Interreg
CENTRAL EUROPE

European Union
European Regional
Development Fund

Dynaxibility4CE

CE1671

LESSONS LEARNED BROCHURE

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DELIVERABLE D.C.3.3 ***MAY 2022***

Project index number and acronym	CE1671 DYNAXIBILITY4CE
Lead partner	PP1 - Leipzig Transport Company (LVB)
Deliverable number and title	D.C.3.3 – Lessons Learned Brochure
Responsible partners	PP3 – POLIS PP2 - RC
Project website	https://www.interreg-central.eu/Content.Node/Dynaxibility4CE.html
Delivery date	05/2022
Status	Final version
Dissemination level	Public

Dynaxibility4CE

The Interreg Central Europe-funded project 'Dynaxibility4CE' aimed to improve low-carbon mobility and air quality across the region of Central Europe by increasing the ability of public transport authorities to deal with new mobility trends. The latter includes 'Mobility as a Service' (MaaS), Urban Vehicle Access Regulations (UVARs), as well as the topic of Cooperative Connected and Automated Mobility (CCAM). The capacity-building was achieved by developing strategies and tools for public (transport) authorities that strengthen the planning capacities of cities throughout the region of Central Europe. Thus, the project enables these authorities to become key actors in creating low-carbon and low-pollution mobility systems in seven cities in the Interreg Central Europe area and their respective Functional Urban Areas (FUAs).

The project, which started in March 2020 and lasted until May 2022 received around one million Euro ERDF funding in the framework of the 4th Interreg CE call. Besides the cities of Budapest (HU), Graz (AT), Koprivnica (HR), Krakow (PL), Leipzig (DE), Parma (IT) and Stuttgart (DE), technical partners of ARPAE, AustriaTech, Mobilissimus and Redmint are part of the consortium partners from Interreg Central Europe countries. The project was supported by Rupprecht Consult and POLIS Network, two organisations from outside the Interreg area.

The project further developed and contextualised the SUMP concept towards planning for MaaS, CCAM and UVAR, down streaming the recently published SUMP 2.0 topic guides for these mobility trends to the level of the involved FUAs of the seven Dynaxibiltiy4CE partner cities. These partners, in cooperation with their functional urban area (FUA) developed seven action plans focusing on CCAM (Stuttgart & Graz), MaaS (Graz, Budapest, Koprivnica) and UVAR (Parma & Krakow).

The main outputs of this project, besides this final brochure, are the topic guides related to the aforementioned topics. Furthermore, the cooperation with other projects from Interreg Central Europe, Horizon2020 and other frameworks -which includes projects such as Low-Carb, CoEXist, SOLEZ, UVAR Box, ReVeAL and SUMPs-Up- enhanced project results, best practices and research stemming from the seven cities and the rest of the Dynaxibility4CE consortium.

1 General objectives

With the demographic changes, increased transport demands and its effects on climate change, urban mobility planning towards multimodal integrated and low carbon is ever more important. Innovative mobility strategies and emerging technologies constitute promising solutions, yet their implementation and management are no easy task and local authorities require support and guidance in doing so.

To address these challenges, cities and regions all over the European Union (EU) have been adopting people-friendly transport policies which support active modes of travel such as walking, cycling and public transport supplied by renewable sources, which all aim to achieve several Sustainable Development Goals to improve health and conserve environmental resources.

Sustainable Urban Mobility Plans (SUMPs) is one such policy, implemented and supported across European cities. The SUMP concept provides a comprehensive and structured framework for strategic planning which guides authorities to better address all aspects of their multimodal networks, including innovative (and disruptive) mobility solutions.

Dynaxibility4CE has supported Central European cities and regions with the implementation of SUMP methodologies to plan for innovative mobility trends such as Connected Cooperative and Automated Mobility (CCAM), Mobility as a Service (MaaS) and Urban Vehicle Access Regulations (UVAR). This included supporting the preparation, analysis and action planning phases in seven CE Functional Urban Areas (FUA), developing tools and strategies to support low-carbon innovative mobility planning, as well as training and knowledge platforms to meet the challenges of their regions.

The project aimed to enable public transport authorities and local authorities in CE to plan in a **more dynamic and flexible manner, i.e., with dynaxibility**, to effectively exploit emerging innovative mobility solutions and provide greener and cleaner mobility systems.

In this way, Dynaxibility4CE has worked to positively contribute to the modern challenge of rebuilding cities into sustainable low-carbon Functional Urban Areas (FUAs) to overcome current problems such as pollution, congestion, road safety, accessibility, and inclusion.

2 Strategies of innovative mobility planning

Dynaxibility4CE has focused on developing innovative mobility planning strategies to integrate UVARs, CCAM and MaaS in SUMP, and supporting partner FUA in their implementation.

