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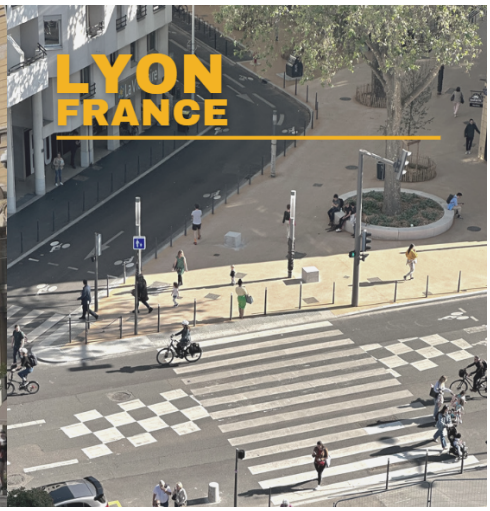
der Mobilität in Metropolregionen

euMOVE
European Mobility Venture Report 2023



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Introducing euMOVE 2023

Mobility in metropolitan regions is underlying a constant change since the city planners realized that the status quo of mobility in metropolitan areas does not surpass the challenges like traffic congestion, environmental pollution, and social inequality.

To be able to surpass those challenges in Munich, we, 12 students with various backgrounds from the Technical University of Munich (TUM), participated in the euMOVE (European Mobility Venture) project, which is a cooperative project between the TU Munich and the Munich Cluster for the Future of Mobility in Metropolitan Regions (MCube). This euMOVE project went now into its fourth round, visiting this year the metropolitan cities Budapest, Lyon, and Prague. In these field trips, we were supposed to discover how European metropolitan cities approach their mobility transition. The overall goal of the project was to come up with approaches and ideas which can change Munich`s mobility landscape to a more environmentally friendly and social inclusive mobility.

For that, this paper consists out of three excursion reports which include the findings from our cities which we visited. The first excursion report, which deals with Urban Living Labs in Lyon, France, sheds a light on how mobility in cities can be designed. The second excursion report, which deals with mobility pricing in Budapest, Hungary, shows us of how mobility pricing can affect the users' choices. The third excursion report deals with increasing the user and planner acceptance for shared mobility options in Prague, Czech Republic

Moreover, this report consists out of three meta topics reports. These reports deal with urgent mobility topics as mobility transition, mobility justice and effects of postgrowth on the mobility sector. These topics, combined with the experiences the students gained during their trips to the different metropolitan regions, provide a valuable framework to understand how these topics affect and shape our today`s mobility.

Finally, we will conclude this paper with an overall conclusion, advising the reader to take a different look on the mobility sector. This will help us as a society to encompass the current mobility challenges in metropolitan regions like Munich.

Excursion report 1:

Urban Living Labs in Lyon, France

A new perspective on designing mobility

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Abstract

This paper examines the practical aspects of mobility experiments and test beds in Lyon, France, as a means to transform mobility systems. The research focuses on understanding how test beds are shaping the mobility landscape in Lyon, analyzing implemented solutions, and exploring opportunities and challenges. The study highlights Lyon as a compelling case study and discusses three significant experimental projects in the city. Insights gained from the project shed light on the contribution of test beds and the scaling potential within the broader context of mobility transformation. The findings contribute to the discourse on sustainable and efficient mobility systems in metropolitan regions, providing valuable insights for future planning and implementation.

1. Introduction

Over the past few decades, mobility has witnessed a remarkable surge in popularity worldwide, thanks to the growing awareness of its extensive scope. This encompassing concept tackles critical issues such as curbing greenhouse gas emissions, improving air quality, easing traffic congestion, and promoting public transportation, all the while striving to ensure universal access to mobility. Notably, mobility stands as a vital aspect of sustainable development, wielding the potential to address an array of global challenges, including climate change, urbanization, and social inequality (Vandycke & Viegas, 2022, p.85-86).

As a result, the euMOVE Project 2023, an interdisciplinary research initiative based in Munich, has brought together 12 students from diverse disciplines at the Technical University of Munich to delve into the subject of mobility in European metropolitan regions. This year, the project places particular emphasis on exploring practical aspects of shared mobility, mobility experiments, and pricing. Specifically, euMOVE is directing its efforts toward the cities of Lyon, Prague, and Budapest.

The central focus of this research paper revolves around the practical exploration of mobility experiments and test beds, offering a fresh perspective on mobility design. The objective is to understand how test beds are shaping the mobility landscape in the context of Lyon, France and to analyze the solutions that have been implemented, with a particular focus on the opportunities and challenges they have presented in our cities.

The metropolitan region of Lyon has been identified as a significant case study for this research. The findings presented in this paper are based on a two-week field trip to Lyon, during which the students engaged with experts in the mobility field, visited project houses, and conducted discussions with both civilians and institutions involved in mobility initiatives. These interactions aimed to unveil critical aspects regarding mobility innovations in Lyon.

The first part of this paper provides a theoretical framework for understanding test beds and their approach to redesigning mobility. It establishes the foundation for comprehending the subsequent analysis of Lyon as a compelling case study.

Subsequently, the paper explores three significant experimental projects that are currently shaping the mobility landscape in Lyon: Lyon Part-Dieu, Okeenea, and Grand Lyon. These projects represent crucial dimensions intrinsically connected to mobility, such as infrastructure, accessibility, and mobility management.

Furthermore, the paper discusses the contribution of test beds in Lyon and presents the insights

gained from the project. It explores the roles of various actors involved in these experiments and considers the scaling potential of test beds within the broader context of mobility transformation. Lastly, the paper concludes with a discussion of the main takeaways from the research, as well as the opportunities and challenges associated with urban living labs—an innovation central to this study.

By examining the practical aspects of mobility experiments and test beds in the Lyon context, this research aims to shed light on the transformative potential of innovative mobility solutions and contribute to the ongoing discourse on shaping sustainable and efficient mobility systems in metropolitan regions.

Intersection at Les Halles de Lyon
Photo credit: A. Herrera

2. Urban Living Labs: An approach to redesign mobility

"Test beds" – and related concepts such as "living labs" or "real-world laboratories" – have emerged in the past decades as a prominent approach to structure and stimulate innovation by testing new sociotechnical arrangements *in situ* and at a meso-scale (Evans & Karvonen, 2014, p. 415-416). Test beds represent an experimental or co-creative approach that aims to test and demonstrate the implementation of new technologies or ideas in real-life settings. This co-creation consists of several actors, whereby governments, or other actors, deliberately seek to establish conditions under which niches for innovation can grow and "breakthrough" existing regime conditions. Therefore, test beds can be seen as a process which seeks to create spaces for innovation, allowing experimentation with alternatives and the accumulation of valuable experience. For that, test beds are a solution to test and grow emerging innovations which need to be tested and scaled in a real-life environment (Marvin et al., 2018, p.17-18).

Additionally, test beds can be seen as a means through which to gain experience, demonstrate and test ideas, so as a step towards scaling-up responses in systems of provision that will have improved effectiveness, political traction, and public support. Consequently, test beds are not a stand-alone set of interventions, but part of a wider "politics of experimentation" through which

the governing of urban sustainability is increasingly taking place. Promoting inclusivity emerges as a crucial element for test beds, given that innovation often hinges on the interests of dominant actors, such as corporations or governments, leading to resource concentration and the marginalization of alternative voices and ideas. As a result, test beds must actively work to include diverse perspectives, ensuring a more equitable and comprehensive approach to experimentation (Marvin et al., 2018, p.17).

Moreover, the concern must be raised that "test beds help create and stabilize the very worlds they ostensibly test – or what has been called the "performativity of instruments". Therefore, it is sometimes a challenge to disrupt preconceived test designs and implementation pathways, and to inject the other actors' visions of a desirable future into the innovation process since test beds purposefully demonstrate pre-defined visions. Consequently, it is challenging for test beds to "step back" after initiation due to the expectations they generate, including investments, shared agendas, and performance evaluation (Engels, Wentland & Pfotenhauer, 2019, p.8-9). Additionally, these predefined roles during the implementation of test beds can lead to nascent path dependencies since test beds are generally understood to be situated in particular places at particular times, and thus, are sometimes incapable of producing generally valid knowledge since test beds often lack a proper representation of society. This often creates tensions for test beds, as they struggle to effectively balance the development of locally rooted mobility solutions and the ambition to create scalable products (Engels, Wentland & Pfotenhauer, 2019, p.8).

Despite this, test beds provide a valuable framework for innovations which can be tested and scaled in a real-life environment. Test beds play a pivotal role in tackling challenges and seizing opportunities that arise from these innovations, enabling their further development to meet the needs of society. Finally, test beds can be understood "as spatially confined, purposeful experimental settings aimed at testing and demonstrating the viability and scalability of new sociotechnical orders and associated forms of governance based on particular visions of desirable futures" (Engels, Wentland & Pfotenhauer, 2019, p.3).

With regard to mobility, test beds can help to identify and address the challenges and opportunities associated with implementing new mobility approaches, including issues such as infrastructure requirements, user acceptance, and regulatory frameworks. Test beds offer a unique opportunity to test and refine mobility solutions, taking into account the dynamic and context-specific nature of urban environments. By involving users and stakeholders in the co-creation process, test beds contribute to the development of more sustainable, user-centric, and effective mobility strategies that address the diverse needs of urban communities (Broggi, 2013, p.1404).

3. Urban Living Labs in Lyon, France

Lyon has become a leading hub for mobility test beds, making it an exciting location for conducting research in this field. In our sense, mobility test beds refer to controlled environments where innovative transportation technologies and systems are tested, evaluated, and refined before being deployed on a larger scale. Lyon offers a unique blend of urban and suburban areas, making it an ideal setting to explore various mobility solutions and their impact on different urban settings.

Hence, for our EUmove project, we made the decision to journey to the Metropolitan City of Lyon and conduct research with a specific focus on how Lyon utilizes test beds to revamp mobility within the city. The next section provides information on three key projects and test beds that were visited. At each location, we had the opportunity to conduct several interviews with experts from such initiatives. Additionally, at each test bed, we had the chance to converse with citizens to understand their individual experience.

3.1 Lyon Part - Dieu: A project focused on the impact of infrastructure on mobility

Part-Dieu, known as Lyon's mobility hub, is a thriving center and gateway to Lyon Métropole. It is Lyon's business district, the second largest business district in France, and at the same time a major center for mobility, especially with the railway station at its heart (8.4, Interviewee 1, 2023). However, Part-Dieu has undergone significant transformations throughout its history. Originally a military base until the 1950s, it was later acquired by the city, which formulated housing and business plans for the area. In the aftermath of the war, the district was constructed in the 1960s with the objective of establishing a contemporary neighbourhood (Lyon Part-Dieu, 2023). The Lyon Part-Dieu train station was subsequently built in 1983 primarily to facilitate high-speed train connections with Paris. However, the station was designed several years after other infrastructure in the district, resulting in a lack of urban integration and a design heavily focused on cars. Consequently, the district became inundated with cars, relegating pedestrians to secondary status and necessitating detours via pedestrian bridges. Presently, La Part-Dieu witnesses over 170,000 individuals relying on public transportation daily, surpassing the station's initial capacity, which was designed for approximately 35,000 people per day (Lyon Part-Dieu, 2023). Therefore, a reinvention of the station and its surrounding area has become necessary (8.4, Interviewee 1, 2023). The transformation of the train station is part of a larger project aimed at redesigning the entire district of La Part-Dieu. Led by SPL Lyon Part-Dieu, a publicly owned local development corporation, the project seeks to create an economically vibrant district that

is also liveable, attractive, green, and easy to navigate. This includes the redevelopment of the multimodal interchange at Lyon Part-Dieu station, with the goal of establishing a more practical and functional city center with improved service offers (8.4, Interviewee 1, 2023).

To enhance the liveability, greenery, and enjoyment of Part-Dieu, it is necessary to repurpose space that was previously dedicated to cars for other purposes and modes of transportation. This involves creating new or redesigned public spaces, roads, and the station itself. However, this was not always the primary focus of the project. With the change of mayors, the project's priorities shifted from a focus solely on economic development to a more sustainable vision that prioritizes a green city and improved quality of life. The project now places pedestrianization of the district as its top priority. To achieve this, a pedestrian plan for the entire district is currently being developed with input from organizations representing the visually impaired and individuals with mobility impairments to better understand their needs. The second priority for the reinvented district is to create easier and safer cycling infrastructure. With "Les Voies Lyonnaises", Part-Dieu is integrated into a larger bike network aimed at establishing secure cycling paths with more space and enhanced safety measures (8.4, Interviewee 1, 2023).

Rue Garibaldi serves as an example of a redesigned street in the district where former "urban motorway" lanes have been repurposed for buses, pedestrians, and cyclists. The addition of vegetation has created a calmer, greener street with separate paths for pedestrians and cyclists, improved public transport routes, and new enjoyable public spaces which can be seen in the photos below.

The project has successfully redesigned urban spaces, thereby improving urban mobility and enhancing the city's liveability. The forthcoming transformations in spaces and transportation resulting from this new infrastructure are eagerly anticipated (8.4, Interviewee 1, 2023).

One major reinvention project yet to be implemented in the district is the station of Lyon Part-Dieu. As a central mobility hub and a quasi-public space at the same time, the station serves multiple purposes. It functions as an arrival point for workers of the district, a shopping mall, access to public transport, a meeting space, and a thoroughfare connecting east and west. The reinvention should make traveling easier and improve the experience of inhabitants, workers, visitors, and regular users. To achieve this, SPL is collaborating with many different actors, such as public transportation companies, local organizations (e.g., for blind people or people in wheelchairs, inhabitants, employees and visitors, urban planners, architects), and engineers.

Overview of redesigned Rue Garibaldi, Lyon from above
Photo credit: A. Spalinger

Redesigned Bus/ Bike line on Rue Garibaldi, Lyon
Photo credit: A. Spalinger

The redesigned Part-Dieu station is envisioned as more than just a transportation hub. It is imagined as a dynamic platform, resembling a public square, where individuals can gather and enter for transit after finding a moment of tranquility. This revamped station should connect various significant destinations and encourage pedestrian movement throughout the area. The new multimodal interchange will be adapted to the needs of the people, adding new entrances and enabling easier navigation. Creating smart infrastructure is essential for transforming urban spaces and transportation (8.4, Interviewee 1, 2023).

However, transforming urban spaces and transportation always presents challenges, and this project is no exception. Part-Dieu is an area where diverse interests and needs intersect, posing challenges in meeting everyone's satisfaction. One major challenge faced by the city is the issue of cars. While the city aims to reduce car usage in the city center, many people still rely on cars to access Part-Dieu for work or to visit the popular shopping mall that attracts visitors from the wider region (8.4, Interviewee 1, 2023). Limited train availability and insufficient parking spaces near the train and metro stations contribute to this reliance on cars (8.4, Interviewee 1, 2023). Achieving a significant reduction in car usage is only possible if effective push and pull strategies are implemented to promote modal shift to more sustainable alternatives.

Engaging with stakeholders is a crucial approach for effectively integrating their needs into the planning process and finding appropriate solutions. The Part-Dieu project stands out for its unique approach to project governance, as it centers around co-creation. It is trying to bring

different stakeholders together through different engagement activities. Public consultations and mediation sessions are conducted to involve citizens in the process. Workshops target both inhabitants and employees, although there are challenges in reaching employees who solely work in Part-Dieu and in engaging a broader demographic, particularly young people who are underrepresented in their public consultations. Since they also do workshops for children in schools where children imagine their ideal park and have excursions to parks in the area, they hope to reach families this way too. Additionally, newspapers are published periodically and distributed to residents, metro stations, and the city hall. Guided walks through the district are also organized. However, public engagement in their consultation is still lower than desired. Factors contributing to this challenge may be the size of the district and the amount of people that come from other parts to Part-Dieu for work and taking the train. These factors may allow people to feel less involved in the district and think that they have no say in the city's mobility transition efforts (8.4, Interviewee 1, 2023).

Part-Dieu has faced challenges due to ongoing construction works and navigation difficulties, leading to a negative perception among the public. Nevertheless, as progress becomes increasingly visible after several years of construction, people are beginning to appreciate the benefits of the greener and safer infrastructure for walking and cycling. The image of the district is therefore improving and giving back more quality of life to people through its newly created mobility infrastructure and public spaces (8.4, Interviewee 1, 2023).

3.2 Okeneea: A project focused on accessibility at the core of technological innovation

Technology's role in urban mobility is highly significant, recognizing non-human actors, their agency, and the complex interplay between social and technical elements. Okeenea, a pioneering technological company, exemplifies this relevance through its efforts to drive accessible and inclusive mobility. Particularly in terms of accessible mobility, Okeenea underscores the necessity for a seamless integration of the physical and digital realms, promoting a world that caters to all individuals.

Throughout this interview[1], we were able to learn more about the history of their technological innovations which play a key role in the development of solutions available nowadays. In 1993, France had no systems in place to enable visually impaired and blind individuals to cross streets.

Okeenea technology in Metro Station Grange Blanche
Photo credit: N. Herrera

At the time, the solution that emerged worldwide was the famously known yellow push buttons, which gained popularity and became the accepted solution in cities around Europe and the rest of the world. However, designers at Okeenea Tech found it rather strange to ask blind people to locate push buttons in the street. Through design thinking methodologies, Okeenea created the remote on-demand activation and became a company dedicated to making cities more accessible for people with disabilities by developing acoustic pedestrian signals. (8.4, Interviewee 2, 2023)

Okeenea continued to innovate through its divisions, Okeenea Bâtiment and Okeenea Digital, both focused on making public and private buildings more accessible. They achieved this by developing ramps, stairs, equipment, store signages with embossed braille, tactile surface indicators, and more. In Lyon, 98% of pedestrian signals are currently equipped with Okeenea Tech (8.4, Interviewee 2, 2023). They are committed to improving the autonomy of the 1.3 billion people who have disabilities in the world by creating solutions that are present not only in France, but also in 15 different countries around the world (Okeenea, 2021).

The technological innovations of Okeenea represent a prime example of accessibility at the core of technological design, changing the approach to ensure mobility evolves and takes into consideration the needs of all of its users. Walking is intrinsically linked to mobility as it serves as a fundamental means of transportation for individuals (Schmeidler, 2010). For able-bodied individuals, walking is often taken for granted as a basic daily activity. However, for individuals with mobility impairments, walking without human assistance can be a significant challenge and, in many cases, not possible. Recognizing the importance of walking and mobility is crucial to

[1] See appendix 8.2 for Interview Summary

prioritizing pedestrian-friendly environments that enable everyone to have the choice of being autonomous.

Investing in accessibility can enhance urban mobility and foster inclusive and vibrant societies. By removing physical and systemic barriers, cities can ensure equal access and mobility for all individuals, regardless of their abilities. By prioritizing the needs of marginalized groups, cities can bring value to their communities while promoting social representation, inclusivity, and equitable mobility. In 2005, the disability rights act was brought to France. It became the first French legal text to provide a definition on what disabilities are but most importantly, it was putting accessibility at the core of society, meaning that urban infrastructure, public places, and mobility systems had to be accessible for all. The 2005 law adopts a new paradigm of disability, viewing it as a potential condition for any individual rather than a personal tragedy experienced by some. "Handicap" is defined as limitations to social participation and citizenship (Calvez, 2010). With accessible pedestrian signals, Okeenea covered a part of the mobility chain of people with vision disabilities (8.4, Interviewee 2, 2023). However, with such changes in the legislation, newer challenges were brought into place and in the case of accessible mobility, the lengthy process of working on standards created a new layer of complexity for changes to quickly become visible.

For example, it can take many years to work on a standard that will be published five years later. By then, eight years have passed, and in most cases, the technologies have already evolved. Working with the state can also lead to initiatives being prolonged, as a long list of bureaucratic barriers need to be overcome. Although this process is lengthy, when discussing safety and security measures, standards, laws and decrees are more relevant than ever. Recognizing the importance of temporality in mobility and accessibility involves acknowledging how time-related factors influence people's ability to move, access resources, and witness changes in society. In that sense, considering temporality aspects in transportation planning and accessible initiatives can enable more efficient and meaningful mobility experiences.

Okeenea technology embedded in traffic signal, Lyon.
Photo credit: N. Herrera

Okeenea currently owns 60% of the market share for accessible mobility innovations in Lyon, however, all competitors ensure they remain compatible with each other as interoperability becomes a fundamental part for accessible solutions to remain harmonious with each other to provide its users with a seamless user experience (8.4, Interviewee 2, 2023). This holds particular relevance in a technological innovation that incorporates a system directly into the pedestrian signal, making users unaware of its presence. Simultaneously, maintaining a connection with the community is equally vital to ensure effective communication about the availability of the tool. Okeenea ensures visually impaired people remain participants in the design phases, keeping vivid links with the communities, user testing, and integrating individuals that are isolated to ensure a better understanding of the users' needs.

It is crucial to critically examine the development of hybrid spaces and how they may lead to issues of exclusion and exacerbate issues of access (Frith, 2012). Accessible mobility includes the notion that all aspects connected to mobility remain accessible as well. This implies that not only physical infrastructure, such as roads, buildings, stations, visual and sound signage, must be accessible, but the digital infrastructure, including map navigations, web finding apps, etc., also needs to maintain accessibility. This ensures seamless integration between both realms.

> **"**If you have an app, but the world is not accessible, the real world is useless. You need to mix those worlds, is the phygital concept, physical and digital, so yes, for us, accessibility has to be phygital.**"** - **Sylvain Denoncin, CEO Okeenea**

Taking care of minorities can help bring value to the cities by understanding that a design that benefits an individual on a wheelchair can also facilitate the journey of tourists, elderly, children, etc. This in turn helps to place the focus on creating technologies that are universally designed. Understanding how accessible mobility is co-produced and constructed in our cities can enable a better understanding of the influences in its development and effective implementation. Accessible mobility is an opportunity for cities to create and transform the perceptions that we have of how we move and to consider accessibility at the core of technological design as a fundamental part of mobility development.

3.3 Grand Lyon: A project focused on the complexity of achieving modal shift

The Métropole de Lyon, commonly referred to as Grand Lyon, is a territorial entity situated in the Auvergne-Rhône-Alpes region of east-central France. This directly elected metropolitan authority includes the city of Lyon and 59 of its surrounding cities/towns (Métropole de Lyon, 2023). The Métropole de Lyon offers users a wide range of modes of travel and develops services

which facilitate the daily journeys of its inhabitants. Its public transportation network, an essential element of urban mobility, undergoes continuous enhancements through a partnership agreement between SYTRAL Mobilités, the authority responsible for transportation in the metropolitan area, and the Metropole de Lyon (Métropole de Lyon, 2023).

