt, South-Bohemia), others focused on the improvement of existing services (Vysočina, HŽPP) or interchange hubs or stops (Žilina, Szatmár-Bereg), and yet others implemented new technology in the operation of an existing service (Mazovia, Castelfranco). In all cases partners needed to collect information about the public transport service in the target area before and after pilot implementation focusing on the particular mode of transport, which was related to the pilot, however some indicators were dealing with data on the whole public transport service in the target area focusing on transit of passengers from target area to central town or city.

Most of the partners' areas are served by bus and rail transport except the Vysočina region which is served only by bus transport. German and Italian regions are also served by DRT service. **Accessibility** of public transport is one of the key attributes of its quality, which indirectly affects its competitiveness in relation to car transport because the advantage of car transport mainly lies in its door-to-door concept. Spatial accessibility was defined as a distance to overcome to get to the public transport stop or station (km). The best situation is in Szatmár-Bereg with average distance 0.3 km to the nearest stop, Figure 7.

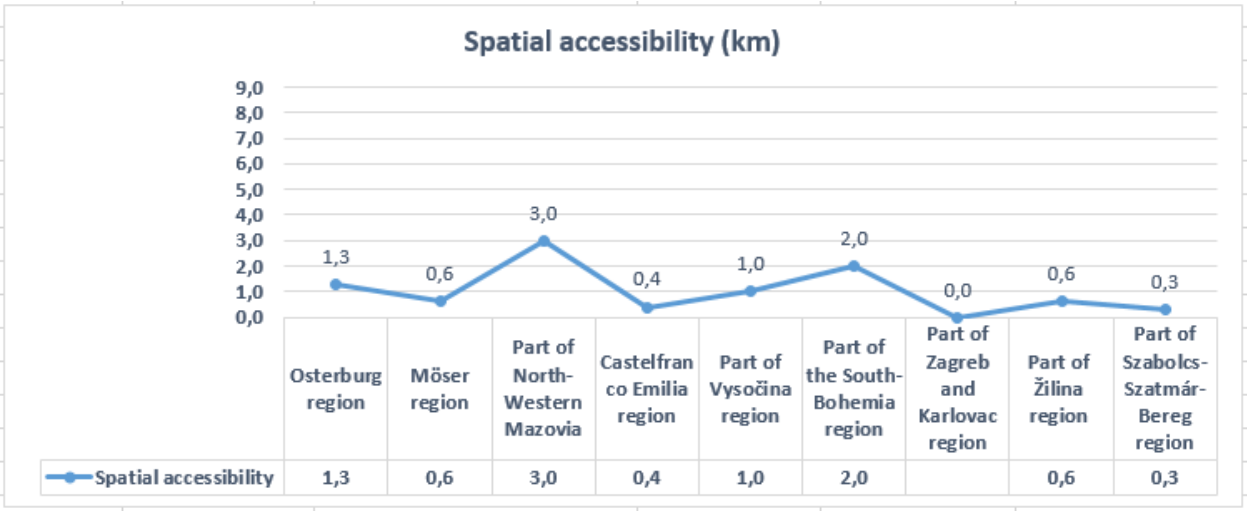


Figure 7. Spatial accessibility of PT in partners' regions, Source: RUMOBIL, D.T2.6.2 – Quantitative evaluation, 2019

Regarding the result of the correlation analysis (Figure 8), there is a mild correlation between population density and spatial accessibility (correlation coefficient -0.53) in partners' regions. HŽPP did not provide data on spatial accessibility.

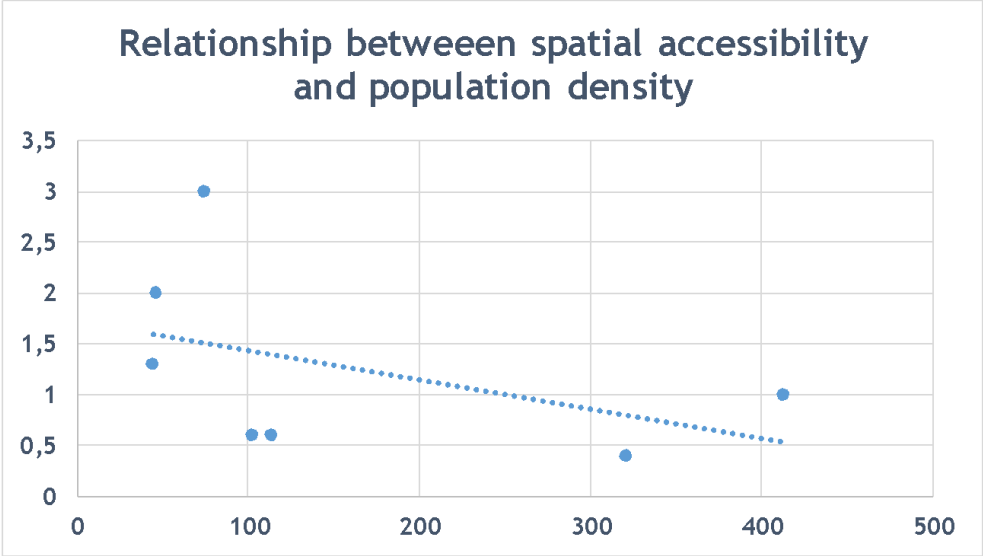


Figure 8. Correlation between population density and spatial accessibility in partners' regions, Source: RUMOBIL, D.T2.6.2 – Quantitative evaluation, 2019

There are different characteristics of target areas in partner countries in terms of size, population density and transport mode evaluated. The most stops are in the Castelfranco Emilia region, where the population density is very high. There is one more important **intermodal point** in each target area of partners' countries, except Mazovia with two of them.

In rural areas, the journey very often starts with driving a car or riding a bike and ends with using public transit. In this case, it is very important to have an appropriate parking lot or parking places or facilities close to public transit stations or stops. The situation is very different in partner countries. There is a lack of parking places, especially in the Mazovia and Ozalj region.

Reachability was defined as total travel time required to get from origin (average distant village) to the destination (in minutes) connecting the rural environment with the central (bigger) city. The biggest distance is between Ozalj and Zagreb (around 60 km), the average travel time by train from Zagreb to Ozalj is 82 min. The best result is in the case of Castelfranco served by DRT service, however, the biggest distance between the most distant village and the central city is only 12 km (Figure 9). If we compare the ratio between travel time and distance for the Italian region (1.5) and Croatian region (1.36) the reachability is better in Croatian region using the train.

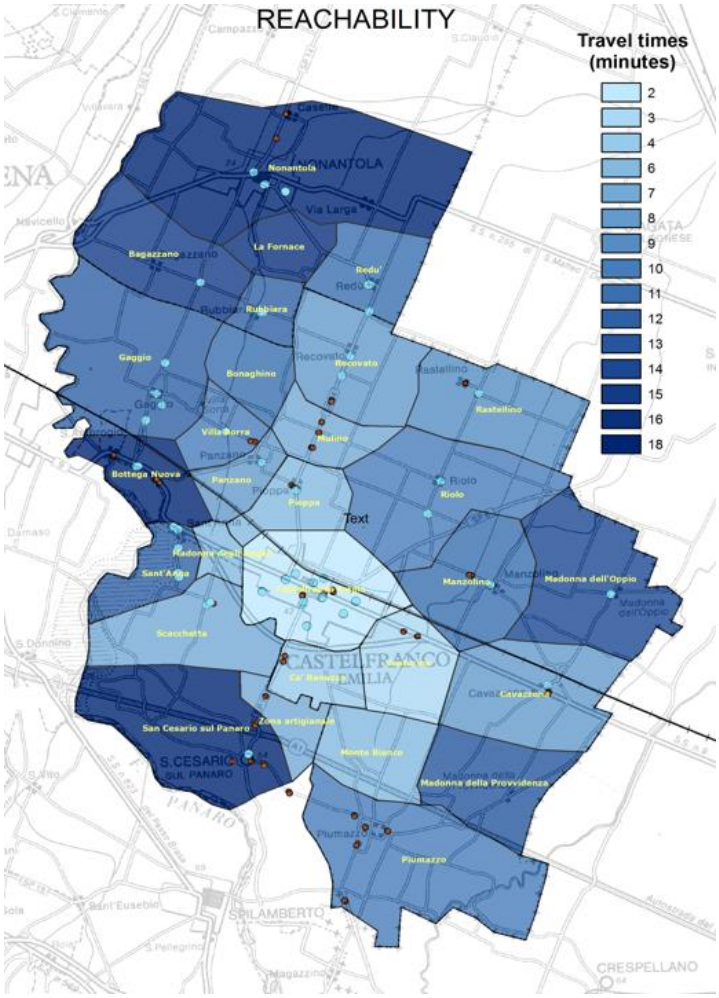


Figure 9. Reachability in Castelfranco region, Source: RUMOBIL, D.T2.6.2 – Quantitative evaluation, 2019

Optimal price, time values and service **frequency of public transport** are very important factors for passengers' behavior. Higher frequency means less waiting, probably the worst part of using public transport. At the same time, increasing frequency may be the best investment that can be made to get people out of their cars. However, it is not easy to ensure the required frequency in rural areas and it is necessary to solve the frequency optimization problem. The solution should satisfy a given origin-destination demand and a constraint on the available fleet of buses or other transport modes. Frequency varies from 9 connections per day in Vysočina (bus connections) and Ozalj region (rail connections) to 144 in the Casterfranco Emilia region including regular bus + on-demand service + train connections per working day (average – 6 rides per hour).

All partners provide a regular **operation regime**, except the German and Italian partners. **Flexible transport service** can cover a range of different mobility offers, where services are flexible in one or more of the dimensions of time, route, vehicle allocation, vehicle operator, type of payment or passenger category. Flexible transport services are usually used as a part of the public transport mix in areas where the demand is too low to support conventional public transport. MLV introduced a new type of service – Burgerbus, characterized by the fact that bus drivers are local volunteers. In this way, service costs are significantly reduced compared to a traditional service. DRT service in Castelfranco is provided by aMo as a combination of regular and flexible, possibly on-demand service.