Urban Vehicle Access Regulations (UVAR)

As the fight against climate change intensifies, Urban Vehicle Access Regulations (UVAR) are becoming more popular due to their potential to tackle the Climate Emergency. The rise of UVARs in Europe calls for guidance documents to help policymakers in the successful implementation of these measures, which are often unpopular and conflictive. A big factor for this perception of UVARs is the broad influence they can have-indeed, these restrictive measures tend to have a significant impact beyond their geographical operational boundaries and in a broad number of matters (accessibility, social inclusion, affordability, spatial distribution of households, etc.).

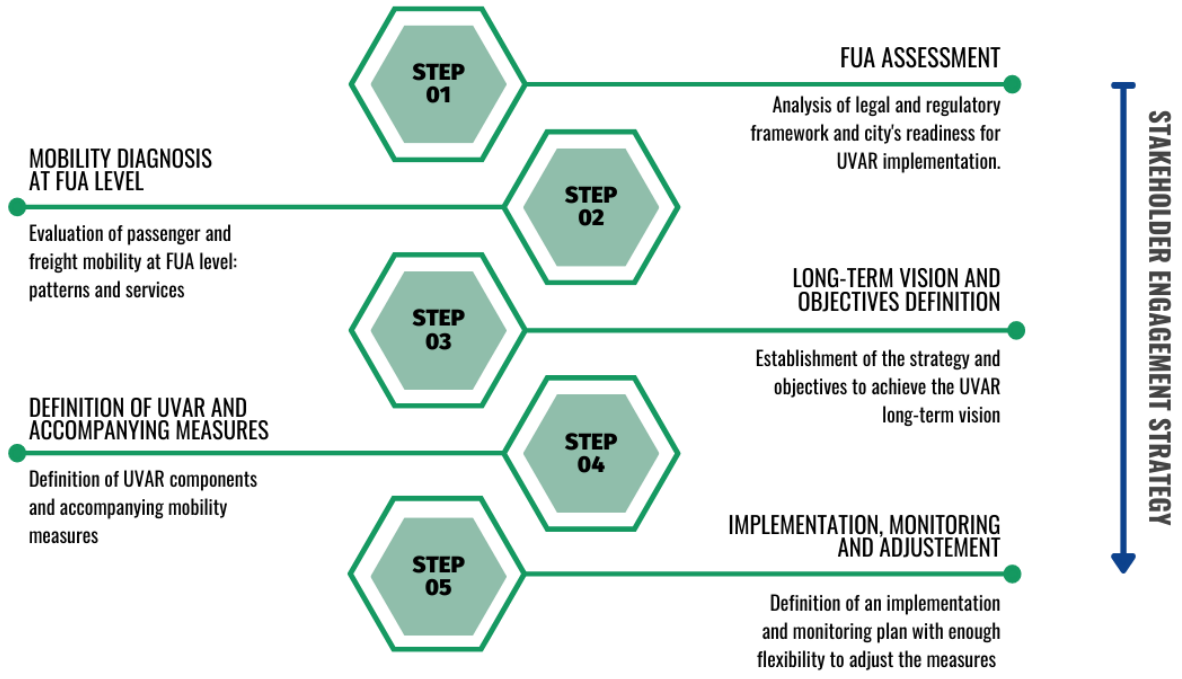

Figure 1: UVAR planning at FUA level

To identify further guidance and planning needs for UVAR, a series of workshops were carried out with relevant EU stakeholders, representatives from other EU projects such as ReVeAL and UVAR Box, and the partner cities of Krakow and Parma, which lead to the development of a SUMP UVAR Annex. The annex further enhances the UVAR SUMP Topic Guide already published in 2018 with some indications on UVAR planning and their application in the SUMP process at the Functional Urban Level (FUA) and tries to get deeper into some specific topics that could pivot to other local authorities deciding to act in the same direction.

The document provides more information on FUAs, how to consider them, during the UVAR planning process, linking with other resources from EU projects for further reading, as well as how to engage with stakeholders during the process. Moreover, the method to plan for UVAR at FUA level described in the Annex is illustrated by the process followed by Krakow (Dynaxibility4CE partner) in their path to implement a LEZ in the Polish city. The general guidance and Krakow case study are complemented with several best practices across Europe that were specifically selected due to their relevance to central European cities, showing that the

UVAR field is complex and diverse, and there is not a one-size-fits-all rigid solution for all cities and FUAs. Finally, this annex also attempts to harmonise all the guidance produced by the other projects with their compilation in the ultimate UVAR Operational Library. This library aims to facilitate access to relevant UVAR guidance for policymakers and urban planners studying to implement UVARs in their region.