Aligned with its "Intelligent Metropolis" strategy, the Métropole de Lyon has embarked on a mission to envision the city of the future, with the overarching goal of enhancing the daily lives of its residents (Métropole de Lyon, 2023). In this pursuit, the focus on mobility emerges as a primary axis of this strategy. To accomplish this, the Métropole de Lyon collaborates with both public and private partners to establish meaningful alternatives and enhance urban mobility within its jurisdiction. A particular objective of the Métropole de Lyon is to encourage a shift in transportation modes, favouring the use of sustainable transportation modes (Métropole de Lyon, 2023).

To further understand this objective, the team had the opportunity to speak with an employee working in the Direction de Mobilite in the Métropole de Lyon for mobility management with a primary focus in mobility management for children. Their primary work in this department is to encourage modal shift mainly in primary and middle school children on their daily commute to school. For the primary schools, it is more catered towards creating a modal shift, however for the middle schools it is more about educating the students about how to ride bikes, road safety etc. (8.4, Interviewee 3, 2023).

Before delving into the work of the Métropole de Lyon, let's first understand the term 'mobility management.' According to the European Regional Development Fund et al. (2021), it involves planning, steering, and controlling non-constructional activities to improve citizens' mobility while reducing negative transportation impacts on the environment, economy, and society. Also known as Transport Demand Management (TDM), it prioritizes demand orientation. To encourage the use of alternative transportation beyond private vehicles, it is essential to understand people's travel needs and decision-making processes (Mundula & Senn, 2012). This requires robust infrastructure, including extensive public transit, pedestrian pathways, and cycling facilities. Mobility management optimizes resource utilization through information provision, effective communication, education, and user incentivization programs (Figg, 2021). Additionally, it involves organizing services and coordinating stakeholders to ensure seamless integration and collaboration.

Currently, the Métropole de Lyon is actively involved in creating a mobility plan specifically for middle schools (8.4, Interviewee 3, 2023). To achieve this, an experiment is being conducted

within the Lyon area, involving the participation of three middle schools. This approach aims to understand the unique challenges and conditions faced by each school, considering factors such as population demographics and infrastructure characteristics The three middle schools involved in the experiment each have distinct circumstances. One school is situated in a financially disadvantaged area, with a large student population who have limited access to cars or bikes. Another school is located in a wealthier area, characterized by a lower population, where most students have access to cars. The third school is situated in a densely populated area with variations in elevation, and students in this area have access to bus transportation (8.4, Interviewee 3, 2023). Due to the contextual differences among the middle schools, it is evident that a universal mobility plan cannot be applied uniformly. Instead, the approach is to create different mobility plans tailored to schools with similar circumstances. Once the schools agree to participate in creating a mobility plan, the experiment begins. The first year acts as a diagnostic run, information is collected via surveys to determine how the children travel to school, their mobility practices, perceptions of road safety, exercise habits, physical well-being, and the potential for modal shift around the school (8.4, Interviewee 3, 2023). Then, in the second year, an action plan is created based on the data collected in the previous year. With the results, the Métropole collaborates directly with middle schools, partnering with teachers and engineering consultants to create projects and strategies focused on safe and sustainable mobility (8.4, Interviewee 3, 2023). Additionally, with the implemented strategy, data is collected on students' mobility behavior to assess its effectiveness, determining if adjustments or further innovations are required.

In addition, the Métropole de Lyon also collaborates with an NGO called la Maison du Vélo Lyon, which focuses on educating children about biking, city navigation, and the importance of sustainable transportation (8.4, Interviewee 3, 2023). The Metropole coordinates events and ensures compliance with conventions. Additionally, they liaise with the department of education to gather information and seek guidance on contacting middle schools or obtaining further project-related information. Through their extensive collaboration with various stakeholders, the Métropole de Lyon plays a crucial role in developing and implementing effective mobility management initiatives within both middle and primary schools. Their work contributes to fostering sustainable transportation habits and creating a safer, healthier, and more environmentally friendly environment for young students in Lyon (8.4, Interviewee 3, 2023).

Implementing Mobility Management initiatives in kindergartens and schools yields multiple advantages, such as promoting children's health and development while simultaneously enhancing safety, convenience, and the overall quality of urban life for all road users. The following

table provides a concise overview of the benefits and stakeholder involvement associated with Mobility Management activities in educational institutions (European Regional Development Fund et al. 2021).

Habits are formed in childhood through repeated behaviors and routines. Children learn by imitating those around them, and their brains create neural pathways based on these experiences (Loewenstein et al., 2015). Positive reinforcement and consistency play a crucial role in shaping desired habits. Thus, teaching Mobility Management in kindergartens and schools is vital. Learning safe cycling early on helps children overcome fear and apprehension towards traffic as they grow, enabling them to instinctively respond to traffic rules and vehicle movements, forming quick and intuitive habits (European Regional Development Fund et al. 2021).

Table 1: Stakeholder involvement associated with Mobility Management

Stakeholder	**Interests**	**Role**
Children	Health; Safety; Autonomy	Behavioural Change; Future Ambassadors
Parents	Children's health and safety	Role models
Teachers	Integration of Mobility Management into curricula	Implementation; Link between management, children and parents
School Administration	Social responsibility on institutional level	Facilitators: Funding; organizational structure; Permits
Municipalities	Safe, accessible, health and livable urban spaces	Integration of Mobility Management into SUMP, urban planning and city budget; Enforcement of traffic rules

According to the interviewee, the primary goal of the mobility management initiative is to develop a renewable implementation plan that raises awareness about road safety and promotes sustainable mobility within the Métropole de Lyon. This plan aims to provide diagnostics and action plans for all cities within the region. In order to effectively disseminate information and foster understanding among schools, regular visits, biannual meetings with experts, and experience-sharing sessions are organized. These activities serve as a platform for networking, enabling participants to establish connections and identify key contacts for future collaboration (8.4, Interviewee 3, 2023).

An important aspect of the initiative is to assess the impact on students' perception of biking after the implementation of the plan. They achieve this by redistributing the original survey sent

out in the diagnostic year to the same sample of students to gain an understanding of whether students' opinions on biking or transport behaviours have changed or not. By monitoring this change, valuable insights can be gained regarding the effectiveness of the interventions and the promotion of biking as a viable mode of transportation. Recognizing that each school possesses unique contextual factors, the initiative seeks to develop individual strategies tailored to the specific needs and challenges of each educational institution. Furthermore, the goal is to ensure the sustainability of the action plan by repeating it on an annual basis within each school. To facilitate this process, the development of a comprehensive toolkit is underway, which will provide schools with the necessary resources and guidance to continue implementing effective mobility management strategies (8.4, Interviewee 3, 2023).

Additionally, collaboration with the vice president of the green party of Lyon focuses on promoting the use of bicycles and increasing their accessibility (8.4, Interviewee 3, 2023). This strategy involves raising awareness about bike security and visibility among middle schools and supporting the development of bike-related projects. One of the key considerations is determining the quantity of bikes required, the ideal placement locations, usage frequency, and associated costs. In some cases, additional funding may be required beyond the existing partnership with the NGO to conduct diagnostics and implement the action plan. Through these collaborative efforts and comprehensive strategies, the mobility management initiative aims to create a sustainable and bike-friendly environment within the Métropole de Lyon, ensuring the well-being and safety of students while promoting sustainable transportation choices (8.4, Interviewee 3, 2023).

Implementing mobility management projects in schools poses several challenges that require careful consideration. Firstly, these projects often involve significant costs and require extensive coordination, making them resource-intensive endeavours (8.4, Interviewee 3, 2023). Moreover, schools need to commit to the project for a duration of two years, which can be demanding and time-consuming for some institutions. While there is interest among schools, time constraints may limit their ability to fully engage in the initiatives (8.4, Interviewee 3, 2023). Another challenge arises from the diverse nature of each school's context, including factors such as geographical location (rural or urban) and the unique characteristics of the student population. This diversity makes it challenging to develop a precise and standardized methodology that applies universally to all schools. While this flexibility allows for tailoring strategies to specific contexts, it also presents difficulties in establishing a comprehensive approach. Furthermore, there is a shortage of qualified personnel to teach biking skills and a lack of adequate biking infrastructure. Many children tend to stop cycling after the age of five, indicating a need for sustained efforts to

promote biking as a preferred mode of transportation. Additionally, the question of providing access to bikes using public funds requires careful planning and justification, as transparency and accountability are crucial when investing public resources (8.4, Interviewee 3, 2023).

The complexity of the mobility field necessitates strategic planning and implementation. It is essential to have a well-defined strategy rather than merely taking actions without considering the specific needs and circumstances of each school (8.4, Interviewee 3, 2023). Developing tailored strategies for individual schools allows for a more effective and impactful approach. Moreover, the allocation of financial responsibilities poses a significant challenge. Determining who bears the costs and how to maintain bikes in good condition requires careful management and coordination among stakeholders (8.4, Interviewee 3, 2023). Additionally, the limited availability of bikes for long-term use and home utilization needs to be addressed to ensure sustained interest and participation. Finally, Introducing new mobility concepts may encounter some opposition, with some car drivers expressing concerns about the available road space. Some expressed that there is not enough room left for their needs. Balancing the allocation of space for bikes and cars becomes a point of contention, requiring careful communication and stakeholder engagement (8.4, Interviewee 3, 2023). Addressing these challenges requires collaborative efforts, innovative solutions, and a strategic approach to mobility management in schools. By overcoming these hurdles, it is possible to foster a culture of sustainable transportation and enhance the overall well-being of students and the community.

Overall, the Métropole de Lyon is making remarkable strides in promoting sustainable mobility and instilling a shift towards more sustainable modes of transportation, starting from a young age. By collaborating with various stakeholders and implementing mobility management initiatives in kindergartens and schools, they are fostering a culture of safe and sustainable transportation. Through diagnostic runs, action plans, and tailored strategies, the Métropole is creating a bike-friendly environment and raising awareness about road safety. They actively engage with schools, parents, teachers, and municipalities to ensure the success and sustainability of these initiatives. Despite the challenges of costs, coordination, and infrastructure limitations, the Métropole is committed to overcoming these hurdles through strategic planning, collaboration, and innovation. By addressing these challenges head-on, the Métropole de Lyon is paving the way for a greener, healthier, and more sustainable future for the community, with children serving as ambassadors for sustainable mobility.

4. Discussion

The three test beds emphasized in this paper illustrate the role of test beds as experimental environments, enabling the testing, integration, and scaling up of new ideas and technologies. These test beds play a vital role in tackling the challenges posed by the city and its existing infrastructure. By utilizing test beds, Lyon can assess and evaluate various innovative mobility solutions with selected citizens before implementing them on a larger scale. This approach allows the city to learn from the experiences gained during the testing phase. Moreover, they help to establish and refine innovations that are beneficial to society. By testing and integrating innovative mobility solutions, Lyon can identify the most effective strategies for improving transportation infrastructure, reducing congestion, promoting sustainable modes of transportation, increasing inclusivity and accessibility, and creating positive mobility experiences for its residents, especially non-motorists - mostly elderly, people with restricted mobility, children, and women.

Despite this, implementing change, as illustrated by the examples of test beds, is a time-consuming and resource-intensive endeavor. The journey towards change is riddled with challenges that must be overcome. Our research has identified that a major challenge when introducing new mobility innovations or technologies is to receive acceptance from society. Consequently, when introducing changes, it is essential to include and engage the citizens who will be impacted, particularly in the process of redesigning existing infrastructure. Their participation and input are crucial for successfully navigating the path to change. By involving citizens, we can address their concerns, ensure their needs are met, and foster a sense of ownership and cooperation in implementing new solutions.

Moreover, our findings indicate that test beds receive greater acceptance when citizens are actively involved from the beginning. We observed that a critical element contributing to success is effective communication. The success or failure of a test bed often hinges on the implementation of a well-executed communication campaign. Without proper communication, citizens may fail to comprehend their role or remain unaware of their involvement in a test bed initiative. Adequate communication not only prevents misunderstandings but also enhances acceptance. Furthermore, it provides citizens with the opportunity to actively participate in the test bed, fostering a sense of engagement and ownership. By prioritizing clear and inclusive communication, test beds can ensure widespread understanding, facilitate meaningful citizen involvement, and to understand the needs and visions of the society.

Despite the challenges Lyon has faced with these test-beds, the results of our previously presented research demonstrate the value of urban living labs for mobility in Lyon as a framework for establishing and scaling innovation. Our study revealed that these test beds can serve as effective tools for integrating innovative forms of mobility. In particular, all three test beds examined in our paper serve as excellent examples of how innovations can be integrated and developed within an urban context. One key advantage of these test beds is their ability to provide a platform for learning from real-world experience. By actively engaging citizens and stakeholders from the very beginning, the test beds facilitate a deeper understanding of the needs and preferences of the local population. This early involvement and collaboration significantly contribute to increasing societal acceptance of new mobility initiatives.

In the context of Lyon's mobility challenges, these test beds play a crucial role in implementing and scaling innovative forms of mobility. By embracing a dynamic and adaptable approach, the test beds enable continuous adjustments and improvements as necessary. This flexibility helps overcome the specific mobility challenges faced by the city. Furthermore, the integration of citizens at the outset of the test beds in Lyon is a notable strength. This inclusive approach ensures that the needs and perspectives of the society are at the forefront of decision-making processes. By involving the community from the start, the test beds promote a sense of ownership and increase acceptance of the resulting mobility solutions.

Overall, Lyon serves as a great example of how mobility innovation can be successfully established within a real-life urban environment before being deployed on a larger scale. The integration of test beds in the city has proven to be instrumental in overcoming challenges and achieving sustainable progress. The lessons learned from Lyon's experience can serve as valuable insights for other cities looking to implement and scale innovative mobility solutions in their own contexts.

5. Conclusion

In conclusion, test beds and the concept of living labs have emerged as effective approaches for structuring and stimulating innovation by testing new sociotechnical arrangements in real-life settings. They provide experimental and co-creative environments where new technologies and ideas can be tested, demonstrated, and scaled in a real-life context. Test beds contribute to the development of innovative solutions by involving multiple actors and creating spaces for alternative ideas to be tested and experienced.

However, it is important to recognize that test beds can also create and stabilize the very worlds they aim to test, leading to potential path dependencies and limited generalizability of the knowledge produced. Test designs and implementation pathways should be open to disruption and incorporate the visions of other actors to avoid predefined roles and expectations. Despite these challenges, test beds offer valuable frameworks for testing and refining emerging innovations, particularly in the context of urban mobility. They help identify and address challenges associated with implementing new mobility approaches, such as infrastructure requirements, user acceptance, and regulatory frameworks. By involving users and stakeholders in the co-creation process, test beds contribute to the development of sustainable and user-centric mobility strategies that address the diverse needs of urban communities.

The transformation of the Lyon Part-Dieu district, including the redesign of the train station, exemplifies the application of test beds in enhancing urban mobility and improving the liveability of cities. Additionally, the work that Okeenea is doing stresses the importance of investing in accessibility to ensure equal access and mobility for all individuals. Prioritizing the needs of marginalized groups and getting their take on how mobility innovations can be improved contributes to social representation, inclusivity, and equitable mobility. In terms of mobility management, understanding individuals' travel requirements and decision-making processes is key to promoting the efficient use of transportation infrastructure and encouraging the adoption of alternative, sustainable modes of transportation. Tailoring mobility plans to specific contexts, as demonstrated in the experiment with middle schools in Lyon, allows for effective and sustainable mobility strategies.

Overall, it is evident from each of the test bed case studies that citizen engagement plays a pivotal role in driving successful mobility innovation. When individuals actively participate and provide input in the development and implementation of new transportation solutions, it leads to more effective and sustainable outcomes. Engaging citizens allows policymakers, urban planners, and innovators to better understand the needs, preferences, and concerns of the community they serve. By involving citizens in decision-making processes, such as public consultations, surveys, and participatory workshops, the resulting mobility solutions are more likely to address the real challenges and aspirations of the people. This engagement fosters a sense of ownership and collective responsibility, enabling the creation of inclusive, accessible, and user-centric mobility systems that truly benefit society as a whole. Moreover, citizen engagement helps to build trust, transparency, and accountability, fostering a positive environment for collaboration and long-term success in mobility innovation.

Finally, test beds provide a platform for testing and refining new mobility solutions, involving diverse stakeholders to ensure solutions meet the specific needs of urban communities. These labs collect valuable data on mobility patterns and user behaviors, informing evidence-based decision-making and enabling the development of more effective interventions. By prioritizing user needs and preferences, mobility labs promote inclusive and user-friendly design. However, challenges still exist for test beds. Scalability and generalizability of solutions can be complex, as variations in infrastructure, culture, and regulations may limit direct applicability to other contexts. Securing sustainable funding and navigating regulatory barriers are essential for long-term success. Integration and collaboration among multiple stakeholders and transportation modes present additional challenges that need to be overcome for seamless and interoperable mobility systems. Overcoming these challenges and leveraging the opportunities presented by urban mobility labs requires coordinated efforts from policymakers, researchers, industry stakeholders, and the wider community to shape a sustainable and inclusive future of urban mobility.

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Excursion report 2:

Unraveling the Puzzle of Mobility Choices in Budapest: Factors at Play

A Case Study Focusing on Mobility Pricing, Policies and Individual Demographic Factors in Budapest, Hungary

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Abstract

This paper provides a comprehensive analysis of urban mobility in Budapest, focusing on pricing strategies, transportation options, commuter behavior, and the effectiveness of pull and push measures. The study explores Budapest's well-developed, extensive public transportation network, the increasing reliance on private vehicles, and the impact of political dynamics on mobility transition measures. Empirical field observations shed light on integrating green infrastructure with transportation facilities and highlight gaps in cycling infrastructure and public transportation services. Interviews conducted throughout the study with various stakeholders including government officials, industry experts, and researchers offer valuable insights into the influence of political affiliations on mobility decisions and emphasize the importance of scientific evidence-based decision-making and public participation. Pull measures, such as affordable public transportation and well-organized micro-mobility options, have positively influenced commuter choices, but the absence of robust push measures presents challenges in achieving a sustainable transportation system. We conclude our paper with the notion that a balanced approach, incorporating both pull and push measures, is essential to address the complexities of urban mobility in Budapest. To create a greener, more efficient city, it is crucial to foster public participation, address certain political dynamics, and integrate evidence-based strategies. By doing so, we discover that Budapest can continue its progress in promoting sustainable urban mobility and create a more livable and eco-friendlier city for residents and visitors alike.

1. Introduction

The transportation sector stands as a significant contributor to global carbon dioxide (CO2) emissions, exerting a profound impact on climate change and environmental degradation. As societies rely heavily on fossil-fuel-based modes of transport, such as private vehicles and commercial aviation, CO2 emissions continue to escalate. This unsustainable trajectory necessitates urgent action to curb the sector's carbon footprint. By embracing sustainable alternatives like electrification, public transit expansion, and active transportation modes, urban areas can mitigate CO2 emissions and foster a more environmentally responsible transportation sector. (*Public Transportation's Role in Responding to Climate Change - Tina Hodges - Google Libros*, 2010)

Therefore, the euMOVE project, an interdisciplinary student initiative, aims to explore innovative and sustainable mobility solutions in European metropolitan regions. It involves collaborative efforts between multiple institutions and focuses on unraveling the complexities of transportation (*EuMOVE 2023*, n.d.). By examining diverse cities and their mobility systems, the project aims to develop a holistic understanding of urban mobility. Budapest has been chosen as one of the cities for the project due to its shared characteristics with Munich, presenting a valuable prospect for conducting subsequent in-depth analyses and enhancing our comprehension of the cultural impacts on mobility patterns (Taubenböck et al., 2020).

Budapest faces challenges related to population growth (*Budapest, Hungary Metro Area Population 1950-2023 | MacroTrends*, n.d.), rising rent prices (Kauko, 2013), and the need for more livable and less car-dependent urban environments. The euMOVE project explores the effects of mobility pricing and mobility sharing on citizens' mobility choices, considering factors such as pricing strategies, social inclusion, accessibility, and availability. Through data analysis, surveys, and qualitative research methods, the study aims to contribute to the development of sustainable, accessible, and inclusive mobility systems that meet the evolving needs of cities like Budapest and Munich. The research question guiding the study is: How do mobility pricing, policy measures, and demographics influence the behavior of citizens in terms of their mobility choices?

2. Literature Review

This chapter provides a comprehensive overview of the current research status on mobility pricing and the status quo in Budapest, focusing on its geographical attributes, climate conditions, governance structure, and urban mobility landscape. Understanding the contextual

factors that shape the city's mobility dynamics is crucial for developing effective strategies and policies to address transportation challenges and improve the overall urban experience.

2.1 Mobility Pricing: An Overview

Several studies have already been carried out to determine the relevant factors when it comes to mode choice. Through comprehensive literature reviews conducted across various cities worldwide, the key factors remain consistently common. Therefore, it can be deduced that subject to purpose of the trip, the most significant factors affecting the travel behavior are travel time, travel cost and travel distance followed by variables such as car ownership, age, gender, income, person in care and education. In the context of Budapest, one of the studies by (Duleba et al. 2022) found that travel time was the most important criterion for commuters in Budapest when choosing a mode of transportation. Nevertheless, it is important to comprehend these factors collectively and individually when it comes to designing effective transportation systems and related policies.

(Rasca and Saeed 2022) conducted a study to identify the factors that enable modal shift of users from private motorized vehicles to public transit services in rural areas where the choice of services is limited compared to that in the cities. This paper builds upon numerous other studies and explains then that to encourage a shift towards public transit services, pricing along with service frequency plays a crucial role influencing mode choice.

(Litman 2004) conducted a study that examined the elasticity of transit pricing with transit ridership. An important discovery is that the impact of price changes on transit ridership is not consistent bi-directional. As transit ticket price increases, the negative impact on transit ridership is greater than the positive impact that follows a price reduction. There are various factors that leads to this phenomenon, one being that the car users tend to consider only the direct cost per travel, such as the fuel cost, while not considering the auxiliary costs such as the maintenance, parking fees or environmental cost while making decisions. As a result, the cost per travel could be perceived less often.