The offered capacity is equal to the number of seats available multiplied by the number of kilometers ridden. Even if there are different types of public transport service available in partners' area, we can compare the offered capacity regardless of the capacity of vehicles (from low-capacity minibuses to medium or high capacity trains). This indicator is very important to provide information for capacity normalization, comparing the offered capacity with other indicators such as the number of passengers, Figure 10.

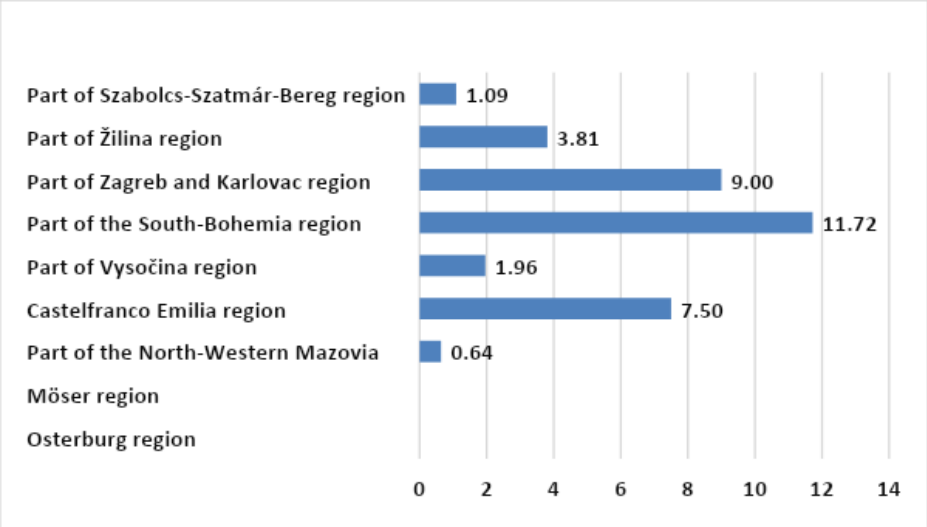


Figure 10. Capacity offered by PT services in partners' regions, Source: RUMOBIL, D.T2.6.2 – Quantitative evaluation, 2019

In most of the partners' regions, there were no substantial changes in capacity offered in the target area after pilot project implementation, Figure 10. The same capacity was offered in Ozalj, Mazovia and Vysočina region; there was a decrease of 5 % in Castelfranco, an increase of 25 % in Mazovia and an increase of 12 % in South-Bohemia (where a new line was introduced). MLV did not provide information on this indicator for Möser and Osterburg region. Travel costs include all travel costs necessary for a trip to the central city. They were calculated especially for a single or intermodal trip by public transport. Some partners also provided costs for individual modes of transport (bus, car, rail) for a standard trip on working day. The highest price was calculated for the trip by train from Ozalj to Zagreb, however, it is also the longest trip (approx. 60 km), Figure 12.

Figure 11. Parking fee in the central city in partners' regions, Source: RUMOBIL, D.T2.6.2 – Quantitative evaluation, 2019

Parking fees were calculated as a standard parking fee for all-day parking in the target city. The highest parking fee is in Zagreb, on the contrary parking is free of charge in Castelfranco, Mazovia, Szabolcs-Szatmár-Bereg County, Möser and Ostreburg, where the central city usually represents small towns, Figure 11.

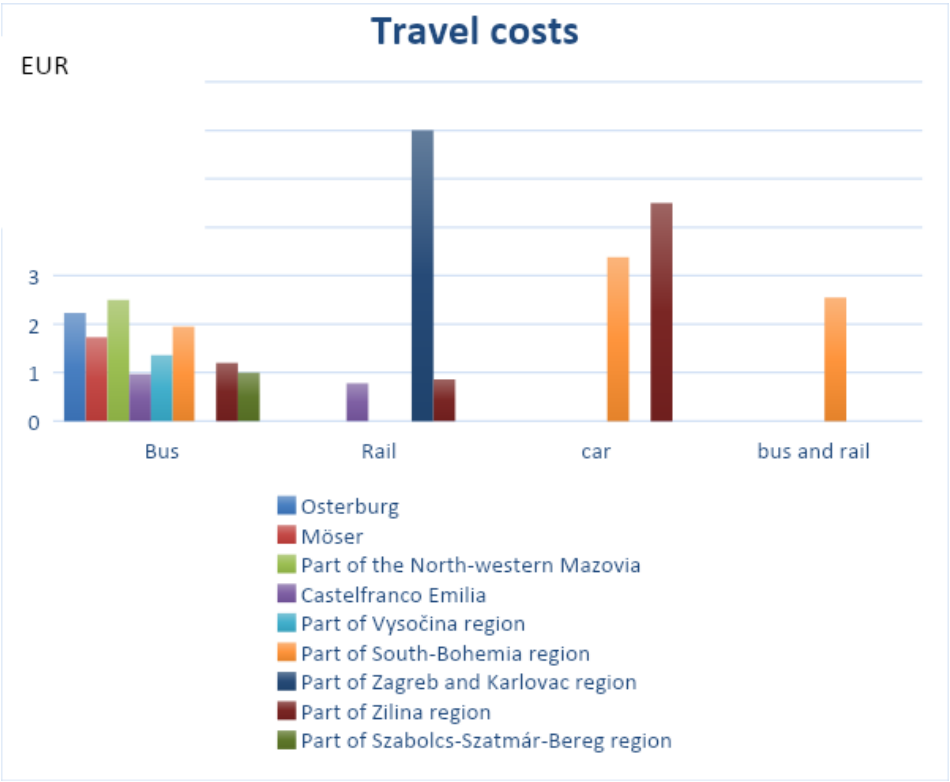


Figure 12. Travel costs to reach the central city in partners' regions, Source: RUMOBIL, D.T2.6.2 – Quantitative evaluation, 2019

Lessons learned from pilot projects

Lessons learned from the pilot measures were summarized in the RUMOBIL Strategy – a decision-support model that proposed a set of general recommendations and verified solutions to reduce the critical issues of mobility in rural and peripheral areas and outline the relative implementation progress. The Strategy was contextualized with consideration given to the very different characteristics of each territory in terms of needs, limits, and potential,. The objective of the RUMOBIL strategy (2018) is to contrast the population decrease, guaranteeing the transferability of the strategy outside the partner territories and beyond the end of the project. In order to pursue this objective, the RUMOBIL Strategy mainly takes into account three key aspects, i.e. the target users, to whom the solutions have been addressed; the users' needs, which should be satisfied; and transferability. The general target user of the solutions identified is the wide group of inhabitants of rural areas, focusing on more specific groups depending on the particular needs to be satisfied in each area (e.g. disabled, elderly people and/or students). In rural and peripheral areas and regarding mobility questions, the need for an effective and useful public transport system is surely the most urgent request to be satisfied. Indeed, in many partners' territories the improvement of PT has been highlighted, in terms of enhancement of the supply (frequency, no. of daily departures, etc.), creation of more appealing services for users, more accessibility to PT systems for all users in rural areas in general, and disabled and elderly people in particular, and promotion of the systems in order to raise citizens' awareness of the services. The RUMOBIL Strategy can be considered "transferable", as it is a unique model that allows decision-makers and stakeholders to identify the most appropriate solutions to be adopted in every rural area.

Considering all the inputs collected and analyzed during the project, the Strategy was built on the identification of solutions, in terms of concrete actions, and recommendations emerged from:

- good practices in Central Europe,
- the current technological state and the correlations with economic and demographic issues,
- analysis of the main requirements of a good "service strategy" able to satisfy the users' needs.

Solutions and recommendations have systematized consistently with the actions to be taken as follows:

Transportation planning

The importance of a rational system of transportation planning and decision making has been recognized in the RUMOBIL partnership, consisting of:

- inventorying existing travel and activity patterns in the region, respecting relationships with other regions, and the national and international context,
- developing models of local transportation supply and demand relationships,
- formulating transportation options,
- forecasting the effects of each option on the travel of different target groups,
- evaluating each option on the basis of economic and other criteria.

Carrying out these steps requires an optimal regional institutional arrangement for transportation planning and decision making. The future is uncertain, especially now in the face of globalization and the high tempo of social, demographic and technological changes. It is difficult but very important to understand uncertainties and objectively estimate transport demand in rural areas. A future-oriented public transport for rural areas should consider demographic trends, socio-economic changes and the diversity of users and provide tailored offers. It is necessary to assess customer expectations and align them with service capabilities. In this way, PT supports the provision of equal living conditions in rural areas. Information analyzed during the project was examined together with respective stakeholders to prepare the decision-

making processes leading to the implementation of the RUMOBIL Strategy through improved transport strategies and plans.

PT offer and local development

A strong public transport is also an important factor for the prospects of rural areas. Well-designed and organized PT supports general development along PT corridors and a more homogeneous countryside. Improving public transport between urban and rural areas can increase connectivity between urban and rural areas, help develop local economies, contribute to the growth of local business and integrate the rural environment into a mainstream economy. Good public transport service offered by operators can, with the help of local government, create satisfaction by employing local people and different stakeholders, promoting heritage, sights and natural beauties. People are interested in visiting rural areas with specific tourist attractions and routes, and if combined with natural adventure, sport or other activities, these kind of routes are excellent for attracting visitors, and thus PT passengers. With people coming, the local population has a reason to stay in a rural area and provide services. For tourist destination areas, encouraging a transfer from cars to public transport can reduce congestion and parking or environmental problems in areas often visited for their tranquility, natural or historic landscapes. PT also presents the potential for engaging with visitors, enhancing the visitor experience and attracting new markets. The elements to which attention should be given are personnel, cooperation and coordination of all stakeholders promoting existing sights (natural, cultural, infrastructural, etc.) to expand tourism in the region. Good examples of this approach are presented by pilots from the Ozalj region and South Bohemia region.