Connected Cooperative and Automated Mobility (CCAM)

To steer a beneficial deployment of Cooperative Connected and Automated Mobility (CCAM) services, ensuring its alignment with sustainable urban mobility goals, local authorities will need to take a leading role. A proactive planning approach is required to effectively regulate how the introduction of Connected and Automated Vehicles (CAVs) should unfold, minimise the potential negative impacts and, more importantly, make the most of the opportunity to influence the paradigm shift into a more sustainable urban mobility vision.

Still, this poses a significant challenge for public authorities. Planning for such an innovative field involves dealing with a lot of uncertainties and understanding the functionalities, requirements, and limitations of the technological solutions. Besides, they need to be able to understand the opinions, needs and concerns of the citizens and stakeholders involved.

Robust guidance, tools and methodologies need to be provided to enable cooperative action and informed decision-making, ensuring the strategic alignment of the deployment scenarios with local conditions, policy goals, and societal needs.

With this in mind, Dynaxibility4CE developed a guideline for the CCAM integration in SUMP processes, leading the preparation of an SUMP Topic Guide for CCAM. Based on the existent Practitioner Briefing for Road-Vehicle Automation, developed by the CoExist project on 2019, Dynaxibility4CE thoroughly analysed current support needs and knowledge gaps, cooperating with ongoing projects like ART-FORUM, PAV and Ride2Autonomy.

Figure 2: AV-Shuttle Pilot on Tartu (Ride2Autonomy)

Moreover, recent experiences, research findings and tools developed, were collected to enhance the planning guidance for CCAM. The results from Leipzig and Stuttgart Region within the project have significantly contributed to such effort, providing valuable examples on how to assess potential impacts of CCAM deployment, test scenarios and develop suitable service models.

Mobility as a Service (MaaS)

The needs for support in the strategic planning of MaaS, which were identified by the partner cities of Graz, Budapest and Koprivnica through dedicated diagnosis workshops, are at the basis of the annex to the MaaS and SUMP topic guide. This innovative strategy has been designed as an annex to the existing MaaS and Sustainable Urban Mobility Planning SUMP Topic Guide issued in 2019 and it focuses on the Central Europe territorial context.

The document provides guidance for the development of a MaaS strategy that faces relevant societal challenges building on: main contributions and views at EU level, the vision of the main stakeholders, MaaS related EU funded projects, and academic literature review on the topic. This is done by complementing the previous sources and providing details on possible analyses, methodologies, and solutions.

A fundamental support to the development of the strategy has been provided by the participation of engaged and experienced experts and cities in the field of MaaS, providing their insights on the key elements to consider in the planning and implementing processes of MaaS initiatives. The annex for Central European cities and FUAS recommendations focus on the following four themes:

- Local engagement and demand analysis
- Data availability, quality, standardization, sharing and management
- Incentive measures and schemes supporting take-up of MaaS
- How to involve traditional and new service providers in the ecosystem.

As a complement to the strategy providing practical guidance to MaaS implementers, a description and tutorial for the MaaS scenarios self-assessment tool developed in the project is included, which facilitates the debate at the local level for the design and implementation of MaaS initiatives. The document is enriched with case studies describing the experiences of our three participating cities, which are engaged in building MaaS ecosystems.

3 Tools for innovative low-carbon mobility planning

Aiming to further support and strengthen capacities to plan for new sustainable mobility solutions, Dynaxibility4CE has developed a series of tools and guidelines.

News stakeholder engagement formats

The guideline for new stakeholder engagement formats in experimental designs/living labs is designed to accompany the collaborative process at the basis of the planning, design, and implementation of mobility innovations such as UVAR, MaaS, and CCAM within the framework of the SUMP methodology. This tool has been developed around the needs, expectations, and experiences of FUAs and stakeholders involved in the project. It aims at supporting local authorities and mobility planners in stakeholder engagement activities leading to an effective co-design of mobility innovations and applications on the territory.

The Guideline provides an analysis of relevant literature, experiences, and good practices on the successful engagement of different categories of stakeholders in mobility projects according to the quadruple helix approach (government, society, business, and academic research).

The investigation across academic works, previous projects and initiatives, and success cases at national and local levels converge in identifying Living Labs and co-design, Regulatory Sandboxes and Citizen Science initiatives as the most promising enablers for a participatory planning and implementation of mobility innovations. The findings are translated into recommendations aligning the stakeholder engagement process for mobility innovations with the SUMP cycle.

CCAM-readiness Self-Assessment tool

The Dynaxibility4CE project has developed an CCAM-readiness Self-Assessment tool to guide authorities in evaluating where their city stands in relation to CCAM deployment and what the next steps could be to get 'automation-ready, i.e., having the capability to make structured and informed decisions about the comprehensive deployment of CCAM.