Certain categories of people including children, students, old, aged people are mostly captive riders and are already absorbed by the sustainable modes of transportation such as cycling, walking and public transit. The middle class and upper-middle class individuals, including employees who have the choice to use private motorized modes over others, are that requires a comprehensive study to encourage modal shift towards sustainable modes. Litman's (2004) study also reveals how these travelers are more price-sensitive than the captive riders when it comes to mode choice. As transit ticket pricing doesn't act as a stand-alone factor that alters the

travel behavior, one or more additional factor needs to be acted upon to necessarily pull the users from current private motorized modes to push them towards the transit and other sustainable modes.

In order to attract new users from their existing choice towards transit and increase ridership, it is necessary to have a positive pricing implementation for a shared service (e.g.: reduced fare, incentives) along with a simultaneous negative pricing strategy for the car users (parking fees, congestion fees etc.). In addition, it is also necessary to facilitate the transit infrastructure and services along with to accommodate the new users effectively and ensure continued quality of services.

2.2 Information: Budapest

Budapest, the capital city of Hungary, is in the heart of Central Europe. With its unique blend of history, culture, and architecture, Budapest attracts millions of visitors each year. In order to understand the dynamics of sustainability and pricing in Budapest, it is important to analyze various factors that shape the city's development. This chapter provides an overview of the demographics, economy, political system, and government, as well as the history, climate, and geography of Budapest.

2.2.1 History, Climate and Geography

Budapest's rich history, unique climate, and geographical features significantly influence its transportation patterns. Divided by the Danube River into Buda and Pest, the city's historical significance and architectural heritage attract tourists and shape urban development. The climate, characterized by cold winters and hot summers, impacts transportation choices and infrastructure needs, while climate change considerations are gaining importance for sustainability efforts. Analyzing these historical, climatic, and geographical aspects provides context for understanding Budapest's transportation challenges and opportunities.

The evolution of Budapest's mobility and transportation system over centuries has been shaped by its historical, geopolitical, climatic, and socio-economic context. The influence of the Austro-Hungarian Empire (1867-1918) and the communist Soviet regime (1945-1989) is evident in the city's transportation infrastructure. Rapid urbanization and industrialization during the Empire saw the construction of major transportation infrastructures, such as bridges and railways. Budapest also became one of the first cities in the world with an underground railway system in 1896.

Despite political and economic challenges during the interwar and World War II period, Budapest's infrastructure continued to develop, with tram and bus networks expanding. The

communist regime, after World War II, emphasized industrial development and transport infrastructure, leading to the expansion of the underground system and public transport networks.

The transition to a democratic system in 1989 saw changes in mobility services to meet the needs of a changing society, including the introduction of private car ownership, which led to traffic congestion and pollution. Budapest made efforts to promote public transport, expand the network, and reduce car dependency. After Hungary's accession to the European Union in 2004, urban planning in Budapest changed, prioritizing pedestrian-friendly streets, cycling infrastructure, and reduced car usage.

Given Budapest's humid climate with hot summers and cold winters, the public transport system is generally resilient for extreme conditions. Efforts are being made to reduce greenhouse gas emissions from the transport industry by promoting electric buses, improving cycling infrastructure, and encouraging car-sharing.

Since 2019, with the Greens' Party in office, the city of Budapest has prioritized green infrastructure as a central element of its transportation policy. This focus on sustainability reflects the city's commitment to address environmental challenges and create a more sustainable and efficient transportation system.

2.2.2 Demographics

Budapest's demographics, as the largest city in Hungary, play a crucial role in shaping transportation patterns and sustainability efforts. With a population of approximately 1.8 million, the city serves as the country's economic and cultural center, significantly influencing various transportation aspects. Different age groups within Budapest impact transportation dynamics. Approximately 17% of residents are under 18, relying on school buses and public transit for education and exploration. Meeting their transportation needs is vital for access to education and personal development.

The working-age population, about 66% of inhabitants, greatly influences transportation demands as they commute to work. Efficient transportation systems are essential to reduce traffic congestion and improve overall productivity during peak hours. Additionally, Budapest has a significant population of residents aged 65 and older, around 17%, facing unique mobility challenges. Providing senior-friendly transportation options is crucial for their comfort, independence, and social engagement.

Demographics not only affect transportation demand but also influence the modal split in Budapest. Sustainability initiatives aim to promote eco-friendly transportation and require targeted approaches aligned with diverse age groups' needs.

Understanding and addressing these demographic factors are vital in developing inclusive, efficient, and environmentally friendly transportation strategies. By doing so, Budapest can continue to evolve as a vibrant city with a sustainable and accessible transportation network for the benefit of all its residents.

2.2.3 Economy

Budapest, the capital city of Hungary, plays a significant role in the country's economic growth due to its diverse and dynamic economy. As a financial, technological, tourist, and manufacturing hub, Budapest contributes approximately 40% to Hungary's GDP. The city's economic output per capita surpasses the national average, reflecting its residents' high productivity and prosperity. This leads to increased disposable income, stimulating economic activity and contributing to overall growth.

With an impressively low unemployment rate of around 4.5%, Budapest offers ample employment opportunities, attracting skilled professionals, entrepreneurs, and investors. This robust labor market fosters innovation and entrepreneurship and instills confidence and stability in the local economy.

The city's strong economy influences transportation choices and demands. Budapest's efficient public transportation network, including buses, trams, metro lines, and suburban railways, caters to the commuting needs of residents and attracts commuters from neighboring areas. However, the rise in income levels has also led to increased private vehicle usage, contributing to traffic congestion and posing challenges for sustainable transportation planning.

Budapest's thriving tourism sector, attracting over 4 million international visitors annually, further amplifies transportation demand. Efficient pricing strategies must be implemented to balance the needs of residents and tourists while ensuring convenient and affordable exploration of the city.

In conclusion, Budapest's dynamic economy drives Hungary's overall economic growth, shaping transportation patterns and demands. Effective transportation management is essential for maintaining the city's economic momentum, promoting sustainable options, and improving the quality of life for both residents and visitors.

2.2.4 Political System and Government

The political system and government structure of Budapest play a crucial role in shaping sustainability initiatives and pricing strategies. Budapest is governed by a mayor and a municipal council, responsible for making decisions related to urban planning, transportation policies, and infrastructure development. Political support and leadership are the main drivers in promoting sustainable transportation and implementing pricing mechanisms. Understanding the political system and government dynamics helps in assessing the feasibility and effectiveness of sustainability measures in the city.

Budapest consists of 23 districts where each district has its own local government and mayor. The districts have certain decision-making authority and responsibilities for local administration specific local matters, such as urban planning, public services, and cultural initiatives. The division of Budapest into districts allows for decentralized governance and administration within the city. These districts work in coordination with the city of Budapest on the city-level governance. The districts have their own distinct identities, characteristics, and priorities, which can be reflected in local policies and initiatives. This sort of governance is often comparable with other metropolitan cities such as Vienna and London where the municipality of the city acts as the enforcer of certain policies to ensure coordination among districts. While Budapest has significant autonomy in its local governance along with its districts there is also strong coordination and collaboration between the capital and the national government, specifically concerning major infrastructure projects and national transportation policies, as well as the funding in the transport sector. Budgeting and resource allocation is a critical instrument for mobility initiatives. The budgeting process involves prioritizing needs and balancing limited resources to address various challenges facing the city. The city receives funding directly from the Ministries of Transport and Finance where the city of Budapest then distributes it among districts. The price of public transport for instance has been only subject to little to no changes regardless of crises in finance and energy sectors globally. The Ministries that fund Budapest are allocated to higher budgets annually and therefore the city manages to maintain a flat price for its residents.

Political parties and coalitions represent different ideologies and interests within the city and the dynamics between parties' influence policy priorities and governance strategies. Since October 2019, the city of Budapest has been governed by the Greens' Party in coalition with five political parties that are positioned from center to center-left in opposition to the ruling right-wing populist party of Hungary, Fidesz. (Agence France-Presse in Budapest, 2019) However, if thought of as a decentralized government the districts might not always be in strong cooperation and collaboration with other districts due to being placed on the other side of the political spectrum

which might result in incompatible policies such as a bicycle lane starting from one district but remaining incomplete in the other. This is where the city of Budapest acts as an enforcer of inter-district coordination, so the districts are harmonious amongst each other, and the effect of decentralized governance is felt at minimum on all levels.

In addition to harmonious integration of districts all-together, the engagement of citizens in the decision-making process and public participation are valued in the development of transport and mobility policies as well. The districts and the city seek input from the residents and stakeholders, as well as the experts in the field to inform the decision-making process and ensure that the policies are in line and compatible with the needs and preferences of the population. An example of public participation would be the heated debate about the closure of the iconic Chain Bridge (see Interviews.)

2.3 General Information: Urban Mobility

This chapter delves into the analysis of urban mobility in Budapest, focusing on the various modes of transportation available and the modal split within the city and its outskirts. Understanding the transportation options and the distribution of trips across different modes provides valuable insights into the mobility patterns of Budapest's residents and helps identify areas for improvement and sustainable development.

2.3.1 Modes of Transportation

Budapest offers a diverse range of transportation options to cater to the mobility needs of its residents and visitors. The city's well-developed transportation infrastructure ensures convenient and accessible travel throughout the urban area. The primary modes of transportation available in Budapest include public transportation, private vehicles, cycling, and walking.

Budapest boasts an extensive public transportation network, comprising buses, trams, metro lines, and suburban railways (*Annual Report BKV*, 2021). The Budapest Metro, with its four lines, provides efficient and reliable connectivity across the city. The tram network covers 174 km mostly in the city center (*Annual Report BKV*, 2021), while the over 1,200 buses serve both central and peripheral neighborhoods (*BKK Fact Sheet*, n.d.). Public transportation is a popular choice for commuting within the city of Budapest due to its affordability, frequency, and wide coverage.

Cars and motorcycles are commonly used for personal transportation in Budapest. As the city's economy continues to flourish, the ownership and use of private vehicles have increased, leading to traffic congestion and environmental concerns (Ismael & Duleba, 2022). While private vehicles

offer flexibility and convenience, efforts are being made to promote alternative modes of transportation and reduce reliance on cars to mitigate congestion and improve air quality.

Budapest has been steadily developing its cycling infrastructure to encourage active transportation and reduce traffic congestion. The city is investing in dedicating bike lanes and paths, making cycling a viable and eco-friendly mode of transport. Cycling is particularly popular for shorter trips within the city center, allowing residents to navigate through congested areas more efficiently while promoting a healthy and sustainable lifestyle. (BKK, n.d.)

2.3.2 Modal Split

Understanding the modal split in Budapest provides valuable insights into the distribution of trips across different transportation modes. The modal split indicates the proportion of trips made by various means of transportation. The modal split in Budapest is influenced by factors such as population density, availability of transportation options, infrastructure development, and individual preferences.

Within Budapest, public transportation plays a significant role in the modal split, with approximately 43% of trips being made using buses, trams, metro lines, and suburban railways. The efficient network of public transportation encourages a significant portion of the population to utilize these services for their daily commuting needs. The affordability and extensive coverage of public transportation make it an attractive and convenient option for many residents. (*PoliMi Master Thesis | SUMPS AND THE TRANSITION BEHIND PLANNING PARADIGMS by Maria Natália Alcântara - Issuu*, 2022)

Nevertheless, despite its broad coverage, public transportation in Budapest exhibits certain drawbacks. Certain regions still suffer from insufficient service frequencies, thereby limiting the convenience and reliability of the system (L. Kerényi, personal communication, May 26, 2023). Additionally, concerns regarding personal safety contribute to apprehensions among potential users, further impeding the attractiveness of public transportation. Consequently, private vehicles account for approximately 43% of the modal split in Budapest (*PoliMi Master Thesis | SUMPS AND THE TRANSITION BEHIND PLANNING PARADIGMS by Maria Natália Alcântara - Issuu*, 2022).

Cycling and walking collectively contribute to approximately 14% of the modal split in Budapest (*PoliMi Master Thesis | SUMPS AND THE TRANSITION BEHIND PLANNING PARADIGMS by Maria Natália Alcântara - Issuu*, 2022). The city's compactness and the development of cycling infrastructure, including dedicated bike lanes and paths, have made cycling a popular choice for

shorter trips within the city center (BKK, n.d.). Similarly, the pedestrian-friendly streets and the vibrant atmosphere of Budapest encourage residents to choose walking for commuting, running errands, and enjoying the city's amenities.

In the outskirts of Budapest, the modal split may differ to some extent. With lower population density and limited availability of public transportation options, private vehicles tend to have a higher share in these areas, accounting for around 60%-70% of the modal split (*Közlekedési Módok Közötti Megoszlás*, 2022). The convenience and flexibility offered by private vehicles becomes more appealing for residents in these areas, especially for longer commutes or trips that require traveling to destinations not well-served by public transportation.

The modal split analysis provides valuable insights into the transportation preferences and behaviors of Budapest's residents. By understanding the distribution of trips across different modes, policymakers and urban planners can develop targeted initiatives and policies aimed at promoting sustainable modes of transportation, reducing traffic congestion, and enhancing the overall mobility experience for Budapest's residents. Efforts can be directed towards further improving the accessibility and efficiency of public transportation, promoting cycling and walking infrastructure, and implementing measures to encourage a shift towards sustainable transportation choices. (*(PDF) Modal Split – Different Approaches to a Common Term*, 2019)

3. Methodology

This research paper employed a mixed-method approach to investigate the topic at hand. The study utilized qualitative data gathered through interviews, as well as quantitative data obtained through a short online survey.

The qualitative component of the study involved conducting interviews with individuals representing diverse stakeholders following the quadruple helix model, which encompasses society, industry, academia, and government. The utilization of the quadruple helix model when conducting stakeholder interviews holds significant importance in research related to complex societal challenges such as mobility pricing. This collaborative approach recognizes that addressing multifaceted issues requires the collective expertise, perspectives, and engagement of all these stakeholders. The Quadruple Helix Collaboration is in accordance with the good governance practice of planning. (*Facilitating the Participation of Civil Society in Regional Planning: Implementing Quadruple Helix Model in Finnish Regions - ScienceDirect*, n.d.)

The interviews were instrumental in obtaining in-depth insights into the workings of mobility pricing schemes in Budapest. The participants included representatives from the Budapest

Transport Company (BKK), the vice-dean of the University of Budapest, researchers specializing in transportation and urban planning, senior researcher in the field of economics, entrepreneurs engaged in the mobility sector, and students. By involving individuals from these different backgrounds, the study aimed to capture a wide range of perspectives and expertise related to the topic.

The quantitative aspect of the study relied on a survey to collect data. This survey provided valuable information on how individuals in Budapest travel, including the distances they travel, their current travel behavior, and their perspectives on mobility pricing and alternate solutions. The quantitative data complemented the qualitative findings by offering a broader overview and enabling the identification of patterns and trends. A significant portion of the survey respondents were affiliated with the University of Budapest. The survey was distributed among the university community, including students, faculty, and staff.

By combining qualitative interviews and quantitative surveys, this research was able to achieve a more comprehensive understanding of the subject matter. The qualitative interviews provided detailed insights into the specific mechanisms and policies implemented in Budapest, while the quantitative data offered a broader perspective on travel behavior and attitudes towards mobility pricing. This mixed-method approach allowed for a nuanced analysis of the research topic, incorporating both individual experiences and broader trends, and enhancing the validity and reliability of the findings.

4. Results

This section presents the findings and results of the research study, through empirical field observations, semi-structured interviews, online surveys, and an analysis of pull-and push measures. Through these research methods, insights were gained into the various aspects of sustainable urban mobility, shedding light on the current state of mobility practices and the effectiveness of different measures and approaches.

4.1 Empirical Results

During the research period from May 27th to June 4th, 2023, the study group travelled to the city of Budapest and conducted an empirical field observation to gain a firsthand understanding of mobility behaviors and patterns within the urban context. The on-site observations provided a detailed examination of how individuals navigate the city, utilize various modes of transportation on weekdays and weekends, and interact with the existing infrastructure. These observations focused on various aspects of sustainable urban mobility, including the green infrastructure of

Budapest, the state of cycling and pedestrian lanes, reliability of public transportation, integration and use of micro-mobility and shared services, and the implementation of BudapestGo (a Mobility as a Service system).

Budapest has demonstrated diligent efforts in maintaining its green infrastructure. Parks and green spaces throughout the city were well-maintained, offering pleasant environments for leisure and recreation. Notably, the parks featured ample seating spaces, providing individuals with opportunities to rest and engage with the natural surroundings. Furthermore, the city has also made efforts to successfully integrate green infrastructure with transportation infrastructure. Bus stops with green roofs exemplified this integration, where the presence of vegetation added aesthetic appeal and environmental benefits. Additionally, strategically placed trees along important cycling highways provided shade and enhanced the overall cycling experience.

The state of cycling lanes in Budapest revealed a mix of strengths and shortcomings. While the city has made efforts to develop cycling infrastructure, there were instances where cycling lanes abruptly ended and mixed with motorized traffic in certain sectors. This discontinuity in cycling infrastructure raised concerns for the safety and comfort of cyclists, potentially discouraging individuals from utilizing sustainable modes of transport.

Observations of public transportation highlighted both positive and negative aspects. Buses, particularly those operating in the inner city of Budapest, frequently experienced delays due to heavy traffic congestion. This issue highlighted the challenges of ensuring efficient bus services in highly congested areas. On the other hand, the metro and tram systems were observed to be highly reliable, providing consistent and predictable transportation options for commuters. The reliable operation of the metro and trams offered a stable foundation for promoting sustainable urban mobility in Budapest.

Another notable initiative in Budapest's mobility landscape is the implementation of the application - BudapestGo, a Mobility as a Service (MaaS) system. This newly introduced app is aimed to integrate ticket purchase, journey planning and traffic information of various public transportation services in one platform and provide a seamless experience for travelers. Currently, the app provides comprehensive information on public transportation services like buses, metros, and trams. However, it lacks the option to book public bikes and scooters, offering only information on the availability of mobility points. Due to the complexities involved with managing the pricing mechanism for the bike-and-scooter sharing services along with transit pricing, a separate application is required (B.1). This poses a potential hinderance to achieving a

comprehensive integration of different modes of transport into a single platform. As a result, the convenience and accessibility of sustainable mobility options is also reduced as users now must switch between at least two different apps to access various services.

4.2 Interview Results

The section presents the qualitative results of the investigation to address the research question concerning impact of mobility pricing, policies, and individual demographics on mode choice of users. The interview results present the insights gathered from engaging with various stakeholders representing different perspectives, including government officials, industry experts, researchers, and community members. These interviews provide a deeper understanding of the challenges, successes, and opportunities associated with sustainable urban mobility. The questions were asked on the key aspects of Budapest's transportation systems, encompassing both current and future pricing mechanisms, including the Hungarian National ticket and congestion pricing. It aimed to explore the effects, challenges, and drawbacks of existing schemes while also examining the general public's attitudes towards the system. The sessions later delved into topics around pricing elasticity and about their current research focus on enhancing modal shift, integrating micro mobility systems, analyzing travel time budgets, policies and government, and system assessment of overall transportation system. By engaging with the stakeholders on these multifaceted topics, we sought to get an understanding of the interplay of pricing mechanism and other additional factors crucial for achieving a successful and effective modal shift towards sustainability.

One significant finding revolves around the governance dynamics and how political affiliations can influence attitudes towards mobility transition. The Hungarian right-wing government, led by Fidesz, has been observed to allocate funds primarily to districts governed by their party. This creates a complex governance situation as the city Budapest itself is governed by the Opposition, the Green Party. Consequently, the concept of mobility becomes entangled in politics, with Fidesz supporters often favoring car travel and resisting mobility transition measures, while opposition supporters are more inclined towards supporting such initiatives. This finding highlights the influence of political affiliations on the perception and acceptance of mobility transition measures in Budapest (B.1).

One specific example illustrating the influence of political affiliations on mobility transition in Budapest is the ongoing debate surrounding the iconic Chain Bridge. The mayor of Budapest, representing the Opposition (The Green Party), has proposed closing the bridge to private vehicles and instead allowing only micro-mobility services, pedestrians, bicycles, and public

transportation. This proposal has garnered significant support from citizens aligned with the opposition, who view it as a positive step towards prioritizing sustainable modes of transport and reducing car dependence. However, supporters of the ruling party (Fidesz government), express their opposition to this plan, emphasizing the importance of maintaining car access to the bridge. This example highlights how political affiliations can shape the discourse and opinions regarding specific mobility transition measures (B.3)

In addition to understanding the political dynamics, the city of Budapest conducted a referendum to gauge citizens' opinions on the proposed closure of the Chain Bridge to private vehicles. The survey aimed to gather insights and perspectives directly from the residents of Budapest. The results of the survey provided valuable data regarding public sentiment and preferences concerning this specific mobility transition measure. The survey findings informed decision-makers about the attitudes and concerns of citizens, facilitating a more inclusive and informed decision-making process. This highlights the significance of engaging the public and incorporating their viewpoints in shaping mobility transition policies (B.3 and B.4)

Experts interviewed acknowledged the importance of public input in decision-making processes. However, they also emphasized the need to base decisions on scientific evidence, especially in highly politicized contexts. It was noted that trying out measures and observing public reactions before making final decisions is crucial. This approach allows for an evidence-based understanding of the effectiveness and public reception of various mobility transition initiatives (B.2)

Notably, the prices of public transport in Budapest have remained constant for the past two decades, ensuring affordable fares for users. However, to maintain affordability, there have been compromises in terms of service frequency, particularly on the city's outskirts. This finding highlights the challenges of striking a balance between affordability and service availability in the implementation of pull measures (B.1)

The interviews also addressed the importance simultaneous push-and-pull measures for mobility transition. Currently, Budapest has made impressive advances and succeeded quite well in their pull strategies with particular focus on pricing schemes. However, experts during the interview, criticized as to how these strategies have now become saturated and are not leading to desired level of modal shift due to lack of simultaneous push measures, such as local congestion charging or road pricing. They emphasized the need for a balance between both pull-and-push measures to effectively steer a sustainable modal shift amongst users with the city’s practical example.

Interviewees also mentioned the potential collapse of the system, both operationally and financially, if this balance between both the measures isn't achieved.