Ozalj region

Ozalj is a small town in central Croatia (Karlovac County), located 65 km far from Zagreb, the Croatian capital. The official name of the pilot project implemented there was "Tourist trains for improving rural mobility and economy". Pilot project activities included the organizing of special tourist trains to the Ozalj area. Each of them was linked to a special event in this region. A total of 39 trains were organized. Provision of pilot project train lines and pilot project communication activities was the responsibility of HZPP (HŽ Passenger Transport Limited Liability Company, the national rail operator). Representatives of the City of Ozalj were responsible for creating the content and the events at the destination – the administrative area of the City of Ozalj. When organizing each special train and its content, HZPP also cooperated with local stakeholders, like the municipality of Ozalj, and 20 other stakeholders representing local organizations, and businesses. HZPP aimed at increasing the number of train passengers by introducing new train services between isolated rural areas in Karlovac County and the secondary transport hub in Karlovac (Zagreb-Rijeka railway – access to the Mediterranean TEN) to the primary hub – Zagreb. The new service was designed to suit both the needs of commuters and the itineraries of tourists and to generate additional users. A marketing campaign, promoting the pilot, was conducted by external experts. They created a Facebook page, arranged radio commercials and TV appearances as well as prepared leaflets so that the public was informed about the new rail service, Figure 13. Most trains were planned to operate and provide services on the following Zagreb – Jastrebarsko - Karlovac – Ozalj – Kamanje route (with possible stops in some stations along the way to allow passengers to board, depending on each train theme). The pilot project helped to enhance the local economy, especially the tourist industry, and supported local producers, shopkeepers, and cultural organizations by attracting more people to visit the Ozalj region. Good lessons were learned around the coordination of the transport offering, cooperation with different local stakeholders and creation of interesting events. Special tourist trains were organized from early spring to late autumn, including for example the “Slava Raškaj tour through the city of Ozalj”, “Spring awakening”, “Honey tour through Zaluka plant”, “Days of wine”, “The old villages games”, “City beach swimming”, “Štrudlafest”, etc. As a positive result, the City of Ozalj recorded an increase in overnight stays of guests from Zagreb and the surrounding area and received very positive comments from people who took a train trip several times.

Figure 13. Thematic ride and promotional material, Source: RUMOBIL, DELIVERABLE D.T1.6.1 – Work paper summarizing the learning from RUMOBIL pilots, 2019

Riding thematic trains in the Ozalj region is not just about getting people from place to place. The pilot aimed to stimulate the development of sustainable rural tourism, providing unique tourist product relating to local natural or cultural heritage and to benefit other economic sectors. It answered a question of how the local community can be involved and what the role of local entrepreneurs could be.

Kaplice – South-Bohemia region

The area of this pilot project was a rural area with a low population density close to the town of Kaplice, situated very close to the main railway line České Budějovice – Linz, part of the TEN-T network. The local transport node is a railway station located 5 kilometers from the town of Kaplice. The station is not very well used for traveling to the region compared to the direct bus lines.

The main railway service includes two-hour interval international trains to Linz, of which half are Prague-Linz express trains and the other half are semi-fast regional trains České Budějovice – Linz, as complementary connections to regional trains from České Budějovice to the border crossing, which are in the summer season reinforced by other connections designed especially for tourists visiting Šumava National Park. All villages and towns have their own bus lines, but they are often slow, especially connections to the regional capital, the City of České Budějovice. For example, the bus ride from Besednice (central village) to České Budějovice takes about 1 hour, some passengers have to change bus or train connections one or two times, and the interchange time is usually very long.

Another problem is the service on weekends, and public holidays, when the transport service is very bad: some villages have only two or three connections per day, some none at all. In addition, bus time

schedules are not well synchronised with trains in most cases. The pilot bus line aimed to change the current situation of public transport in the area. Passengers were provided not only the new pilot bus line, but they also received access to the regional and national rail transport network. The second objective was to learn how to use rail transport more to reach the pilot region and to make the region more visible and attractive. The ultimate goal, perhaps the most important, was to improve the quality of life in the pilot area and to keep the population here, to increase the number of people in the region. The new pilot bus line led from the railway station Kaplice to operate in neighboring municipalities and settlements/solitudes with the destination city of Benešov nad Černou. The line helped to improve the availability of public transport in the area (including weekends and public holidays, especially in places where access was not available), but the interest of the local populations did not meet the level of demand that would lead to the inclusion of this pilot line to the public transport obligation in future. To change this unfavorable situation, local governments should encourage and promote public transportation more.

Figure 14. Promotional material for a new bus line, Source: RUMOBIL, DELIVERABLE D.T1.6.1 – Work paper summarizing the learning from RUMOBIL pilots, 2019

Bearing in mind the low demand of local people for new bus lines it is necessary to better understand their requirements and prepare a more tailored approach to marketing than what's currently offered. It will require a willingness to take personalization to the next level, evolving to offer exactly the right product, to the right customer, at the right time. A concept of MaaS is also to provide people with easy access to travel information so they can be better informed as to the different ways to undertake their trips, or perhaps a service allowing access to multiple transport providers via a monthly user fee. Personalized travel marketing, accompanied by other hard and soft measures, and the possibility for

participants to give feedback on the existing public transport services in their region, could be an efficient way to increase awareness and encourage people to use public transport more often in rural areas. The secondary objective, to allow tourists access to the area, was fulfilled successfully, see Figure 14. Despite the short test period of the pilot project, which covered the tourist season for only 3 months, there was considerable interest from both individual tourists and organized groups (senior clubs, tourist clubs, scouts, as well as schools that used the bus for school trips).

Integration coordination and intermodality

The significantly inadequate mobility options in rural areas very often result from the lack of spatial coverage of the area by public bus transportation services, with railway transport available only to the inhabitants residing in the vicinity of the railway lines. The availability of public transportation, and especially, the better management of routes and the establishment of integrated systems in public transportation contribute to the change of many negative trends in rural areas. Integrated transport systems aim to provide residents with high quality, easily accessible transport network across a whole region. Travelers should be able to move using different modes of transport - such as rail, bus service, cars, on-demand service, bicycles, and even feet. The network should have a unified tariff and payment system. Connections should be easy to reach, resulting in fewer transfers, reasonable costs, a reliable service, and convenient travel times. Consistent with pilot targets, actions facilitating integration have been implemented in several pilot regions (Saxony-Anhalt, Mazovia, Vysočina, Žilina, and South Bohemia), which also included new services implementation, optimization of interchange nodes and intermodal options.

Vysočina Region

The Vysočina Region aimed at improving the offer of public transport connections as a key condition for the development of mobility of the population, in terms of linking rural areas to major settlements and, through them, to transport networks of national and EU importance. The pilot strived to test and verify the demand for new public bus transport connections in a territory with fragmented settlement structure and in the context of the preparation of the “Public Transport of Vysočina” concept. The tested measures combined “standard” existing solutions, designed by the current regional public transport system, with ongoing preparations to launch the future integrated system “Public Transport of Vysočina”. These connections were ensured by 4 public bus transport operators based on long-term public service commitment contracts with the Vysočina Region. To sum up the whole trial period (March 2017 – June 2018), a total of 34 new public bus transport connections were introduced, operated on 4 lines, both on working days and at weekends. During this period, buses on pilot connections covered a total distance of almost 204 000 kilometers and transported more than 75 000 passengers. The pilot connections contributed to the improvement of accessibility of rural municipalities and their connection to nodes of regional or subregional importance, that are significant centers of education, employment, and various public services for the inhabitants (regional capital Jihlava, cities of Třebíč and Havlíčkův Brod, the town of Velké Meziříčí). These centers also serve as traffic junctions and interchange points between transport modes. One of the pilot lines also strengthened the connection to the locality of Světlá nad Sázavou and Lipnice nad Sázavou, which is an attractive tourist destination as well as an important interchange point with the railway.

Žilina region

The area of the pilot project was a rural area around the small spa town Rajecké Teplice. The town serves as a local transport node for the surrounding countryside area with railway and bus stations. The railway transport is operated by Železničná spoločnosť Slovensko, a. s. on the regional line Žilina – Rajec. Railway transport is partially integrated with urban transport in Žilina city. However, urban, suburban and bus transport services between Žilina and Rajec are operated by different operators. The transport schedules were not fully harmonized and connecting interchange points were missing. Railway transport did not fulfill the criteria of its capacity. Before pilot project implementation integration and intermodality

were not supported properly in the Rajecké Teplice region. The main aim of the project was to restore the small rural intermodal connection hub in the town of Rajecké Teplice to better serve the local people and to promote intermodal traveling options in this rural territory. The improved station acts now as an interface between the various modes of transport (rail, bus, car, cycling, walking) and will potentially also increase the ratio of people using public transport connections to the central city Žilina and consolidate the entire public transport system in the pilot area. Another aim of the pilot project was to examine how the higher level of multimodal hub services would influence the behavior of commuting passengers. With the newly rebuilt multimodal node, the Žilina self-governing region expected the stabilization of the decline in the number of passengers despite the aging of the population. They expected better coordination of different types of transport and at the same time a gradual increase in the number of passengers in the period of two or three years.

The project aimed to upgrade the space of the bus station, install monitoring panels providing information about departures and arrivals of public transport lines, ensure barrier-free access from bus to the railway station and accommodate this connecting point with an adequate number of safe bike kickstands, Figure 15. Another important aspect was security. Among other infrastructural improvement works, CCTV (Closed-circuit television) was installed at the intermodal station in Rajecké Teplice to ensure safety at the station, to make the intermodal node more attractive to passengers by increasing their feeling of safety and preventing damage to parked vehicles, or bicycles.