As proposed by the Automation-ready Framework (CoEXist, 2020), depending on the local conditions and objectives, each city might find themselves in a different phases of action: (1) automation awareness creation; (2) planning for automation-readiness; or (3) preparing for the implementation of automation-ready measures. With this in mind, the questions in the self-assessment tool are tailored to support practitioners in assessing the applicable phase(s) of automation-ready planning for their FUA. It is meant to facilitate the preparation of the planning process and analysis of the contextual conditions. And supports the assessment of available capacities and resources to carry out the planning activities and later implementation, including human resources (i.e., available staff and skills) as well as financial resources.

Due to the high levels of uncertainty and complexity associated to CAV, authorities often have trouble understanding where to start, what types of strategies and measures are recommended or possible to address CCAM. The self-assessment tool provides a simplified entry point for planners, supporting in the assessment of key questions to assess local challenges, opportunities, risks and requirements for the deployment of CCAM services. The tool mainly targets (transport) planners and working for local and regional public authorities, who do not necessarily have deep knowledge on automation technology. But it will also be useful for mobility service providers, researchers, academia, and other stakeholder. It guides them towards the most relevant information on planning for automation in their context, raising awareness of existing tools and resources, and on how to integrate them into the SUMP processes.

MaaS-readiness Self-Assessment tool

The MaaS scenario self-assessment tool has been developed to give guidance to cities and regions interested or engaged in developing a MaaS system. It supports the planning process by helping policymakers and

mobility planners to evaluate the consequences of measures fostering the implementation of different MaaS models. The tool provides different challenging scenarios according to territorial and socioeconomic characteristics of the application areas, and to the operational and market structure of existing and planned mobility networks.

The self-assessment, which is based on 18 multiple-choice questions, analyses territorial, socio-economic and mobility characteristics, and provides several outputs, including a SWOT analysis of the existing regulatory, operational and market framework. Furthermore, a set of recommendations calibrated on different MaaS operational and business scenarios are given. The outcomes of the self-assessment represent a preliminary checklist of key points to be discussed among policymakers and stakeholders setting and/or fine-tuning the strategy for a successful implementation of a MaaS ecosystem. The tool is developed by building on experiences of the project's case studies in Graz, Budapest, Koprivnica and Krakow, as well as on projects and initiatives analysed during the Dynaxibility project.

New data collection methods

The tool "Guideline for air quality data collection for clean mobility" is meant to be a support for administrators and stakeholders who are involved in the definition of mobility policies and plans aiming at the reduction of the concentrations of traffic-related pollutants. In this respect, the Guideline contains an overview of several possible approaches and of valuable solutions to bridge the gap between air quality technicians and administrators.

In fact, there is an increasing demand for detailed information about air quality conditions at high spatial and temporal resolutions, especially inside urban areas, in order to assess the environmental impact of mobility policies and plans. The complexity of the relationship between air quality and mobility is due to the large number of factors affecting air quality. Therefore, careful planning of the most suitable approaches is required according to the main features of the areas where measures are and/or will be implemented.

The selection of a set of mobility indicators that are important in connection to air quality is another important issue developed in the Guideline. Comparisons of mobility indicators among Dynaxibility city partners are also highlighted to provide an updated overview of the situation, but also to promote the dialogue and the information exchange making a step forward in the definition of a common background among different institutions.

SUMP in Central Europe

A SUMP National Task Force (NTF) is a higher-level body committed to preparing the ground for a national SUMP supporting programme (NSSP) or to improving an existing programme, ideally led by a national level representative with responsibility for urban mobility issues. Further details are available in the Practitioner Briefing on National Support Frameworks for SUMP.

Dynaxibility4CE supported NTFs in 9 Central European countries during the project lifetime by facilitating existing NTFs and supporting the setting up of new ones through project partners, and experts talking about the integration of MaaS, UVAR and CCAM during the preparation, analysis, and planning stages of SUMP. As the starting situation was different in each country, we took a tailored approach. Some countries, such as Slovenia, have an active SUMP NTF where only limited support was needed, while there are also countries without a clear leadership role of SUMP at the national level which makes the engagement process harder. As a success story of the project, Dynaxibility4CE partners facilitated existing NTFs, like in Hungary or supported the setting up of new NTFs or collaboration platforms on SUMP in, among others, Austria, and Germany.

4 Dissemination & Learning Materials

First and foremost, the Dynaxibility4CE homepage is a great starting point and repository for all information related to the project, including our project leaflet and all public deliverables, such as the previously mentioned topic guides. Additionally, news about the three focus topics and our project partners remains accessible via Twitter and LinkedIn. Furthermore, updates about SUMPs in Central Europe will be available on the SUMP-Central.eu platform, which was created by the Low-Carb project and was continued by Dynaxibility4CE.