Another interesting finding was the potential impact of increasing fuel costs on citizens' mobility habits. Although immediate modal shifts may not occur, gradual increases in fuel prices and related costs can influence long-term behavioral changes. By adjusting prices, including those for parking spaces, authorities can incentivize sustainable mobility choices and shape the mobility patterns of Budapest's residents over time (B.3). During the interviews, the issue of overcrowding in public transportation was also raised. BKK, the public transport authority, has assigned a capacity of 5 persons per square meter in public transportation, but some lines already exceed this capacity. This issue has led people to perceive public transportation as uncomfortable and unsafe, creating a perception that traveling by car is a better alternative (B.1). Budapest has also implemented effective regulations for bike-sharing and e-scooter services. Specific parking areas have been designated, and fines are imposed for improper use. However, it is important to note that while these initiatives promote sustainable transport, they alone cannot substantially shift car users towards alternative modes of transportation. Instead, they help enable multi-modality together with transit services and improve last-mile connectivity (B.2, B.3 and B.4)

4.3 Survey Results

An online survey was distributed to gather insights regarding the transportation preferences aiming to understand the mode choice from among randomly chosen commuters about their preferences and attitude towards various proposed ideas. The survey aimed to identify the status quo of the most used transportation modes and assess their perception.

The survey was distributed via online platforms and personally during the site visit and responses were collected from May 26th, 2023, until June 10th, 2023. Most respondents were students from the University of Budapest, research academia and connections attained through our interviewees. In total, 25 responses were received, of which all of them were fully completed and deemed suitable for analysis.

Current mode choice for commuting within the city

One main objective was to look at the prevalent mode of transportation used for commuting in the city. The choice of private vehicle included use of personal car, motorcycle, and any individual motorised modes. The results indicate a significant preference for public transit among participants for their daily commute, followed by similar count for rest of the modes. Over 90%

of the respondents reported an average commuting distance of less than 15km, indicating that most of the daily trips remained within the city limits.

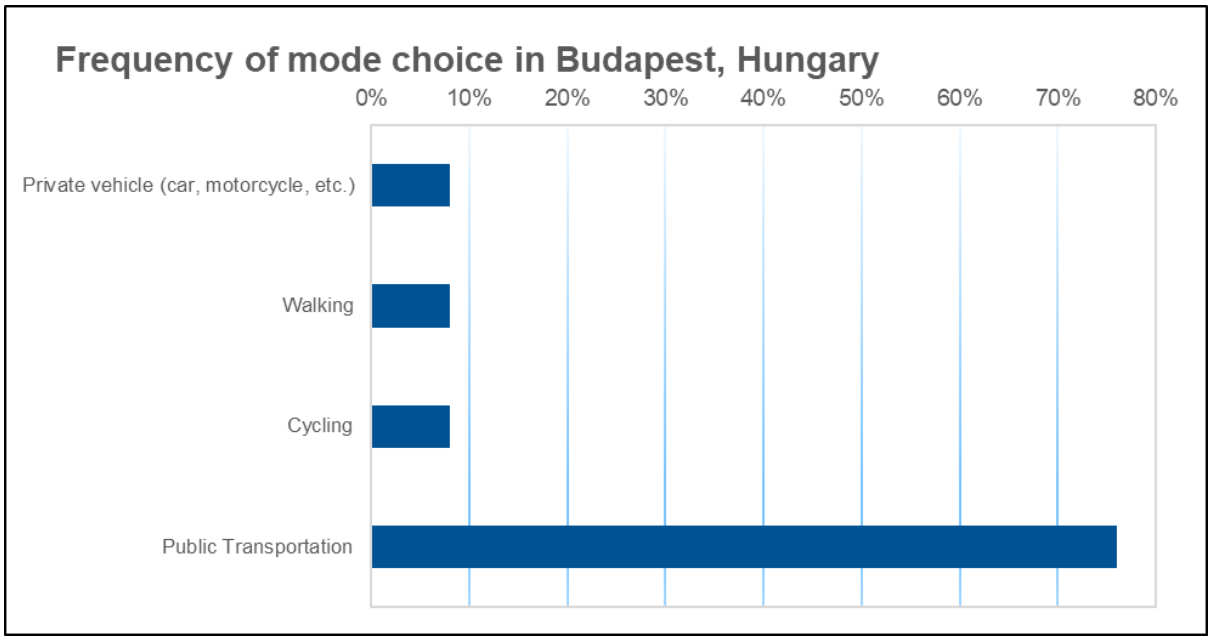

Figure 1. Current mode choice amongst users in Budapest (survey sample)

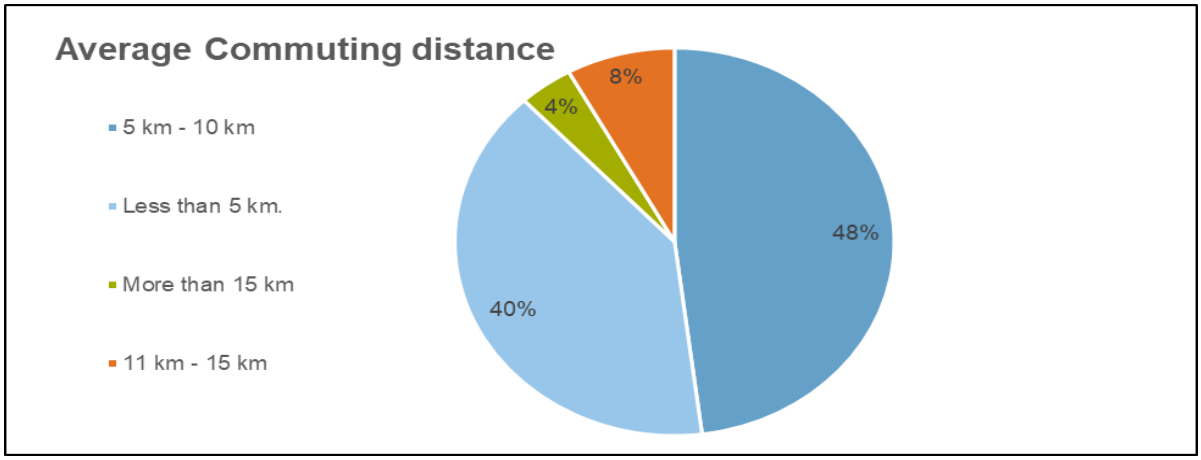

Figure 2. Average daily commuting distance.

The respondents varied age from the range of 18 to 65, with a predominance within the category of 18 to 34. The survey was primarily distributed amongst the young and working-class population in Budapest, reflecting the demographic reach within the limited time. Interestingly, amongst the range of participants, it appeared to be having lower number of individuals in care at home. This factor likely contributes to the reduced reliance on cars since fewer responsibilities at home may afford them more flexibility in transportation choices. This observation aligns with that of the literature findings claiming how mode choice and caregiving responsibilities are influencing an

individual's transport choices and preferences. It is interesting to note the higher percentage of transit ridership, despite the 40% car-ownership reported within the survey.

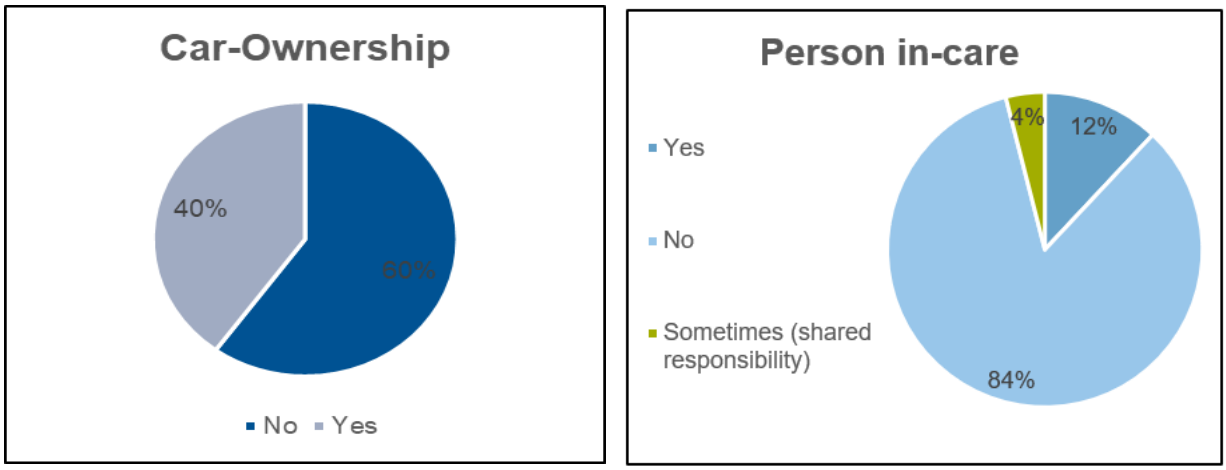

Figure 3. Statistics of car-ownership and person in care

Furthermore, the survey tried to explore the potential impact of simultaneous reduction in transit fares along with an increase in car-use pricing. Car-users were asked about their willingness to shift to other sustainable modes of transportation under these circumstances. The responses were equally divided, with a high willingness to switch to better shared alternatives and on the other hand reluctance or slight unwillingness even with the proposed pricing changes. It is interesting to note that age range of these users are between 45-54, belongs to mid-to-high income category and has people in care.

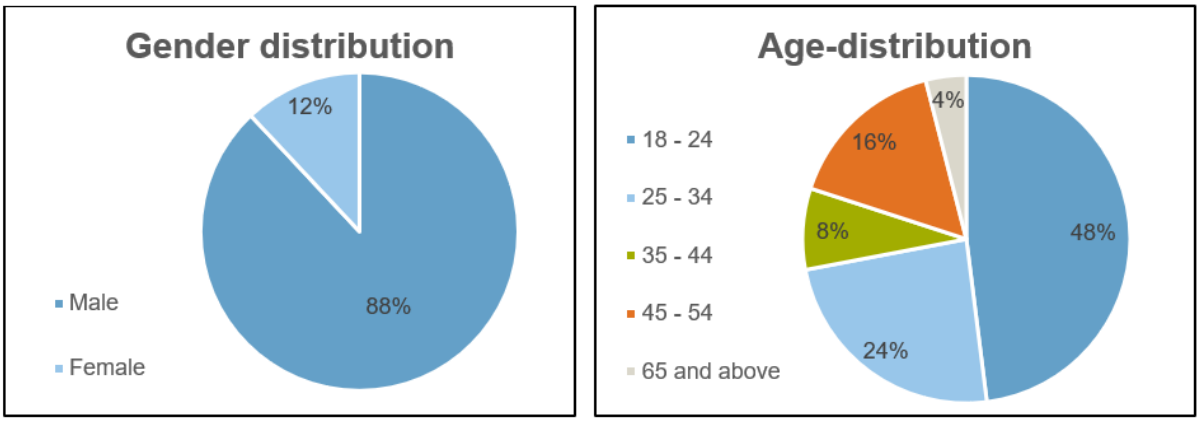

Figure 4. Gender and Age Distribution

Preferred mobility solution amongst users

The survey presented a cluster of mobility solutions, and the respondents were asked to express their preferences through close-ended questions utilizing a ranking system. The clusters were centred around four distinct themes: 'Quality of public transit service,' covering factors such as

frequency, services, and infrastructure etc, 'Improved facilities for car-users,' including improved parking spaces, car-sharing options etc. 'Comfortable and liveable spaces,' focusing on liveability and aesthetic spaces, 'Innovative and technologically advanced solutions,' such as ride hailing services and flying taxis, and 'Quality of active mobility infrastructure' such as bike and pedestrian lanes.

The responses show a dominant preference for the public transit service improvement and active mode infrastructure followed by need for liveable spaces, innovative technological solution, and improved car-user facilities.

As evident from the literature sources, the survey also showed how the individual's mode choice primarily depends on travel time and travel cost. It was then followed by other variables such as the distance to destination, comfort, and service quality, last-mile connectivity, environmental concerns and potential for enjoyment or multi-tasking during the journey.

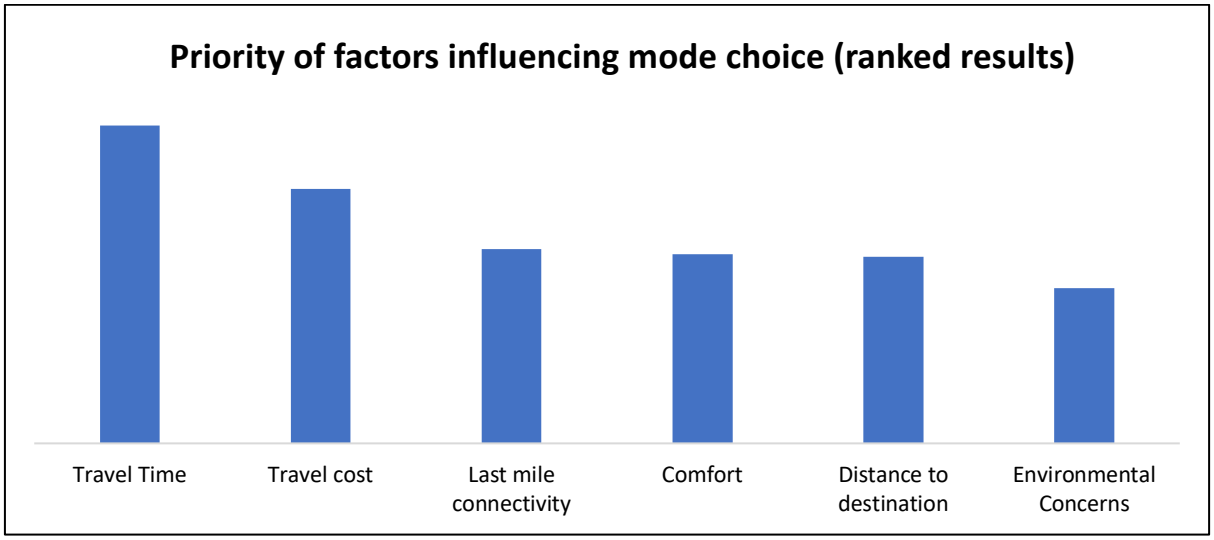

Figure 5. Factors influencing mode choice as ranked by users.

4.4 Push Measures

This section on pull-and-push measures examines the effectiveness of different interventions and policies aimed at influencing mobility choices and behaviors. Pull measures refer to incentives, rewards, and positive reinforcements that encourage the adoption of sustainable modes of transport, such as improved infrastructure, reduced fares, or access to shared mobility services.

One notable approach is the maintenance of constant prices for public transportation, ensuring affordability for commuters. This consistent pricing structure contributes to making public

transportation an attractive option for residents, as it provides a cost-effective alternative to private car ownership (B.1). Additionally, Budapest has placed a strong emphasis on frequency in the city center. Public transportation services are provided at high frequencies, enabling convenient and reliable travel options for commuters. The frequent service intervals contribute to reducing waiting times and enhancing the overall efficiency and attractiveness of using public transportation. Nevertheless, the frequency in the outskirts has been compromised. People must wait for prolonged periods of time, making the private vehicle their first option. (*Annual Report BKV*, 2021)

For other shared systems, Budapest has implemented pull measures to incentivize ridership. For instance, the BuBis bike-sharing system offered by the BKK (Budapest Transport Company) provides affordable access to bicycles for residents and visitors. The subscription fee is less than 3 euros per month, granting users the opportunity to ride for free every day for up to the first thirty minutes. This cost-effective pricing structure encourages the use of bicycles for short trips and commuting within the city. Furthermore, if the thirty-minute limit is exceeded, riders can simply end their current ride and start a new one, avoiding extra charges and ensuring a seamless and economical experience. (*MOL Bubi - Official Bike Sharing in Budapest*, n.d.)

Budapest's well-organized micro-mobility offer serves as another compelling pull measure. The city has implemented a comprehensive network of micro-mobility options, including e-scooters and shared electric bikes. These services are easily accessible and widely available throughout the city, allowing residents and visitors to conveniently choose the mode of transport that best suits their needs. The organized and diverse micro-mobility options contribute to providing flexible and sustainable alternatives to private car usage, attracting riders, and reducing congestion on the roads. Additionally, the BudapestGo application, a Mobility as a Service (MaaS) system offers integrated information on various transportation options including real time information about the transit services along with information of the shared bicycles and e-scooters mobility points (B.1). By implementing these pull measures, Budapest has made significant strides in promoting sustainable and convenient mobility options for its residents. The combination of affordable public transportation fares, high-frequency services, cost-effective shared systems, and a well-organized micro-mobility offer collectively contribute to shaping the mobility patterns of Budapest's residents and reducing reliance on private car usage.

4.5 Pull Measures

Push measures, encompass policies and regulations that discourage car usage and prioritize sustainable options, such as congestion pricing, parking restrictions, or emissions regulations.

By evaluating the outcomes of these pull and push measures, insights can be gained into their impact on mobility patterns and the potential for scaling up successful interventions.

The current pricing situation in the city of Budapest, lacking stringent push measures along with the pricing regulation in the shared service sector has raised concerns among experts. This imbalanced situation may potentially be going to collapse the system and not lead to an effective outcome as expected (B.3). Research and academia are investing efforts to find suitable road pricing and congestion pricing strategies that would work the best for Budapest. However, the ongoing political debate hinders the action to implementing such a strategy.

Presently, the city has a parking pricing system in place, but road pricing/congestion pricing strategies are yet to be established. The city's paved streets fall under the ownership of either of the 3 levels in the regime: the districts, Budapest municipality and the national government of Hungary. The revenue generated from these street parking is directed to the respective authority depending on the ownership of the street. Nevertheless, to provide a seamless user experience, a simple mobile application manages the use and payment. Experts also proposed that the parking scheme needs further enhancements by itself, suggesting introducing a different pricing scheme based on the number of car ownership rather than the current simplistic approach (B.3 and B.4)

Addressing these issues and simultaneously implementing effective strategies requires cooperation between various stakeholders and overcoming the obstacles posed by political debates.

Additionally, insights were shared regarding the potential for soft mobility-management measures that can encourage modal shift towards sustainable modes. One of the key approaches being importance of educating the public and engaging them in the planning process. It creates an active community that fosters responsibility and encourages them to perceive these measures with an attachment to the cause rather than arbitrary impositions. Incentives offered to promote biking among children and the younger population cultivates a generation of physically active individuals who aren't overly reliant on the car culture (B.1).

5. Discussion

The aim of this study was to investigate the influence of mobility pricing, policy measures, and individual demographic factors on citizens' mobility choices. Through a combination of qualitative and quantitative analysis, the study yielded valuable insights and identified challenges relevant to effective mobility planning and sustainable practices.

One of the major findings indicated that residents living in the outskirts of Budapest heavily rely on cars for commuting, especially for distances exceeding 15 kilometers. While the city has allocated resources to improve public transportation in the city center, attention should also be given to enhancing service frequency and reliability in the outskirts, where limited public transportation options drive the dependence on private vehicles. This observation may apply to other cities beyond Budapest as well. To promote multi-modality and active transportation options like walking and cycling, local authorities should prioritize the safety and attractiveness of active mode infrastructure even outside the city center.

Regarding pricing mechanisms, the study emphasized the need for both push and pull factors to be simultaneously present for effective results. A simple reduction in fares may not be sufficient to encourage a modal shift from private vehicles to public transit. Car users tend to overlook additional costs associated with car ownership when deciding between using their car or opting for public transit. Therefore, if only considering the pricing of transit fares, very large fare reductions may be necessary to attract car users to transit, and this may not be practically feasible. Additional push-measures, such as congestion pricing and higher parking prices, can further incentivize the shift to alternative transportation modes.

The younger generation exhibits a decline in vehicle ownership, with a preference for shared and sustainable modes of transportation. This trend is not solely driven by the green agenda but also attributed to factors such as the affordability of services, a preference for an active lifestyle, and the availability of appealing car-sharing options. People with fewer caregiving obligations have also shown to be having the freedom to explore and adopt sustainable transportation options, such as public transit, cycling, and ridesharing services.

However, implementing measures requires thorough study to tailor solutions to each region's specific context. The findings underscore the importance of balanced transportation planning, effective pricing mechanisms, and fostering a supportive environment for sustainable and multi-modal transportation options.

6. Conclusion

In this paper we attempted to provide a comprehensive examination of urban mobility in Budapest on pricing, shedding light on the city's transportation options, behavior of commuters, modal split, and the effectiveness of various push and pull measures. As a result of our examinations, we reached the conclusion that Budapest's well-developed, historic public transportation network remains a popular choice for many residents due to high efforts in managing to keep it affordable and its extensive coverage. However, factors such as the increase in private vehicle ownership has led to traffic congestion and environmental concerns, as well as the lack of push measures have shown that there is still a necessity and further work to be achieved in the promotion of sustainable modes of transportation.

While shared infrastructure shows progress, some gaps and safety concerns remain borne from the decentralized structure amongst inter-district politics, affecting its attractiveness for commuters. Public transportation services, particularly the metro and tram systems in the city, offer highly reliable, efficient and consistent options for commuters, whereas gets overlooked in the outskirts from where a huge commuter traffic comes from.

The interviews with various stakeholders, including government officials, industry experts and researchers reveal the high influence of political affiliations on mobility transition, with differing attitudes towards mobility measures based on governance dynamics. This complex governance situation has led to high politicization of the mobility industry. The survey results indicate a strong preference for improvement in public transit and active mode infrastructure, emphasizes the need for continued investment and improvement in these areas of shared services. Understanding these influences helped us comprehend the complexities in the decision-making processes on mobility in Budapest.

The pull measures played a significant role in shaping mobility patterns and reducing reliance on private car usage. The city's well-developed public transportation network, comprising buses, trams, metro lines, and suburban railways, offered affordable, frequent, and wide coverage, making public transportation a popular choice for daily commuting needs. The constant prices for public transport over the past two decades contributed to its attractiveness, ensuring affordability for commuters. These efforts have shaped the mobility patterns of Budapest's residents positively as both public transport and shared mobility services are highly promoted. However, the absence of robust push measures such as road pricing and congestion presents a challenge in achieving a balanced and sustainability mobility system in the city. To address these challenges, it is important to emphasize the importance of scientific evidence-based decision-

making, public engagement, and cooperation between various stakeholders without high involvement of politics. It can be understood that along with hard-measures, soft mobility-management measures and educating the public can also create a culture of sustainable transportation and support modal shifts toward greener options.

In conclusion, Budapest has made significant progress in promoting sustainable urban mobility, but further efforts are required to achieve a truly balanced and efficient transportation system. By addressing political dynamics, integrating push measures with pull measures, and fostering public participation, Budapest can continue to advance its mobility landscape and create a greener, more livable city for its residents and visitors alike. These successful strategies and setbacks can also be applied with further learning into other metropolitan contexts as well.