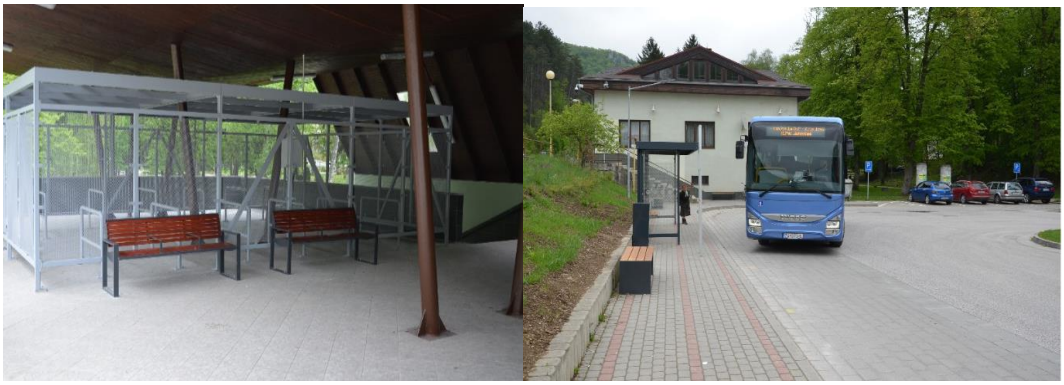


Figure 15. New facilities in Rajecké Teplice railway station, Source: RUMOBIL, DELIVERABLE D.T1.6.1 – Work paper summarizing the learning from RUMOBIL pilots, 2019

The term integrated mobility is used when different mobility service providers collaborate and market their options to travel in integrated way, by supplying information, reservations, bookings or payments. The aim is to offer a product where all these services are integrated. It is time for transport companies to transform their mobility portfolio and use new solutions & technology for multimodal MaaS platforms.

Flexible transport systems

Flexible transport systems bring a promising approach to improving the efficiency and performance of passenger transportation services in rural areas. They provide passengers with flexibility in choosing routes, times, modes of transport, service provider or payment systems. The flexibility can be based on the integration of different modes of transport, or possibly spanning multiple service providers. Service is more sophisticated, comfortable and cost-effective. The concept of flexible transport is not new. There are many existing systems, like DRT services, shared taxicabs, or car-clubs. This concept is especially suitable within rural areas, which usually suffer from a lack of service availability and demand uncertainties. Flexible transport systems could be integrated into existing PT services and aim to support it reaching low-density areas. They can also cover specific time frames. In some cases, they can represent the only PT alternative.

Möser and Osterburg

Partners in Saxony-Anhalt tested a new bus service supplementing the existing regular bus service on selected days of the week, on specific routes, connecting rural settlements with higher-level transportation node (e.g. railway station). Whereas Saxony-Anhalt provides a good main transport network (rail service and interregional bus services), many rural/peripheral areas are not adequately connected to the main transport network. Residents of those areas cannot benefit from Saxony-Anhalt's main transport network despite higher mobility demands. New approaches are therefore necessary to better connect peripheral areas affected by the demographic change to the transport network. The MLV together with its in-house transport agency NASA aimed to introduce a new bus service operating according to the demand of residents. A "Citizens' Bus", in German "Bürgerbus" operated by local communities and volunteers represents a highly innovative and cost-effective approach for connecting rural/ peripheral areas. The approach was tested in two municipalities Möser and Osterburg, with the buses running between remote villages and bigger towns/secondary or tertiary transport hubs. The Citizens' Bus service in Osterburg and Möser is arranged by the local community and its residents. A minibus with 8 passenger seats is driven by volunteers. Both Osterburg and Möser attracted enough voluntary drivers to launch the service. The administrations of Osterburg and Möser organized the operation of the bus. Buses with fixed routes and running times connect smaller settlements to both the city centers and train station.

Accessibility for people with reduced mobility was ensured by using a low floor bus equipped with a ramp for wheelchairs and mobility scooters, Figure 16. GPS transmitters and devices for ticket sales were installed in Citizens' Buses and software was developed to arrange ticket sales and GPS tracking in the bus. This will later allow integration of the Citizens' Buses into real-time information systems. Furthermore, software to arrange the operation of the bus (planning of voluntary drivers, etc.) was purchased.

Figure 16. Burgerbus service vehicle in Osterburg, Source: RUMOBIL, DELIVERABLE D.T1.6.1 – Work paper summarizing the learning from RUMOBIL pilots, 2019

Spatial densification of stops/stations

Accessibility of the public transport system is an essential indicator that guarantees equal traveling opportunities for all people. Accessibility to PT mostly affects low-income people, the elderly and people with disabilities. Access to public transport routes is among the public transport indicators that are important for these social groups of people. The proximity of homes or target destinations to public transport networks is a key factor supporting the usage of public transport. One of the most frequent strategies for increasing proximity to public transport is to densify the stops. Both the location and the spacing of bus stops significantly affect service performance and passenger satisfaction as they influence travel time. Every transit trip begins and ends with pedestrian travel. Distance to stop is considered a critical factor for accessibility of public transport, especially for vulnerable PT users. MLV tested densification of stops in the Möser and Osterburg region.

Möser and Osterburg

To make public transport in both pilot areas more attractive, the Citizens' Bus implementation was accompanied by densification of bus stops in each settlement along its routes. More precisely, in each settlement 3 to 4 bus stops were installed instead of just one, to shorten the distance between passengers' homes and bus stops. In this way, the number of bus stops substantially increased in both pilot areas Figure 17. As this approach is regarded as a trial process, the installed bus stops were only a bus stop sign and an information plate for the bus schedule. This also helped to reduce costs in the service trial period.

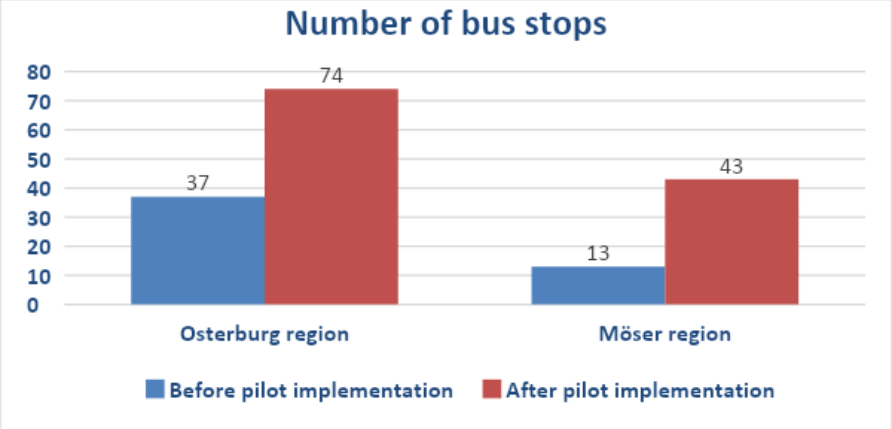


Figure 17. Number of bus stops in pilot areas in Saxony-Anhalt, Source: RUMOBIL, DELIVERABLE D.T1.6.1 – Work paper summarizing the learning from RUMOBIL pilots, 2019

An appealing design and the consideration of comfort

According to the results of qualitative surveys performed among passengers in partners' regions, comfort is an important factor in residents' choice of traffic mode. Thus, improving comfort in vehicles and at bus stops and stations to attract more passengers received much attention from PT service operators and authorities in some partner regions.

Szabolcs-Szatmár-Bereg County

Hungarian partners rebuilt selected bus stops on the bus line Nyíregyháza – Nagykálló. New bus shelters were installed there. A good bus shelter – a waiting area for passengers - is an essential part of any successful PT bus service system.

Figure 18. New bus shelter and information table in Nagykálló, Source: RUMOBIL, DELIVERABLE D.T1.6.1 – Work paper summarizing the learning from RUMOBIL pilots, 2019

From the perspective of the PT operator and infrastructure manager, a good shelter has low maintenance and energy consumption requirements and is vandal-resistant. From the passenger's point of view, an ideal shelter allows easy access to the bus, is comfortable and convenient and provides accurate information. The new design of bus stops in Nagykálló respects both these principles. Apart from the physical reconstruction of shelters, several enhancements were performed including digital passenger information boards to provide real-time information collected via GPS from buses. WiFi accessibility can also contribute to public inclusion and increasing of bus-stops' attractiveness, Figure 18.

Information and info-mobility tools

New info-mobility tools are probably the ones more often considered recently. Info-mobility measures concern a lot of fields that are all important to make a service more attractive and, above all, easy to use. Many of them refer to real-time information that can improve the quality of service. Other actions focus on helping people to plan their trips, to make decisions, or to manage booking services and ticket buying. Journey planners based on information technology save time and prevent trouble during the trip. Several partners involved new info mobility tools. aMo developed a new app for users of the existing DRT service – Prontobus - to view reservations updated in real-time and with the ability to book a trip directly in the app, or through a web site. Mazowieckie Voivodeship launched the TropKM app based on the operation of GPS transmitters installed in regional trains, where the position of the train is available on mobile devices in real-time. The Žilina region, and partners from the self-government of Szabolcs-Szatmár-Bereg County, and the Municipality of Nagykálló installed info panels providing real-time information at bus stops and intermodal nodes.

Castelfranco Emilia region

Flexible and demand-responsive transport systems have been identified as one of the promising solutions for widespread public transport in rural areas and many flexible transport services have been established. The DRT service called Prontobus was established in the Modena region to integrate with the conventional PT service (based on fixed lines and timetables). Before RUMOBIL intervention the service was available with reservations that could be made only through a call center. The call center handled reservations manually and no information about the service was provided to users. The lack of information on the DRT service was highlighted by users – through a phone survey – as one of the main difficulties in accessing it. The main aims of the project were: to significantly improve information and accessibility to the DRT service that was actually underused compared to its potential; to improve the integration of the various public transport modes existing in the territory and the quality of public transport offered; to better connect the rural areas to the main European (TEN-T) and national transport network that are available in the area; to improve the performance of the reservation center providing a tool that would simplify the activities of recording and reporting the DRT services.

The RUMOBIL pilot project tried to reach these aims by implementing a new software application connected to a web portal specifically dedicated to the information about DRT services. The system consists of:

- a web portal (www.rumobil-modena.eu) for the users of the Prontobus service with information about the service and the situation of reservations updated in real-time with the possibility to register in order to receive e-mails or SMS about interesting services recognized for the following day;
- a site dedicated to the management of reservations for the call center;
- an app for users of the Prontobus service to view reservations updated in real-time and with the ability to book an existing trip directly from the app;
- an app for drivers of the Prontobus service to get information about reservation in real-time and the trips to be made (Figure 19).

Starting from the date of the press conference, the advertising activity of the RUMOBIL project began with posters posted in the main stops covered by the Prontobus service.

End-users with the mobile apps can register directly for existing on-demand services that are interesting for them, without needing to make a phone call to the reservation center. Another interesting feature of the new software is that it is possible to automatically transmit the details of the services to be performed on a tablet to the bus drivers, updated in real-time.