Besides these documents, which aimed for the dissemination of project results, all project cities submitted an action plan, which should help the urban municipalities to position the project into the wider framework of local sustainable urban mobility plans, as well as the long-term transformation of the city. Additionally, Dynaxibility4CE organised a joint webinar with the Interreg Central Europe Smacker project, a common webinar with ReVeAL in the framework of the POLIS Network Mobilising Mobility Webinars,and a joint webinar with projects PAV and Ride2Autonomy in the Public Transport Lab webinar series from POLIS Network.

In addition, several tools were developed with the aim to support the decision-making and uptake of UVARs, CCAM and MaaS in Central Europe and beyond. Dynaxibility4Ce has the intention to provide this content on a dedicated space on the website, as well as linking the information on SUMP-central.eu and Rupprecht Consult.

The following tools & guidelines were published:

- CCAM-readiness self-assessment tool & MaaS-readiness self-assessment tool
- The SUMP Self-Assessment tool
- Guideline for new stakeholder engagement formats
- Guideline for MaaS/CCAM-ready transport models
- Guidelines for new data collection & management approaches
- Updated SUMP CE Competence Centre & National Task Forces

5 Innovative low carbon mobility planning in FUA: results and conclusions

In the following chapter, a brief summary of all seven Dynaxibility4CE cities is given, as all of them have unique challenges on their paths implementing MaaS, UVAR and CCAM solutions over the period of the project, which were:

- CCAM: Leipzig, Stuttgart, Graz, Parma
- MaaS: Graz, Budapest, Koprivnica, Krakow
- UVAR: Parma, Krakow.

This brochure provides but an overview of the main aspects and results of the local challenges, achievements, and key findings of the process in each partner city.

For further information, please consult the project outputs on our homepage:
https://www.interreg-central.eu/Content.Node/Dynaxibility4CE.html

Budapest

The capital of Hungary is home to nearly 1.8 million inhabitants and is struggling with congestion, as 48% of trips are made by private car and just 10% use active modes of transport. Nevertheless, public transport use is relatively high at 42%. One essential problem of Budapest is the increasing suburbanisation process, which encourages commuters to use their private cars. Additionally, car use was further promoted due to the COVID-19 pandemic, as public transport was deemed unsafe by many citizens.

Therefore, search traffic for parking spaces and congestion rose. In order to counteract the negative externalities of the passenger car, the city on the Danube riverbanks aims to establish a MaaS solution in the upcoming years, which will improve the already extensive public transport offer.

Besides the aim to provide a compelling service for the customer, the transport provider BKK also strongly believes in the benefits of integrating all transport solutions to facilitate administrative procedures. The plan started with several pilots, which helped to integrate a bicycle sharing service and a Horizon2020 research and development project called MaaS4EU. During these initial stages, as well as throughout the Dynaxibility4CE project, Budapest benefited from the best practices of other European city administrations and aimed to redesign the diverse set of solutions to adapt them to the local user and provide a modern service that serves user expectations.

Main messages

Dynaxibility4CE provided BKK a concrete ground for developing its MaaS tools. The established Action Plan aids the future development of Budapest's mobility application (BudapestGO), creating clear milestones for the process. Additionally, the methodology used in the project serves as a monitoring and supervising tool for any further updates and revisions of MaaS tools.

Dynaxibility4CE action plan on MaaS will be used as guideline for future implementation. Thanks to the thorough action plan that was created during the project and which will cater as a strategy plan for the future MaaS application process, the plans are laid out well. These include infrastructure implementation

and tool procurement, as well as several regulatory tasks and a communication and marketing strategy for stakeholder engagement.

Graz

The 300.000 inhabitants of the Styrian capital are very active, as 41% of trips are made by active mobility (21% walking and 20% cycling). The majority of trips are made by private car (41%) and only 18% of users prefer public transport, which is the reason for research on Mobility-as-a-Service to attract more users. This aim is very essential by taking into consideration the functional urban area (Graz Umgebung), which is home to around 500.000 inhabitants, who live in a heterogeneous region, as it includes urban, dense and compact areas as well as widespread settlement structures in the suburban and rural areas. Since the functional urban area of Graz is the fastest growing in Austria, new solutions need to be found beyond the currently existing on-demand service of GUSTmobil, a DRT solution, and 't.i.m.' as the local sharing solution. The 't.i.m.' is an abbreviation for daily, intelligent and mobile (täglich. intelligent. mobil) and offers (battery electric) cars, (cargo-) bikes and electric taxis.