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Excursion report 3:

Shared Mobility in the City of Prague

An Exploration of the Challenges and Incentives for User and Planner Acceptance

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Abstract

As European cities aim to become more sustainable, shared mobility receives increased attention in policymaking and the related economic sector is fast-growing (Guyader et al., 2021). While shared cars face scrutiny for the space they take up and their contribution to traffic volumes, shared micromobility in the form of bikes and e-scooters is praised as a viable car alternative for short-distance travels (Clewlow, 2018). These transportation modes also prove especially effective when integrated with public transport (Guyader et al., 2021). With consideration to Prague's integrated mobility system and plans for sustainable development, the Czech capital was chosen as a case study. This research paper examines Prague's shared mobility with a focus on existing practices, challenges and incentives for the acceptance of shared modes among the public but also in the planning community. The topic was approached through a literature review and a series of interviews with local actors involved in or knowledgeable about mobility in the city.

Some of the identified challenges to the acceptance of shared micromobility are the perceived danger by its users, unsuitable terrain and the limited spatial distribution of the service. In the case of shared cars, the cleanliness of the vehicle is a concern and a public discontent with the almost ubiquitous right to parking is perceived.

For users of shared cars, incentives mainly come from the providers and include easy access to the vehicles and overtaking maintenance responsibility. For shared micromobility, integration into the public transport card is available and many municipalities are expanding the dedicated infrastructure. However, the decentralized decision-making process when it comes to infrastructure planning slows down the developments.

1. Introduction

Urban mobility patterns and lifestyles have been changing across the globe in the past decade. With growing mobility needs comes the need for better regulations, infrastructure development, public awareness, safety standards and environmental considerations. European cities have been the breeding grounds for several mobility innovations and Prague is among the major cities aiming to achieve efficient and sustainable mobility with its new initiatives and action plans. These cities are driving decarbonization efforts in different sectors as they are central to dynamic innovations that contribute to carbon emissions. Urban planning and regulations have an important role in this process.

Prague was chosen for this study due to its extensive network of integrated public transport for the development of shared mobility infrastructure, and most importantly, the future mobility plans that Prague envisions to attain sustainability. Prague is well known for its high ranking in user satisfaction with public transportation systems (Bills, 2023). The Prague Public Transit Company[2] (DPP, Dopravní podniky hlavního města Prahy) operates a dense network of metro routes, trams and buses and is integrated in the Prague Integrated Transport System[3] (PID, Pražská integrovaná doprava) (Prague Public Transit Company, 2023). PID distributes the chargeable PID Lítačka Card, an integrated transport card which gives its owner access to public transport, electric car charging spots and serves as an identifier among other bonuses. However, private car ownership numbers are constantly rising (Expats.cz, 2022; Huerta Melchor & Gars, 2020), leading Prague to an ambivalent mobility behaviour. Future mobility plans are mainly guided by the Sustainable Urban Mobility Plan (SUMP) for Prague and its suburban areas (Prague City Hall, 2019) as well as the Smart Prague 2023 concept based on the Smart Cities concept (Operátor ICT, n.d.).

The state-of-the-art research on shared mobility in Prague suggests that there is a lack of progress in shared mobility programs and requires effective strategies for improving the shared options (Huerta Melchor & Gars, 2020; Prague City Hall, 2019). The City of Prague realized the need for integrating shared mobility with all forms of transportation and developed measures to accomplish its sustainability goals, such as reducing negative impacts of transportation on environment (Prague City Hall, 2019). This study explores sustainable mobility practices in the Czech capital in relation to the research question:

[2] https://www.dpp.cz
[3] https://pid.cz

"What challenges and incentives influence shared mobility acceptance in the city of Prague among the wider public and the planning community?".

The topic is approached by studying the mobility patterns, modes of transport, challenges to shared mobility, and the incentives and plans implemented by the city of Prague during a field trip in the period 23rd May – 3rd June 2023. This paper starts with an introduction to sustainable mobility and related terminology followed by an explanation of the employed methodology. In the next section, Prague's political framework is described, and findings are presented for the different shared mobility modes. The final chapter provides a summary of the challenges and incentives found.

1.1 The race towards sustainable mobility

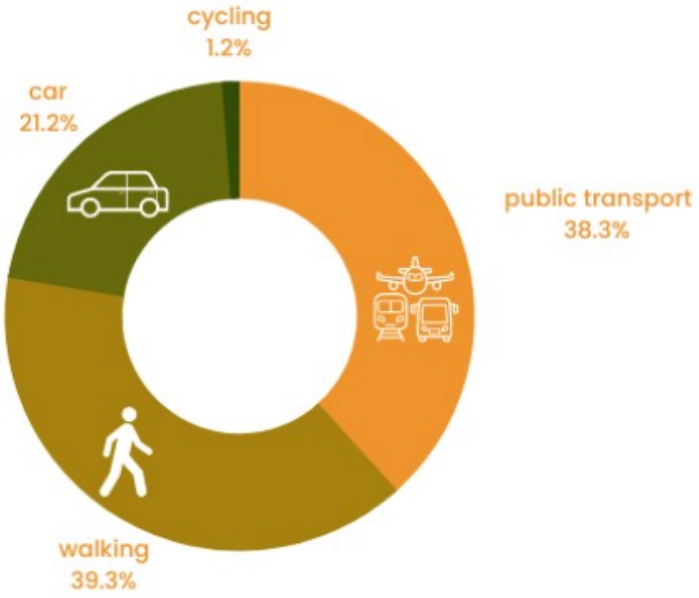
Prague is approaching sustainability through several sustainable mobility initiatives and decarbonization efforts. With greener alternatives of mobility, the city is focusing on reducing its carbon footprint from the transport sector. The Sustainable Urban Mobility Plan (SUMP) for Prague and its suburban areas addresses the development of transport networks without putting a burden on public resources and the environment (Prague City Hall, 2019). Drafted in cooperation with the Transport Department and other transport companies including Prague Institute of Planning and Development[3], Operator ICT[4] and Prague Public Transport Company, the plan emphasizes on strategic objectives such as infrastructure development, integrated mobility services, campaigns to promote sustainable mobility, and innovations in City Transport administration among others, envisioning environmental sustainability by 2030.

Commuters from the suburbs of Prague choose cars (45%) over public transport (36%) to travel to the city (Prague City Hall, 2019). Due to a high number of tourists from outside the city and daily commuters, especially from the Central Bohemian region to Prague, the city has decided to integrate the public transport systems with shared mobility and other micromobility options. This is done by establishing a station bike-share scheme and developing a car-sharing and carpooling scheme. The city promotes cycling through the development of commuter cycling, for example through measures addressing the absence of pedestrian and cycling links on the outskirts of Prague and in the region and through digital platforms to integrate shared mobility with existing public transport systems (Prague City Hall, 2019). Additionally, the construction of Park & Ride facilities at railway stations near the suburban areas and other Central Bohemian cities connects the population of the regions with the City of Prague.

The analysis of the Modal Split in Prague's transportation (Figure 1) shows that roughly 38% of the residents choose public transport, 39% choose walking, a little over 1% cycle and 21% use

automobiles (private vehicles, shared fleet, etc.) to get around the city. The city pays most of the operating costs of public transport in order to reduce the ticket rates, making it the primary choice of most residents in Prague. This significant share of public transport users (38.3%) is an indicator of how Prague achieves lower levels of carbon emissions (Svitková, 2023). To boost this, the Czech capital has also introduced electric powered buses, battery powered trolley buses and replaced existing diesel heating in public transport with electric heating. Electric versions of shared bikes and scooters are also seen on roads for commutation which demands the construction of more charging infrastructure in the public places.

Figure 1: Modal split in Prague before and after Covid-19 pandemic. Source: Amendment to SUMP, 2022



1.2 Mobility terms

Mobility research contains many subject-specific terms which will be explained in this section to support the reader's understanding.

The German Institute of Urban Affairs (Deutsches Institut für Urbanistik, Difu) explains how **Multimodality and Intermodality** both name combination strategies of different means of transport, such as biking, driving, using public transport and walking. While Multimodality means that one means of transport is considered particularly good for one route and therefore one means of transport is used for one destination and another for another destination, intermodality[4]

[4] While we are aware of the terminological distinctions in literature, the report will mostly use "intermodal" as a connecting, integrated transport term.

stands for the combination of different means of transport to achieve optimal travel to a certain destination (Difu, 2023b).

Shared Mobility covers all transportation modes where a vehicle is being shared. As this strategy allows short-term transportation mode usage, it helps reduce private ownership and supports multimodality (Machado et al., 2018).
Push and Pull measures reference the implementation of certain strategies, either restrictive or inviting. An exemplary push method against car presence in the city are parking fees to bring a certain disadvantage or discomfort into car driving. A pull method would be the newly introduced 49-Euro ticket in Germany which invited users to switch their transportation mode - in this case to increase the use of trains (Difu, 2023a).

Micromobility is quite broad and due to advancements in the technology of light vehicles fast changing, it is defined " (...) as the use of micro-vehicles, that is vehicles with a mass of no more than 350 kilograms (771 pounds) and a design speed no higher than 45 km/h. This definition limits the vehicle's kinetic energy to 27 kJ, which is one hundred times less than the kinetic energy reached by a compact car at top speed." (OECD/ITF, 2020). As their definition contains a speed and energy limit, it shows how impactful micromobility is, in reducing severe injuries. This applies to bikes, scooters, skateboards, cargo bikes, electric bikes, and many more means of transport.

Integrated Transport planning is a people-oriented approach to develop a sustainable transport system. It considers an intermodal perspective and consists of three management poles: Infrastructure, Traffic and Mobility. These contain both supply and constraint measures, which often match the Push- and Pull measures (Schwedes & Hoor, 2019).

Mobility as a Service "(...) integrates various forms of transport and transport-related services into a single, comprehensive, and on-demand mobility service where the user is able to access and pay the desired intermodal routing though a single application and payment channel" (MaaS Alliance, 2023).

Modal split is an indicator in transportation engineering used to evaluate transportation behaviour. It refers to the percentage of travelers using a particular means of transport compared to the ratio of all trips made (Ungvarai, 2019). It can be used to argue the efficiency of a new policy or as an indicator for how sustainable a city is (reflected by the percentage of users commuting by bike or public transport). There is no unified framework for calculation which leaves room for error in the evaluation of transportation modes (Haney, 1971). Depending on the definition, different modes of transport can be ignored – for example whether a binary is constructed

between privately owned vehicles and all other types of transportation and whether non-motorised vehicles such as bicycles are considered.

On-demand mobility is a mode of simultaneous car sharing between multiple strangers with mostly two types to discern between: Ride-sourcing and Ride-splitting (Machado et al., 2018). Ride-sourcing is a new mobility offer for individual mobility where vehicles respond to individual requests through commonly known services like Uber. The sharing effect here arises primarily from the joint use of the car by owner and user. Since individual trips are booked here, the aspect of optimal route planning between several similar requests is not considered. Ride-splitting considers this and connects overlapping routes of passengers (Machado et al., 2018). This leads to a service that "(...) can facilitate shared rides, higher vehicle occupancies, reduce travel costs, and provide first-mile and last-mile connectivity to public transit along the routes" (Machado et al., 2018).

2. Methodology

This qualitative research uses the Grounded Theory methodology by exploring the views and experiences of the transportation and mobility professionals, representatives of the district administration, public and private shared mobility providers in Prague. By analyzing the SUMP plan, activities of different districts and services of various mobility service providers, the study addressed the challenges and opportunities of shared mobility in Prague. Participants include representatives from the city administration, journalists, public and private companies involved in transportation and other actors working on sustainable urban mobility planning and infrastructure (Refer Appendix). The main research question on the trends of shared mobility in the city of Prague, and the level of acceptance of people towards shared mobility are addressed mainly through semi-structured interviewees, literature review and field observation.

Sampling

Professional networks like LinkedIn are used to sample out the profiles of transport and policy professionals in the first round. Keywords like Sustainable mobility manager, transportation manager, mobility planner, transport policy maker, mobility enthusiast, shared mobility, car-sharing, bike-sharing, shared vehicles, etc are used to filter the profiles on LinkedIn. Additionally, emails are used to contact potential interviewees for confirming the interviews. More than 30 profiles were contacted, out of which 13 participants from different backgrounds and organizations such as CITYA (On demand mobility service for rural areas), IPR – Prague Institute for Planning and Development (Subsidiary organization of city planners), OICT – Operator ICT (Municipal Company smart solutions), etc accepted the interviews (see Appendix).

Methods of data collection

Interviews involving few opening questions, intermediate questions and some ending questions (Charmaz, K., & Belgrave, L.L., 2012) were conducted in person and virtually which allowed us to understand the various perspectives of the interviewees in detail. For the virtual interview, Zoom is used as a medium and the interviews were recorded with the consent of the participants, obtained before the interview sessions.

Secondary data: Discourse analysis on the available resources on shared mobility such as research on the topic through an extensive literature review, desk research on the existing sustainable mobility plans created by organizations (Eg: SUMP, Smart Prague by 2030), transport policy documents, and data provided by interviewees.

Analytical methods

Interview recordings are clearly transcribed and sent to the interviewees for a review, followed by categorizing the data based on the research objective. The transcripts are then checked for any errors and analyzed through several rounds of open manual coding. The codes generated are assigned with certain phrases and recurring phrases are analyzed further for addressing the main and sub research questions (Clarke, 2005). The recurring phrases are identified as themes relevant to the focus of the research. Those codes that didn't match with the research questions are not considered for theory formation. Some of the major themes identified during the analytical process include infrastructure, public acceptance, participation, incentivization, sustainable mobility, public and user safety, etc.

3. Findings & Discussion

Based on the communist past of the Czech Republic, personal property has a special significance to this day. It shapes the usage and consumption behaviour of the people, making the use of sharing services undesirable to some for socio-cultural reasons (I5, I11, I2). However, the country aligns with the European trend of behavioural change with people aged 15-34 being the most frequent users for shared mobility (Horatius, 2022); (Reck, D. J., & Axhausen, K. W., 2021).

Sharing systems are a relative novelty in Prague with the first bike sharing system appearing in 2014 (with a proceeding pilot project from 2007) and the first car sharing also operational since 2014 (Filonova, 2023). Since then, their use has grown substantially over time, as fleets have also expanded. For example, the total amount of shared cars in the Czech capital grew from just 265 in 2017 to 1554 in 2021 (Prague Index, 2022).

Cycling regardless of vehicle ownership only constituted 1.2% of all trips in 2021 (Figure 1) which leaves room for improvements. The challenges the city faces in this regard are discussed in the following chapter. A universally encountered problem, which could explain the slow rise of the modal split percentage despite rising user numbers, is that users of shared services mostly are frequent public transport users, so there is little "conversion" of frequent car users (Filonova, 2023); (Efthymiou et al., 2013). It is subsequently noteworthy that while shared car use is generally seen as a sustainable practice, an increase in the use of shared automobiles doesn't always denote a decrease in personal vehicle use but rather takes from other modes (Liao et al., 2020).

In this chapter, the decision-making process in the City of Prague is outlined, followed by an explanation of the researched shared modes and sections about the challenges and incentives faced in each case.

3.1 Prague's Political Dimensions

How the city of Prague operates on the political level informs the way policies about shared mobility are implemented. The city of Prague has a democratic political system that governs its administration and the provision of essential services to its residents. Three key components of the Prague City Government are the Prague City Council, Prague City Hall, and the City Districts.

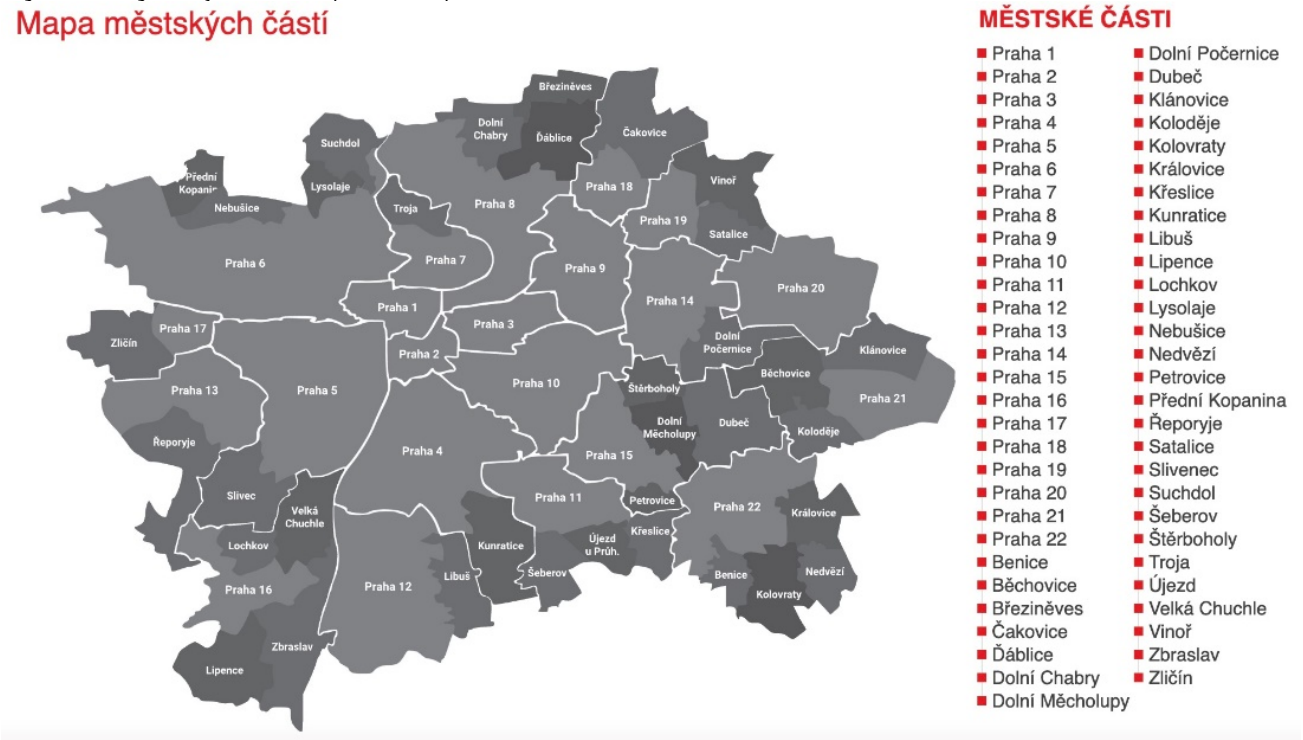
The Prague City Council serves as the primary governing body for the entire city and plays a pivotal role in shaping the city's policies and initiatives. Its 11 members include the Mayor of Prague, four Deputy Mayors, and six Councilors. The Council is entrusted with a diverse range of responsibilities that span various areas. The Council manages essential municipal services like natural gas, electricity, water, sewage, and coordinating city planning. The last component of Prague's political structure is the Prague City Hall. The City Hall comprises a team responsible for overseeing the city's various administrative tasks.

As shown in Figure 2, Prague is divided into 57 self-governing city districts, each with its own distinct office responsible for self-governing activities and exercising delegated powers. These districts are further grouped into 22 self-governing administrative units.

Each city district possesses the authority to review decisions issued by municipal district authorities in administrative proceedings. This decentralized approach empowers local communities and ensures that their needs and concerns are adequately addressed. However, there is a downside to the structure. The decentralized approach translates into a lack of cohesive infrastructure. When the mayor of Prague plans a positive change in the infrastructure of the city, the individual municipalities have the power to block it. For example, if there is a proposal to create a cycling lane that crosses Districts, it requires the approval of multiple parties

from those Districts. While one District may support the idea, the other may oppose and effectively block it. This multi-step approval process between the municipalities hinders the development of a well-connected cycling infrastructure throughout Prague (I12).

Figure 2: Prague city district map. Source: praha.eu



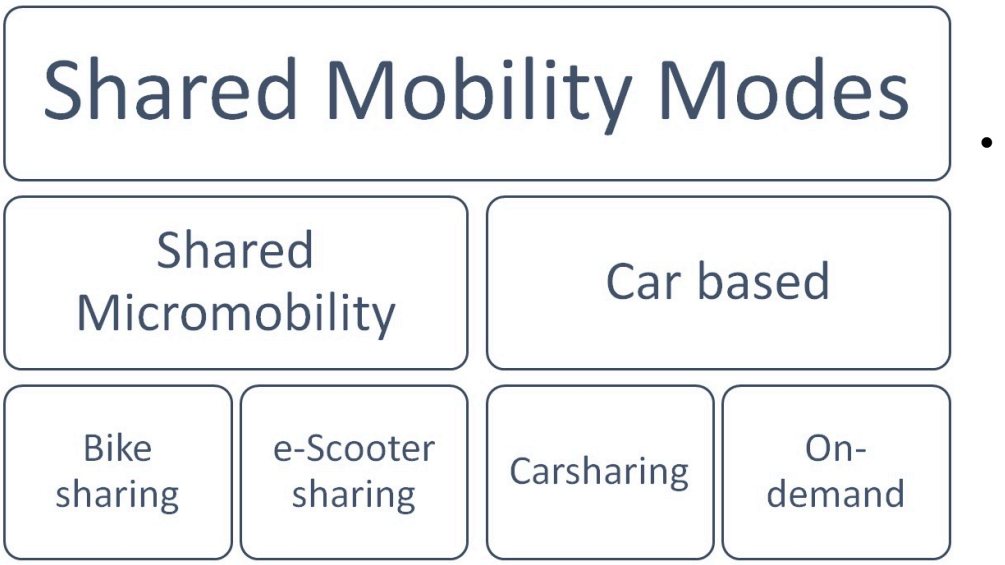
3.2 Shared modes

This research paper considers shared mobility options in the city of Prague as exemplified in Figure 3. The shared micromobility options available in the city are E-scooters and dockless bikes which can be picked up from designated parking spaces and left at designated spots around the city, freeing the user of the responsibility to find a specific station and thereby increasing user satisfaction at the end of a trip (Chen et al. 2020). The bike sharing providers Rekola and Nextbike are integrated in the city's public transportation network, other bikes and e-scooters can only be accessed through phone applications. The users are mostly younger and in the case of e-scooters, almost exclusively tourists (Chen et al., 2020; Shaheen et al., 2020); I10).

The car-based shared mobility is exclusively available through mobile applications. For the purposes of this study, taxis are not classified as a shared mobility option but as an extension of public transportation. The modes considered instead are carsharing services where only one person from a user pool at a time drives company-provided vehicles and on-demand services

where the user isn't behind the wheel but instead shares a personal or company vehicle with others on the same route.