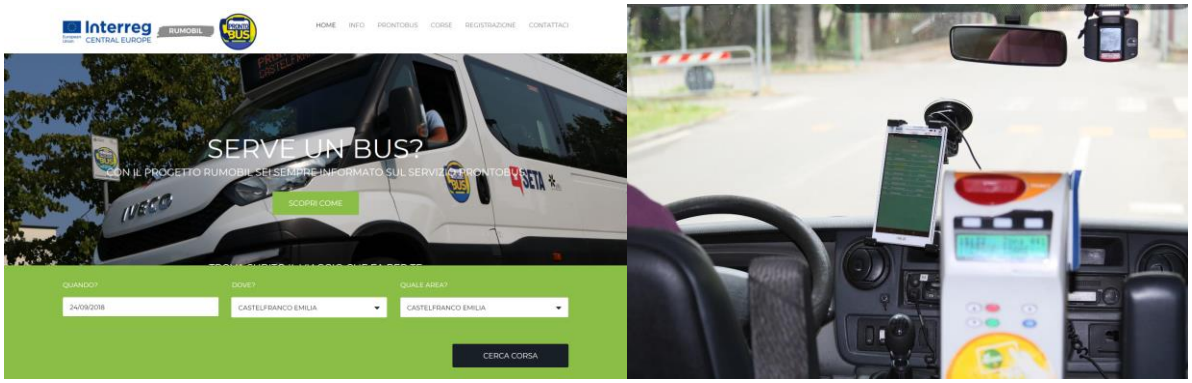
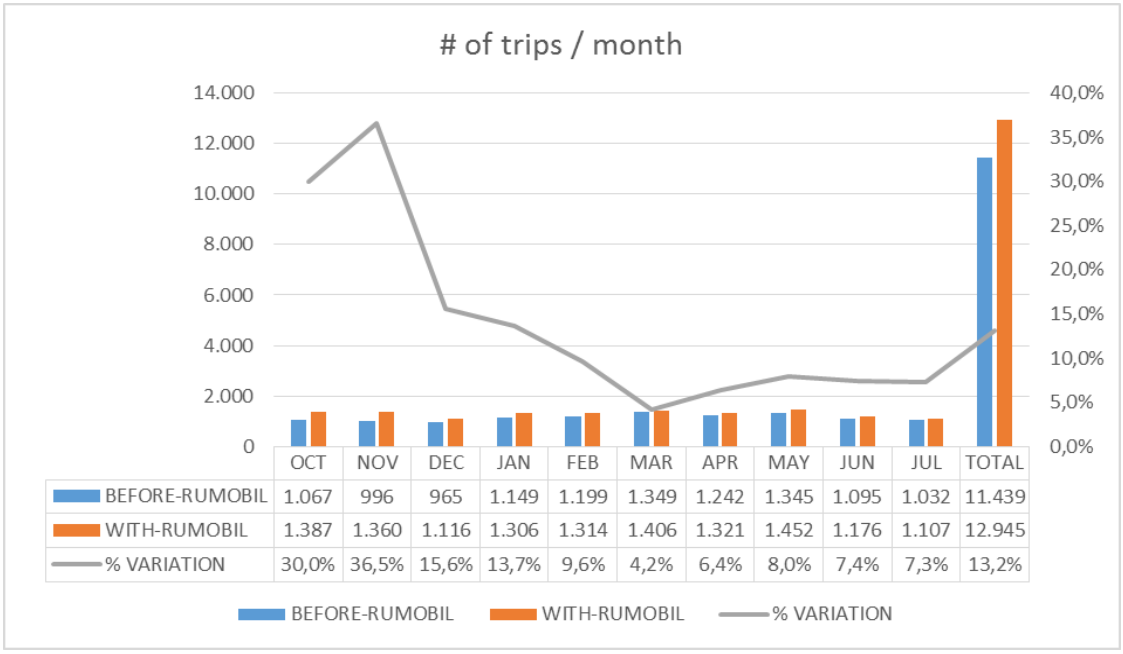


Figure 19. Web portal for users, App for drivers on buses, Source: RUMOBIL, DELIVERABLE D.T1.6.1 – Work paper summarizing the learning from RUMOBIL pilots, 2019

In the period from October to July (2017-2018), an increase of passengers was detected on the Prontobus service in Castelfranco Emilia compared to the same period of 2016-2017. The total increase in passengers was 13.3 %. In the first 3 months of the implementation, the increase of passengers was higher than 25 % while in the last months the increase stabilized at about 7 % per month, Figure 20. This is a very good result that allows us to state that the introduction of the new info mobility service supported by a publicity campaign had a positive effect on the number of passengers, achieving the project objective to increase the number of trips.



	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	TOTAL
BEFORE-RUMOBIL	1.067	996	965	1.149	1.199	1.349	1.242	1.345	1.095	1.032	11.439
WITH-RUMOBIL	1.387	1.360	1.116	1.306	1.314	1.406	1.321	1.452	1.176	1.107	12.945
% VARIATION	30,0%	36,5%	15,6%	13,7%	9,6%	4,2%	6,4%	8,0%	7,4%	7,3%	13,2%

Figure 20. Number of trips per month comparison, Source: RUMOBIL, DELIVERABLE D.T1.6.1 – Work paper summarizing the learning from RUMOBIL pilots, 2019

Mobility apps with their users can be an essential source of data. The new app designed according to aMo's specific requirements was the starting point for data insights. Each transaction made in a mobility app creates valuable data for the service provider. Analysis of this data enables the determination of patterns of mobility demand from Prontobus users. As such, analysis not only provides insights into current activity at particular stops or trips, but also allow for prediction of future passenger flows, driving service improvements.

Mazovia region

Information about rail services (e.g. timetables, position of trains) has been substantially transformed in recent years. Real-time information systems enable passengers to access that information simply. This is very useful, especially if for any reason reliability cannot be guaranteed and the situation is uncertain. If there is a long delay in the next service shown, passenger can use another mode, or do something else and come back to the stop later. However, if a user knows that the real-time information is reliable and if the train is only a few minutes away, he will probably decide to wait.

Mazowieckie voivodeship implemented a new information system in the North-western part of Mazovia at two railway lines, Nasielsk – Sierpc, and Sierpc – Kutno. The region in which the pilot project is located is about 120-150 km away from Warsaw. This is a typical farming region with low population density. There is no attractive PT offer in the target area and rural inhabitants are dependent on cars. Their usage of PT services is low. The bus network is not tailored to the needs of passengers and timetables are not cyclical. Vehicles used to transport people are old and uncomfortable. Also, they do not serve all small towns and villages, or they handle them very rarely during the day. This makes it more difficult to plan a trip or a return trip, and it takes a lot of time. In the region, there are two railway lines which run several pairs of trains during the day. Modern trains run on single-track lines with low average commercial speed. There is no cyclic timetable. At certain times of the day, the gap in the train schedule is 4 hours. Railway infrastructure and stations are neglected: they need modernization. In many cases they are distant from settlements, destroyed and under-invested, need to be repaired and possibly relocated to a better location. There is no dynamic passenger information system, and many stops have no voice prompts. In case of a train failure/delay, the passenger has no information on the possible start time of the trip.

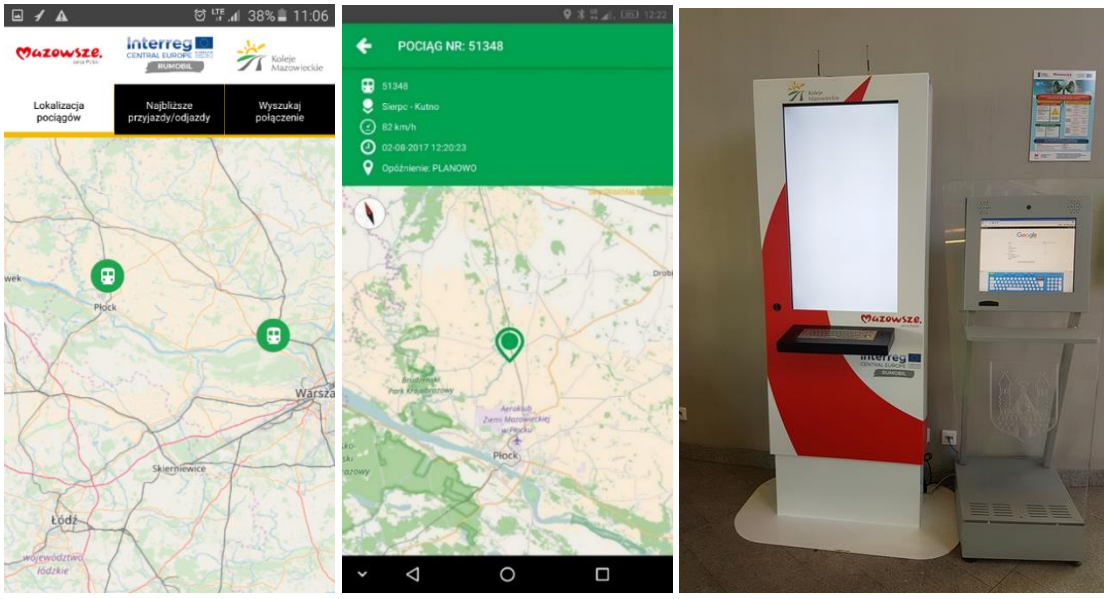


Figure 21. Mobile app screenshots, info kiosk, Source: RUMOBIL, DELIVERABLE D.T1.6.1 – Work paper summarizing the learning from RUMOBIL pilots, 2019

The aim of the pilot project was to increase the number of train passengers in the target area by implementation of a new real-time passenger information system. To reach this goal, several measures were implemented that allow passengers to plan their trips more effectively, including installation of GPS transmitters on trains, an app for mobile phones, and interactive kiosks at railway stations, Figure 21. Passenger can use their mobile devices (phone/tablet), as well as desktop computers and info kiosks, to check where the train is currently located, if it is running according to the timetable, or the possible waiting times.