Even though these solutions exist and the annual ticket for residents of Graz is just 315€, the city still has an ambitious goal to foster its public transport offer. Graz and the state of Styria have considered MaaS as a viable option and have initiated stakeholder consultation processes during the Interreg CE-funded SOLEZ project, which continued during Dynaxibility4CE. The exchange and the MaaS implementation plan were driven by the Maas Steering Group, which is composed of various urban and regional stakeholders from public administration and transport companies. The overall goal is to create a diverse, fair mobility offer for the region that is adapted to individual needs to promote independence from the private car. Mobility as a service has the potential to provide an offer adapted to individual needs and to promote the shift to more environmentally friendly modes.

Main messages:

Bring a diverse set of stakeholders to the table. For the continuous development of the cross-regional MaaS process, all stakeholders should continue to be involved in the future. It is promising to bring together the urban and regional actors (in the areas of public administration/transportation companies). Connecting stakeholders and using all opportunities is considered central to MaaS implementation in the Graz region.

Funding remains a challenge. Investment and operation costs of a MaaS solution are quite high, but EU funding programmes were a great solution, but a sustainable option must be found in the future. The City of Graz is certain that MaaS can contribute to the mobility strategy objective (shift towards more sustainable forms of mobility), but the effectiveness is still unknown and other measures might have higher priority.

Main lessons learned:

Future online configurators need a diverse set of mobility solutions that can be combined flexibly, as the FUA of Graz is very heterogeneous. Therefore, the main challenge will be to gather all mobility offers and achieve an intermodal integration of "tim" and micro-public transport, as well as on-demand-services.

Also, based on the survey, mobility types that exist in the Styrian Central region were analysed and MaaS-target groups were defined. The results show that over 50% of the respondents are among the main target groups for MaaS. A further 38% of the participants can be assigned to target groups with shifting potential (from car to environmental-friendly modes of transport).

Overall, the City of Graz definitely considers Dynability4CE a success, as it provided opportunities to analyse the potential for MaaS in the Styrian capital. Thus, a roadmap for the future is currently planned, which requires further analysis of the future (personnel) costs and political backing to continue the path towards MaaS implementation. Luckily, a technical concept was already found, but it remains to be seen if transport providers in Graz can use the technical platform and whether or not it can be extended to the entire region of Styria. In general, the City of Graz is positive concerning the future of MaaS in Styria.

Koprivnica

Koprivnica is the smallest of all project cities with just over 30.000 inhabitants and is located around 100km North-East of the Croatian capital of Zagreb. Even though the surroundings are relatively rural, still a significant number of trips are done by public transport. 32% use the local public transport facilities, whereas 50% take the car and 18% of trips are done by active mobility means. Low-emission public transport provides a suitable solution inside the small city, but the connection with the functional urban area creates challenges, as most trips by the 50.000 inhabitants of Koprivnica functional urban area are done by car. This is also because the city an important industrial hub in Northern Croatia, which attracts commuters from the surrounding villages, especially to the second-largest food processing company, which is located in the proximity of the Croatian city.

The infrastructure is adequate for car users and active mobility, as citizens are contented about the pedestrian and cycling infrastructure. Furthermore, free public transport system, which consists of a fully electric bus system and public (e-)bike-sharing system is provided. The most significant transport challenge of Koprivnica is the lack of control of transport that is coming into the city from the wider urban area. Thus, the best practices and results of the are helping to tackle this challenge. In order to encourage public transport use, Mobility as a Service can be a great solution to create a common transport system that is more transparent, cost-effective, focused and reasonably priced. MaaS is not only seen as a tool for the sole purpose of billing and integrating, but a tool that ensures that the transport system will be functional.

Main messages:

Governmental support is needed. Since MaaS isn't a widely used concept in Croatia yet, initiatives from the central government are lacking, which creates a significant hurdle for cities that are often already dedicate their investments to maintain or extend the physical infrastructure. Thus, the lack of financial incentives hinders innovation in Croatia, a situation that will hopefully change soon.

MaaS can work in smaller systems, but they require innovative thinking. Even though MaaS is a concept that is mostly used by larger local authorities in populous urban environments, the Dynaxibility4CE project in Koprivnica shows that MaaS can also be adopted in smaller communities with limited users and services. To achieve this, innovative approaches have to be considered in order for the system to be functional under the given circumstances.

Future outlook:

The future for the City of Koprivnica and its FUA partner municipalities will be a MaaS public transport system that spans across the entire functional urban area. Thanks to the Dynaxibility4CE project, the foundations were laid to start the MaaS activities, especially due to the new local cooperation that was established during the project.