Figure 3: Shared Mobility modes considered in this paper.



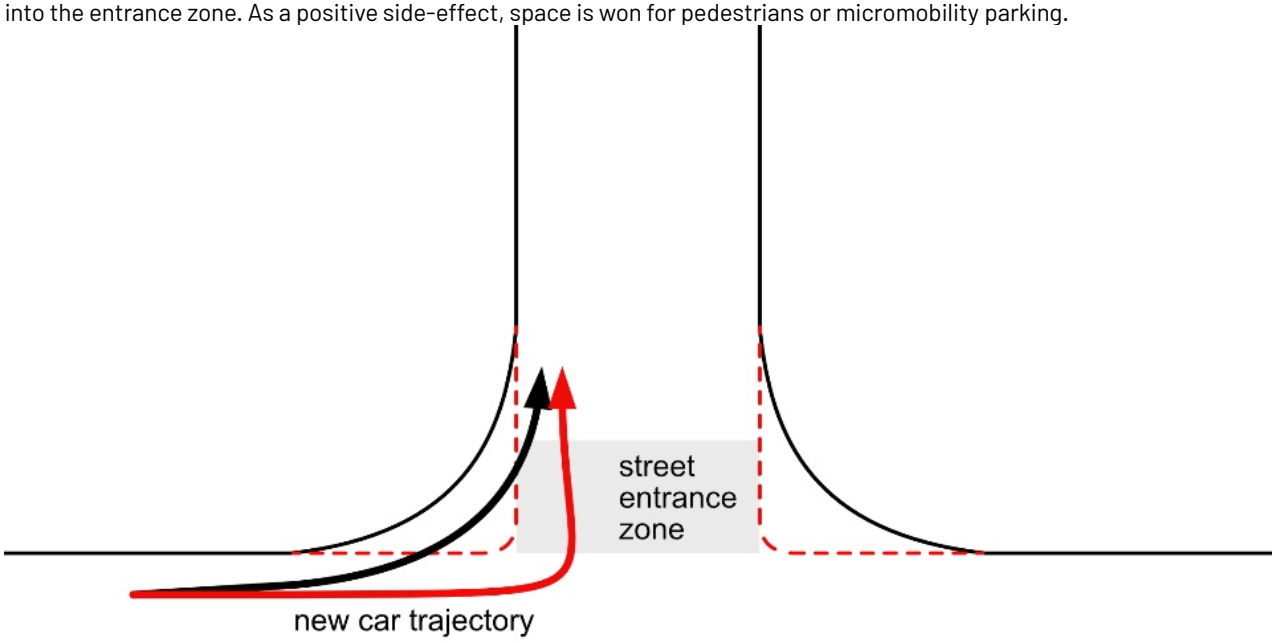
3.3 Bike sharing

The three major bike sharing companies in the City of Prague are Rekola, Lime and Nextbike. They all offer their services via a dockless bike system. Despite the availability of providers, the City of Prague faces various challenges with the implementation of shared bike systems. Among the most significant ones is the administrative autonomy of the municipalities due to which infrastructure solutions appear in a patchwork-pattern around the city. The lack of a continued network of cycling lanes has a dissuading effect on potential cyclists (I11). A further obstacle as described by a city counselor are the medieval street dimensions in the central parts of the city which don't allow for flexible implementation of cycling infrastructure and hilly terrain in some parts of Prague which discourages users (I10). From a planner's perspective another problem arises when considering parking spaces, a strongly debated topic in municipal elections in Prague (I11). When parked on the street, micromobility vehicles are criticized by drivers. When parked on the sidewalk, they inconvenience pedestrians and pose a threat as users are more likely to ride on the sidewalk (I10). Furthermore, the unequal spatial distribution of sharing services limits some users. Providers have to overcome financial and logistical challenges to expand, including the redistribution of dockless bikes from their final destinations each day. A related concern is the environmental viability of redistributing from areas with little use as a van is needed to transport bicycles- it would be undesirable to employ a transporter automobile to collect bikes from a large area. Finally, cyclists aren't perceived as a standard element of traffic but rather as

an alien element by automotive drivers, which causes conflicts to arise and contributes to safety concerns related to cycling (I10).

General measures aimed at increasing the cycling infrastructure have a positive effect on the use of shared bikes (Heydari et al., 2021). An example of a complex pull-measure Prague implements to enhance road safety for cyclists is the zone 30 for cars, introduced in many streets in the central region. It is combined with speed bumps and strategic constricting of entrance space into new roads (see Figure 4) to ensure a safer environment for all traffic participants (I11).

Figure 4: The corners of the sidewalk protrude further into the street, forcing automobiles to slow down when turning into the entrance zone. As a positive side-effect, space is won for pedestrians or micromobility parking.



On the other hand, new roads are built with improved characteristics for cycling. Figure 5 shows new cycling paths such as the A2 cycle route in Prague 8 city District that underwent reconstruction, resulting in a newly paved, wider and well-lit path. Costing 12 million Czech crowns, the project was carried out by the District of Prague 8 with financial support from the Prague City Council. The one-kilometer-long section of the path was expanded to 4 meters, with the most significant improvement being the new solid surface, replacing the previously poorly maintained gravel surface. The A2 is a part of a network of cycle lanes with the designations A1-A499 for the metropolitan area of Prague, more than a third of which has been completed.

Figure 5: Prague's main cycle route network in 2019 Source: mestemnakole.cz

For the specific case of shared mobility, pull measures already in place are the dockless systems which don't restrict the users at the end of a ride. At the same time, to address civil discontent related to chaotic parking, the city and companies have recently introduced designated parking zones, shared between providers, placed close to preferred destinations. An initiative that is no longer in use even used to allow frequent Rekola users to vote for the placement of new parking stations (I12).

Another positive measure provided by Rekola are the lightweight bike frames of their fleet that make cycling more accessible (I12). Similarly, Lime's e-bikes require less exertion from the users albeit for the opposite reason – that the bike takes on some of the performative energy. An attempt to unburden users is also made in Prague 6 with the bus line 147 which allows bikes to be taken uphill, however the upturn has been less than expected (I10).

Users have generally recorded a preference for shared bikes when combining cycling and public transportation on their route (van Kuijk et al., 2021). Since 2021, this has been possible with the "Lítačka" card. Its holders can use the bicycles of Nextbike or Rekola free of charge for two 15-minute intervals daily. A positive reaction in the population has already been noted (I10).

Finally, to combat the mindset of non-cyclists or infrequent cyclists, some organizations have information campaigns about active mobility like the ones organized from CAMP (Centre for Architecture and Metropolitan planning) or the World Cycling Ride organized by AutoMat, NaKole and co-organized by the UN Information Centre in Prague. Initiatives like putting flags on the bikes for national celebrations of Rekola also work to create a sense of community and a positive mindset around bikesharing.

3.4 E-Scooters

Bolt and Lime are the major companies to provide rental scooters for local commutation in the streets of Prague. Others are Re.volt and Blinkee. The customer base for e-scooters is distributed across several service providers and applications such as e-scooters.cz, e-bike tours and rides, Gogo scooters, Segway, SCROOSER tours. ŠKODA AUTO DigiLab, a Czech innovation centre, has launched the e-scooter project "BeRider" which currently operates the largest[5] fleet of e-scooters in Prague.

E-scooter fleets operate within the city's existing transport infrastructure with specific pick-up slots in the streets. Providers frequently gather and relocate user-parked vehicles back to these slots. The transport companies cooperate with digital service providers to create smart platforms to integrate shared mobility with public transport (Svitková, 2023). The e-scooters can be rented via smartphone applications which is a perfect example of how decarbonization and sustainability are achieved through digitalization. With electric scooters on roads, Prague can reduce its environmental burden from transportation (Svitková, 2023).

[5] Tried and tested: these shared e-scooters offer the fastest way to get around Prague - Prague, Czech Republic (expats.cz)

However, the development of e-scooters is sometimes limited by regulatory barriers adopted by cities and municipal districts such as regulation of land development, economic regulations and legal regulations on spatial planning in public spaces (Prague City Hall, 2019).

Another challenge for e-scooters use is the road surface in Prague, often cobble stones, which makes it feel unsafe to ride on the streets. Some users choose to drive and subsequently park on the sidewalk instead, endangering pedestrians (I10). Enforcement of stricter rules on parking and riding e-scooters, organizing public awareness campaigns and improving the road infrastructure can solve the mentioned problems to some extent. For example, the city of Prague has already worked with providers to create designated parking spaces for e-scooters and imposes congestion charges for wrong parking. Some improvement in user behaviour has been observed as a result (I4). However, a biased resident perception towards e-scooter use is still noticeable, with some people viewing e-scooters as tourist-oriented "bad sharing schemes" as opposed to "good" bike sharing (I13).

Although e-scooters (private or shared fleet) compete for users along with the bicycle market, these micromobility modes can be combined and regulated to function as complementary to public transport. The City of Prague utilizes the possibility of e-scooters as well as bike sharing to solve the problem of last-mile logistics (Nawaro, 2021). There are e-commerce delivery persons using the e-scooters in Prague, which shows how the electric vehicles are occupying the streets of Prague in different ways.

Local commutation in Prague is supplemented by e-scooters and the incentives and discounts provided by the city and the transportation companies have enabled people to accept e-scooters in a short span of time. For instance, I8 from the Operator ICT company who takes charge of the PID Lítačka & Mobility transportation group in the company says,

"I can say what people prefer in Prague from my opinion and from the data, what I can see is bike sharing and electric scooters are the most important for people because we provide them with free tickets for these services. For example, if you have a long-term ticket for public transportation, you can use this bike sharing two times per day for 15 minutes. We provide this discount…." (I8).

It is conveyed in the above excerpt that the city and the private companies together ensure the incentivization of e-scooters by providing free parking. This advantage of not having to pay for a parking spot combined with their ubiquity makes e-scooters a popular option among the public (I8). Based on the interview data analysis, it is understood that the ease of parking and the quality

of services are two important factors in popularizing e-scooters without compromising the customer base for other public transport systems in Prague.

3.5 Car sharing

The car sharing providers reviewed in this paper are Car4way, Autonapul, AJO, anytime and Hoppygo. Their services mainly cover the city area of Prague. Whereas the first four companies own fleets, Hoppygo is a service in which car owners can rent out their personal vehicles.

Shared cars remain cars and providers must overcome the discontents a user of a personal vehicle faces. Solutions for the individual have been found to deal with maintenance-related costs and parking. However, public discontent arises around the latter as shared cars are allowed to park in blue and green zones. Blue zones are otherwise only reserved for district residents and green zones allow parking for prolonged periods, which makes both zones highly favoured both by private car owners and users of shared vehicles (Filonova, 2023). This clash between drivers is especially perceptible in the central regions where car providers promise a vehicle "around each corner" (Filonova, 2023; Car4way, 2023).

On the planer's side, the ubiquitousness of shared cars is viewed in negative terms as they are often concentrated for example around universities, thus influencing a shift away from public transport in student habits. In the long term, a negative effect is expected as students enter the work force and are potentially more likely to invest in a private car (I10).

Personal discontent with the quality of the service discourages potential users. An analysis of complaints conducted in 2023 showed impractical and unfriendly customer service as the most influential status. Other concerns are also related to the state of the vehicles, especially their cleanliness. It is also noted that there is sparse availability of shared automobiles in Prague's peripheral districts which causes user dissatisfaction (Filonova, 2023).

A controversial but strong incentive for car sharing is the right to park inside blue and green zones in the City of Prague as a part of the rental price. Providers also cover other maintenance costs, including insurance of the vehicle and the driver (however, the user is still liable for damage until a certain monetary amount) and petrol or gas. The company Hoppygo incentivizes car owners to participate in the shared economy by being a reliable middle-instance for people offering their vehicles to others.

In summary, car sharing companies provide various incentives to their users but still have to deal with public discontent regarding the quality of the services. From a planner and political

perspective, car sharing isn't a top priority in the mobility transition but rather a competitor as it incentivizes non-frequent car users to turn away from public transportation.

3.6 On-demand rides

Prague, being a famous tourist destination, has ride sourcing services like Uber, Bolt or Liftago, however this study lacks sufficient data on on-demand services in the city of Prague itself and mostly cites findings from the interview with the provider CITYA, active in the Central Bohemian region. In this chapter, the paper focuses on two purposes for on-demand mobility in Prague: a) coverage mobility in rural areas not as densely served by public transport, such as the wider metropolitan region (I3) and b) as a service especially for elderly persons (Rybickova & Betkova, 2022).

In the case of CITYA, on-demand mobility is intended as a symbiotic addition to public transport (I3). The further away one gets from the centre, the thinner the coverage by transport routes and their frequency becomes. In this environment, the following dilemma arises: the routes connecting cities further out with the train stations are not laid out optimally or particularly frequently. Due to this dependence on the time schedule, fewer people use the route. If measures are taken to save money, these routes are used even less frequently or not at all over time (I3). The ride splitting approach does not aim to replace a car as a single commuting tool on the route to Prague and back but to bring commuters to train connections to improve intermodality and cover smaller rural areas to cease the need of having a car (I3). Whether these goals are achieved depends on the fleet size and service capabilities. CITYA uses a single driver's shift, providing mobility and transportation options to those who are left after the commuting wave to Prague, i.e. kids, parents, and elders (I3).

For the special target group of elderly persons, on-demand mobility can also be found not only in the city centre (I11) but in the whole Czech Republic as "senior taxis" (I3).

On-demand mobility faces different challenges based on the two purposes. A general regulatory challenge regarding on-demand mobility is its legal definition.

"We have the issue that (...) the public transportation in Czech Republic is defined by something that has time scheduled routes, lines and exact stops that are somehow confirmed by Bureau of Transportation (...). And if we have dynamic routing, we don't have any time scheduled stops, we are not public transportation. So right now by the law we are not existent or we need to be a taxi. And being a taxi, we cannot be subsidised by the public money." (I3)

Often named as "taxis", this definition implies use for leisure activities and the service therefore will not be subsidized by the cities as part of the public transport or properly included into the

integrated transportation application (I3). Municipalities which want to use the service often propose the reuse of bus stations, as these locations hold the infrastructure of housing waiting clients and are a safe and secure spot to stop and board. Yet, if the on-demand service is not recognized as a public transport item, the service is not allowed to stop there. (I3)

From the general target group of CITYA originates an inclusivity challenge: buses must be well equipped and inclusive, for example to be able to carry child seats, strollers, and wheelchairs. The current solution of having a driver with a simple license would lose effectiveness, as the offer of inclusivity asks for bigger coaches or more room in general (I3).

In the case of elderly transport, a technical challenge arises as the planning and booking of the service via a mobile application is often not well received. Payment with cash has been avoided from companies so far as not to burden the driver with an additional task for fear of distraction and time delays. (I3)

There is only one main incentive this study found. Even if the city is not able to integrate the service into the integrated transport plan by considering it public transport, the respective administrative institutions subsidize the on-demand service by partnering with the providers while considering them another category. This keeps the service affordable and accessible. (I11)

On-demand mobility brings an aspect of actively lived inclusiveness only due to its target group. It makes daily mobility without a personal automobile possible and therefore also helps with the worsening car ownership problem. The possibility to flexibly include stationary car fleets which are only used during traffic peak hours (e.g. cars belonging to filmmaking crews dwelling in the area, school buses, etc.) brings an additional sustainable and circular aspect (I3).

4. Conclusion

The research for this paper was centered around the acceptance of shared mobility services in Prague, with a focus on the influential factors affecting the acceptance of shared bicycles, e-scooters, car sharing and on-demand rides in the city. The integration of shared mobility services with public transport, accompanied by incentives and discounts, has played a vital role in obtaining its public acceptance in Prague. To further encourage acceptance and use of shared mobility services, this paper proposes the necessity for continued research and study, stronger policy initiatives, and infrastructural enhancements. By addressing regulatory concerns regarding shared mobility services, improving infrastructure, and slowly altering public perceptions, Prague can create a more comprehensive and sustainable transportation ecosystem, significantly enhancing the mobility experience for both its residents and visitors.

The challenges faced by the bike sharing providers underscore the need for a cohesive infrastructure development. Despite the lacking conditions for cycling in general, the positive impact that bike sharing providers have made through information campaigns, incentives like integration with public transport and customer service is noticeable. The efforts to enhance accessibility and foster a cycling-friendly mindset are promising steps towards a more sustainable transportation landscape in Prague. A continuous effort to develop more cycle friendly environments on the planner's side would benefit existing users and encourage new ones.

The growing popularity of e-scooters in Prague shows their potential to revolutionize urban commuting. There is, however, a need to address regulatory barriers and public perceptions while ensuring safety and convenience. Just as with shared bicycles, the issue of parking spaces will continue to play an important role in this regard.

On-demand mobility is a feasible way to serve non-drivers but to also connect drivers who live outside the area covered by Prague's public transport network to it services, replacing a trip to the centre by a shared trip to the nearest public transport station. Challenges faced by planners and providers introduce the search for a collaboration strategy with public transport that would enable on-demand services to keep their key feature – flexibility while connecting to a service with a strict time-schedule at the city-scale.

Car-sharing providers have worked with the city of Prague to offer the incentive of the right to park in blue and green parking zones in the city. To make the service more attractive, providers also organize vehicle maintenance costs and insurance. User dissatisfaction regarding vehicle availability, cleanliness and customer service is a challenge to be overcome in the future. Furthermore, although car sharing is viewed as a personal car alternative and mentioned in Prague's plan for sustainable urban development, planners prioritize other modes of transport. One reason is that shared cars currently add to traffic volume and pull in public transport users instead of changing the habits of car-owners. The city of Prague and providers must work towards reversing these trends to make car-sharing a viable part of the city's sustainable mobility transition.

In conclusion, this research underscores the importance of continued efforts by providers and policymakers to enhance shared mobility services and infrastructure in Prague to gain wider citizen acceptance, which in turn further incentivizes planners. By addressing the identified factors and challenges, promoting the use of eco-friendly car alternatives, collaborating with providers and implementing strategic measures, the city can pave the way towards a more sustainable, efficient, and user-friendly transportation landscape.

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Meta topic 1:

Navigating Sustainable Mobility Transitions in European Cities

Insights from Prague, Budapest, and Lyon

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Table of Contents

1. Introduction

Mobility is undeniably a vital aspect of our daily lives, offering us the freedom to move and fulfill our needs through various modes of transportation (Eltis, 2019). It connects us with loved ones, enables us to explore new horizons, and plays a crucial role in shaping our lifestyles. However, the prevalence of unsustainable transportation practices, particularly the heavy reliance on private cars, has raised alarming concerns regarding its impact on human health and the environment (Noy & Givoni, 2018). It is evident that a transformative shift towards sustainable travel practices, including cycling, walking, and public transit usage, is of urgent importance to secure a greener, healthier, and more interconnected future for both present and future generations (European Commission, 2020).

Therefore, this research paper undertakes an investigation into sustainable mobility transition strategies in three diverse European cities: Prague, Budapest, and Lyon. The objective of this research is twofold: first, to identify the planned and implemented measures adopted by these cities to achieve sustainable transportation within their urban areas. Secondly, the study aims to explore and reflect on the cities' understanding of transformation—what future they envision and who should be responsible for this transformation. Additionally, the research seeks to discern the methodologies employed in pursuing this transformation, whether through test beds, experimentation, overarching strategies, or incremental approaches. By delving into these aspects, we aspire to gain a comprehensive understanding of how cities are striving towards sustainable transportation and their vision for the future of sustainable mobility.

2. Navigating the mobility transition towards more sustainable cities

In this section, we delve into the intricacies of a mobility transition, shedding light on its definition and significance. We explore the best practices and strategies to successfully achieve this transformative process, empowering cities to embrace sustainable transportation systems. Moreover, we also identify and address the potential obstacles and barriers that might impede the smooth progression of mobility transition, ensuring comprehensive insights for effective decision-making and planning.

2.1 Mobility Transition

According to the European Commission, a mobility transition refers to a fundamental shift in the way that people and goods move within a given region or society (European Comission, 2020). It involves a comprehensive transformation of transportation systems, modes, and behaviors towards more sustainable, efficient, and equitable forms of mobility. This typically entails a departure from traditional, car-centric transportation models and aims to prioritize alternatives

such as public transit, cycling, walking, shared mobility services, and the integration of emerging technologies (European Comission, 2020). As will be discussed in depth in Section **Error! Reference source not found.**, this transition can be realized in many ways. One approach involves engaging the public in events and campaigns that encourage reduced vehicle usage. Another method is implementing pricing measures to make public transport more affordable and accessible. Additionally, test beds and living labs provide a platform for experimenting with new technologies through user interaction, facilitating the transition towards sustainable mobility. The concept of mobility transition is vital for shaping a sustainable future. By transforming transportation systems and adopting sustainable alternatives like cycling, walking, and efficient public transit, we can address environmental challenges, improve public health, enhance social equity, and stimulate economic growth (Remme et al., 2022).

2.2 Factors needed to achieve a mobility transition

To achieve a mobility transition, several key parameters must be implemented. Public participation and awareness form the foundational elements for success, as engaging the community in planning and decision-making ensures that diverse needs and perspectives are considered, fostering tailored solutions and accountability (Gallo & Marinelli, 2020). Equally crucial are public awareness campaigns that educate individuals about the benefits of sustainable transportation, inspiring collective action (White et al., 2019). Additionally, policies and regulations play a vital role, offering economic incentives for eco-friendly transport and shaping cultural norms towards sustainable mobility (White et al., 2019).

Aligning policies with public awareness efforts creates a supportive environment for sustainable transportation, prioritizing infrastructure development (Loorbach et al., 2021). The quality of urban space also influences transportation choices, with dedicated infrastructure encouraging active modes like walking or cycling, fostering a sense of place and comfort in sustainable transport, reducing reliance on private cars, and promoting a smooth mobility transition (Mattson et al., 2021). By embracing such a comprehensive approach, these cities can pave the path to a sustainable future, inspiring other urban areas to follow suit.