The mobile application "tropKM" is available on devices running Windows, iOS, and Android for all passengers of Mazowieckie Railways without limit or charge. The application makes it possible to search the appropriate train, the train location on the interactive map indicating the time of the last data update and the speed of the vehicle. The application is designed to show the delay of the train (if such occurred) a description of the DMU train type and difficulties. It is possible to check the current timetable of all trains of Mazowieckie Railways.

In the first two months of the system operation, the application was installed 2 300 times and was in use 11 500 times. After 12 months of the system operation, the application was installed 7 830 times and was in use 115 600 times. On average, the system recorded over 10 000 inquiries related to rail traffic in the RUMOBIL project target area monthly.

Participation of stakeholders

Citizens and stakeholders' involvement is a precondition for any mobility intervention since the long-term perspective of the measure requires a high degree of support and acceptance. The main project beneficiaries were groups of residents who were awaiting the arrival of a better transportation system and services in the region. Both individuals and groups of residents, in this case, are looking forward to the benefits they reap from quicker, or more efficient transportation. Besides residents, there can be other types of beneficiaries, e.g. tourists or specific groups of residents. The stakeholder identification process is one of the most important processes in each project management because projects are undertaken to fulfill the requirements of stakeholders. Stakeholders can be a person, group or organization that has an interest or concern in mobility intervention. Stakeholders can affect or be affected by a mobility measure. In the RUMOBIL project potential stakeholders were divided into three categories:

Primary stakeholders (or beneficiaries): Those who are ultimately affected by new transport measures (e.g. different social groups — certain municipalities or village communities, elderly people, young people, employed or unemployed people, business branches, organizations, etc.).

Key actors: Those who have political responsibility (mayors, other authority levels); financial resources (public and private funds); the authority (by domain or territory); the skills and expertise (public administrations, universities, private sector) in transport and related domains (land use, environment, education, health, tourism, etc.).

Intermediaries: Those who implement transport policy (PT and infrastructure operators, public administrations, police, etc.). Those who carry out major transport activities (PT operators). Those who represent pertinent interest groups (associations, chambers, cooperatives, networks, and nongovernmental organizations -NGOs). Those who inform and report on transport (authorities, operators, local media).

Involvement of stakeholders is fundamental for the start-up and the success of the measure. All partners prepared a map of stakeholders engaging (example from Germany is in Figure 22) before the project implementation and stakeholders' engagement was ensured throughout a whole pilot lifecycle. Partners took into consideration stakeholders' requirements, expectations, and perceptions. Stakeholders helped to organize a pilot and impact the outcomes that were achieved.

Saxony-Anhalt region

The important aspect of the pilot was the involvement of local public authorities, local associations, and the local public. With their knowledge and experience of local peculiarities and possibilities, they contributed to the planning and the operation of the new bus services in the Möser and Osterburg region. Local stakeholders were involved at various levels: development of routes and bus schedule, and identification of places for additional bus stops.

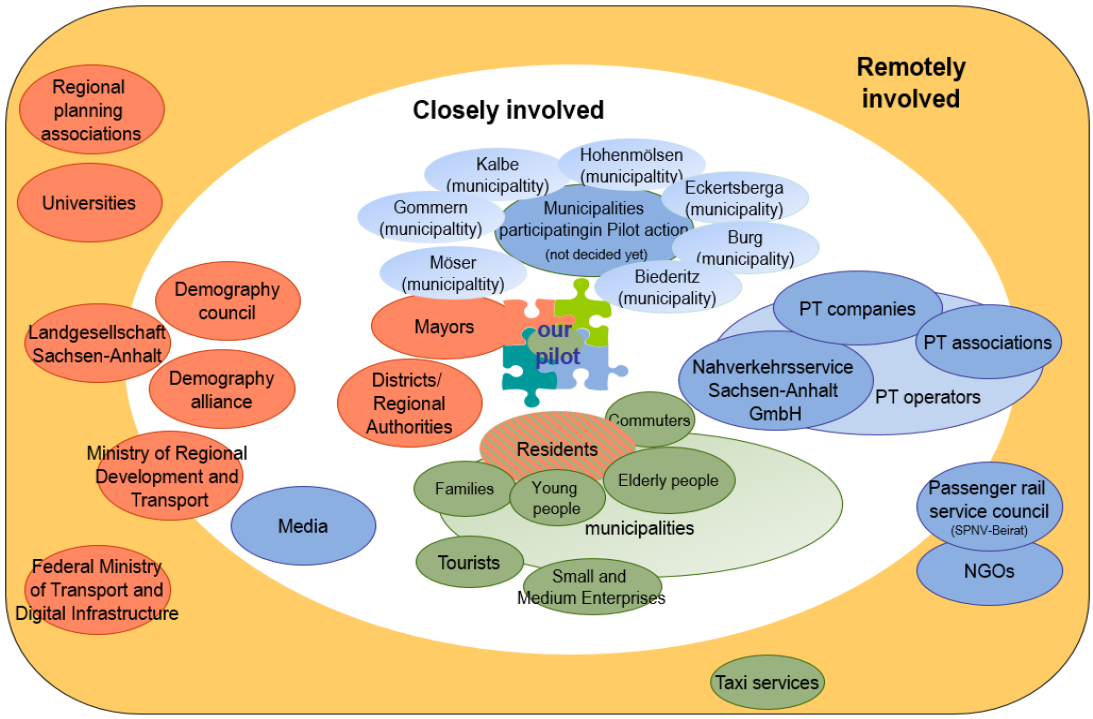


Figure 22. Stakeholder engagment map for pilot regions in Saxony-Anhalt, Source: RUMOBIL, DELIVERABLE D.T1.6.1 – Work paper summarizing the learning from RUMOBIL pilots, 2019

They had also many proposals and ideas about the specific needs of residents. Further, the public was asked to support the project with voluntary drivers. The properly trained volunteer drivers include especially seniors. In this way, they support their local community and feel useful. This model is efficient in communities with less dense populations. Figure 22 shows the map of stakeholders who could be involved in project implementation.

Promotion campaigns

To raise awareness of sustainable mobility among people in rural regions, various techniques may be used, such as designated educational programs, seminars, meetings, or different types of campaigns. The production of a successful sustainable mobility campaign is a complex task and requires an understanding of the general needs of those affected. The campaigns provided by partners in their regions offered an opportunity to present sustainable mobility alternatives to residents and to explain the challenges that their regions are facing. Another aim of the campaigns was to inform beneficiaries about concrete pilot measures and their advantages, as well as to test new measure and get feedback from the public. The campaigns promoted public transport as a high-quality alternative to individual car transport among all target groups and highlighted the main advantages of the new measure. The campaigns aimed to make the regional public transport more attractive for citizens and increase the share of public transport in the modal split. The campaign was done through different channels like local media, competitions, web sites,

apps, social media, events, posters, printed materials, etc. Partners performed campaigns in different ways.

Appropriate evaluation methods and tools

Assessing the impact of measures is an essential part of mobility or transport planning. Monitoring and evaluation activities deliver data about the progress of measures and the impact of measures. Monitoring activities should be carried out before, during and after implementation of intervention measures. They provide information to planners and decision-makers that allow timely identification of problems, potential successes and the need for readjustment of plans. Appropriate funding and institutional co-operation are necessary to successfully carry out monitoring and evaluation activities. A key part of the monitoring and evaluation process is the definition of indicators for which data needs to be collected before, during and after implementation. A set of indicators was defined to measure outputs against the goals of pilots and the RUMOBIL project. All partners gathered data from their pilot regions. Some measures implemented generated new knowledge on PT performance or users' travel behavior. A good example is represented by a pilot from Italy.

Castelfranco Emilia region

aMo developed procedures to upload all data on DRT service performance recorded by the call center to a dedicated database. Using a reporting tool, it is now possible to have detailed information that was previously unknown. Before the introduction of the new RUMOBIL info tool, the only data available was the number of travelers per day, whereas now it is possible to know how the trips have been made in detail (travel time, origin-destination of the trip, users behavior, etc.). For example, an interesting analysis comparing users' trips helped to detect the trend that the number of users making few trips (less than 10 trips per month) is increasing and at the same time the number of persons making many trips each is decreasing, Figure 23.

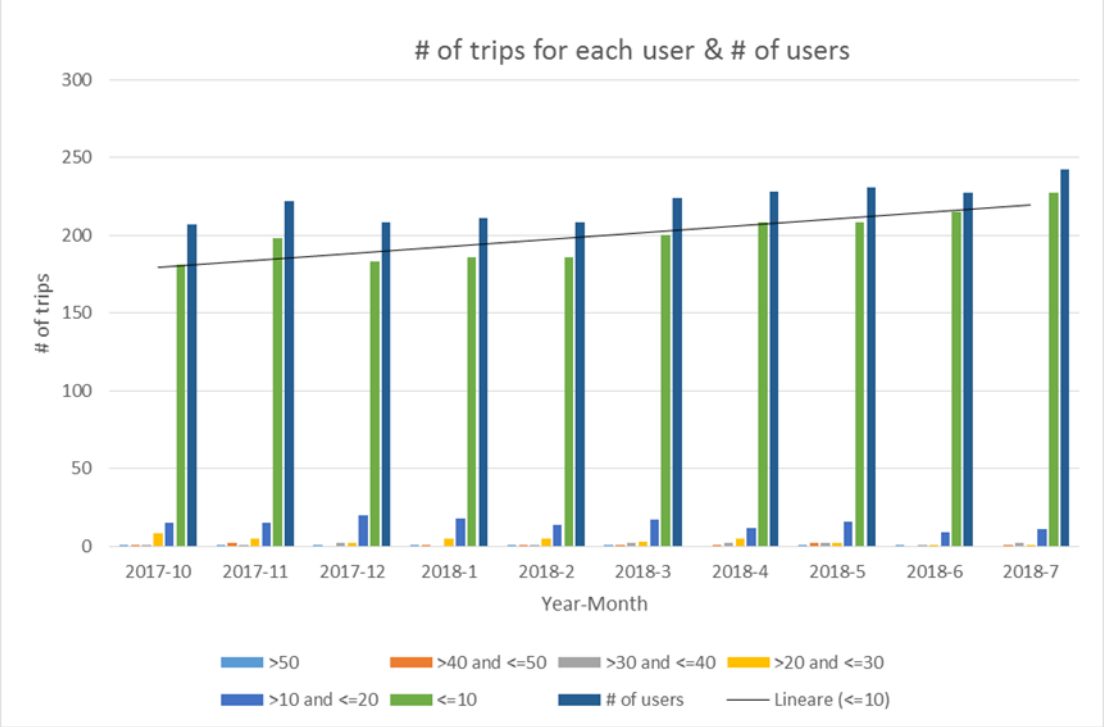


Figure 23. Number of trips for each user and number of trips of users per month, Source: RUMOBIL, DELIVERABLE D.T1.6.1 – Work paper summarizing the learning from RUMOBIL pilots, 2019

1. This is a very interesting result discovering the fact that DRT Prontobus service is not designed for people doing everyday commuting (thus making many trips with the same origin-destination), but more for those making occasional trips. The RUMOBIL pilot brought a new tool for the PT operator allowing it to analyze service performance and users' travel behavior. This new knowledge can be used for research examining public transportation performance and how it may be enhanced in the future. New tools of info-mobility in the DRT services increased their attractiveness. This is an important indication for future pilot replications and in fact, in Modena region, aMo began to replicate RUMOBIL on the other 5 existing DRT services.