Krakow

The second largest city of Poland, which is home to nearly 800.000 inhabitants, has significant plans to reduce the burden of passenger cars in the historic city centre by extending its UVAR. Currently, most trips are done by private cars (around 40%), but public transport (around 30%) and walking (23%) also play an important role. Even though the current numbers for public transport look positive, car use has increased from 21% (1995) to 34% (2018) - a phenomenon that is observed across Central Europe. The same car-centric situation applies for trips to Krakow from the 14 neighbouring municipalities in the FUA, as 40% use the private car for commutes. Despite these numbers, Krakow is a pioneer of green mobility in Poland, thanks to the introduction of the first public bike rental system and DRT system in the country. Since the national legal framework came in place on 11 January 2018, a plan was set up by the city of Krakow to establish an LEZ. In addition to the reduction of trips by passenger cars, public transport is promoted by the plans to introduce MaaS elements, including travel planners or applications for car-and scooter sharing.

Main results

UVARs:

The upcoming introduction of an LEZ will hopefully discourage people from the FUA and the inner city of Krakow to use their cars, while providing additional sustainable mobility solutions by investing in public transport and active mobility. Furthermore, a transition period will be essential for citizens to adapt to the LEZ, which can be promoted by continuous exchanges with the community of local stakeholders to foster support and avoid nuisance. Additionally, the introduction of an LEZ should not be perceived as a limitation of mobility options, but as a promotion of a mobility shift. Therefore, support packages for lower-income residents, such as a scrapping bonus for active mobility solutions or free public transport tickets for residents can be a great opportunity to facilitate the transformation.

MaaS:

The main challenge was the integration of potential mobility providers into one common framework, as transport systems currently developing separate strategies. MaaS can aggregate and integrate these systems into a user-friendly solution, which can promote sustainable mobility behaviour among citizens and tourists. The city of Krakow started to create a database of tariff systems, types of public transport tickets, vehicles, equipment, and public transport stops. Furthermore, Krakow currently plans the rollout of contactless payment that will potentially enable dynamic payment for travel depending on the actual time/route of travel. Overall, the long-term plan is to achieve a full tariff integration for the transportation system in Krakow's agglomeration.

The city created a platform for regular knowledge exchange with Polish cities on topics such as air pollution, UVARs, MaaS and other urban mobility framework policies.

Leipzig

36% of all trips that are done by the roughly 600.000 inhabitants of Leipzig can be categorised as active mobility, with similar numbers for cars and motorbikes (36.5%). The remaining trips are done by public transport. Public transport use is high among the residents of the historic inner neighbourhoods where distances are short, and districts are well-connected. Meanwhile, cars are still the dominant factor in the rural and suburban outskirts of the German city, where public transport offer is historically weak.

As Leipzig is the fastest growing city in Germany, new mobility solutions need to be provided, including demand-responsive transit (DRT). Since walking and cycling are not the sole solutions for those longer distance trips above 6km at the periphery of Leipzig, DRT is a great solution. Thus, first pilots were already finished successfully in these dedicated peripheral neighbourhoods. Since the city administration and the local transport company LVB are convinced that autonomous or highly automated vehicles will play a significant role, the city aims to prepare for this potential future reality by participating in a pilot.

Main messages

Cities should prepare for new technologies now

DRT and automated vehicles are at the core of innovative solutions of Leipziger Verkehrsbetriebe (public transport provider), as the 'Flexa project' provides DRT services to users in two pilot areas and the ABSOLUT project, which is currently in its planning phase, aims to provide an autonomous shuttle between the Leipzig fairgrounds and the local BMW factory. The ambition of the autonomous driving project is to reach inner city driving speeds of 50km/h and more, as well as the operation of the testing vehicle in real-world scenarios of normal daily traffic. Thus, both projects are essential to study supply & demand, the maturity rate of systems, as well as acceptance rates of the population, long before these novel solutions are market ready.

Public transport operators should manage autonomous vehicles

The central finding of the ABSOLUT project is, that on the development of highly automated vehicles, public transport operators are the prime integrators of such fleets. They have local knowledge to prepare and identify operational fields. They are on-site and can resolve conflicts physically. They operate control rooms already today. And most important via teleoperated driving they can benefit from incremental improvements in technology reducing the number of human interventions and increasing the number of teleoperated vehicles per teleoperator. They can reduce costs even before the breakthrough of real autonomous driving.

Stakeholder engagement and cooperation with the city administration is essential

Thanks to great cooperation between the transport provider and the city administration, the two projects could flourish. A win-win situation was created as LVB was able to set up a short-term pilot with a duration of one year, while the city planning department could use the results for a long-term local neighbourhood developmental concept. The latter has a planning framework of five years. The DRT engagement benefitted

from the established engagement format and the coordination between the city of Leipzig and the transport company.