2.3 Challenges or barriers hindering a mobility transition

Although there are many factors which can facilitate a mobility transition, there are also several challenges and barriers that hinder their successful implementation. Two major challenges mentioned in later sections of this report include people's resistance to adopt new transportation behaviours and the lack of communication between policy makers and citizens. Established habits, cultural norms, and personal preferences often favour private car usage, making it challenging to shift towards sustainable modes of transport (Oteh et al., 2021). Overcoming this

resistance requires effective communication, education, as well as targeted awareness campaigns that demonstrate the benefits of sustainable mobility and encourage behavior change (Duckworth & Gross, 2020). Additionally, the lack of communication between policy makers and citizens hinders a sustainable mobility transition by impeding the understanding of citizens' needs and preferences. Without effective communication channels, policymakers may overlook crucial insights from the public, leading to the implementation of initiatives that do not align with the community's desires and potentially face resistance or lack of support (Dearing, 2000). Addressing these challenges demands the formulation of supportive policies and effective coordination among stakeholders to ensure a smooth transition towards sustainable mobility.

3. Mobility transition in European metropoles: Our EuMOVE experience

As part of the euMOVE project, our team embarked on a scientific journey to investigate the intricacies of mobility in Prague, Budapest, and Lyon, with a particular emphasis on shared mobility, mobility pricing, and mobility experiments. These vibrant urban environments provided us with unique perspectives on the complex nature of a mobility transition. Through data collection, insightful interviews, and analysis, we uncovered a noteworthy finding: the approach to achieving a mobility transition can vary significantly across different cities and regions.

In the upcoming section, we present our insights into the diverse approaches to foster a mobility transition that we observed during our journey. From Prague's innovative policies to Budapest's community-driven initiatives and Lyon's forward-thinking infrastructure, each city demonstrated its own distinctive strategies for embracing the future of transportation. These different approaches not only highlight the richness and adaptability of mobility transition but also hold valuable lessons for other urban areas seeking to navigate the challenges of sustainable mobility.

3.1 Mobility transition in Prague

Prague has been the pioneer of several mobility initiatives and offers efficient public transport connectivity in terms of buses, rail, electric traction, and other modes. Navigating the city of Prague is swift and convenient for both residents and visitors, thanks to the frequent availability of trams, shared bikes, metro trains, and other public transport options. However, cars remain a primary choice for many people who travel from the suburban areas of Prague to the city. One reason behind this is the people's mindset because in Prague, owning a vehicle is still part of the social status and lifestyle. Despite this, the trend is changing signalling a shift towards more sustainable modes of transportation.

The Sustainable Urban Mobility Plan (SUMP) for Prague and its suburbs aims at achieving sustainable mobility through developing mobility infrastructure and enhancing the standard of

living (Svitková, 2023). Some of the initiatives undertaken by the City of Prague (CoP) in this regard include purchasing new electric buses and replacing the existing ones with an electric variant. In addition, the public transport infrastructure is constantly revisited and improved to make it more inclusive for people from the vulnerable sections of the society, such as children, women, elderly, and mobility restricted people. For example, the introduction of railing in the bus stops was trialled for supporting handicapped people. Additionally, expanding the network of low-floor buses and trams with a kneeling system eases boarding for passengers (Prague City Hall, 2019).

With respect to local mobility initiatives, people's participation in events and campaigns that facilitate reduced vehicle usage and ownership is commendable. For example, 10,000 steps, an event organized by the Partnership for Urban Mobility, is designed to create awareness about a healthy lifestyle among the public through walking. Moreover, public transport systems, such as buses, now incorporate emission-free electric air-conditioning and heating, replacing the previous diesel-based method. This is expected to reduce the carbon-emissions from public transport buses, thus contributing to the decarbonization of urban mobility by 2030 (Svitková, 2023). City planners and transport companies collaborate to boost electromobility for example, Smart Prague Project by Operator ICT aims at improving the electricity distribution network and public charging infrastructure for electric vehicles. The City of Prague Technology (THMP) installed electric vehicles (EV) ready lamps, thus enabling the charging of electric cars from lighting networks (Prague City Hall, 2021). Further, many municipal companies purchased low emission vehicles including electric vehicles for their business use.

The shift towards cutting-edge mobility, including autonomous and connected driving systems, progresses slowly as city planners prioritize improving public transport, parking facilities, shared mobility, park and ride systems, cycling infrastructure, and the incentivization of these services. For example, developing safe cycling infrastructure, facilitating easy payment on shared vehicle applications, incentivizing public transport tickets and parking fees, integrating digital applications for Mobility-as-a-Service, introducing zero-emission mobility alternatives are their primary concerns. However, it is expected that some of the metro lines in Prague be transformed to autonomous metro units run by artificial intelligence soon (Prague Convention Bureau, 2021).

The case study in Prague reveals a pressing need for immediate infrastructural and mobility pattern changes in the public space. Public responses to such changes significantly influence decisions made by administrators, policymakers, and politicians. Overcoming challenges, including funding limitations, legislative barriers, and local election agendas, is crucial for implementing sustainable mobility plans (Foltýnová et al., 2016). Addressing socio-cultural, infrastructural, regulatory, and governance aspects requires equal support from the public,

political parties, and administrative bodies. Public participation in mobility-based decision-making emerges as a critical factor to drive sustainable mobility action plans and innovative policies in Prague.

3.2 Mobility transition in Budapest

Budapest, the capital city of Hungary, has made commendable strides in pursuing sustainable urban mobility. This research delves into the city's comprehensive strategy, encompassing the integration of mobility and green infrastructure, the implementation of mobility pricing measures, the regulation of micro mobility services, and the complexities arising from political dynamics. Through analyzing these components, valuable insights emerge regarding Budapest's dedicated efforts to cultivate an environmentally friendly and cost-efficient transportation system.

An integral aspect of Budapest's commitment to sustainable mobility lies in its emphasis on integrating mobility infrastructure with green spaces. The city has invested significantly in the development and maintenance of parks, creating green oases within the urban landscape (Adorjan et al., 2019). These green areas enhance aesthetics, provide seating spaces, and encourage engagement with the natural environment. Innovative green roofs on bus stops integrate transportation infrastructure with greenery, promoting active mobility and well-being (Silva Dantas & Nagy, 2022). These green spaces also enhance resilience, mitigating the urban heat island effect by absorbing excess heat (Doick & Hutchings, 2013). Thus, they help to improve comfort, livability, sustainability, and climate resilience in Budapest (Silva Dantas & Nagy, 2022).

Budapest recognizes the importance of mobility pricing measures in shaping sustainable transportation patterns. The city has maintained consistent public transportation prices for over two decades, ensuring accessibility for all residents and incentivizing the use of public transportation over private vehicles (L. Kerényi, personal communication, May 26, 2023). By offering dense public transportation networks at affordable rates, Budapest has effectively encouraged residents to opt for sustainable mobility options, aiming to reduce congestion and pollution.

To further augment sustainable mobility, Budapest has introduced and regulated micro mobility services. With 600 strategically placed hubs, seamless transitions between E-scooters and bicycles are facilitated (L. Kerényi, personal communication, May 26, 2023). These hubs enhance the convenience and accessibility of micro mobility for residents and tourists alike. Budapest's approach to regulation includes restrictions on public space use to prioritize citizens' well-being

and safety. Striking a balance between innovation and regulation, the city has adeptly integrated micro-mobility services, lessening people's reliance on private vehicles.

Despite Budapest's concentrated efforts to foster sustainable mobility, challenges persist, particularly in the region and outskirts of the city. Political disputes between the city and the national government hinder progress, obstructing the necessary laws and governance measures. Urgent actions, such as increasing parking fees, reducing parking spaces, and expanding cycling infrastructure, demand political will and support. Unfortunately, the lack of cohesion between the city and the national government hampers the implementation of these vital sustainable mobility initiatives (L. Kerényi, personal communication, May 26, 2023). Overcoming these political hurdles is crucial to ensure a comprehensive mobility transition across the entire metropolitan region, granting all residents access to sustainable transportation options.

3.3 Mobility transition in Lyon

Lyon, nestled in the heart of France, stands as a prominent model of sustainable mobility. With a forward-thinking approach and a strong commitment to reducing environmental impacts, the city has successfully implemented numerous innovative solutions, fostering a transition towards sustainable mobility. By addressing mobility challenges, including traffic congestion and crowded roads, Lyon has devoted considerable resources to achieve its mobility transition through a range of innovative strategies (Grand Lyon, 2022).

Presently, Lyon showcases a comprehensive public transportation network with an eco-friendly metro, trams, and buses, significantly lowering its carbon footprint. Furthermore, Lyon encourages eco-friendly transportation such as cycling, offering a well-established bike-sharing program and dedicated cycling lanes citywide. Car-sharing initiatives and support for electric vehicle infrastructure further empower residents and visitors to embrace sustainable mobility choices, while still having access to private transportation. (ITF, 2020).

Lyon's success in new mobility lies in test beds—experimental and co-creative environments that allow real-life testing of innovative technologies and ideas. By involving users and stakeholders in the co-creation process, test beds foster the development of more sustainable, user-centric, and effective mobility strategies that cater to the diverse needs of urban communities (Engels et al., 2019). Currently, multiple test beds drive Lyon's mobility transition. The Part-Dieu district, centrally located, aims to alleviate traffic congestion and benefit the community. Meanwhile, the Confluence district focuses on redesigning transportation infrastructure and urban spaces to better serve society's needs. (Lyon Part-Dieu, 2023).

Despite Lyon's achievements, the city's mobility transition faces significant challenges. The lack of effective communication with the public has left citizens feeling neglected and uninformed, resulting in heightened criticism and resistance. The transformation process has been met with skepticism, as residents question the true impact and benefits of the proposed changes. To rectify this, Lyon must urgently prioritize open, transparent communication and engage the public in the decision-making process. A more inclusive approach, with increased public participation in the redesign process, is imperative to address concerns, build trust, and foster greater acceptance and adoption of new transport modes. Without swift action, the city's mobility transition risks facing even more resistance and delays, hindering its progress towards a more sustainable future.

4. Discussion

The discussion centers around understanding how the cities of Prague, Budapest, and Lyon approach the concept of mobility transition and what aspects are transformed in their approach. By analyzing their strategies and initiatives, we can gain valuable insights into the pathways and elements involved in guiding a socio-ecological mobility transition. Prague, Budapest, and Lyon each exhibit distinct approaches to mobility transition, encompassing various aspects such as infrastructure, transportation modes, social practices, legislation, and technology. Comparing these cities' approaches allows us to understand the different understandings of "transformation" they embody and identify potential pathways for sustainable mobility transitions.

Infrastructure plays a crucial role in facilitating sustainable mobility. Prague, for example, focuses on enhancing accessible infrastructure by introducing measures such as low-floor buses and trams as well as cycling infrastructure and the integration of electric vehicle charging stations to support the transition toward active and electromobility. Budapest integrates transportation and green spaces green roofs on bus stops. Lyon prioritizes the development of an extensive renewably powered public transportation network and promotes cycling infrastructure through well-developed bike-sharing programs and dedicated lanes.

The way people move within these cities is also undergoing transformation. Prague is witnessing a shift in mindset as shared bicycles gain popularity, indicating a movement towards more sustainable transportation options. Budapest emphasizes affordable public transportation fares, incentivizing residents to choose sustainable modes of transport over private vehicles. Lyon encourages environmentally friendly modes of transport, such as cycling and car-sharing initiatives, while actively supporting the development of electric vehicle infrastructure.

Social practices and routines are being influenced by the mobility transition efforts in these cities. Public participation and awareness campaigns are key factors in Prague, where events like "10,000 steps" promote walking as an emission-free form of mobility. Budapest's focus on micro-mobility services and regulations shapes new mobility practices. Lyon's implementation of test beds and living labs facilitates user-centric mobility strategies and encourages the co-creation of solutions.

Legislation and governance play a vital role in driving sustainable mobility transitions. Prague aims to reduce its carbon footprint through its SUMP strategy and implements policies like purchasing electric buses and revisiting public transport infrastructure. Budapest maintains affordable public transportation prices and regulates micro-mobility services to create accessibility while addressing safety concerns. Political dynamics and the need for cohesive approaches between the city and national government pose challenges for Budapest's sustainable mobility initiatives. Lyon demonstrates strong governance practices through the implementation of test beds, which allow for experimentation, refinement, and scalability of sustainable mobility approaches.

Technological advancements are shaping mobility transitions in these cities. Prague focuses on electromobility and envisions the transformation of some metro lines into autonomous metro units run by artificial intelligence. Budapest utilizes technology in the form of micro-mobility hubs and the regulation of services. Lyon leverages test beds to test and scale innovative mobility solutions, enabling constant adjustment and development of infrastructure. An overview of the approaches to achieve a mobility transition can be seen in **Error! Reference source not found.** in the **Error! Reference source not found.**. Examining these diverse approaches can guide other urban areas in their socio-ecological mobility transitions, providing valuable lessons and pathways for sustainable urban mobility. Considering factors like infrastructure, transportation modes, social practices, legislation, and technology can lead to comprehensive and successful mobility transitions, fostering sustainable, inclusive, and livable urban environments. Furthermore, below is a summary table depicting each city's vision for achieving a mobility transition and the key parties responsible for driving this transformation

Table 1: Each city's vision for achieving a mobility transition and the key drivers of this transition.

		VISION FOR MOBILITY TRANSITION AND RESPONSIBLE PARTIES		
CITY	***Prague***	• Integration of public transport systems with shared micro-mobility services, infrastructure development and regulations.	• Public participation and policy regulations are crucial for mobility transition.	• Policy makers, urban planners, and Prague citizens form the responsible entity.
	Budapest	• Establish sustainable transportation with cycling and public transit infrastructure and stable pricing for public transportation.	• Local government drives the transformation, but citizen involvement is crucial too.	• Achieving goals with active citizen participation to create pressure on the government.
	Lyon	• Developing public transport networks, cycling infrastructure, and car-sharing initiatives.	• Policy makers and citizens of Lyon together form the responsible entity.	• Effective communication between these groups is crucial to drive the desired change.

5. Conclusion

In conclusion, European cities like Prague, Budapest, and Lyon exemplify the transformative potential of mobility transitions in achieving sustainable urban mobility. Each city faces unique challenges, such as car dependency in Prague and political disputes in Budapest, but they make significant progress through reduced car usage campaigns, public-private partnerships, and sustainable infrastructure development. Our research underscores the importance of pursuing a mobility transition to address environmental, social, and economic challenges associated with transportation. By embracing sustainable mobility options, cities can significantly improve the quality of life for their citizens. The adoption of eco-friendly transportation choices leads to

reduced congestion and air pollution, creating cleaner and more breathable urban environments. As a result, citizens can enjoy healthier and more pleasant surroundings, fostering a more liveable and vibrant city for both current and future generations. Despite the obstacles, a collective commitment to change and innovative solutions can pave the way for sustainable mobility and a more promising future.

Overall, these cities showcase successful mobility transitions driven by environmental concerns, public health, and enhanced quality of life. Public engagement, effective pricing regulations and experimenting new mobility technologies each play a crucial role in promoting eco-friendly transportation choices. Through their comprehensive approaches, these cities provide inspiring examples of how mobility transitions can lead to more sustainable, inclusive, and livable urban environments.

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7. Appendix

Table 2: Mobility transition approaches in Prague, Budapest, and Lyon

MOBILITY TRANSITION APPROACHES

		Social Practices	***Legislation***	***Technological Advancements***
CITY	***Prague***	Public participation and awareness campaigns	Sustainable Urban Mobility Plan (SUMP)	Electromobility and autonomous metro units
	Budapest	Micro-mobility services and regulations to shape new mobility practices	Affordable public transportation prices, political dynamics and cohesive approaches between the city and government remain as challenges	Micro-mobility hubs and services
	Lyon	Implementation of test beds and living labs	Strong governance practices through test beds, allowance of experimentation	Leverages test beds for innovative mobility solutions

Meta topic 2:

Investigating Mobility Justice in European Metropolitan Regions

Case Studies from the Cities of Budapest, Lyon and Prague

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1. Why we should we care about mobility justice

The design of cities, along with their urban spaces and mobility infrastructures, significantly influences our daily lives. Nevertheless, these benefits have not been equally distributed among all groups. Historically, conventional transportation approaches have often reinforced social disparities, resulting in marginalized communities having restricted access to vital services, education, jobs, and opportunities for social engagement (Ramboll, 2021; Levy 2013). This disparity emphasizes the need for mobility innovations that prioritize social justice and ensure equal access for all.

In the realm of urban planning and mobility, the concept of mobility justice has emerged as a critical discourse, addressing the equitable distribution of transportation resources and opportunities among diverse communities. As European cities continue to evolve in response to societal, economic, and environmental challenges, understanding mobility justice becomes paramount to foster sustainable and inclusive urban environments (Verlinghieri & Schwanen, 2020).

The aim of this paper is to explore the manifestation of mobility justice in urban planning and transportation across Europe, focusing on three cities: Budapest, Lyon and Prague. By examining mobility and urban spaces through the lens of justice in a European context, this research contributes to the ongoing dialogue on mobility justice by highlighting concrete examples, opportunities and challenges that cities face in relation to mobility justice.

2. Dimensions of Mobility Justice: Gender bias, Accessibility, Affordability and Spatial Distribution

The concept of mobility justice is one that has been explored through many different aspects. The published paper "Transport and mobility justice: Evolving discussions" highlights several different ways of how mobility justice can be conceptualized. For purposes of our theoretical framework, we have taken four important dimensions of mobility justice which are gender bias, accessibility, affordability and spatial distribution (Verlinghieri & Schwanen, 2020). The focus on analysing these four distinct dimensions

will ensure that the research done in the three European cities show exactly what mobility justice patterns and implementations emerged. The framework analysis that will be undertaken is the investigation of the qualitative data obtained from the research of the cities of Prague, Budapest and Lyon.

2.1 Spatial Distribution

Spatial distribution is the arrangement of individuals in a particular area or space (Oxford Reference). For mobility justice, this can mean the unfair spatial distribution of the street usage and its allocation results in injustices concerning accessibility, affordability, and the overall well-being of different segments of the population. For example, researchers investigated this injustice in Bogota, Columbia and concluded the importance of integrating a justice lens into urban planning processes to foster a more inclusive and fair distribution of resources and to address power imbalances in transport decision-making (Guzman, 2021).

2.2 Gender Bias

Gender bias are the prejudiced actions or thoughts based on the gender-based perception that women are not equal to men in rights and dignity (European Institute for Gender Equality). The interviews of Ana Bibilashvili, an architect and urban planner and Lena Osswald, founder of the Mobilivers platform, whose company focuses on gender-equitable mobility demands and intersectionality spoke about this aspect of mobility justice (EU NEIGHBOURS east., 2021). They determined that safety in public spaces is a crucial aspect, and one example to ensure women's security is the inclusion of safety measures such as well-lit streets and visible subway exits. By addressing these aspects, cities can foster inclusivity and promote gender equality in urban environments that meet the mobility needs of women.

2.3 Affordability

Affordability of the use of a city's public transportation is a consideration for mobility justice that should not be ignored. The need for a comprehensive understanding of transport affordability, considering transactions, journeys, and budget constraints is essential for this dimension of mobility justice. Advocating for more equitable transport

policies to address the diverse needs faced by communities will bridge the gap between transport affordability and unaffordability (Plyushteva, 2023).

2.4 Accessibility

The topic of accessibility concerning mobility justice has many different aspects. One such study conducted was of a comprehensive focus group discussion to explore the cognitive access barriers faced by individuals with intellectual disabilities (ID) within the public transport system (van Holstein, etc, 2020). By applying the mobility justice framework, the researchers emphasize the importance of collaboration with the disability support sector and advocates for essential structural changes in the transportation network. Their study highlights the potential for achieving greater mobility justice by integrating technological innovations with staff training and providing favourable working conditions.

3. Case Studies of Mobility Justice Dimensions across Europe

Due to the limited scope of this paper, this chapter focuses only on the pre-selected dimensions of mobility justice and provides examples from the cities that came up during the interviews and observations on the research trips. Therefore, only some dimensions for each city are discussed.

3.1 Geographical Distribution in Budapest

The spatial distribution of the public transportation services in Budapest has impacts on those who live on the outskirts of the city. While the city is proud of its extensive and well-developed network, it is not yet collectively accessible throughout all 23 districts. Public transport remains a lot cheaper and more affordable compared to its European counterparts. Despite the constant energy crises, prices have remained the same for nearly 20 years. The recent crisis in 2021 has led to complexities in maintaining affordability and there have been compromises in terms of frequency. BKK (transportation authority in Budapest) could not afford to decrease the frequencies in the central areas to keep the city functioning so the burden was systematically handed over to the outskirts. (Interview A.2, 2023) While central districts enjoy better infrastructure as well as frequent, economically disadvantaged areas experience inadequate public transportation coverage. Public transportation services such as the buses and trams are

not as extensive and frequent compared to the central areas. As a result, residents of these areas must rely on fewer options, leading to longer travel times, and limited connectivity to essential services such as education institutions, health services, and employment hubs. These disparities in the distribution of public transport networks lead to fostering of the existing socio-economic gaps.

Like its many European counterparts, Budapest also has an operating long-distance suburban train that is aimed to serve those who live in the outer circle. However, these trains suffer from first and last mile connectivity issues where integration with buses has not been a successful implementation. This connection issue is being tackled to a minimum by micro-mobility solutions such as e-scooters and bikes for those who can afford them on a daily basis. In addition to this issue, the suburban trains suffer from overcrowding. BKK has allocated a capacity of 5 persons per square meter in public transportation, but these trains already exceed this capacity both peak and off-peak hours. (Interview A.1)

3.2 General Sense of Safety in Budapest

In this section, two significant mobility challenges in Budapest are highlighted: the deterrence of public transport at night (1) and the hindrance of cycling due to poor infrastructure (2)

At night, a noticeable portion of Budapest's residents refrain from using public transport (1.). Safety concerns are the primary reason behind this reluctance, as passengers fear encountering potential threats such as harassment, theft, or even violence during nighttime journeys. Additionally, some public transport lines exceed their designated capacity of 5 persons per square meter, (Interview A.1, 2023) leading to a sense of unsafety and contributing to the decline in nighttime usage.

The perceived lack of security measures, such as insufficient street lighting and surveillance also plays a crucial role in shaping residents' preference against nighttime public transport usage. Certain central districts such as the 8th and 10th have gained a reputation for their insecurity, (Tordai, 2022) As a result, individuals who refrain from using public transport at night often turn to alternatives such as taxis or ride-hailing services to ensure a better sense of safety and convenience. Taxis and ride-hailing

services are prevalent in Budapest and are generally favored as a means of transport due to their availability and affordability.