Customer satisfaction has been considered one of the most important factors in PT service due to its direct relation to customer retention. User surveys were developed to explore the satisfaction of users with pilot measures. Qualitative indicators described the level of satisfaction with new or existing public transport service and allow passengers to evaluate the pilots. Information was gathered from the survey on the specific sample of respondents using pilot results in the area where the operation takes place. Users ranked the service on a 1-5 scale, ranging from 1 (not satisfied at all) to 5 (very satisfied). Partners included selected indicators relevant to their pilots such as infrastructure quality, accessibility, space design, comfort, access to information, availability, punctuality of service, security, safety, etc. The results of the surveys are provided in Figure 24. The users were satisfied with improved access to information, and they also appreciated accessibility and safety, while infrastructure quality or space design at bus stops are still problems in some partners' regions.

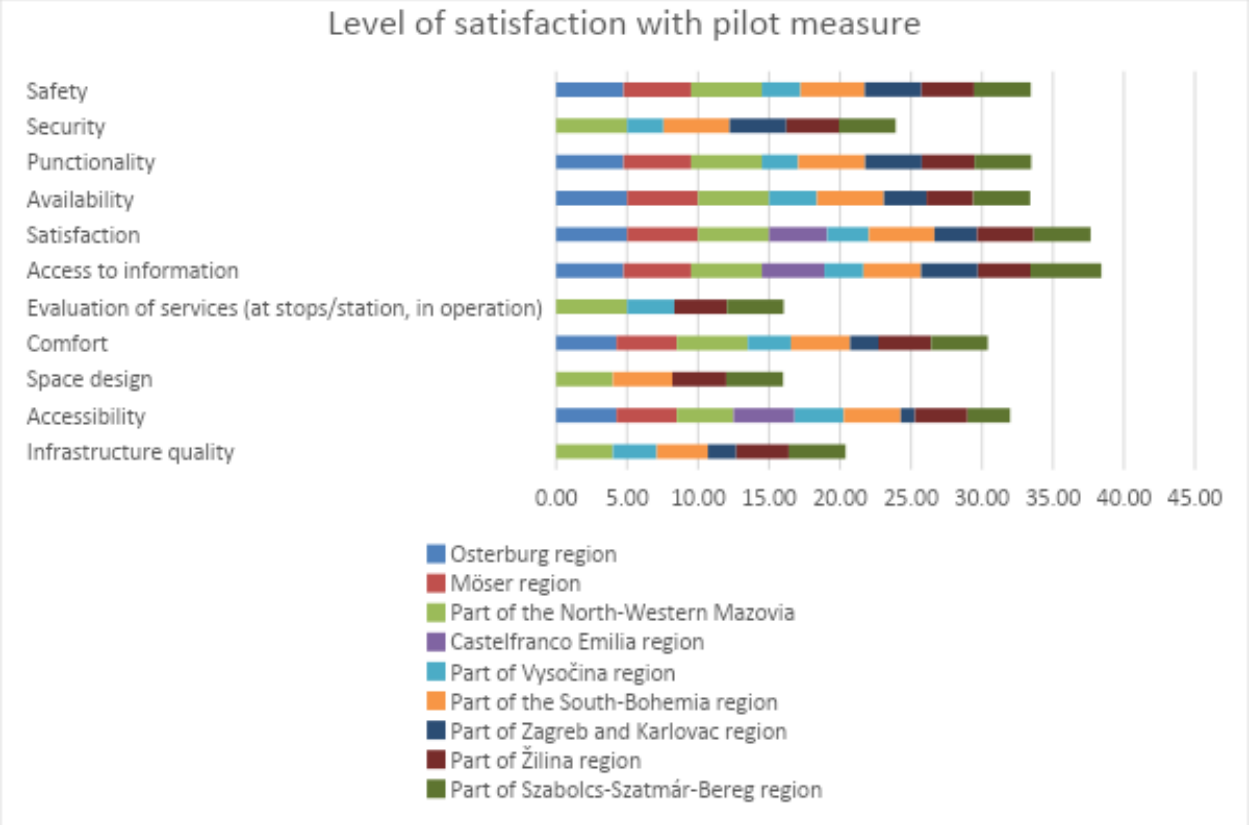


Figure 24. Summarization of users' survey, Source: RUMOBIL, DELIVERABLE D.T1.6.1 – Work paper summarizing the learning from RUMOBIL pilots, 2019

CONCLUSIONS

In this chapter, we discussed how regions throughout Europe were struggling to sustain mobility in sparsely populated rural areas. We can see that there is a big difference among various types of urban, suburban or rural areas that requires different approaches. Demographic changes such as the aging population and limited public finances endanger the accessibility of public transport services in many European rural areas and it is becoming increasingly difficult to ensure adequate mobility offers in these sparsely populated regions. New rural transport services require holistic, user-focused approaches. Local barriers, priorities and suitable options must be determined together with stakeholders. Increase in awareness of rural citizens requires more promotion, credit and market-related initiatives by transport operators as well as municipalities. Innovations represent the potential for exciting new transport and accessibility solutions. Geographical location and related transport accessibility and traffic services are without any doubt essential elements to create preconditions for economic development. It is well known that higher opportunities to travel mean higher work opportunities and, consequently, also more resources for leisure activities. This process is a basic principle of the economic development of an area and it is the core of the concept of accessibility.

Some outputs of the RUMOBIL project were introduced. The final RUMOBIL project deliverable is the RUMOBIL Strategy, a work paper that highlights the necessity to link rural areas to European and national transport networks and shows how this can be accomplished with the limited resources available. Furthermore, the RUMOBIL Strategy is the step thanks to which solutions that could be accepted by decision-makers for the improvement of sustainable mobility in their own rural and peripheral areas have been pointed out. The enhancement of the existing PT systems is based on the improvement of basic features (timetable, integrated tariffs, friendliness of vehicles and stations/stops, new and better interchange terminals) and in particular on deployment of new info mobility tools, that play a key role in all the layers (onboard, at the stops, on users' devices). What emerges from all pilots is that no result can be achieved without a proper and well-managed communication campaign that allows all potential users to be aware of their opportunities beyond private cars and collaboration with stakeholders. As expected, the most common objective among the pilots was to increase the use of PT in partners' rural areas, also considering the introduction of new services or more flexible ones. As shown in Figure 27, there was an increase in public transport service usage recorded in all partner regions (two partners were not able to provide accurate data).

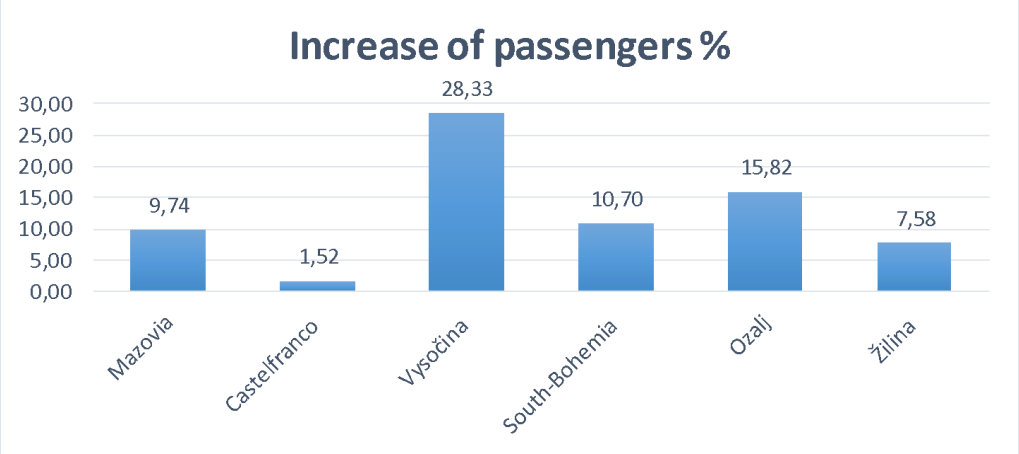


Figure 25. Number of passengers in partners' regions, Source: RUMOBIL, D.T2.6.2 Quantitative evaluation, 2019

Figure 25 represents the difference between the number of passengers before and after pilot implementation. The highest growth was in the Vysočina region, where the pilot project tested new bus lines for a new regional transport plan. Based on data from partners, we can consider all pilots as successful.

Considering the sustainability of pilots, we can see various scenarios for the tested measures in the future. All the pilots were implemented within the RUMOBIL project, funded by the Interreg Central Europe program as short-term and small scale projects. Keeping in mind the MaaS concept, information technology driven pilots (including mobile apps) were especially successful and they have been already spread to other regions in Poland and Italy. Partner testing of the concept of citizens' buses in Möser and Osterburg needs more time to evaluate the feasibility of such services in rural areas of the Saxony-Anhalt region. The Vysočina region plans to sustain pilot bus lines and include them into the new integrated transport system, which will be launched in December 2019. HZZP will dispatch thematic trains againin 2020. The Žilina region will try to advance the multimodal service in Rajecké Teplice with the help of IT solutions, and more comfort and information will be available at bus stops in Szabolcs-Szatmár-Bereg County.