Parma

The city in the heart of Emilia Romagna is home to nearly 200.000 inhabitants of which more than 10% are students. External tourists that visit Parma by car are a significant burden since Parma is the second-most important tourist destination in the Emilia Romagna region after Bologna. Efforts were made to reduce the current dominance of the passenger vehicle by investing into a cycling network of around 160km of cycle path. The low emission zone which covers around one third of the city also reduces the impact of the car and has significant positive effects on the health of citizens and increases the attractiveness of the city for tourists.

Thanks to the analysis and exchange of best practices that took place during the Dynaxibility4CE project, Parma is currently setting up an extended LEZ, the so-called 'Green Area', which applies to the territory inside the highway ring road that surrounds the Italian city. This zone, which was planned to be introduced in 2022, will cover an area of more than 30km2 and bans diesel vehicles with a EURO4 homologation or lower, as well as petrol cars in the categories of Euro2 or lower. There are plans to exacerbate these measures in the upcoming years – a measure similar to the plans of Milan. The currently foreseen roadmap foresees the installation of the first electronic gates to be installed in 2022. From this starting point, the preparations will take another year and the LEZ will come into effect on 1 January 2024. The scheme, which will be active during workdays between 8.30 and 18.30, will have several exemptions, including low-income car users, and historical and special vehicles (such as fire trucks or police cars).

An access ban without providing alternatives in the sense of active mobility and public transport solutions cannot be successful. Therefore, the city administration is taking further measures with the goal to improve safety of road and cycle and pedestrian traffic, promoting the use of shared and electric mobility and digitising mobility and sharing solutions while planning towards an implementation of a MaaS solution in the future. Moreover, the city government is providing significant financial aid for the transition to greener vehicles by providing funds and incentivisation schemes, as well as investments in the municipal public transport fleet.

Main messages:

Use factual evidence to convince your critics. The proposed UVAR aims to reduce air pollution of fine particulate matter (PM2.5), which is a significant challenge for Parma, as indicated by its rank 276 of 323 European cities for air quality, published by the European Environmental Agency. The Italian city tried to overcome this by installing mobile emission measuring devices to map and monitor the extent of urban pollution. Thus, the analysis of monitoring and data is a significant asset during the stakeholder engagement phase, as an essential part to gain support for an UVAR.

Offering alternatives to car users, who are impacted by the UVAR. Preferential lanes to enhance local transport, establishing bike- and (electric) car-sharing schemes, installation of electric charging

stations, as well as the plan to introduce a 30km/h zone are all great ideas of Parma to provide mobility alternatives for car users and decarbonise the inner city.

Stuttgart

The metropolitan area of Stuttgart is home to around 2.8 million inhabitants and several large car manufacturers, which is reflected in the car-dominant modal split of 58% for the region. while active mobility accounts for 30% of trips and just 12% are using public transport. The capital of Baden-Württemberg is facing the challenge of high volumes of commuter traffic, which accounts to nearly 40km per inhabitant per day in the FUA, as Stuttgart provides a significant number of high-quality jobs.

The Dynaxibility4CE partner Verband Region Stuttgart (regional organisation of Stuttgart) aimed to assess the potential impacts and solutions for the regional capital. Based on previous project results of testing the potential of integrated autonomous ridesharing offer in a more urban area, a new test case was found in a peri-urban and less densely populated area. The study in the Schurwald area was a very important first step in analysing the potential impact of autonomous vehicle feeder systems to existing train lines in the North and the South of the area. Thus, the question was answered whether or not this new technology can promote access to public transport, while reducing problems like congestion, bad air quality and other negative environmental impacts can be improved by shifting private car users to public transport users.

Main messages

Since CCAM, and autonomous driving in general, are still largely unknown to a wider audience of stakeholders and a very uncommon territory in planning, VRS realised the importance of raising awareness of these topics among stakeholders.

Transport model studies, which are also a relatively new field for cities, are functioning quite well to assess new mobility solutions, like systems of autonomous vehicles, and their potential impacts. Thus, the Schurwald study fostered interest in transport model studies among the transport planners in the Stuttgart region, as well as first results and potential future outlooks concerning AV integration in a peri-urban area.

Successful results

One major learning is that any autonomous ridesharing offer needs to be integrated into the public transport system to avoid cannibalisation effects and to strengthen public transport. This could be achieved by implementing a feeder and increasing the attractiveness of the innovative offer by tariff and booking integration. Furthermore, this increases the chance by all social groups in the peri-urban area to access basic public transport by implementing CCAM offers. Thus, the Schurwald study depicted that the S-Bahn Stuttgart, the backbone of the public transport, needs to become more accessible especially for the population in peri-urban and rural areas.