Regarding cycling, poor inter-district infrastructure forces cyclists to change their transport mode (2.) Budapest's unique district-level administration leads to disparities in the implementation and continuity of bicycle lanes across different districts. The lack of coordination often results in bicycle lanes suddenly ending at district borders, making it challenging for cyclists to navigate the city properly. The disintegration of the network of bicycle lanes creates an inconvenient and unsafe environment for cyclists, discouraging them from choosing cycling as a viable mode of transportation.

This lack of interconnected bicycle lanes affects the overall efficiency and attractiveness of cycling as a sustainable mode of transport. Cyclists face difficulties in planning their routes and experience longer travel times due to detours or navigating through motorized traffic where accidents occur. Districts that are not cooperating in this regard contribute to eliminating bicycles as a daily-commuting option, particularly for those residing in districts with poor cycling infrastructure.

3.3 Affordability in Prague

The city of Prague spends up to 35% of its budget annually on the maintenance, operation and development of its transportation system (Svitkova, 2023). This exceptionally high number in comparison to other European cities is owed to the negative revenue ticket fares bring in. Public transport in Prague is so inexpensive that it is unable to cover its operation costs, obliging the city to subsidise the system to a higher extent than others. In the context of mobility justice, this is a positive example. Affordable public transport paired with the Prague's reliable, 24-hour network enables all residents, regardless of their economic status, to access essential services, education, and employment opportunities across the city area. As a comparison – the yearly pass for all public transportation costs 3,650 Czech crowns, 1,9% of the minimum annual income of Prague's residents (Prague Public Transit Company, 2023; Salaryexplorer , 2023).

An important characteristic of Prague's public transport is its ongoing expansion. When calculating the personal costs of transport, the array of available connections plays an important role. An unjust spatial distribution of transportation services or infrastructure

makes transport more expensive for people in underserved areas. In the Czech capital, this is combatted by a new regulation guaranteeing a public transport stop no further than 600m in front of new building projects (Interview B.1, 2023). Thereby residents of newly developed peripheral areas can still expect a satisfactory level of service corresponding to the personal investment in fares for residents of central areas.

Another aspect of affordability are shared mobility services. Most of them are accessible via a mobile app and require mobile internet data to unlock vehicles. However ubiquitous, the possession of smartphones cannot be considered a just prerequisite for access to a service. By demanding this invisible initial cost, shared systems become unaffordable for certain groups of the population.

A positive practise can still be found in the integration of the fleets of the bike-sharing companies Nextbike and Rekola into the public transport system. The owners of the yearly Litachka card are now entitled to two free 15-minute intervals of use daily, allowing access to users who for financial reasons wouldn't have invested in an abonnement (Nextbike Website).

3.4 Accessibility and Inclusivity in Lyon

Lyon has implemented various projects to create a more accessible urban mobility landscape, addressing the specific needs of diverse communities and contributing to larger issues of mobility justice within the city.

One critical aspect of mobility justice is ensuring accessibility for all, regardless of physical limitations. Lyon has made significant progress in this regard, with a fully accessible metro system. Moreover, it is currently testing innovative technologies like sound beads in trains and stations, connected to a mobile app that help guide visually impaired and blind people safely through stations. Additionally, 98% of pedestrian signals now have on-demand remote activation technology, allowing them to guide people to the crossing from a distance by sound instead of searching for a button. The signals also provide street names, helping blind people to orient themselves (Interview C.2, 2023). These infrastructural improvements to Lyon's mobility landscape provide marginalised groups, like visually impaired people, with greater autonomy and freedom of movement, breaking down physical and systemic barriers. By prioritising the needs of diverse

communities more, the city is promoting social representation, inclusivity and equitable mobility.

Another notable project is the redesign of Part-Dieu, a major transportation hub of the region. It focuses on transforming a car-centred district into a pedestrian and cyclist-friendly environment. Through space redistribution and prioritization of non-car users (Interview C.1, 2023), who primarily include women, children, and the elderly, Lyon works towards enhancing mobility justice. By reclaiming space for those who have been historically underserved by the area and promoting sustainable transportation alternatives, the city fosters a more inclusive and accessible urban mobility landscape. An example is the redesign of Rue Garibaldi, a former motor way where cyclists and pedestrians had to cross streets over bridges. The space is now redistributed from cars to other modes. By giving more space to pedestrians, cyclists and public transportation the city serves the needs of non-motorists, often women, children, elderly or people with restricted mobility. Nevertheless, Lyon is still far from a fair distribution, given the amount of space cars take up in the city.

This spatial redistribution in Part-Dieu includes also another important aspect of mobility justice - the consideration of different mobility patterns, particularly those associated with gender roles. Women often bear the greatest share of care work, leading to unique transportation needs centred around accessibility to transport infrastructure. Trip-chaining, a combination of multiple trips, is more common for women and relies heavily on a well-developed walking and cycling infrastructure (Ramboll, 2021; Criado-Perez, 2020). This makes a functioning multimodal transport system vital for supporting the complex mobility requirements of women, who constitute a significant proportion of public transport users (Ramboll, 2021). Since the redesign of the district prioritizes cycling, walking, and seamless navigation (Interview C.1, 2023), serving the needs of women better and contributing to a more equitable urban environment.

In conclusion, Lyon's efforts in improving the mobility infrastructure show a commitment to creating an inclusive and sustainable urban environment. By prioritizing the needs of marginalized groups and promoting safety and accessibility the city moves towards a more equitable and just mobility landscape for all its residents. These initiatives not only

help to transform Lyon's transportation systems but also serve as valuable models for other cities striving to achieve mobility justice on a broader scale.

4. Discussion & Conclusion

In this paper, our exploration of mobility justice in three distinct European cities - Budapest, Lyon, and Prague - has provided insights and perspectives into existing challenges and opportunities for achieving equitable and sustainable urban mobility. Each city's unique context has shed light on various dimensions of mobility justice, including general sense of safety, accessibility, affordability, and spatial distribution of transportation services.

In Budapest, the distribution of public transportation services poses significant challenges for residents living in the outskirts of the city. While central areas benefit from an extensive network economically disadvantaged areas suffer from insufficient frequency and limited connectivity to essential services. Additionally, safety concerns are present in both passengers having to travel at night and cyclists who lack dedicated lanes in a few districts.

Prague, on the other hand, has made commendable progress in affordability, offering an exceptionally low-cost public transport system. The subsidized network allows all residents, regardless of their economic status, to access essential services and education institutions throughout the city. However, the lack of integration with shared mobility services and the assumption that the entire population possesses smartphones can still present challenges for certain segments of the population.

In Lyon, the city's focus on inclusivity and accessibility for marginalized groups such as people with reduced mobility, women, and children, has resulted in significant improvements in the mobility landscape. Fully accessible metro systems and innovative technologies for visually impaired individuals showcase Lyon's commitment to breaking down physical and systemic barriers.

The conclusion drawn from these case studies primarily emphasizes the importance of adopting a society-centric approach to mobility justice. Understanding the diverse mobility needs and experiences of various individuals, particularly those frequently

marginalized, is essential in identifying disparities and injustices in urban mobility. By addressing safety concerns, enhancing accessibility, and promoting affordability, cities can foster just and compassionate mobility, creating a more inclusive urban environment. For instance, the innovative initiatives implemented in Lyon demonstrate the significance of considering gender roles as well as care work in mobility planning.

As the cities continue to evolve and address societal, economic, and environmental challenges, it is vital to integrate mobility justice into urban planning and transportation policies. The findings from these case studies have provided insights and perspectives that can be adapted and implemented in other European metropolitan regions.

We conclude that through citizen participation cities can foster sustainable, equitable, and all-encompassing mobility practices and lead to a more inclusive urban mobility landscape for all residents.

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Meta topic 3:

Effects on Postgrowth Economy on the Mobility Sector

Exploring the Impact of Post-Growth Principles on Urban Transportation: A Study of Mobility Patterns and Quality of Life in Prague, Budapest, and Lyon

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1. Introduction

In today's world, where economic growth has long been debated to be the ultimate measure of success, a notable shift is occurring, challenging this conventional wisdom. The concept of post-growth, an alternative economic framework, prioritizes sustainability, resilience, and quality of life over endless expansion. As we navigate the intrinsic landscape of urban transportation, understanding the concept's relevance becomes essential due to the urgent need to address numerous crises. The crises require an urgent call for biodiversity conservation, climate action, emission reduction, and social injustice in the transportation sector. As the reckless energy consumption and production nature of industrialized nations continue to disregard planetary boundaries, the rising number of cars on our streets worsens the situation. Furthermore, the effects of neoliberal market deregulation prioritizing financial gains over social justice and sustainability, measuring prosperity solely by income per capita, makes it detrimental.

This report aims to explore the possible impact of post-growth principles and their opportunities on urban mobility, with a specific focus on understanding if the adoption of post-growth principles in urban transportation systems has positively affected mobility patterns and quality of life in Prague, Budapest, and Lyon.

The backdrop for this research is the euMOVE project, which aims to investigate and analyze innovative and sustainable mobility solutions within European metropolitan regions. This essay is built upon a theoretical framework that outlines the criteria and effects of a degrowth economy. By exploring the intersection of these principles with urban transportation, the study seeks to illuminate the potential for transformative change and the necessary adaptations required in mobility planning.

While we are aware of the terminological distinctions in literature, this research focuses on the aspects of degrowth as a narrowed-down approach to post-growth. This comprehensive study examines the strategies, policies, and innovative solutions driving sustainable mobility within these cities.

Embracing post-growth principles within urban transportation holds significant promise for creating inclusive, resilient, and sustainable mobility systems. By examining the experiences of Prague, Budapest, and Lyon, we aim to unravel the complexities associated with this emerging paradigm and contribute to the ongoing dialogue surrounding the future of mobility.

2. The Post-growth Concept

Post-growth and Degrowth are often misunderstood due to their word component *growth* or reduced to a lesser meaning of the actual concept. It is important to note that both do not mean an economic recession. (Wiedmann et al., 2020) defines post-growth as a concept with the goal of decoupling economic growth and well-being. Degrowth instead aims to lessen adverse outcomes of blind development and shifts the gaze to different criteria, all aiming towards an improved society without the need to achieve economic growth as the only indicator of success (Demaria et al., 2013). Since this term provides a stronger direction than the more general postgrowth, we make particular use of the definition of degrowth in this study.

Ecological economists define degrowth as an equitable downscaling of production and consumption that will reduce societies' throughput of energy and raw materials (Schneider et al., 2010). (D'Alisa et al., 2015), introduce the concept of 'degrowth' from multiple perspectives. The authors argue that our current economic model, which relies on continuous growth in production and consumption, hasn't improved any of the causes leading to economic, social, and environmental crises and emphasize that pursuing endless growth is not a sustainable or just solution for our environment. This leads to the need for fundamental change and an urgent questioning of the economic systems we currently promote.

The concept does not include the claim to be a goal of a superior organization as it aspires radical change in the search of alternative ways to the existing deadlocks (Demaria et al., 2013). According to the authors, the umbrella concept holds its sources in the topics of Ecology, Development Critiques, Meaning of life, Bioeconomics, Democracy and Justice.

3. Effects of Postgrowth on the Urban Mobility Context

Building upon the approach adopted by (Cattaneo et al., 2022), this study aims to apply a degrowth framework and evaluate various mobility alternatives and the effects on it. A set of criteria is established and the effects of the de-growth strategy on the mobility sector within this framework are evaluated for each city. Their approach draws on Ivan Illich's (Illich, 1973) ideas for a convivial society and articulates seven principles for a degrowth mobility vision. (Xue & Kębłowski, 2022). Relying on these principles, they indicate that a mobility transition should favor active, hybrid and shared mobility options (Kębłowski, 2023). This report focuses specifically on three of these criteria and post-growth principles: environmental sustainability, enhanced social equity and limited infrastructure with the purposes of understanding if the adoption of such has

positively impacted mobility patterns and quality of life in Prague, Budapest, and Lyon. The focus was on these as we could see a connection between them and the cities that were visited.

3.1 Environmental Sustainability: Reduced dependency on private motorized vehicles and emphasis on sustainable alternatives.

It is a widely accepted fact that private motorized transport is a sector with a high environmental impact (Cattaneo et al., 2022). Reducing the number of cars and promoting sustainable modes of transportation such as walking, cycling, and public transit, can contribute to improved air quality and reduced carbon emissions. The reduction of reliance on private cars may lead to a reduction in car ownership and usage, resulting in fewer cars on the road. Containing the significant environmental and social costs associated with private car use is essential to sustainable mobility (Samsonova, 2021).

Citizens of Prague heavily depend on private vehicles, with continuously rising numbers in ownership (Huerta Melchor & Gars, 2020) and 45% of suburban residents using cars for their daily commute (Prague City Hall, 2019). The problem of a huge number of cars in the city and resulting congestion has already been admitted by the City Hall itself (P.1, l. 171 – 177). Reducing the number of cars in Prague is one of the main goals and therefore an implementation of this postgrowth principle, even if it does not primarily originate from the thought of environmental sustainability. Prague's sustainable alternatives involve especially a recently introduced pilot program for the integrated transport app PID Lítačka implemented by Prague's municipal company Operátor ICT[6], which means moving one stage further along the mobility integration process according to (Maria Kamargianni, 2015).

Budapest's remarkable developments with the shared services that are both operationally efficient and infrastructurally sound, including micro-mobility services, makes the public transit and other shared services, convenient and appealing in the city center and helps to reduce car-dependency for commuting purposes. Nevertheless, the increasing rent prices and lack of affordable living places in the city center, have driven the middle-class population to seek residence in the outskirts, where public transport services may be compromised, eventually leading to increased car travels from outskirts to the city (B.1 and B.4). Experts (B.1, B.2, and B1.3) unanimously agreed that along with making efforts to improve the service quality of shared services, lack of simultaneous and appropriate push measures to encourage people to abandon

[6] https://operatorict.cz/en/

cars, is going to result in an in-effective outcome towards transitioning towards sustainable modes.

The development of cycling infrastructure in Lyon for sustainable purposes has met with a lot of resistance from car owners who see these new changes as having their physical space taken away (L.3). Permanent and voluntary relinquishment of the car is more likely or feasible in very dense urban areas. While the proximity of stores and jobs or the existence of alternative transportation options facilitate travel by other means than the car, most urban areas are primarily associated with negative externalities that ultimately encourage people to relinquish car ownership: expensive parking, congestion, fatigue, etc. (Chevallier et al., 2023). However, in metropolitan regions such as Lyon, even if the inner city is well connected, there is still much left to do to integrate rural areas that are substantially dependent on cars. This means that for the environmental goals of Lyon to be achieved, a lot of efforts need to be concentrated not just in the inner cities but in the whole metropolitan area while at the same time efforts need to be allocated in ensuring the public perception of sustainable mobility is taken into further consideration.

3.2 Enhanced Social Equity: Affordable and Inclusive transport options for all.

Post-growth mobility focuses on achieving social justice and equity in transportation. Policy discourses are centered on the environmental virtues of certain mobility options, while less attention is paid to the injustices involved in promoting certain options compared to others (Cattaneo et al., 2022). Postgrowth initiatives can involve the improvement and expansion of public transit networks, providing affordable and reliable transportation options for low-income populations. Additionally, promoting active modes of transportation can enhance physical activity, accessibility, and social inclusion (Edwards & Tsouros, 2006).

As previously mentioned, Prague's main focus lies on the reduction of the number of cars in the city. The largest part of the City Halls's budget, counting 35 – 40%, is used for subsidizing the public transport (Prague City Hall, 2019): this measure keeps it affordable and it shows in the high percentage of 46% of the residents using this modality (Prague City Hall, 2019). With rising alternative mobility options as well as a historical preserved tram system, Prague's planning community is aware of the problem to keep it inclusive; tram lines were extended by stepless coaches, indicated in the app as well as at the stations. Special On-demand systems for the elderly population and equipped for wheelchair transportation are also found within the city center. There are also attempts to enable more biking in the form of new biking lanes (Johnston, 2022) and free shared bikes withing the MaaS-offer (nextbike Czech Republic s.r.o., 2022).

However, there still are prejudices and barriers for traffic participants to overtake, which the survey (MEDIAN, 2021) convincingly shows.

Hungary has introduced a national ticket system covering regional buses and trains, excluding Budapest municipal services (which comes with a small additional cost). The fare pricing system in general is on the lower side, with students enjoying a 90% discount. Given a well-quality maintained transit system, enjoying such incentives encourages the younger population to be bound to the shared services and less-car dependent even after their student life (B.4). The Public transport prices have remained almost constant and very affordable for almost two decades, but maintaining this affordability has led to compromises in service frequency, especially in the outskirts (B.2). This creates an injustice for those living in those areas. Bubi's, the shared bike-sharing service, offers a very cost-effective and attractive option for short commutes that makes it affordable for all. Based on empirical field observation, overall accessibility options for a disabled person remains average within the city. Stations and vehicles have markings and signs, but elevator ramps appear faster than average compared to other cities, which could make it difficult for use for the differently abled.

Promoting autonomous mobility is an important part of Lyon's overall strategy to become more accessible. This is particularly important considering that 30 % of the people who use Lyon's public transport network are affected by mobility issues (Modijefsky, 2019). Okeenea, a technological company driving the change of accessible and inclusive mobility in Lyon, created a remote on-demand activation and became a company dedicated to making cities more accessible for people with disabilities by developing acoustic pedestrian signals (L.2). This enabled blind or visually impaired individuals in Lyon the ability to be autonomous when walking. Walking is intrinsically linked to mobility as it serves as a fundamental means of transportation for individuals (Schmeidler, 2010). The universality of the design also enabled further groups in society to benefit from the solution which positively demonstrated that prioritizing the needs of marginalized groups, cities can bring value to their communities.

3.3 Limited infrastructure: Control and reduction of unnecessary development

Degrowth is critical of excessive and unnecessary development (Demaria et al., 2013). The larger or faster a means of transportation, the more complex, costly, and technologically advanced will be the infrastructure required (Cattaneo et al., 2022). The future of public transport depends on long-term investment in costly infrastructure that cannot be considered as a first-best alternative (Cattaneo et al., 2022).

Of note is the approach of on-demand mobility services in the Prague metropolitan area, which sees its role as a symbiotic component solving the difficulties of public transport in less densely populated areas (P.2, l.319-327). Plans for integrated mobility are also based on the integration of multimodality to achieve intermodal route planning (Prague City Hall, 2019).

Budapest's approach to growth and infrastructure development may not have been explicitly stated, but it appears to be shifting towards improving existing services rather than investing in newer ones. On a holistic level, the BMT 2030 plan aims to enhance transport competitiveness and sustainable livability, a major part of which focuses on upgrading deteriorating vehicles and infrastructure and improving fragmented network connections. Renovation and maintenance of old metro lines and stations have been prioritized to ensure better service quality. Integration with micro-mobility services and redesigned public spaces for mobility points are also being pursued. To reduce car traffic, P+R (Park+Ride) and B+R (Bike+ Ride) service points are being established on the outskirts. Investments are being made in electrifying old bus fleets aiming to optimize and streamline the process for increased efficiency.

For the past years, Lyon has seen a significant increase in the cycling infrastructure of the city. These developments have been recognized as necessary efforts to further promote cycling within citizens and shift to more sustainable means of transportation. The city acknowledges how in the mobility field it can be quite challenging to create something new, so the efforts should be focused instead on taking newer and innovative ideas and integrating them into something that already exists (L.3). In this sense, minimizing unnecessary developments and focusing on the key priorities of the region. However, improving or constructing new cycle lanes may be necessary but not sufficient to induce significant changes in cycling levels. (Xiao et al., 2020). This has been the case in Lyon where even with a new cycling network, the numbers do not yet reflect the desired modal shift within citizens which highlights the complexity of mobility management and the need of not solely infrastructural changes but also a societal one.

4. Findings and Conclusion

In terms of environmental sustainability, all three cities acknowledge the significance and their urgent need to reduce car dependency and enhance sustainable transportation options. Prague has already taken steps by incorporating technology and alternative transportation options, while the actual impact of it is yet to be seen as these initiatives are still in their early stages. Budapest has made significant progress in developing operationally efficient shared sustainable services and identified their gaps. However, challenges remain in implementing effective actions due to

political considerations and the lack of timely measures supported by various stakeholders' opinions. Lyon, in addition have identified that to achieve this sustainability goal, the actions should extend beyond just the city center.

Social justice and equity in transportation includes various dimensions such as service availability, pricing, accessibility, and inclusivity. Prague's subsidized pricing measures have yielded positive results, while Budapest's constant fare system has proven to benefit the captive riders more. Lyon's actions to enhance social inclusivity show potential for community value and equitable mobility. These cities demonstrate how achieving social justice in transportation requires a multifaceted approach and not focus on a single factor; rather, a comprehensive strategy.

Degrowth criticizes excessive development, while investment in costly infrastructure impacts the future of public transport, each city has adopted different approaches unique to their goal and context to this development. It could be by integrating more technology, and improving service quality and management, or focusing on societal changes along with infrastructural improvements.

In conclusion, it is evident that while these cities may not have explicitly stated their goal being degrowth principle, they have acknowledged the negative impacts of a growth-centric economy and are gradually responding. This initial step is promising, yet the current rate of progress falls short in adequately addressing urgent concerns. Therefore, a more focused and critical approach, coupled with comprehensive research, becomes imperative to effectively tackle these critical needs.

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Overall Conclusion

All excursion reports provide a valuable understanding of how mobility can be approached in metropolitan regions. Even though the chosen cities are very different from one another, including their location, demographics, and weather conditions, they have similar goals: Making their cities a better place to live by introducing sustainable and active – mobility – initiatives. Of course, their variances lead to different approaches. Despite that, since all the cities understood that there is a need of change to surpass the current mobility challenges in metropolitan regions, all contribute more or less to the overall goal.

Combined with the meta topic reports, this report of the euMOVE 2023 cohort sheds a light on urgent questions which need to be considered when redesigning the mobility landscape of metropolitan regions. The findings of our meta topic reports help to understand the impact of three major topics which come along with the transformation of urban transport planning. Consequently, the findings of our meta topic reports need to be considered when redesigning the existing mobility landscape.

Finally, these initiatives, approaches, projects, and ideas can be seen as examples of how Munich can enhance its mobility plans and approaches, by considering at the same time the challenges the cities had to face in their successfully implemented projects. We hope that we provide with this report an understanding of how mobility is being understood and approached in different mobility metropolitan regions in Europe. Moreover, we expect with our findings to enhance an understanding of how mobility can be realized in Munich to design a mobility environment which overcomes the current mobility challenges.

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