Nevertheless, the RUMOBIL project allowed public authorities and entities responsible for the organisation of public passenger transport to assess which solutions could be suitable for their rural territories, and discuss and coordinate those with all relevant actors. RUMOBIL aimed to improve their planning capacities, to enable transport planners to better understand how to optimise the organisation of public transport in peripheral areas affected by demographic change, and to integrate new approaches and solutions in their strategic and operational transport planning. This approach led to the elaboration of a RUMOBIL Strategy consisting of policy recommendations regarding how public transport is to be designed to better link peripheral areas to national and European transport networks.

General findings and recommendations

Some general findings and recommendations are already mentioned in the previous section. Following facts can be emphasized for implementation of MaaS concept in rural areas. Smaller scale pilot projects usually don't cost much financially. In general, they help planners and companies to understand what works and what doesn't without the same level of risk that a bigger project would. However, they can generate success stories that can be used for vision casting. Measures proved to be effective can be implemented in other sites and reduced cost will allow mobility companies to focus their resources on enhancing and proving out their technologies.

Local conditions and circumstances should be carefully examined during implementation and supply and demand side of any region transport market should be analyzed. MaaS services were mostly presented in urban context. Some solutions for MaaS services in terms of collaboration, services & markets, planning & decision-making, and technology & information were proposed and implemented also in rural areas, especially as pilot projects funded by different EU or national programs. Before wider implementation of MaaS in rural regions we should better understand the needs of different types of rural communities and distinguish between different spatial settlement structures, demographic patterns and tendencies.

Most of public mobility services providers in rural areas still focus on collective transport based on modes such as trains or buses, usually being a fixed in many ways. These services often lack flexibility, especially regarding geographical issues. By contrast the mix of traditional and innovative on-demand transport services can provide higher level of flexibility, since there are different conditions in rural areas compared to inner city mobility. E.g. trip distances are longer, population is dispersed and there are potentially fewer people that could share a ride. By new technological breakthroughs many of the current obstacles could be hindered and novel technologically advanced services could contribute to seamless mobility. E. g. implementing a new public transport built on autonomous shared vehicles might be the major step in the near future.

The fundamental question for policy makers is how to address different processes like urbanization or suburbanization and how to understand urban-rural relations and functions. Very often there's a need for a

new intervention logic or policy instrument to help establish new partnerships or business models. Partnership should not be focused only on cooperation between administrations and transport providers. It must involve also the market actors like private firms or civil society organizations.

Some countries like Finland or Netherlands have positive experience with implementation of MaaS in rural areas, as proved in the study by Eckhardt (2018) or Geurs et al .(2018). They underlined that MaaS for rural areas are specific. In cities with many transportation options, the MaaS model provides maximum flexibility to travelers for deciding among travel modes, schedules, or price. Having centralized information give them opportunity to understand the choices and decide on the most appropriate. On the other hand, there are also benefits for service providers. They are able to better identify and fill gaps, and actively determine areas of unmet demand. By tracking searches for origins and destinations in the system and comparing them with service availability they can help especially small urban and rural communities, which lack the varied mobility options. This can be crucial also for vulnerable customers as elderly people.

The MaaS concept is relatively new and current MaaS are still operated usually at a local level. Much effort should be made into turning MaaS as a broader and integrated solution. An appropriate policy framework is necessary which allows implementation of MaaS and brings benefits of MaaS to rural travelers. Operation of such services still faces many challenges for appropriate business models. Users' perspective is important as well. Sometimes scientists or practitioners tend to be too optimistic about the possible rate at which MaaS might replace car transport or conventional public transport. Therefore, one of the most important parameters that need to be considered when implementing MaaS in regions is the perspective of users, as stated for example in the study by Lyons et al. (2019). If the users are convinced that the service is usable, they are going to choose and pay for it. This confirms also the study by Ho et al. (2018) testing various subscription plans for MaaS service.

Any technology that cannot be used from the user's perspective can be destined to fail. Although current targeted customers of MaaS are mainly the young generations who wish to adopt a sustainable lifestyle, MaaS may have great benefits to elderly travelers and play an important role to meet travel demand of the aging society in rural areas, Li & Voege (2017). Therefore a customization will be one of the most important MaaS parameters.

Considering experience of RUMOBIL project we suppose that an application of MaaS in rural areas of Central Europe is still limited especially by the following factors:

- willingness of responsible transport authorities to implement new technologies;
- legal barriers for service implementation (e.g. UBER);
- the complexity of transportation operational systems and diversity of technology platforms;
- responsibilities of different actors to operate joint MaaS services;
- implementation costs.

However we suppose that MaaS, when coupled with conventional public transport services, could give rural areas the catalyst they need to deliver substantive reform, providing a cost-effective and reliable alternative to car use. As one of the fundamental recommendations for Maas implementation is to start to build organizational structure of MaaS based on entities who hold control over the integration of mobility services and to set up legislative framework and rules.

FUTURE RESEARCH DIRECTIONS

Current research conducted in the area of concept of smart city and its mobility, or mobility in megacities has discovered the basic condition of managing huge passenger flow in various forms. Solving the problem has been discussed in various studies, e.g. Canitez, F. (2019), or Ghosh, Schot, (2019). In particular the focus on mobility opens a variety of approaches as described in the study by Ismagilova et al. (2019). This study provides a valuable synthesis of the relevant literature by analyzing and discussing the key findings from existing research on issues related to smart cities from an Information Systems

perspective. The research focuses on many aspects of smart cities including smart mobility highlighting the limitations of current developments and potential future directions.

Based on these results, the authors agree that there is still a lack of research dealing with the implementation and examination of how new innovative technologies can enhance mobility in rural areas. Also, the perspective of demographical and economic changes in rural regions has been described in various studies, however, there is still a problem of how to assess their consequences. According to material "*Demographic trends in EU regions*" provided by European Parliamentary Research Service (2019), the EU response to the demographic challenge is currently limited and poorly developed and indicates that cohesion policy should play a more critical role in this respect. It suggests that the EU should seek to mainstream demographic considerations across all policy areas and include budget headings to enable further development of these policies. The opinion calls for measures to fight transport isolation and the digital backwardness of rural, peripheral and remote areas.

Economists often use the argument that the operation of public transport should be done efficiently. But cost constraints are not as important as the other factors or added values which are generated by providing a transport service in rural areas. Due to its capacity and ecological acceptability, public transportation still serves as a framework for mobility in rural regions. An interesting topic for further research is an examination of different types of rural areas varying from country to country as written in the study of Li, Westlund, Liu, (2019). Further research work in the field of mobility in rural areas should be examined using adequate data such as data on population (e.g. demography, age-groups, etc.), travel behavior, and demographic changes. It should be easier to gain such data in the future thanks to new and innovative technologies not only dedicated to Smart Cities, but also to Smart Rural Areas.

Some former RUMOBIL partners are continuing their work in a new project. The YOUMOBIL project launched in April 2019 aims to enhance the passenger transport system for young people living in rural areas and their access to the European and national transport networks. Poor mobility options other than the personal car is among the most frequent reasons why young people choose to leave their native rural area and to migrate to larger cities or even beyond, intensifying the demographic change troubling most rural areas in Central Europe. Some tools including shared mobility and demand-oriented flexible collective transport services have emerged across Europe but only a few have been introduced in the rural areas of Central Europe. This has led to a lack of knowledge and data among the relevant transport stakeholders and researchers as well. Moreover, public transport and related infrastructure suffer from a rather poor image among Central European youth. Therefore, YOUMOBIL partners together with rural areas' local youth test the potential of new demand-driven service features through interfaces for mobile devices. Moreover they explore how youth initiatives can revitalize disused rail infrastructure to enhance the attractiveness and image of public transport. Five technology-driven pilots will demonstrate the use of modern ICT (Information communication technologies) solutions for smart youth-oriented transport in rural areas while one investment and five feasibility studies will deal with upcycling and adaptive reuse of rail infrastructure.

Pilots will test solutions based on the MaaS concept, combining different services and providing a platform, where multimodal journey planning and booking are integrated. The RUMOBIL pilot test realized in Italy has confirmed the feasibility of such a service. A website (www.prontobus-rumobil.eu) and a mobile app (Prontobus-RUMOBIL) have been developed with the purpose of giving users real-time information about the DRT service in Castelfranco Emilia. The results were very satisfying especially regarding the increase in travelers that occurred, which showed the importance of infomobility. The state of Saxony-Anhalt supported the two Citizens' Bus initiatives in the municipalities of Möser and Osterburg by procuring the vehicles and relevant infrastructure, and in planning and implementing the schedule. Both citizens' buses were provided with tablets, ticket printers and distribution software enabling the bus drivers to sell tickets directly on-board. Furthermore technical equipment is being used to track the vehicle and inform potential passengers in real-time through INSA, the public transport information system of Saxony-Anhalt. The success of the creation of a small multimodal rural hub in the

Žilina region will be accomplished by the new app integrating ticketing of main public transport services (rail, bus) and other services focusing on individual mobility (bicycle parking, bicycle sharing, etc.).

New MaaS solutions planned in the YOUMOBIL project will provide new options or mobility packages. Those will be predefined with the help of a survey among young people and feedback from them, taking into account several rural specific parameters (e.g. sociodemographic, economic, or environmental). The focus of the YOUMOBIL tool-box will be on innovative approaches and involving local youth (gamification apps, on-demand collective mobility for rural areas). The concrete results of these on-field experiences allow the enrichment of the tool-box with practical guidelines for its transfer and implementation. During the test phase, all available data on usage of the pilot service is aggregated (without violation of data protection legislation) for careful analysis. The quantitative data demonstrates the added value of the tested services to decision-makers in public transport and allows detailed estimation of the financial costs to continue the service beyond YOUMOBIL's pilot phase. This represents a further value-added that will strengthen the reliability of the partner areas' transport strategies. The data will be also used for further research activities and transport demand prognoses.

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